

UNIVERSIDAD DE COSTA RICA
SISTEMA DE ESTUDIOS DE POSGRADO

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS: TEACHING PRACTICES
TO IMPROVE THE SPEAKING SKILLS OF INTERMEDIATE STUDENTS IN
AN ONLINE TASK-BASED ESP COURSE

Trabajo final de investigación aplicada sometido a la consideración de la Comisión del
Programa de Estudios de Posgrado en Enseñanza del Inglés como Lengua Extranjera
para optar por el grado y título de Maestría Profesional en
Enseñanza del Inglés como Lengua Extranjera

ANDREA MORALES OLIVERIO

MARÍA ARAYA PORRAS

Ciudad Universitaria Rodrigo Facio, Costa Rica

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Dedications

To my family for their love, support, and encouragement throughout this process and to all my close friends who inspired me to reach this goal. I also thank God for giving me this opportunity and helping me in every step of the journey. I will be forever grateful.

Andrea

I dedicate this work to my family, especially my parents, for the sacrifices they have endured for me to pursue this dream and for their endless love and support. To my loving life partner for his constant support and encouragement on this journey and for being by my side even on the tough days. Finally, to my best friend and colleague for always encouraging me to be the best I can be and to work toward my dreams.

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Dra. Irene Marín Cervantes

Representante de la Decana del Sistema de Estudios de Posgrado



Mag. Randolph Zúñiga Coudin

Profesor Guía



Mag. Jennifer Céspedes Araya

Lectora



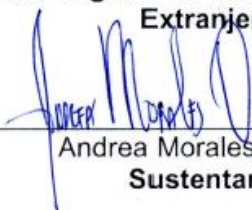
Dr. Alonso Canales Viquez

Lector



M.A. Xinia Rodríguez Ramírez

Directora Programa de Posgrado en Enseñanza del Inglés como Lengua Extranjera



Andrea Morales Oliverio

Sustentante



María Lidia Araya Porras

Sustentante

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Resumen

La presente investigación tiene como objetivo explorar las prácticas de enseñanza que pueden ayudar a mejorar las habilidades de expresión oral de un grupo de estudiantes de Ingeniería Eléctrica de la Universidad de Costa Rica, con un nivel de inglés intermedio, a través de un curso en línea de Inglés con Fines Específicos basado en tareas. Este curso estuvo dirigido a una población meta de 20 estudiantes, y fue diseñado e impartido por dos estudiantes-docentes, quienes también son las investigadoras, como requisito para egresar del Programa de Maestría en Enseñanza del Inglés de la misma universidad. Se realizó un análisis de necesidades para recopilar información sobre necesidades, deseos y carencias de los estudiantes en relación con el uso del inglés en el contexto académico y profesional. Asimismo, se aplicó una prueba de diagnóstico para evaluar su nivel de dominio del idioma inglés. Estos resultados condujeron a priorizar la expresión oral en el diseño del plan de estudios que sirvió como base para la práctica del curso. Posteriormente, las investigadoras efectuaron una revisión de literatura sobre las prácticas de enseñanza que pueden ayudar a mejorar la expresión oral en inglés de los estudiantes, entre las que se incluyen: actividades de expresión oral, aprendizaje colaborativo, técnicas de trabajo en grupo, retroalimentación correctiva o corrección de errores, y enseñanza de idiomas en línea. Por último, se realizó una reflexión con base en evidencia sobre la experiencia de práctica, en la cual se triangularon las percepciones de estudiantes-docentes, supervisores y estudiantes y donde los resultados sobre la eficacia de las prácticas de enseñanza seleccionadas por las estudiantes-docentes parecen ser positivos. Este documento también brinda recomendaciones para la implementación exitosa de dichas prácticas como referencia para futuros contextos similares de enseñanza del inglés.

Palabras clave: Inglés para Fines Específicos (ESP), Enseñanza de Idiomas Basada en Tareas (TBLT), Inglés para estudiantes de Ingeniería Eléctrica, prácticas de enseñanza, enseñanza de idiomas en línea

Abstract

This research aims at exploring the teaching practices that can help to improve the speaking skills of a group of intermediate Electrical Engineering students at the University of Costa Rica in an online task-based ESP course. This course was addressed to a target population of 20 students, and it was designed and taught by two student-teachers, who are also the researchers, as a requirement to graduate from the Master's Program in Teaching English as a Foreign Language from the same university. First, a needs analysis was carried out to gather information about the learners' needs, wants, and lacks related to the use of English in their academic and professional context. A diagnostic test was also administered to assess the students' language proficiency level. These results led the researchers to prioritize speaking in the task-based ESP syllabus designed as a basis for the course practicum. Then, the researchers conducted a literature review to explore a repertoire of teaching practices that could help to improve the English-speaking skills of the intermediate Electrical Engineering students, including: speaking activities, collaborative learning, grouping techniques, corrective feedback or error correction, and online language teaching. Finally, an evidence-based reflection on the practicum experience, where the perceptions of the student-teachers, the supervisors, and the students were triangulated, seemed to yield positive results on the overall effectiveness of the teaching practices selected by the student-teachers. Recommendations for the successful implementation of these teaching practices are also provided in this paper as a point of reference for future similar English-teaching contexts.

Keywords: English for Specific Purposes (ESP), Task-Based Language Teaching (TBLT), English for Electrical Engineering students, teaching practices, online language teaching

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List of Abbreviations

ACTFL	American Council on the Teaching of Foreign Languages
CEFR	Common European Framework of Reference for Languages
ESP	English for Specific Purposes
TBLT	Task-Based Language Teaching
UCR	University of Costa Rica



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English for Electrical Engineering Students: Teaching Practices to Improve the Speaking Skills of Intermediate Students in an Online Task-Based ESP Course

In an era of growing demands in terms of education and employment, English for Specific Purposes (ESP) offers learners the opportunity to acquire the language skills that best align with their needs as students and professionals. As a requirement to graduate from the Master's Program in Teaching English as a Foreign Language (TEFL) from the University of Costa Rica (UCR), the student-teachers, who are also the researchers, need to design and implement an ESP course focused on the learners' immediate and future needs. To achieve this, the student-teachers carry out an extensive study divided into two parts. The first section is related to the course design stage, and the second section involves a literature review and a reflection based on the practicum experience.

During the course design stage, a needs analysis (Chapter I) has to be conducted to gather information about the learners' needs, wants, and lacks related to the use of English in their academic and professional context. The results and insights gained through this research serve as a basis for the ESP syllabus (Chapter II). Thus, this study attempts to investigate the English language needs and learning styles of third- and fourth-year Electrical Engineering students from the University of Costa Rica with the aim of designing an ESP course that meets the specific language skills needed to succeed in academic and professional target situations. As part of the needs analysis, the researchers collected and analyzed quantitative and qualitative data by designing and administering surveys to identify the students' primary needs, considering also the views held by primary stakeholders. In addition, a diagnostic test was carried out to assess the students' language proficiency level and their areas of strength and weakness. Then, based on the data collected from the needs analysis, the researchers designed a detailed task-based syllabus to be implemented in the course practicum. This

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syllabus includes the course description, the statement of goals and objectives, the contents organized in three units, the methodology, and the assessment.

It is worth mentioning that the needs analysis conducted as part of this study identified speaking as a top-priority macro skill for the academic and professional field of Electrical Engineering, especially considering the status of English as an international language for communication and its relevance for scientific and technological areas of study. Scenarios such as conversations with foreigners, international conferences, meetings, job interviews, and telephone calls, among others, are key examples of situations in which the participating Electrical Engineering students and future professionals may have to communicate in English. Interestingly, in addition to occupying such a prominent position as a language need, speaking was also reported as the skill that most of the students and professionals struggle with. These results led the researchers to prioritize speaking in the syllabus designed for the ESP course addressed to Electrical Engineering students, exclusively dedicating two units out of three to the improvement of this macro skill. In view of these considerations, a major pedagogical inquiry emerged from the ESP course design and practicum stages: What teaching practices can help to improve the speaking skills of a group of intermediate Electrical Engineering students at the University of Costa Rica in an online task-based ESP course?

This research question served as the main guide for the second part of the research project, which covers a literature review (Chapter III) and an evidence-based reflection on the practicum (Chapter IV). Based on the categorization provided by Sunderland (2018), this research question is descriptive and empirical because it aims to identify and describe, by means of primary data, teaching practices to help intermediate Electrical Engineering students improve their speaking skills in an online task-based ESP course.

For the purposes of this study, *teaching practices* will be operationalized according to the focus areas identified in related literature as the basis for the speaking component of the course. They include speaking activities tailored to intermediate students following pertinent theoretical principles, collaborative learning, grouping techniques, feedback or error correction, and teaching strategies adapted or unique to online language teaching. All of them constitute instructional techniques that are promoted and explicitly taught by the teacher so that the students can achieve the course objectives.

Addressing the research question is significant as it may shed light on future similar contexts related to oral communication skills for intermediate students, teaching practices in online environments, task-based language teaching, and ESP courses for populations related to engineering or other similar technical fields, thus representing a research milestone in the field of online task-based ESP teaching and a contribution to the literature niches of each variable covered.

Chapter I: Needs Analysis

According to Brown (2016), a needs analysis is “a systematic collection and analysis of all subjective and objective information necessary to define and validate defensible curriculum purposes that satisfy the language learning requirements of students within the context of particular institutions that influence the learning and teaching situation” (p. 4). Based on this, conducting a comprehensive needs analysis was of paramount importance to identify the participants’ primary needs for this research. This chapter provides a description of the target population, the data collection methodology, the views held by different stakeholders regarding the students’ current and future requirements, and the results of the students’ needs and learning styles. This information allowed the researchers to have a better understanding of the context and to make well-informed decisions during the course design stage.

As part of the needs analysis, a diagnostic test was also designed and administered by the researchers to measure not only the students' English proficiency level, but also areas of strength and weakness in terms of language skills to be considered in the ESP course. Brown (2004) indicates that a diagnostic test is designed to diagnose specific aspects of a language, for example features of English that are difficult for learners and should therefore become part of a curriculum (p. 46). In addition, Coombe et al. (2007) state, "Diagnostic tests identify language areas in which a student needs further help" (p. xvi). With these considerations in mind, this chapter also describes the rationale behind the diagnostic test and presents the results elicited from it to serve as a guide in the development of the ESP syllabus. The diagnostic test conducted by the researchers was divided into two parts: a written section to assess the skills of reading, writing and listening, and an oral communication section to assess speaking.

A. General Description of the Field

The target population assigned for this project is constituted of third- and fourth-year Electrical Engineering students from the University of Costa Rica. For several decades, this school has been training professionals in a major that is critical for the economic, social, scientific, and technological development of the country. According to its Director, Eng. Lochi Yu, the School of Electrical Engineering currently has an enrollment of 2,000 students and a faculty of 60 professors. He also reported that approximately 140 students graduate every year, 20 percent of the students are women, and 30 to 40 percent of the student population comes from outside the Costa Rican Central Valley. Electrical Engineering is a five-year major with three main specializations: Electronics and Telecommunications, Power Systems, and Computing and Networking. The program leads to two degrees, a Bachelor of Science and an undergraduate Post-Bachelor's degree (*Licenciatura*) (personal communication, April 15, 2021).

As a general definition, the School's website indicates that Electrical Engineering is "an applied science based on Mathematics and Physics; therefore, it requires a solid background in these areas, which are complemented with electrical, electronic, and computational analysis techniques." (Escuela de Ingeniería Eléctrica [EIE], 2020). Electrical Engineering students are provided with sufficient theoretical and practical knowledge to be able to perform a wide variety of tasks once they graduate, ranging from consultancy services as independent workers to collaboration with interdisciplinary teams in both the public and the private sector. Thus, Electrical Engineering has become one of the most in-demand careers in a broad spectrum of fields, including biomedical applications, telecommunications, computing, robotics, artificial intelligence, renewable energy, electronics, manufacture, space industry, and so forth.

Within this framework, English plays a key role from the perspective of educational and professional success. The most up-to-date information, as well as business-related interactions within the domain of Electrical Engineering, frequently demand the use of this language. In the academic context, for example, Electrical Engineering students are often required to read field-related articles and books, and even navigate websites in English for research purposes. They may also need to understand video tutorials and lectures on topics related to their major (Gözüyeşil, 2014, pp. 4184-4186; Rezaee & Kazempourian, 2017, p. 10). Once in the professional context, electrical engineers may require a combination of English language skills, with speaking ranking in the first position, to be a qualified candidate for a job and to communicate with others in the workplace, especially in the case of international firms. Professionals need to attend meetings or conferences, make telephone calls, send emails, and write technical reports. Moreover, they should have knowledge of technical vocabulary to understand articles, books, manuals, specifications, datasheets, and software guides (Rezaee & Kazempourian, 2017, p. 13). In terms of communication, they also need to become familiar with

text patterns that may be used even in more general situations, for example: giving instructions, describing a process, describing a product, asking for clarifications, giving recommendations, making comparisons, expressing figures, expressing ideas politely, making a critical judgement, and identifying and using connectors, among others. All these language demands represent a challenge for Electrical Engineering students and professionals, especially if they have not previously received any proper English instruction.

B. Methodology

This section provides a detailed description of the research approach, the context, the participants, the instruments, and the procedures used for the needs analysis.

Research Approach

This research project follows a mixed-methods approach, which is defined by Johnson et. al. (2007) as follows:

Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration. (p. 123)

The researchers selected this hybrid method to take advantage of both the statistical or numerical measurement of data obtained from closed-ended questions in the surveys and the qualitative coding analysis procedures for open-ended questions. The integration of these two methods leads to a more comprehensive study of the information, and the triangulation of data from different sources, a key feature of the mixed-methods approach (Dörnyei, 2011, p. 43), also contributes to improving and strengthening the validity of the findings.

Context

The research project is contextualized at the School of Electrical Engineering from the University of Costa Rica, specifically considering third- and fourth-year students who have English language needs for academic or future professional purposes. Data from the needs analysis was gathered during a four-week period from the beginning of the first academic term at said university in April 2021.

Participants

The participants correspond to an initial group of 118 Electrical Engineering students from the University of Costa Rica. The non-probability sampling method called convenience sampling, in which “members of the target population are selected for the purposes of the study if they meet certain practical criteria, such as geographical proximity, availability at a certain time, easy accessibility, or the willingness to volunteer” (Dörnyei, 2011, pp. 98-99), was used as the target population volunteered to participate in the study by following a series of steps for registration. The School of Electrical Engineering posted the invitation to the ESP course via its Facebook page. This invitation was mainly addressed to third- and fourth- year students. Those interested in participating had to send an email with their personal data, including their full name, their academic year, their perceived proficiency level, their contact information, and the main reason why they would like to study English. This information was collected in a database by the researchers, allowing a preliminary overview of the students’ previous knowledge of English and main language needs. For example, preferences related to speaking skills, as well as an English level ranging from Basic User to Independent User, emerged as a commonality based on the data initially reported by the students during this registration stage. The total number of participants was reduced to 88 students after conducting the needs analysis survey, as they were the only ones who responded within the time allotted.

The research project also had the participation of a group of primary stakeholders, including Eng. Lochi Yu, PhD, who is the Director of the School of Electrical Engineering, and three professors recommended by the Director, namely Eng. Mercedes Chacon, PhD, and Eng. Jose David Rojas, PhD, both from the Automation Department, and Eng. Gustavo Valverde, PhD, from the Power Systems Department.

In addition, a group of seven professionals in the field also participated as stakeholders. They were also selected through convenience sampling. These electrical engineers were considered suitable sources of information as they are former UCR graduates and have extensive professional experience in the public and private sectors, including companies such as the Costa Rican Electricity Institute (ICE) and Intel, two of the main employers of electrical engineers in the country.

Instruments

The instruments used to collect needs analysis data included questionnaires and interviews. Questionnaires are defined as “any written instruments that present respondents with a series of questions or statements to which they are to react either by writing out their answers or selecting from among existing answers” (Brown, 2001, as cited in Dörnyei, 2011, p. 102). Based on this, the questionnaire designed for Electrical Engineering students (see Appendix A) comprised four sections: the participants’ personal data, their previous and current knowledge of English, their language needs in academic and future professional contexts, and their learning styles. Most items in the questionnaire were closed-ended, including yes/no questions, Likert scales, multiple-choice items, and rank order items. Additionally, open-ended questions were incorporated to further explore specific aspects of their English needs and to identify less-known details not previously anticipated by the researchers.

Interviews were used as an additional instrument for data collection. In the case of the primary stakeholders, online interviews were scheduled with the Director and the professors from the School of Electrical Engineering (see Appendix B). This type of interview was semi-structured as a set of topics and questions was defined in advance to serve as a guide for the researchers; however, during the interview, further details were explored in a conversational and flexible manner depending on the responses given by the interviewees. The instrument was made up of open-ended questions corresponding to three main sections: personal information of the participant, generalities of the academic major, and English language needs for academic and professional purposes.

Regarding professionals from the field, online questionnaires and virtual semi-structured interviews (see Appendix C) were used depending on the participants' availability. Both instruments included the same open-ended questions and were subdivided into three main parts: personal information of the participant, generalities of the professional field, and English language needs for professional purposes.

Procedures

To administer the questionnaire for students, an advance notice was sent to them via email to announce the survey, describe its purpose, and set the dates on which it was going to be available online. This notice was sent to the institutional or personal email accounts obtained from the registration process, and it allowed raising awareness of the students' participation in the needs analysis as a required step to be eligible for the ESP course.

From the total number of 118 students registered, the researchers selected a sample group of 18 students to conduct a pilot questionnaire. This group was defined through random sampling, and it represented 15% of the original total population. An email was sent to this specific group of participants with the link that redirected them to the online survey.

Later, the remaining 100 students were contacted via email to send them the link to the final version of the questionnaire. This final redesigned version considered feedback provided by the pilot survey, the Course Design professor, the review by peers from the Master's program, and information collected from the interviews with the stakeholders; however, no significant changes that could affect the main structure or content of the original pilot version were made. Because of this, the pilot group did not have to retake the questionnaire.

The tool selected to administer the pilot research tool and the final questionnaire was Google Forms, which is an online survey administration software for collecting results in a simple and efficient manner. The estimated time required for completing the pilot and final instruments was approximately 15 minutes per person. The data from the questionnaires was subjected to numerical analysis and then summarized as averages, frequencies, and percentages for representation in tables and graphics.

Regarding the administration of the interviews for the stakeholders from the School of Electrical Engineering, the researchers sent an email to their institutional accounts to describe the purpose of the research and to request their participation. Once they had accepted the invitation and agreed on a scheduled date, each interview was conducted via a virtual meeting and required approximately 30 to 45 minutes. Note-taking and video recording were used by the researchers as support to gather information. The interviews were transcribed by the researchers, and the data was analyzed through inductive coding, meaning that the information was carefully scanned in search of specific patterns or emerging categories for further comparison of findings and building of meanings and interpretations (Burns, 2010, pp. 104-109).

Similar planning and administration strategies were used for the professionals. They were contacted via email to confirm their availability, and they decided to participate via an

online interview or a Google Form questionnaire. Taking each instrument required about 15 to 30 minutes.

The results of the questionnaires completed by the students were correlated with the findings from the interviews and surveys taken by the stakeholders. Reasonable conclusions derived from this correlation led to well-founded suggestions for the ESP course design.

C. Interests of Primary Stakeholders

Director and Professors from the School of Electrical Engineering

This group of primary stakeholders provided deep insights into the students' English language needs and shared their expectations and valuable recommendations for the ESP course. For example, regarding the importance of this language for academic purposes, all the interviewees agreed that, although English is not an official requirement in the Electrical Engineering major at UCR, most courses demand that students read texts in English for their studies. In fact, the participants highlighted that the most updated information and books related to their field are only available in English. Therefore, being able to read and understand a text in this language seems to be a minimum requirement for students. One of the professors also mentioned that the School of Electrical Engineering sometimes organizes conferences with international guest speakers. While some students understand the main ideas, some others may have a hard time understanding what is being said, and others do not even attend these events because they do not have the required English level. Another professor also referred to the speaking and writing skills required of applicants for scholarships abroad.

As for the importance of English for the professional context, all the stakeholders indicated that mastering speaking is essential to find a job, especially in multinational companies, and students or graduates who are not proficient enough could face many difficulties in job interviews and in daily interactions at the workplace. It was also pointed out that

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students may face obstacles to find an internship at a company, which would reduce their chances of satisfying this graduation requirement or entering the workforce early.

When asked about the language skills that are considered the main priorities for academic and professional purposes, three out of four interviewees identified reading as an academic priority for Electrical Engineering students; nevertheless, one of them argued that most students already know how to read or take advantage of online translation tools, so that reading does not represent an obstacle for them. For professional life, three of the interviewees stated that speaking and reading are the main priorities. Interestingly, one of the participants stated that, in the professional field, the most important skills are writing, reading, and speaking, with writing being the most relevant and speaking the least relevant skill.

With regard to specific activities that Electrical Engineering students need to carry out in English, all of the interviewees agreed that reading technical documentation is one of the main tasks for academic purposes. One of the stakeholders also mentioned that a small percentage of students may need to write in English as part of assistant hours, and another interviewee reported that students need to be able to understand the spoken language as well because sometimes they need to watch field-related videos.

When asked about the specific activities that professionals need to perform in English, the interviewees provided a series of examples related to all four macro skills. For instance, according to three of the interviewees, professionals may be required to have meetings or phone calls with English-speaking clients and colleagues from different countries to explain a project, a product, or software. In the same vein, professionals sometimes need to travel abroad and receive training in English. Graduates from the Computing and Networking specialization, in particular, may need to install and manipulate different tools that require consultation of websites to solve problems they may encounter. In general, professionals are likely to read

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datasheets, manuals, specifications, and specialized books in English. Furthermore, they may need to write specifications, reports, or quotes and send them over to a client abroad, and they often need to write emails in English as well. Finally, professionals have to understand videos in English to extract technical information for their work.

As for the main deficiencies in English that affect Electrical Engineering students and professionals, one of the interviewees warned that knowledge of English is one of the major selection criteria when applying for a job nowadays. Unfortunately, when they are required to have an advanced level and demonstrate fluency, they have more difficulty finding a job or getting a job promotion. One of the stakeholders also admitted that the vast majority of the professionals in the field have trouble speaking and writing in English. A similar situation occurs in the case of students, who are characterized by interviewees as “being afraid” of productive skills such as speaking and writing. In addition, one professor stated that some do not know the English equivalents of technical words and have pronunciation issues as well, a situation that prevents graduates from being hired or getting better jobs.

The primary stakeholders had a series of recommendations for the ESP course, such as taking the students to the next level and helping them gain confidence as they learn English. They also suggested teaching useful phrases and technical vocabulary for the learners to communicate fluently and sound more native-like in their future job interactions. Two interviewees also stressed the importance of paying attention to developing soft skills and addressing multiple intelligences when planning and teaching the lessons. These recommendations were taken into consideration for the purpose of data triangulation in the subsequent course design stages of this project.

Professionals in the Field of Electrical Engineering

A group of seven electrical engineers, each with over ten years of professional experience, has also provided relevant data related to the demands of English in work-related scenarios. Firstly, when asked about the importance of this language in the Electrical Engineering field, all the participants described it as “very important,” “indispensable,” and “completely necessary,” among other comments. One of the respondents added that English is an essential requirement in the private sector, and that it is desirable in the public sector as well. In fact, 100% of the professionals reported a frequent use of English for their work. In the same vein, two experts concurred that the vast majority of technical information and the standards used by electrical engineers are mainly available in English. Moreover, three respondents claimed that, even though the School of Electrical Engineering at UCR has not integrated English courses into its curriculum, most of the didactic materials used by the professors are in this language. Thus, knowledge of English becomes an important requirement.

Concerning the skills that most professionals struggle with, all the respondents agreed that speaking occupies the first place as the most difficult to achieve. Then, they chose writing and listening in the second and third positions, respectively. Reading and technical vocabulary were the least difficult to achieve. Overall, the professionals warned that English is a selection criterion in their field since the proficiency level demonstrated in a job interview has a direct bearing on the prospective employee’s ability to perform future tasks in English.

When asked about the language skill that they considered the highest priority for the professional context, the entire group of stakeholders agreed on reading as the most important skill to do their job. This was followed by speaking and technical vocabulary as the second priority, and listening was ranked in third position.

Regarding the specific activities related to reading and writing in the professional field, most of the respondents chose tasks such as reading technical articles, reports, manuals, specifications, and standards with the same level of priority. Reading technical textbooks was in the second position, while navigating websites and writing emails were in the third position. The participants were also asked to rank speaking and listening activities in order of importance. The most relevant results were related to the following: attending international presentations and conferences, having conversations with foreigners, and participating in meetings, debates, and group discussions.

The researchers requested examples of typical interactions for which the use of English is necessary in the field of Electrical Engineering. For most respondents, the main activity in multinational companies is speaking, as they need to hold meetings and have conversations in English with managers, clients, and sponsors from all around the globe. For instance, one of the professionals who works as a team leader for Intel added that understanding different accents is very important in this particular context. Some other examples included attending meetings and conferences and reading technical manuals and datasheets.

When asked about the most relevant topics and areas to be considered in the design of an English course, the participants suggested the following: telecommunications, computing and networking, power systems, process automation, design and electrical installations, robotics and artificial intelligence, renewable energy, and project management, among others. Finally, the professionals recommended that the instructors focus on teaching technical vocabulary that can be used either in written or spoken interactions within the Electrical Engineering discipline.

D. Group Profile

Students' Educational Background and Future Positions

The total number of participants who responded to the survey was 88 students. Regarding their year in the major, 41% corresponded to fourth-year students, and 38%, to third-year students. Learners from other levels not corresponding to the main target population also participated in the survey; for instance, 11% were fifth-year students, and 6% were first-year students. No reports were given by second-year students, and 5% belonged to postgraduate programs.

In regard to the Electrical Engineering subdisciplines, the majority (41%) belonged to Electronics and Telecommunications, followed by Power Systems (36%) and Computing and Networking (20%).

As for the acquisition of previous English knowledge, public schools were selected by the majority of the participants (68%), followed by self-learning (61%), English courses (24%), private schools (17%), and visits to an English-speaking country (3%). An additional 3% reported that they have never studied English before, specifying that they were students in public schools with deficiencies or limited access to English language instruction.

In relation to future positions, most stakeholders reported that electrical engineers are highly employable and that they can find jobs in a broad range of areas, including electronics, telecommunications, automation, biomedical applications, consultancy, robotics, higher education, renewable energy, power systems, control systems, industrial design, construction, computing and networking, operation and maintenance of electrical equipment, etc.

Professionals may work for local companies and institutions from the public sector, such as ICE, CNFL, SUTEL, ARESEP, ESPH, Coopelesca, Coopeguanacaste, and Coopesantos, among others. They may also work in the private sector for international firms such as Intel,

Hewlett- Packard, Boston Scientific, National Instruments, Procter and Gamble, Philips, Emerson, Avionyx, and so forth. A minority was reported to work as freelance professionals.

Description of the Students' Needs

To identify the needs determined by the demands of academic and professional situations, the students were asked to categorize the language skills according to levels of priority by using a ranking scale. The results collected are displayed as frequency distributions and percent distributions. Table 1 shows the language skills that occupied the first three levels of priority for academic settings.

Table 1

Priorities for Academic Purposes

Skill	Level of priority					
	First		Second		Third	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
a. listening	18	20	22	25	12	14
b. speaking	15	17	21	24	10	11
c. reading	27	31	9	10	18	20
d. writing	3	3	6	7	12	14
e. grammar	4	5	9	10	11	13
f. technical vocabulary	7	8	17	19	14	16
g. pronunciation	14	16	4	5	11	13

As can be seen, reading was reported as the macro skill with the highest priority for academic purposes by the largest number of students, with nearly a third of the responses (31%). Listening was in second place with a fifth of the participants (20%) reporting it as their first priority, closely followed by speaking with slightly less than a fifth (17%). Writing occupied the fourth position with only 3 out of 88 participants ranking it as their first priority for academic

purposes. In the case of micro skills, pronunciation was reported as the first priority (16%), followed by technical vocabulary (8%) and grammar (5%).

For the second level of priority, the ranking of the macro skills, in order, was listening, speaking, reading, and writing, while the ranking of the micro skills was technical vocabulary, grammar and pronunciation. For the third level of priority, the macro skills were ranked as follows: reading, listening and writing (with the same number of respondents), and speaking, while the ranking of micro skills corresponded to technical vocabulary, followed by grammar and pronunciation (with the same number of respondents as well).

Thus, in addition to the prominent position occupied by reading, the results coincided in that listening is the second macro skill as first priority and the first macro skill as second priority, making it the second priority for course design for academic purposes. Speaking emerged as the third priority and writing as the fourth. To complement this information, Table 2 presents the prioritization of language skills for professional settings.

Table 2

Priorities for Professional Purposes

Skill	Level of priority					
	First		Second		Third	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
a. listening	24	27	24	27	10	11
b. speaking	36	41	26	30	5	6
c. reading	3	3	5	6	28	32
d. writing	3	3	5	6	9	10
e. grammar	5	6	5	6	11	13
f. technical vocabulary	6	7	15	17	9	10
g. pronunciation	11	13	8	9	16	18

According to Table 2, speaking was selected as the macro skill with the highest level of priority for professional purposes (41%). Listening was in second place with nearly a third of the participants (27%) reporting it as their first priority. Both reading and writing occupied the third position, each reported by a low percentage of students (3%) in comparison with the skills in the first two ranks. Regarding micro skills, pronunciation was reported as the highest priority (13%), followed by technical vocabulary (7%) and grammar (6%).

Curiously, for the second level of priority, the ranking of the macro skills followed exactly the same pattern as in the previous case: speaking, listening, and reading and writing (these two with the same number of respondents again), while the ranking of the micro skills was technical vocabulary, pronunciation, and grammar. For the third level of priority, the macro skills were ranked as follows: reading, listening, writing, and speaking, while the ranking of micro skills corresponded to pronunciation, followed by grammar and technical vocabulary. Despite the variations found in the third level of priority, the ranking of the skills categorized as first priority for professional purposes, with speaking occupying the most important position, was clearly confirmed by the prioritization shown in the second level.

Furthermore, as part of the identification of needs, Electrical Engineering students were asked to provide examples of interactions with other people for which they require the use of English. The qualitative analysis of this open-ended question highlighted job interviews, conferences, conversations or dialogues in job-related environments, meetings and presentations, telephone calls, training sessions, participation in technical forums, and scholarship procedures. Interestingly, they also provided examples of more specific communication subskills such as the following: explaining the solution to a problem or a design modification, giving instructions, requesting quotations or technical specifications, describing electrical components or products, preparing or giving lab reports, indicating warnings or

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specifications of equipment, explaining a process, understanding videos, giving opinions, and presenting a project, among others. Students reported that those interactions may involve the participation of other professional colleagues (engineers, technicians, etc.), experts and consultants, professors, clients, suppliers, coworkers, and employers.

In another open-ended question, the Electrical Engineering students were required to provide examples of documents or materials that they use in English. The most relevant examples on which most of them agreed included articles and reports of technical, scientific, or academic nature; technical documentation (manuals, specifications, catalogues, datasheets, and standards); textbooks; informative and training videos; websites of different institutions or companies; programming forums, and publications related to the National Electrical Code (NEC) and the Institute of Electrical and Electronics Engineers (IEEE). Some examples of these authentic materials are included in Appendix D.

Description of the Students' Wants

Several questions were included in the questionnaire to explore the students' wants from a top-down perspective, which means that the English skills in which the students were interested were first identified from a general level, and then additional survey items allowed the researchers to dig deeper into more specific subskills, activities, and topics on which the students would like to focus during an ESP course.

Based on this, the participants were first asked to categorize the language skills by using a priority rank order. The results included in Table 3 show the skills that they would like to improve based on the first levels of priority.

Table 3*English Skills That Students Would Like to Improve*

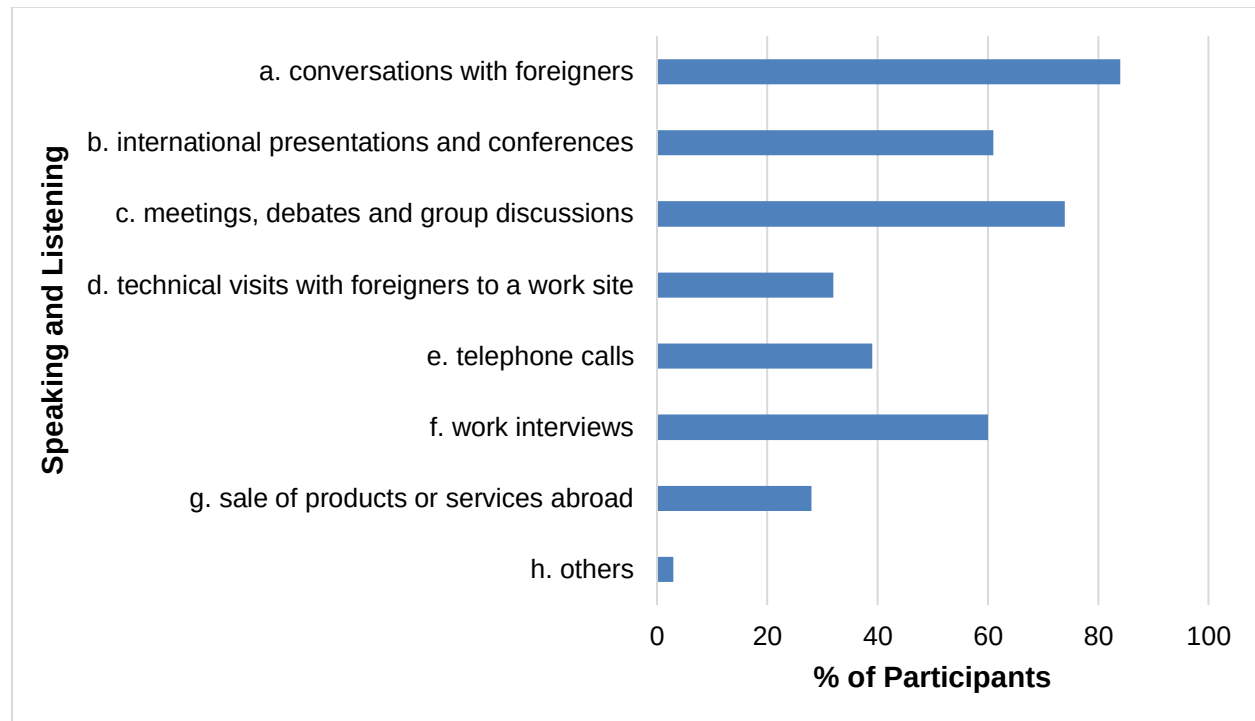
Skill	Level of priority					
	First		Second		Third	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
a. listening	19	22	16	18	13	15
b. speaking	36	41	23	26	4	5
c. reading	4	5	4	5	25	28
d. writing	4	5	11	13	11	13
e. grammar	2	2	5	6	18	20
f. technical vocabulary	10	11	17	19	5	6
g. pronunciation	13	15	12	14	12	14

As Table 3 shows, speaking was identified as the first priority or most important want by almost half of the participants (41%), followed by listening skills with 22%. The same pattern was found for the second level of priority, in which speaking was reported by 26% of the respondents, followed by listening with 18%. Additionally, reading was the macro skill most frequently reported as third priority. In relation to micro skills, pronunciation obtained the highest rank for first priority, technical vocabulary obtained the highest rank for second priority, and grammar was most frequently reported as the third priority.

When students were asked about the particular speaking and listening activities of interest, their answers provided the results shown in Figure 1.

Figure 1

Speaking and Listening Activities That Students Would Like in the Course



According to Figure 1, four main speaking and listening activities stand out from the rest. The majority of the participants (85%) indicated that conversations with foreigners are the main activity that they would like to put into practice. The activity corresponding to meetings, debates, and group discussions was classified by 74% of the respondents as the second most interesting task. The third position was occupied by international presentations and conferences. This activity was selected by 61% of the participants. A fourth activity, corresponding to work interviews, was also taken into account by the researchers since it was chosen by almost the same percentage of participants (60%) as the previous one.

The survey results also identified the main activities that students would like to learn in terms of reading and writing skills. These activities are displayed in Figure 2.

Figure 2

Reading and Writing Activities That Students Would Like in the Course

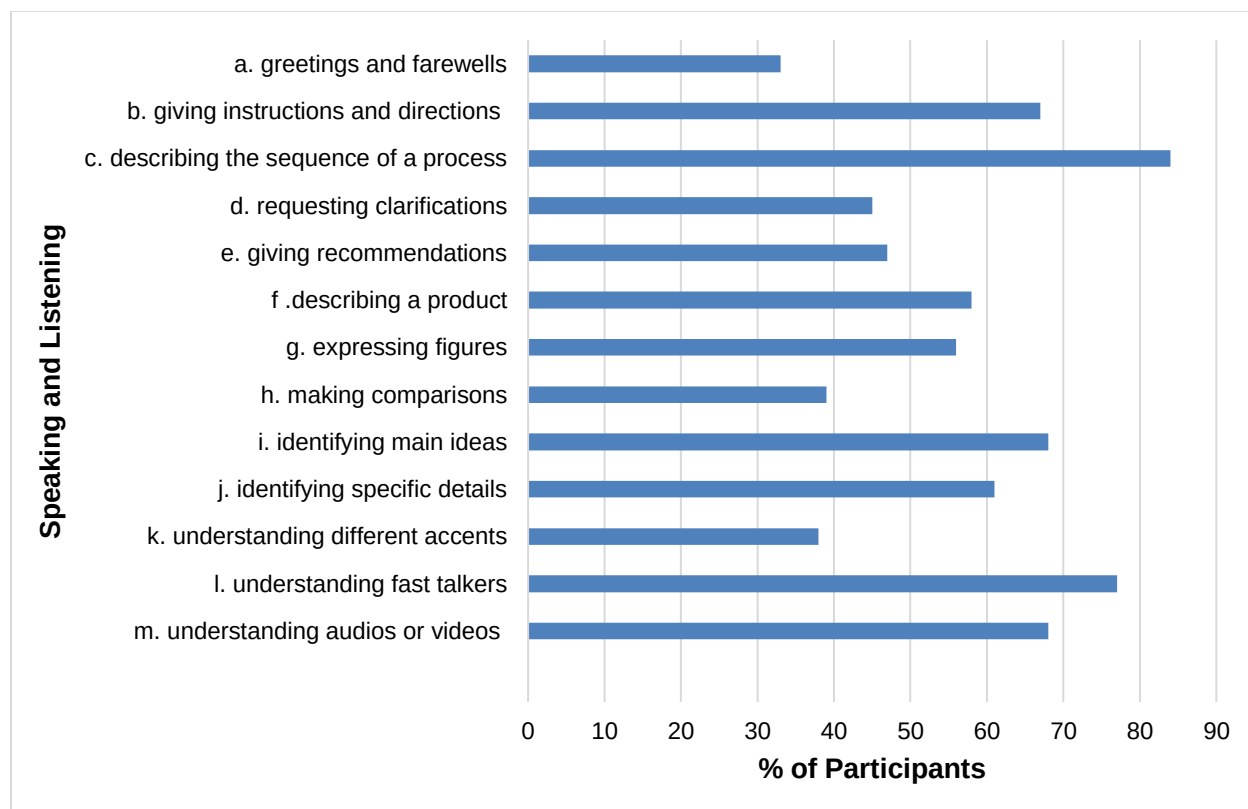


In this case, the results revealed three main activities with the highest frequencies. Almost all the participants (93%) identified articles and technical reports as the most relevant reading and writing activity. The second activity corresponds to manuals, specifications, and standards, which was selected by 78% of the respondents. The third activity, which is related to the use of textbooks, was reported by 73% of the sample population. These three main results are followed by résumés (45%) at a more distant position in the graph but still relevant to be considered in the future ESP course.

At a more specific level of detail, the questionnaire also provided information about particular communication subskills and text patterns that each student would like to address. Figure 3 shows the results corresponding to speaking and listening.

Figure 3

Speaking and Listening Subskills That Students Would Like in the Course

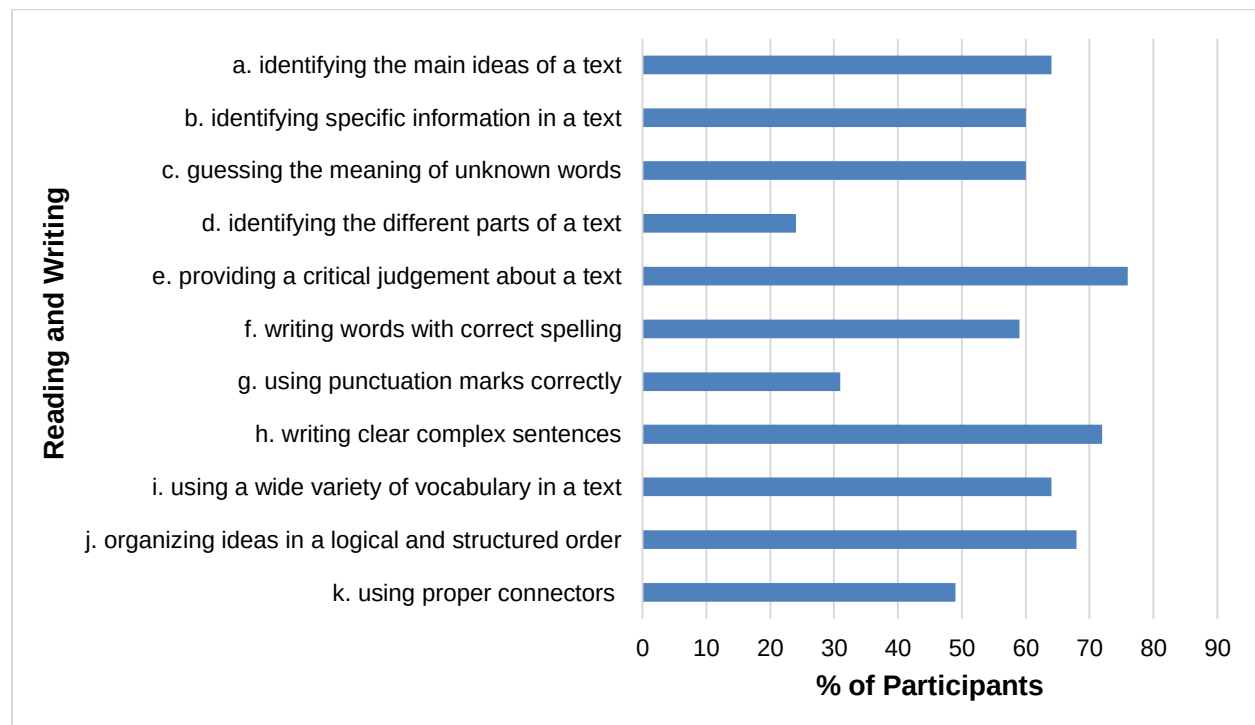


Regarding speaking, the majority of participants (84%) indicated that describing the sequence of a process is a key subskill that they would like to learn to perform appropriately in the field of Electrical Engineering. Giving instructions and directions was also selected by most participants (67%). Two more additional speaking activities were identified by more than a half of the respondents: describing a product (58%) and expressing figures (56%). For listening activities, the highest percentage corresponded to understanding fast talkers (77%). This result is followed by two listening activities evenly selected by 68% of the respondents: identifying main ideas (in conversations, presentations, audios, videos, etc.), and understanding audios or videos. Identifying specific details was the third listening activity with the highest number of respondents (61%).

Figure 4 presents the results gathered for reading and writing.

Figure 4

Reading and Writing Subskills That Students Would Like in the Course



As can be seen from Figure 4, making a critical judgement about a text was identified as a key reading subskill by most of the students, specifically 76%. In addition, identifying the main ideas of a text was selected by 64%. With respect to writing, the highest results corresponded to writing clear complex sentences (72%), organizing ideas in a logical and structured order (68%), and using a wide variety of vocabulary in a text (64%).

The exploration of students' wants also allowed the researchers to identify the most relevant Electrical Engineering topics for students. From a list of twenty different topics, more than a half of the results were linked to the following options in hierarchical order: renewable energy (60%), design and electrical installations (57%), robotics and artificial intelligence (56%),

process automation (55%), instrumentation, machines and equipment (53%), electronics (52%), project management (51%), and computing and networking (50%).

Description of the Students' Lacks

A Likert scale was included in the survey to identify the level of difficulty experienced by the students in relation to the main English language skills. The results obtained from the instrument are displayed in Table 4.

Table 4

Level of Difficulty Experienced by the Participants

Skill	Level of difficulty							
	Very easy		Easy		Difficult		Very difficult	
	N	%	N	%	N	%	N	%
a. listening	8	9	33	38	37	42	12	14
b. speaking	0	0	15	17	53	60	20	23
c. reading	7	8	54	61	24	27	4	5
d. writing	1	1	32	36	48	55	7	8
e. grammar	2	2	22	25	48	55	3	3
f. technical vocabulary	1	1	15	17	50	57	23	26
g. pronunciation	1	1	23	26	53	60	11	13

Based on Table 4, speaking is the macro skill perceived as the most difficult by the respondents. The total sum of participants who categorized it as difficult or very difficult is equivalent to 83%. The results also revealed that writing (63%) and listening (56%) were challenging skills in terms of difficulty. In the case of micro skills, it is worth noting that technical vocabulary occupied a remarkable position, with well over three-fourths (83%) of the population classifying it as difficult or very difficult.

To complement the information about lacks, the participants were asked to rank the four major language skills according to detailed descriptors given to them to understand the performance expected at each proficiency level. The results allowed the researchers to have a first glimpse of language proficiency based on the participants' own perceptions and background before administering the actual diagnostic test. The results are summarized in Table 5.

Table 5

Description of the Current English Proficiency Level Perceived by the Participants

Perceived level	Skill							
	Listening		Speaking		Reading		Writing	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
a. advanced	11	13	2	2	14	16	4	5
b. intermediate	33	38	25	28	40	45	29	33
c. beginner	28	32	39	44	23	26	37	42
d. extremely limited	16	18	22	25	11	13	19	22

The results point to the majority of students being categorized as beginners or intermediate, matching the preliminary information obtained in the registration process. By exploring the findings in more detail, the data showed that the main lacks are related to productive skills. For example, in the extremely limited level, speaking (25%) and writing (22%) represented the highest percentages of students within this category. The same pattern was found in the case of the beginner level, which reported 44% for speaking and 42% for writing as the highest percentages for that specific proficiency level. As the perceived level increases to higher categories, the percentage of students corresponding to productive skills decreases proportionally. Thus, the intermediate level reported 28% of students for speaking skills and

33% for writing, the lowest results within this category, while the advanced level included only 2% for speaking and 5% for writing, which are also the lowest values.

Commonalities

The triangulation of data provided by the three sources of information (professors, electrical engineers, and students) allowed the researchers to identify the following commonalities regarding the participants' needs, wants, and lacks.

First, it is worth noting that the stakeholders and the students clearly consider English an essential requirement in the field of Electrical Engineering, as it opens the doors to a more diverse collection of academic and professional opportunities.

Specifically for academic purposes, the general perception is that reading is the most important language skill needed by students. Although it is not an official requirement in the major, all the professors agreed that most courses demand that students read technical texts. In relation to this, the professionals added that most of the didactic materials and updated technical references are in English. In addition, the professors highlighted the relevance of listening for attending conferences or watching videos, and of speaking and writing in the case of applying for a scholarship abroad. These findings are consistent with the responses provided by the students. When asked to categorize the different language skills by using a rank order, reading occupied the highest priority, followed by listening and speaking.

In the case of professional needs, the findings demonstrate that all the macro skills become important when performing work-related activities; however, students and stakeholders emphasized the importance of speaking, which is currently a requirement to find a job or to get an internship at a company. Additional priorities reported by the professionals included reading and technical vocabulary. As for the students, the secondary priorities corresponded to listening and reading.

After exploring the needs in the academic and professional contexts, the students were also asked to select the English skills that they wanted to improve. Interestingly, the tendency of the respondents was closer to the needs identified for the professional settings. This means that speaking was identified as the first priority, followed by listening and reading. A possible explanation attributed to this trend is that students may be more interested in language skills required for job-related environments since they will soon complete their major and expect to enter the labor market.

Regarding particular activities that require the use of English, the most relevant speaking and listening tasks selected by the stakeholders included attending international presentations and conferences, having conversations with foreigners, and participating in meetings, debates or group discussions. In terms of reading and writing, the activities were mainly related to reading technical documentation (articles, reports, manuals, specifications, datasheets, and standards), reading textbooks, and writing emails. These needs reported by the stakeholders clearly matched the wants selected by the students in the survey.

In terms of lacks, both groups of stakeholders mentioned that the main deficiency affecting students and professionals corresponds to speaking, as it has recently become an important selection criterion used by employers. Writing was also identified by stakeholders as the second most difficult skill. These findings are consistent with the results collected from the students in the survey.

Finally, in regard to recommendations for the ESP course, both groups of stakeholders agreed on similar suggestions: helping students gain confidence, developing soft skills, and improving technical vocabulary for usage in written or spoken interactions.

Students' Learning Strategies, Styles, and Attitudes

The survey taken by students explored their learning strategies, styles, and attitudes.

Figure 5 presents the main findings collected in this part of the research.

Figure 5

Participants' Learning Styles

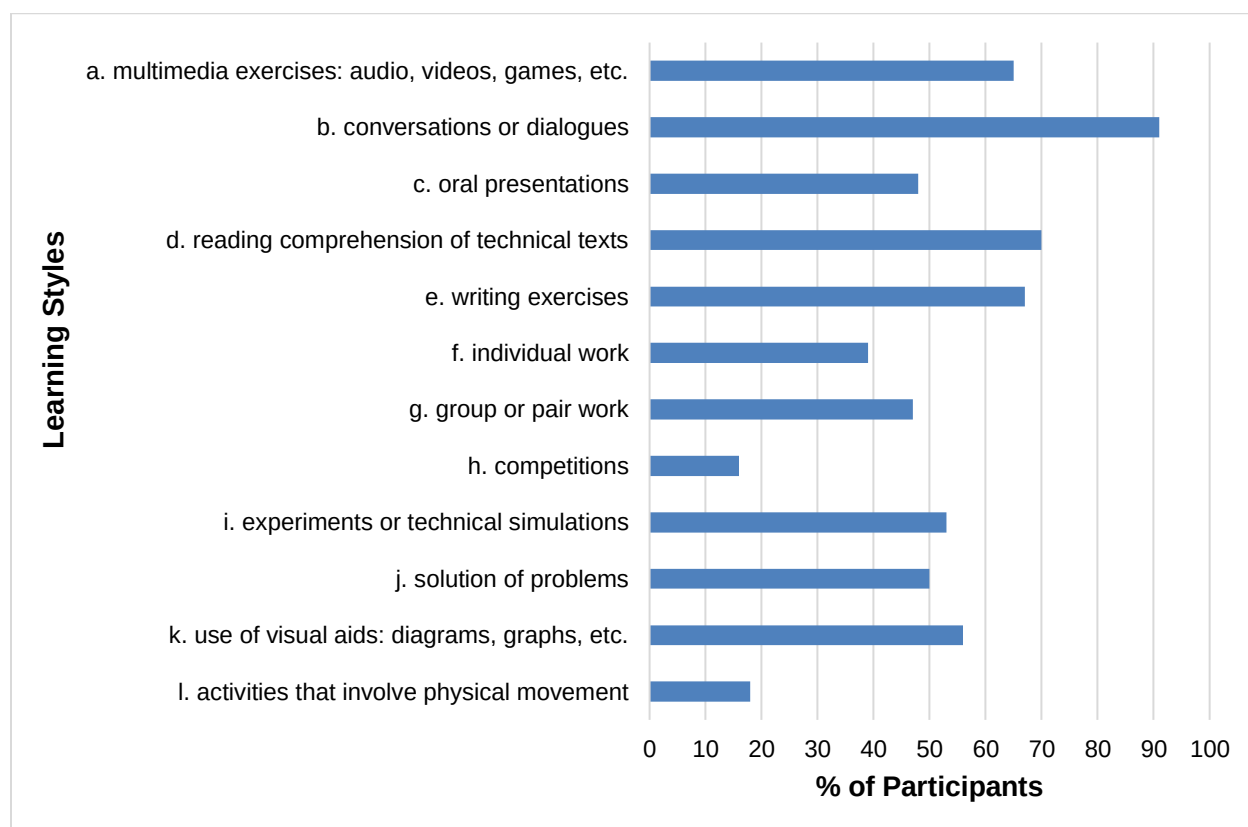


Figure 5 evinces that conversations or dialogues are some of the main activities that students would like to have in the English class, representing 91% of the total sample. The second activity in which they are mostly interested corresponds to reading comprehension of technical articles (70%). Two additional preferences reported by more than a half of the participants include writing exercises (67%) and multimedia exercises (audios, videos, games, etc.) (65%). Regarding interpersonal or intrapersonal participation, most students seemed to prefer group or pair work (47%) in comparison with individual work (39%). The participants also

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showed more interest in the survey items related not only to spatial-visual intelligence, as 56% indicated that they like the use of visual aids (diagrams, graphs, images, etc.), but also to logical-mathematical intelligence, reporting interest in experiments or technical simulations (53%) and solution to problems (50%). The bodily-kinesthetic intelligence (activities that involve physical movement) featured the lowest percentage of participants (18%).

The purpose of the last open-ended question in the needs analysis questionnaire was to collect additional information about the learners' attitudes towards learning, as well as their expectations and suggestions for the design of an ESP course. Overall, the students are greatly interested and have very positive attitudes towards the course. Several salient trends emerged from the qualitative analysis. For example, the main opinion among the participants was that they would like to improve their speaking skills to communicate effectively in a professional context. Many students mentioned that they are interested in practicing constantly to improve fluency, learning useful expressions, improving their pronunciation, and becoming familiar with different English accents to feel confident enough to engage in spontaneous conversations. Furthermore, a large number of students also pointed out that they would like to learn technical vocabulary that helps them improve their receptive and productive skills in both the academic and professional fields. Some of the participants also stated that they would like to improve their reading and writing skills. Additionally, the students highlighted that it is important to teach these skills in a fun, dynamic, and interactive way. Finally, yet importantly, the learners stated that they would like to have instructors who really care about their progress and help them improve in every way possible. Their time is limited due to the requirements of their major, but they would clearly take advantage of the ESP course.

Participants' Individual Profiles

To have a general overview of the potential students for the ESP course, the individual profile of 25 participants selected at random from the entire group is provided as part of this study. This number was suggested by the Course Design professor as a representative sample of the target population. Based on the information gathered from the needs analysis, a one-page table was prepared for each student, including information about their academic year, academic specialization, needs, wants, lacks, previous English language experience and perceived proficiency. A coding number was also used to avoid giving the participants' names. The descriptions can be found in Appendix E.

E. Diagnostic Test***Key Assessment Principles: Validity and Reliability***

To render effective and trustworthy results, the researchers considered the assessment principles of validity and reliability important cornerstones for designing, administering, and analyzing the diagnostic test, which is included in Appendix F.

First, validity is defined as “the extent to which a test measures what it purports to measure” (Coombe et al., 2007, p. xxii). Brown (2004) and Coombe et al. (2007) refer to different types of validity. For example, a test shows content validity when it assesses the content and outcomes by using formats familiar to the students and by requiring test-takers to perform the behaviors being measured; construct validity occurs when the underlying theories and methodology of language learning match the type of assessment; and face validity refers to the extent to which a test appears to measure the knowledge and the abilities that it is supposed to measure.

Thus, the diagnostic test achieved content validity because it aimed to measure language proficiency based on the ESP context, considering academic and professional

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situations that Electrical Engineering students may face in real life: technical readings such as datasheets and articles, applications for student exchange programs, audios on technical topics, and job interviews. These situations were selected based on the data collected from the needs analysis questionnaire and interviews. In addition, when designing and selecting the items for each skill, the researchers were careful to ask students about the specific required ability and not to measure other skills or previous knowledge in a subject. The test was also divided into sections for each macro skill, and a relative weight was assigned to each. Moreover, in line with Genesee and Upshur (1996), who suggest that “it might be useful, in some cases, to prepare the test instructions for students with a common first language” (p. 201), the instructions for each section were provided in English and Spanish in order not to test comprehension of directions, a situation that could mainly affect the performance of students with a low proficiency level.

The diagnostic test also evidenced construct validity as different constructs (theoretical knowledge) and rubrics were established for assessment. Even though the main construct corresponds to the students’ current performance and knowledge in English based on the objectives and descriptors from the Common European Framework of Reference for Languages (CEFR), the following specific language constructs were also assessed as part of each skill:

- Reading: Scanning, using typographical clues, guessing meaning from context, reading for main ideas, reading for specific details, and identifying facts and opinions.
- Listening: Listening for main ideas and for specific details and making inferences.
- Writing: Organization, content, grammar, mechanics, and style and quality of expression.
- Speaking: Content, fluency, grammar, pronunciation, and vocabulary.

Regarding face validity, different considerations were taken into account by the researchers to make the test look professional, relevant, and useful for students. For instance,

the test was well-structured in terms of format and familiar tasks relevant to the Electrical Engineering academic and professional settings. Feedback from the review by the Course Design professor was also incorporated to make the items clear. The difficulty levels for each skill presented a reasonable challenge from the easiest to the most difficult items. Furthermore, considering that the test had to be administered online, detailed instructions were also provided to the students for accessing the virtual platforms and for taking the test. The researchers were constantly monitoring the contact address and the online platforms in case of questions from the students, and even several positive comments were received from the examinees after administering the instrument.

The second assessment principle with a key role for the diagnostic test was reliability. According to Brown (2004), a reliable test is consistent and dependable, meaning that it should yield similar results if given to the same or matched students on different occasions (p. 20). As an attempt to accomplish student-related reliability, the researchers made the written test available for two days in order for students to take it at their most convenient time. In the case of the speaking section, small talk and warm-up questions were included at the beginning of the interview to reduce the students' anxiety and help the test-taker become comfortable with the situation. For test-administration reliability, the general instructions highlighted the importance of the following special requirements: having the proper equipment and Internet connection, taking the test at a quiet and undisturbed location, providing a personal identification, and not using any support to obtain accurate results that could truly reflect the students' level of competence. For test reliability, the test was properly constructed regarding format, type of items selected for the test, levels of difficulty, and clear instructions. Students were also provided with information about the purpose of the test, the weighting of each section, the time available, the number of sections, and special test conditions. The researchers decided to use an extensive exam in

terms of number of items because “testing research shows that longer exams produce more reliable results” (Bachman, 1990, as cited by Coombe et al., 2007, p. xxiii). For example, the written test for assessing reading, writing and listening included approximately 40 items, two different readings, and three different audios, and the oral communication test was scheduled for a date different from the written test in order not to overload students with information. Finally, for inter- and intra-rater reliability, specific rubrics were prepared beforehand for the productive skills of writing and speaking, and the test items were graded and discussed by the two researchers to avoid any inconsistency issues related to fatigue, subjectivity, or human error.

Test Administration Issues and Time Allotted

Due to the large number of participants who submitted the needs analysis questionnaire (a total of 88 students), the diagnostic test was divided into two parts for practicality purposes, so that the researchers would be able to develop the test and analyze the results within the available time and with the available resources.

The written section was the first part to be administered, and it assessed the skills of reading, writing, and listening. A total of 70 students out of 88 completed this section of the diagnostic test. Google Forms, which is a common online tool for conducting surveys and tests, was the platform selected for the written section. In addition, Google Classroom was also required to provide students with the general instructions and to attach the diagnostic test and the complementary materials: two readings in PDF format, one video, and two MP3 audio files. Google Classroom also served as a means of contact with students in case of questions during this test. The written section was available for two entire days, from Thursday, May 27 to Friday, May 28, 2021. As part of the general instructions, the participants were informed that they had a maximum of 3 hours to complete the test.

The second part, corresponding to the oral communication section to assess speaking skills, was administered separately by scheduling an online interview with each student who took the written test. Zoom, which is a well-known software for video conferencing and distance education, was the virtual platform selected for administering this part of the test, as it allows the researchers to record the sessions for backup purposes and to organize students in waiting rooms if they log into the session before the scheduled time. The appointments were scheduled every 10 minutes, meaning that the total time required for administering all the oral interviews was approximately 12 hours. The oral interviews were set up one week after administration of the written section.

Macro and Micro Skills Selected

In light of the results collected from the needs analysis, the researchers decided to include the four macro skills in the diagnostic test to support the perceived levels that had been previously reported by the students in the questionnaire. Additionally, the micro skills selected for the test were closely related to the language needs and the academic and professional tasks identified as priorities by the students: reading technical documentation, writing emails, listening to technical audios, and interacting in a job interview.

Constructs Behind the Test

Under the umbrella of a main general construct corresponding to the students' current performance and knowledge in English based on the objectives and level descriptors from the CEFR, specific language constructs were also assessed for each major skill as described in the following subsections.

Reading

Reading skills were assessed by means of two technical texts: one datasheet about a fiber optic cable, and an IEEE article about a wave energy power system. The constructs

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assessed included scanning, using typographical clues, guessing meaning from context, reading for main ideas and specific details, and identifying facts and opinions.

Writing

The writing section consisted of one productive response item where students had to write an email. The constructs evaluated in this task were organization, content, grammar, mechanics, and style and quality of expression.

Listening

The constructs considered in this section were listening for the main idea, listening for specific details, and making inferences.

Speaking

The oral communication test consisted of an individual guided interview with each student. Three sets of questions were used, each set corresponding to a proficiency scale from the CEFR (two questions for Basic User, two for Independent User, and one for Proficient User). The language constructs assessed were content, fluency, grammar, pronunciation, and vocabulary.

Types of Items to Assess Each Skill

The diagnostic test used a combination of receptive and productive response items. For the written section, the selection of items for each skill was largely determined by the format and options already established in the online platform for administering the test (Google Forms).

Reading

The reading section included receptive response items, specifically multiple choice and true-false. The multiple-choice items required students to choose one of three possible options, except for the true-false exercise for main ideas and the fact and opinion exercise, in which only two possible options were available.

Writing

This section consisted of a productive response item task where students were required to write an email with a minimum extension of 10 lines and a maximum of 15 lines.

Listening

Receptive response items were used for assessing this skill. While the first two parts of the listening section corresponded to a multiple-choice exercise, the last part was composed of true-false items.

Speaking

The speaking section included productive response items as the skill was assessed by means of a set of open-ended questions and prompts in an oral interview.

Subskills Addressed in Each Section

The particular subskills addressed in the diagnostic test resembled a series of objectives established for each section.

Reading

1. To show understanding of technical readings with different lengths and levels of difficulty.
2. To identify specific details in a technical reading by means of scanning.
3. To show understanding of typographical clues in a text.
4. To decode the meaning of words in a reading based on contextual clues.
5. To recognize main ideas in a technical reading.
6. To recognize facts and opinions in a technical reading.

Writing

1. To write an email where students introduce themselves and talk about their background in an academic context by using appropriate language and writing conventions.

2. To explain the importance of being selected for a student exchange program by giving reasons, opinions, and examples in terms of future plans and expectations.

Listening

1. To show understanding, aided by visuals, of phrases, and expressions related to areas of most immediate relevance regularly encountered at work and school.
2. To show understanding of the main point and the specific details of speech, including technical discussions in the field of specialization.
3. To identify the speaker's viewpoints and attitudes as well as the information content.
4. To demonstrate understanding of finer points of detail in recorded and broadcast audio material.

Speaking

1. To demonstrate understanding of texts (questions and prompts) during an oral interview.
2. To successfully interact by asking and answering questions, giving descriptions, narrating experiences, and giving opinions about a variety of familiar and technical topics.
3. To produce chunks of language at different lengths, fluent speech, correct grammatical structures, appropriate English phonemes, and an adequate repertoire of vocabulary.

Number of Items for Reliability

To ensure reliable results, the diagnostic test included a total of 90 points. The reading section was made up of 25 items distributed in six different exercises for a total of 25 points. The writing section contained a single item that assessed multiple subskills at the same time; therefore, it was worth 25 points. The listening section consisted of 15 items distributed in three exercises for a total of 15 points. The speaking section included three sets of questions for a

total of 25 points (two questions for Basic User, two for Independent User, and one for Proficient User).

Task Design in Terms of Proficiency Levels and Source

The tasks for each macro skill were mainly designed based on the descriptors set by the CEFR for each proficiency level, as these scales “describe in a comprehensive way objectives that learners can set to achieve” (Kantarctoglu & Papageorgiou, 2012, p. 85). The levels of difficulty defined for each macro skill usually start increasing as the communicative functions, vocabulary, and structures become more demanding for the examinees. The CEFR includes six broad levels of ability, with A1 being the lowest and C2 the highest, and learners can be classified into three distinct groups or categories: the Basic User (levels A1 and A2), the Independent User (B1 and B2), and the Proficient User (C1 and C2) (Cambridge University Press, 2015, The CEFR, para. 2).

Reading

The reading section included six exercises, each assessing a different reading strategy. The Basic User level (A1 and A2) was exclusively associated with the scanning tasks because students were required to understand simple words and short sentences that, in some cases, were very predictable or had similar equivalents in Spanish. Moreover, some of the items were complemented with visual support. A score of 0 to 9 points was assigned for the Basic User level. With regard to the Independent User level, it included the reading strategies related to typographical clues and meaning in context for B1, and identification of main ideas for B2. The student was required to score from 10 to 21 points to be placed at the Independent User level. The Proficient User level (C1) was exclusively dedicated to the identification of facts and opinions because this task requires understanding a text in more detail. To reach this level, the student had to score from 22 to 25 points in the reading section.

Writing

To assess the learners' proficiency level in writing, the researchers designed an analytic scale combining the descriptors dictated by the CEFR and the DIALANG scales, the latter also based on the CEFR guidelines and commonly used for diagnostic purposes (Council of Europe, 2001, p. 226). The researchers used this rubric to determine whether the learners showed command of the five constructs evaluated according to the different CEFR levels: Basic User, Independent User, or Proficient User. For this section, the students who showed mastery of the Basic User writing skills were assigned 1 point in the corresponding constructs, the students with skills suggesting an Independent User level were assigned 3 points, and those who exhibited more advanced skills, corresponding to the Proficient User level, were assigned 5 points. Furthermore, students had to write an email in which they were required to introduce themselves, which is a task that Basic Users are expected to accomplish according to the descriptors and scales mentioned above (A1 and A2). Then, they were instructed to describe their academic qualifications in the email, as Independent Users should be able to write straightforward, detailed descriptions on a range of familiar subjects within their field of interest (B1), and more advanced language users (B2) should be able to produce clear, detailed texts on a wide range of subjects and explain their viewpoint with appropriate highlighting of significant points and relevant supporting detail. The test-takers also had to refer to their plans and expectations in the academic and professional field, which would be a task easily accomplished by a Proficient User as per the descriptors followed by the researchers (C1). Therefore, the test-takers had the opportunity to write an email, either simple or elaborate, according to their abilities.

Listening

The researchers designed listening tasks with levels of difficulty also based on the CEFR and the DIALANG scales. The listening section was divided into three parts, each containing five items. A total of 15 points were assigned to this particular macro skill, meaning that each item was worth 1 point. The first five items dealt with listening for specific details. The students with a Basic User proficiency level were expected to understand the first listening text as the speech was clearly and slowly articulated, the phrases and expressions were mostly related to school or work, and the speech was supported by visuals (A1 and A2). The second set of items involved two questions to listen for specific details, two questions where the students had to make inferences, and one last question to identify the main idea of the audio. At this point, the students with a perceived Independent User level should have been able to guess the meaning of occasional unknown words from the context, identify both specific details and main ideas since the audio was related to an academic and professional topic, and understand the audio material delivered in standard language to identify the speaker's mood and tone, among others (B1 and B2). The third exercise was a true-false activity in which the test-takers were required to listen for specific details and make inferences to determine if each item was accurate or not. The students suggesting a Proficient User level were expected to understand this broadcast audio material and identify finer points of detail, as well as understand the speech that was delivered at a fast native speed (C1 and C2). Thus, the students had to score 0 to 5 points to be considered Basic Users, 6 to 10 points to be Independent Users, and 11 to 15 to be Proficient Users.

Speaking

The oral interview used for assessing speaking skills was designed based on a combination of different CEFR descriptors for production and interaction, and a rubric was

developed for scoring the various components of speaking skills. The interview adapted the stages proposed by Canale (1984) as a framework for oral proficiency testing: warm-up, level check, probe, and wind-down (Brown, 2004, p. 168). As part of the level check, the first set of questions corresponded to the Basic User, and it required students to score from 0 to 10 points. The students had to provide simple descriptions and short exchanges of information mainly about personal or familiar topics (A1) or about routines, educational or professional background, likes and dislikes, past activities, and future plans (A2). The second set of questions during the interview corresponded to the Independent User, and here the students were required to narrate an experience or sequence and to describe a solution, a simple point of view, or a plan of action (B1). The students could also go further and interact with a degree of fluency on more specialized and detailed topics (a technical discussion, advantages and disadvantages, advice on technical matters, a procedure, etc.) (B2). The Independent User scale required a total score of 11 to 20 points in the oral interview. Finally, the questions corresponding to the Proficient User (probe), with an assigned score of 21 to 25 points, demanded clear, fluent, and detailed texts on more complex subjects, with a broad command of vocabulary and expressions; therefore, it was the most challenging stage for the test-takers.

Types of Rubrics for Assessing Writing and Speaking

Analytic rubrics, which “result initially in several scores, followed by a summed total score” (Mertler, 2001, p. 2), were used for assessing writing and speaking skills on a multidimensional level. Even though this type of rubric usually implies a slower scoring process, it provided the researchers with more specific feedback and supporting data for placing the participants at the corresponding perceived English levels.

Writing

For the writing section, the student-teachers adapted an analytic scale based on the CEFR descriptors, the TOEFL writing rubrics, and a rubric sample for rating composition tasks (Brown, 2004, pp. 244-245). According to Coombe et al. (2007), “unlike holistic marking scales, analytical writing scales provide teachers with a “profile” of their students’ strengths and weaknesses in writing, which is very useful for diagnostic feedback” (p. 83). Thus, this type of rubric helped the researchers to place students at the perceived proficiency level, determining strengths and weaknesses for appropriate design of tasks that address the identified needs. The rubric reflected the following constructs: organization, content, grammar, mechanics, and style and quality of expression. See Appendix G.

Speaking

The analytic scoring guide used for assessing speaking was developed as an adaptation from references such as the table on qualitative features of spoken language by the CEFR (Council of Europe, 2020, pp. 183-185), oral proficiency scoring categories (Brown, 2004, pp. 172-173), and a speaking assessment scale (Coombe et al. 2007, p. 127). The rubric included the following five components: content, fluency, grammar, pronunciation, and vocabulary. See Appendix H.

Types of Parameters for Assessing Reading and Listening

The parameters or descriptors that characterize the proficiency levels of reading and listening were taken and adapted from the CEFR guidelines for the specific context under study. The CEFR was selected as the main source of reference because its main purpose is “to provide a common basis for the elaboration of language syllabuses, examinations and textbooks, by describing in a comprehensive way what language learners have to learn to do in order to use a language effectively for communication” (Kantarctoglu & Papageorgiou, 2012, p.

82). In line with this, Willis and Willis (2007) also note that this manual “provide[s] a useful starting point to illustrate the principles of syllabus specification” (p. 181). Thus, the learner’s strengths and weaknesses identified after reviewing the results of these sections should directly correlate with the types of tasks to be created during the syllabus design stage.

Reading

Basic User Level

1. Can understand familiar words and very short and simple sentences. (A1)
2. Can get an idea of the content of simple informational material and short descriptions, especially if there is visual support (e.g., a catalogue). (A1)
3. Can find specific, predictable information in short and simple texts. (A2)

Independent User Level

1. Can understand straightforward and factual texts that consists mainly of high frequency everyday or job-related language (e.g., instructions for a piece of equipment). (B1)
2. Can scan different parts of longer texts to locate information required to fulfill a specific task. (B1)
3. Can read articles and reports concerned with contemporary problems in which the writer adopts a particular viewpoint. (B2)
4. Can understand the main ideas of complex texts, including technical texts in his/her field of specialization. (B2)

Proficient User Level

1. Can understand in detail long and complex texts likely to be encountered in professional or academic life (e.g., specialized articles and technical instructions). (C1)
2. Can identify finer points of detail including attitudes and implied or stated opinions. (C1)

Listening***Basic User Level***

1. Can follow speech which is very slow and carefully articulated. (A1)
2. Can understand phrases and expressions related to areas of most immediate priority (e.g., school and work), provided that speech is clearly and slowly articulated. (A2)
3. Can identify the main points of a listening text where the visual material supports the speech. (A2)

Independent User Level

1. Can guess the meaning of occasional unknown words from the context and understand sentence meaning if the topic discussed is familiar. (B1)
2. Can understand straightforward factual information about academic and job-related topics, identifying both general messages and specific details, provided that speech is clear and generally familiar accent is used. (B1)
3. Can understand the main ideas of complex speech on both concrete and abstract topics delivered in a standard language, including technical discussions in a field of specialization. (B2)
4. Can understand most audio materials delivered in standard language and can identify the speaker's mood, tone, etc. (B2)

Proficient User Level

1. Can understand a wide range of recorded and broadcast audio material, including some non-standard usage, and identify finer points of detail. (C1)
2. Can understand any kind of spoken language, whether live or broadcast, delivered at a fast native speed. (C2)

Diagnostic Test Results

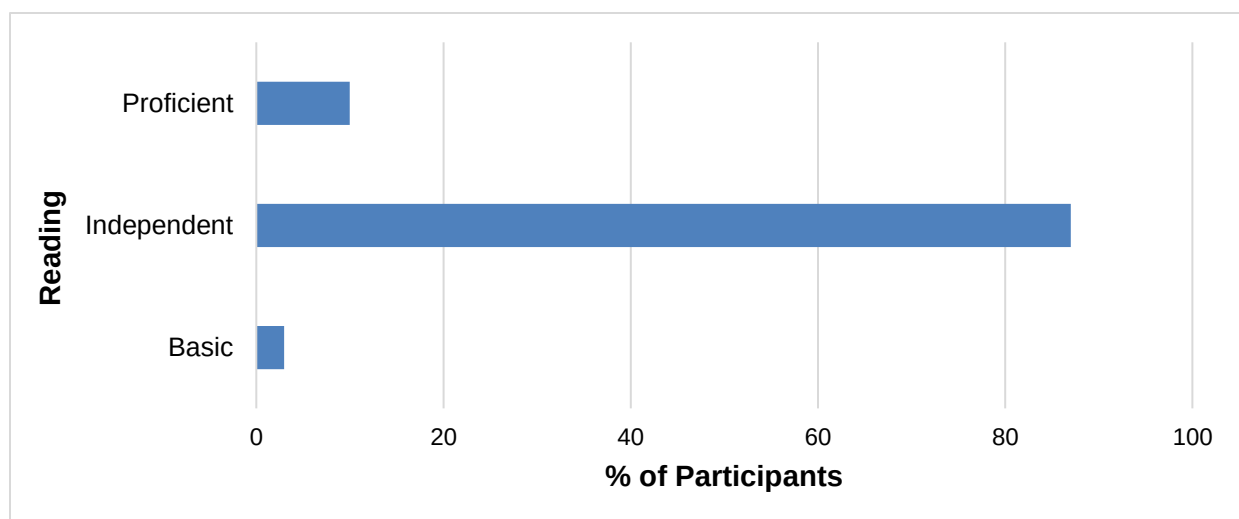
The results elicited from the diagnostic test for each specific macro skill are presented in the following subsections.

Reading

As shown in Figure 6, the findings suggested that most of the participants (87%) had a reading level corresponding to the Independent User scale since they scored 10 points or higher for this skill. In addition, based on the total score obtained in this section, the Proficient User level included 10% of the participants, and the Basic User level represented only 3% of the population.

Figure 6

Test Results for Reading Skills



This means that most test-takers scored higher than the Basic User level since they were able to understand factual information as that included in the datasheet and the technical article used for the test, and they successfully scanned the specific details required from the readings. The students demonstrated that they can go beyond by using other reading strategies more related to the Independent User, such as typographical clues, guessing meaning from

context, and identification of main ideas. However, the scoring process evidenced that the reading exercises in this category started to be more challenging for the test-takers in comparison with the results of the scanning exercises, in which less than 10% of the students had more than two incorrect answers. For example, the total percentage of students who scored from 0 to 2 points was 47% for typographical clues, increasing to 67% for meaning from context and 61% for identification of main ideas (see Table 6).

Table 6

Scores Obtained in the Use of Reading Strategies

Score	Reading Strategies							
	Independent User						Proficient User	
	Typographical clues		Meaning from context		Main ideas		Facts and opinions	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
a. 0 points	6	9	4	6	1	1	1	1
b. 1 point	8	11	21	30	13	19	0	0
c. 2 points	19	27	22	31	29	41	14	20
d. 3 points	23	33	18	26	13	19	29	41
e. 4 points	14	20	5	7	14	20	26	37

Curiously, the exercise for identification of facts and opinions, corresponding to the Proficient User level, represented a less challenging task for the students in comparison with the strategies assessed for the Independent User level. Only 21% of the students scored from 0 to 2 points in the facts and opinions exercise, suggesting that most students were able to identify finer points of detail in a long text, including implied or stated ideas. Despite this, the total sum of points obtained by the test-takers in the reading section was not sufficient to reach the score established for the Proficient User level due to their low achievement in the sections related to understanding typographical clues, inferencing meaning from context, and identifying main

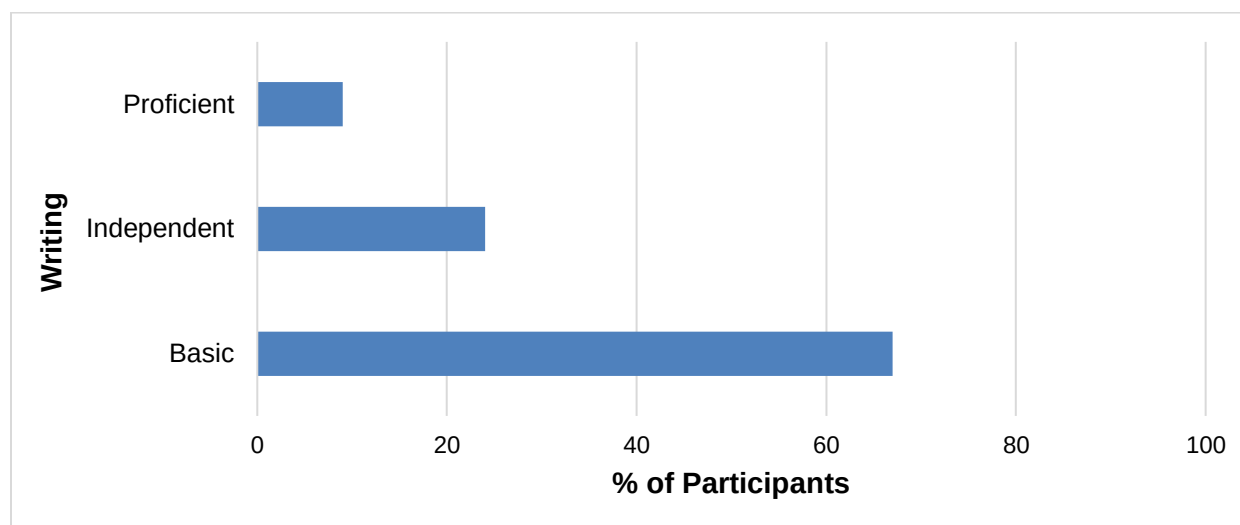
ideas. These results revealed that, if the ESP course were eventually addressed to a population of Independent Users or even to Proficient Users, these specific strategies would have to be reviewed and put into practice with the students to improve comprehension of technical texts.

Writing

In the case of this production skill, the results in Figure 7 suggested that more than a half of the participants (67%) had a Basic User level. In addition, the total percentage of students perceived as Independent Users was 24%, and only 9% of the population was perceived as Proficient Users.

Figure 7

Test Results for Writing Skills



Interestingly, this is consistent with the results of the needs analysis questionnaire. When asked about their self-perceived writing proficiency, 64% of the students stated that they were Basic Users, 30% were Independent Users, and 6% considered themselves Proficient Users. Therefore, self-perceived proficiency compared to the actual results demonstrated that most of the Electrical Engineering students are lacking skills for writing emails, which is a

challenging skill they would like to develop in a future ESP course according to the needs analysis.

While the majority of the students completed the email task report, 8 out of 70 students simply left it blank. A possible reason is that they had trouble understanding the requirements of the task or did not have enough language knowledge to frame an appropriate response. Some other students wrote a very short and simple email. In fact, by correlating these emails with the CEFR descriptors for the Basic User, most test-takers were able to convey personal details using simple isolated phrases and sentences (A1), write a formulaic message relating to matters in areas of immediate need or interest, and describe plans and arrangements (A2).

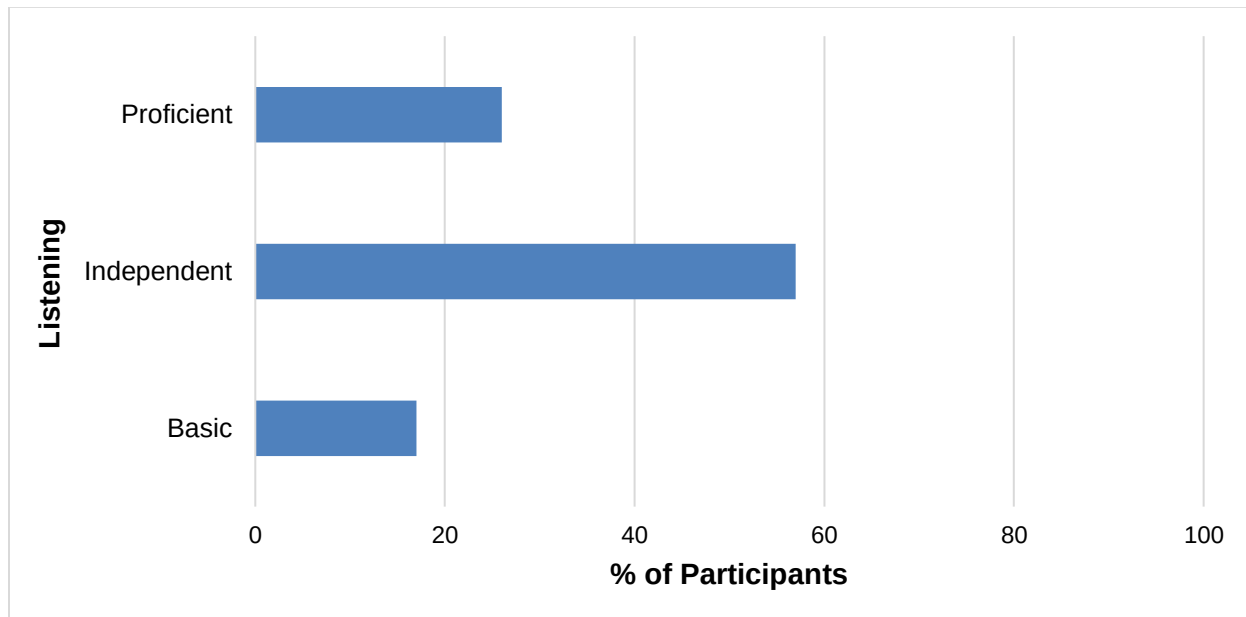
Based on the CEFR parameters, the learners perceived as Independent Users went a step further by getting across the points that they felt were important, described their dreams and ambitions from an academic and professional level, justified their decisions, and conveyed degrees of emotion by highlighting the personal significance of the opportunity to participate in an exchange program. Upon checking the email that the students wrote, the researchers found out that the learners perceived as Proficient Users were able to express themselves with clarity and precision, relating to the addressee flexibly and effectively, and they were also able to expand and support points of view at some length with subsidiary points, reasons, and relevant examples. Additionally, these students showed command of appropriate and effective logical structures, which made it easy for the researchers to identify the different parts of their email and their purpose, for instance: the salutation, the body, and the closing sentence.

According to the scoring process, most of the students had issues with three main aspects: organization, content, and mechanics. The test-takers did relatively better in grammar and in style and quality of expression. In fact, from the students who scored from 0 to 5 points (Basic User), 90% struggled with organization, 83% with content, and 77% with mechanics. In

the case of grammar, as well as style and quality of expression, the percentage of students who had trouble was 70% for each category. In general, most students did not make use of English writing connectors to help them express ideas in a smooth, logical, and clear way. As for content, many students had some issues with the development of their ideas, as their emails were very brief and did not provide enough details as required in the task instructions. Lastly, mechanics represented a challenge for most students. For example, misspelled words, capitalization errors in words such as the pronoun “I” or the noun “English,” and lack of commas and periods (run-on sentences) characterized a great deal of the emails revised. Therefore, the results suggest that special attention will need to be paid to these constructs during the syllabus design and the practicum stage to help students improve their writing skills and avoid common mistakes.

Listening

Figure 8 presents the results gathered for the perceived level of listening proficiency. It was suggested that more than a half of the test-takers were Independent Users (57%), approximately a quarter were Proficient Users (26%), and the rest were Basic Users (17%).

Figure 8*Test Results for Listening Skills*

The findings shown above differed from those reported in the needs analysis questionnaire, in which 53% of the student population had indicated that their self-perceived listening level was Basic, 33% stated that they were Independent, and 14% considered themselves Proficient listeners. This discrepancy can be attributed to the fact that Electrical Engineering students are usually required to watch videos or listen to audios related to their field in order to extract important details for research or even for class discussions. Thus, even though their self-perceived level was mostly basic, the majority seemed to have developed their listening skills and to be capable of understanding an audio text, as this is an activity regularly encountered in the academic context of Electrical Engineering.

According to the CEFR parameters used to measure listening skills, Basic Users can follow slow and carefully articulated speech, understand phrases and expressions related to areas of most immediate priority (e.g., school and work), and identify the main points of a listening text where visual material supports the speech. This is precisely what most test-takers

demonstrated in the first part of the listening section, as they were able to listen for specific details to answer the five items correctly.

For the Independent User level, students showed that they had the ability to guess the meaning of unknown words, understand straightforward factual information and main ideas about academic and job-related topics, and also understand audio material delivered in standard language to identify the speaker's mood and tone. The most challenging items for students were the last two of the second section, which were intended to test their ability to make inferences and understand the main idea. This can be attributed to the distractors being plausible and effective in deviating the test-takers' attention to similar options.

Finally, according to the CEFR descriptors, Proficient Users can understand a wide range of recorded and broadcast audio material and identify finer points of detail delivered at a fast native speed. In the last listening exercise, which was intended for Proficient Users, some of the items contained traps such as modifications in the original statement and addition or removal of a word or phrase, which made the statements inaccurate and distracted the learners from choosing the right option. Thus, it was noticeable that many students relied on their background knowledge or assumptions to answer some of the questions and did not choose the option based on the listening text.

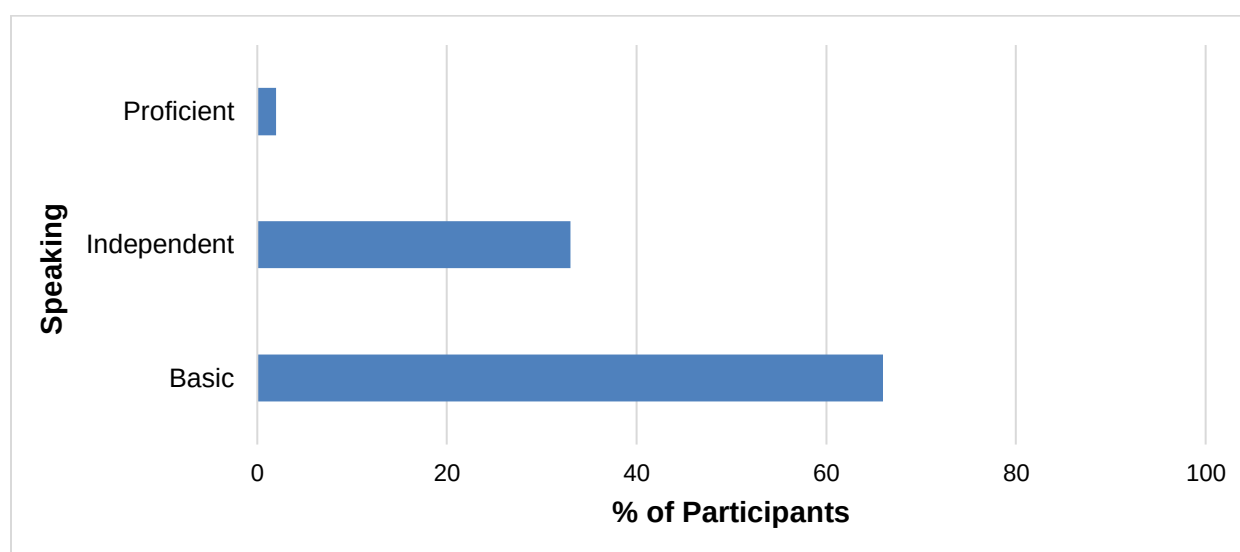
Based on the results, it is possible to infer that Electrical Engineering students have difficulties identifying main ideas and making inferences, as well as difficulties in choosing between true and false statements. The researchers will consider these findings to address the learners' needs in the future ESP course.

Speaking

The speaking section was taken by 58 students out of 70 who participated in the written test. The results gathered represented the majority of the test-takers and provided a clear picture of the perceived proficiency of most participants. These results are shown in Figure 9.

Figure 9

Test Results for Speaking Skills



As illustrated in Figure 9, the scores obtained by 66% of the students suggest a Basic User level, while 33% performed at a level suggestive of an Independent User. Only one student was reported as a Proficient User. Therefore, by correlating these perceived levels with the CEFR descriptors, it is possible to infer that most Basic Users are able to introduce themselves, interact in simple and short exchanges of information, and answer simple questions in familiar topics. Most of them can also give simple descriptions of routine tasks, their educational background, likes and dislikes, and simple past experiences or future plans. However, the responses given during the test evidenced that exchanges with Basic Users were characterized by repetition of questions and answers, short and isolated utterances, long pauses to search for expressions, hesitation, incomplete statements, limited or simple use of

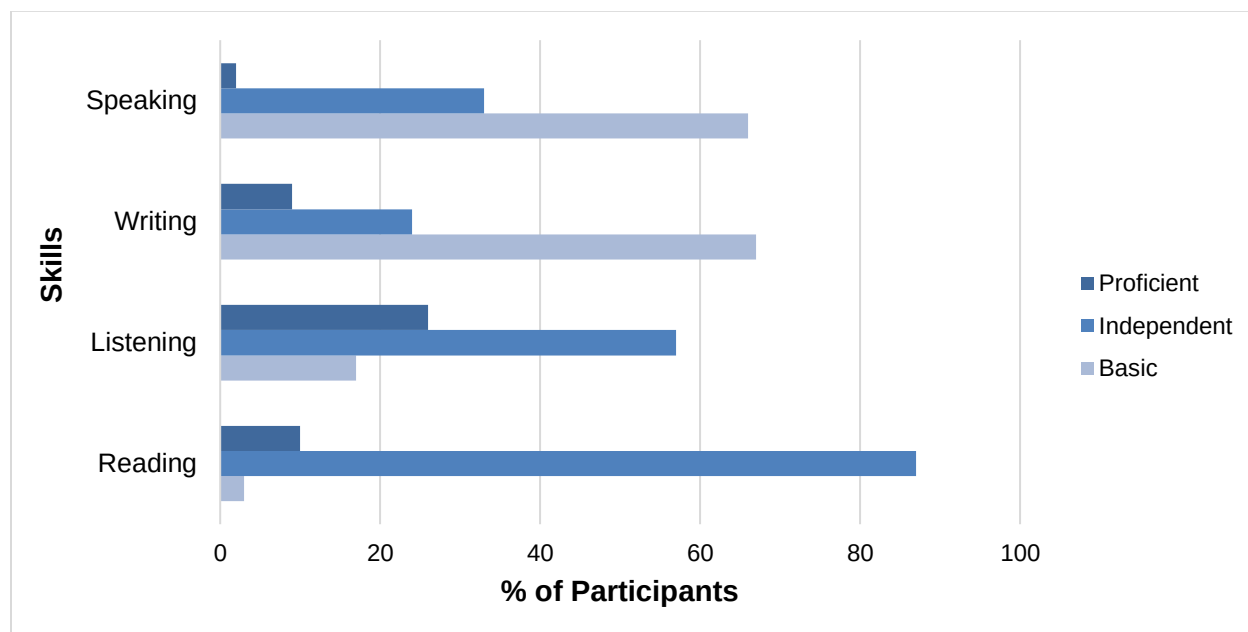
grammatical structures, pronunciation and intonation problems, and a very basic repertoire of words and phrases.

On the other hand, the group of Independent Users was very variable between the levels B1 and B2. For instance, students perceived as B1 were able to maintain simple conversations on topics that were familiar or of personal interest, as indicated by the CEFR parameters. They also gave brief descriptions, narrations, or explanations of a viewpoint. Their interactions were usually characterized by occasional pauses and hesitation, a fair repertoire of grammar patterns and vocabulary, the use of a few technical words related to their field, and some pronunciation and intonation problems that did not really affect meaning. These students will need to gain more confidence and put into practice more technical vocabulary and complex grammar structures if selected as the target population for the English course.

As for students perceived as B2, this group was able to provide descriptions in more detail, including viewpoints on challenging and specialized topics related to their field. Their interactions demonstrated a higher degree of fluency with few pauses or hesitation, a high degree of grammar accuracy and complex sentence forms, minor pronunciation errors, a broad command of vocabulary, and self-correction. Although B2 students were much more proficient, the researchers noticed that they still need to polish their technical vocabulary and fluency during conversations, so that they can be fully ready for future challenges such as job interviews, studies in foreign countries, and other academic and professional needs.

Discussion of Results

Figure 10 provides a general overview that summarizes and compares the test results collected for the four macro skills.

Figure 10*General Overview of Test Results*

This comparison evinces that the productive skills of speaking (66%) and writing (67%) represent the macro skills with the highest percentages of perceived Basic Users, while reading (87%) and listening (57%) include the highest percentages of perceived Independent Users. These results are consistent with the data reported by the participants in the needs analysis survey. According to the information collected during that stage, speaking was not only the highest priority for students in terms of needs for future professional purposes, but also the most difficult macro skill experienced by them. In addition, the survey had reported that writing and listening also posed a significant challenge as they ranked in the second and third position, respectively, in the hierarchy of lacks. This information is supported by the results obtained in the diagnostic test since these three skills represent the main areas of weakness experienced by students. In contrast, the areas of strength are more related to the receptive skills of listening

and reading, skills to which students are frequently exposed as part of the academic requirements of the Electrical Engineering major.

Chapter II: ESP Syllabus Design

Based on the results collected from the needs analysis stage for Electrical Engineering students at the University of Costa Rica, the researchers designed a detailed task-based syllabus that will serve as the basis for the course practicum. This syllabus includes the course description, the goals, the general objectives, the contents organized in three units, the methodology, and the assessment. Each unit includes the respective tasks, macro skills, strategies, language to be used, and the time allotted. A brief, student-friendly version of the course syllabus was also prepared by the researchers (see Appendix I).

A. Course Logo



A dynamo can be simply defined as an electric generator or “a device for converting mechanical energy into electrical energy.” In informal terms, it also means “an energetic hard-working person.” The word “dynamo” comes from the Greek word *dunamis*, meaning “force or power”. (*Collins English Dictionary*, 2021). With these considerations in mind, the logo combines the words “ESP” and “dynamo” to represent how the course will function as a language generator to meet the students’ English needs for specific academic and professional contexts.

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The logo also implies the combination of language teaching and the technical field of Electrical Engineering in an effort to promote collaboration, creativity, critical thinking, and communication. A dynamo is also considered a representation of dynamism, continuous change, and progress, which are all related to the students' and teachers' roles in this course with the aim of accomplishing the goals proposed. The logo uses the colors blue and red as these are often associated with the English language. A thunderbolt, which is an iconic electricity symbol, is included as an isotype to reinforce the concept of power, creation, and bright ideas.

B. Course Name

ESP Dynamo: An Online English Course for Electrical Engineering Students. Course designed by Morales, A., & Araya, M.

C. Course Description

ESP Dynamo: An Online English Course for Electrical Engineering Students is an English for Specific Purposes (ESP) course designed as part of the final graduation project for the Master's Program in Teaching English as a Foreign Language at the University of Costa Rica (UCR). The main purpose is to meet the specific English language needs, lacks, and wants, as well as address the learning styles and preferences of Electrical Engineering students for an adequate and effective performance in academic and future work-related settings. The four macro skills (speaking, listening, reading, and writing) will be covered throughout the course, with an emphasis on productive skills.

This course is addressed to a group of 20-25 students from the School of Electrical Engineering at UCR with a perceived Independent level of proficiency in English (B1 and B2). The course will be taught over 16 weeks in the second cycle of 2021, three hours a week. The course schedule is Tuesdays from 5:00 pm to 7:00 pm (synchronous session via Zoom) and from 7:00 pm to 8:00 pm (asynchronous modality). The course will be taught by two student-

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teachers acting as language instructors, Andrea Morales and Maria Araya, under the supervision of professors from the Master's program. The course has no co-requisites, and it will be offered in a 100% online modality. Students will be provided with the materials every week by the instructors. A certificate of completion will be granted to students with a passing grade of 70 or higher at the end of the course.

D. Statement of Goals and Objectives***Unit 1: Powering-up Reading Skills*****Goal 1**

By the end of the unit, the students will be able to successfully demonstrate understanding of technical readings for academic purposes by identifying main ideas, locating specific details, and making a critical judgement through the use of top-down and bottom-up strategies.

General Objectives

By the end of the lesson, the students will be able to:

1. effectively identify the main ideas in a technical text about the integration of energy storage systems and renewable energy through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.
2. accurately locate relevant specific details in a technical text about a satellite project through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.

3. successfully make a critical judgement about technical texts related to Power Systems, Telecommunications, and Computing and Networking through the use of reading comprehension strategies such as identification of facts and opinions.

Unit 2: Empowering Communication at Work

Goal 2

By the end of the unit, the students will be able to actively interact with prospective English-speaking professionals by role-playing work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting.

General Objectives

By the end of the lesson, the students will be able to:

1. successfully role-play a small-talk conversation for networking with other participants at an international conference on Electrical Engineering by using appropriate starters, exchanging opinions, and sharing contact information before leaving the conversation.
2. successfully role-play a job interview at a company that requires electrical engineers by discussing their own academic or work experience, skills and achievements, and professional goals based on their résumé.
3. appropriately make a telephone call to coordinate a technical site visit by using proper openings and closings, scheduling the date (e.g., suggesting and agreeing on the date), and making and responding to suggestions politely (safety measures).

Unit 3: Engineering the Future

Goal 3

By the end of the unit, the students will be able to effectively describe orally and in writing their interest in participating in an international fair, an innovative product or system in the field of Electrical Engineering, and a business idea for a solution to a problem.

General Objectives

By the end of the lesson, the students will be able to:

1. properly write an email to express their interest in participating in an international fair or exchange program by analyzing illustrative texts and following the basic stages of the writing process (planning, drafting, editing, and final drafting).
2. successfully describe a hydroelectric, wind, or geothermal power generation, transmission, and distribution process orally in a meeting by identifying the main technical components of the system, explaining the steps required for its operation, and using a mind map as guide for the presentation while working in groups.
3. effectively design and present a business idea in the field of Electrical Engineering, including information about the entrepreneurs, the problem to be solved, and the value proposition or competitive advantages of the proposed product or service.

E. Methodology

Approach: Task-Based Language Teaching

The syllabus designed for this ESP course is based on the Task-Based Language Teaching (TBLT) approach. Richards and Rodgers (2001) state that TBLT is “an approach based on the use of tasks as the core unit of planning and instruction in language teaching” (p. 223). In addition, Shehadeh (2005) defines a task as “as an activity that is (1) goal-oriented, (2) content-focused, (3) has a real outcome, and (4) reflects real-life language use and language need” (as cited in Shehadeh, 2012, p. 156). Some other characteristics of tasks suggested by existing literature include the following: they are primarily focused on meaning rather than on form; they provide enough context or input for negotiation of meaning; they resemble real-life activities; and their completion has some sort of priority (Ellis et al., 2019, p. 7; Willis & Willis, 2007, p. 12; Robinson, 2011, p. 2). These attributes make the TBLT approach particularly well-

suited to teach an ESP class since Electrical Engineering students have an immediate need and a clear purpose (academic or professional) for learning the language, making the tasks more meaningful. The aforementioned considerations provided a useful framework for the researchers because the students' language needs and learning styles that emerged from the needs analysis process were carefully studied, classified, and transformed into particular goals and tasks for the syllabus, reflecting real-life situations that are meaningful and motivational for students and, thus, should facilitate second language acquisition. The interest in adopting the TBLT approach also lies in pedagogical reasons such as the focus on interaction for students to learn from each other, the use of lexical units, and the implementation of a task cycle. These aspects are significant not only because the participants explicitly mentioned their interest in conversations and technical vocabulary to gain more confidence in the use of language, but also because the task cycle (pre-task, main task, and post-task) follows an organized sequence to adequately prepare them with the input and skills required for achieving the final outcome.

Classroom Dynamics

In terms of classroom dynamics, two student-teachers will take turns to teach a lesson every week, meaning that one student will be in charge of the lesson while the other will act as an assistant. The assistant teacher will be responsible for monitoring students' work and progress, modeling conversations with the lead teacher, delivering materials, and providing support for the lead teacher at all times. This co-teaching model will be adapted to the online modality in which the classes will be developed. The researchers have decided to use Zoom, which is an online meeting and videoconferencing tool, to interact with students during the synchronous component of the sessions. In light of the remote teaching mode, the student-teachers can also take advantage of the breakout rooms to implement grouping for collaborative work and interaction among learners. This will also allow the student-teachers to visit the

different groups to observe them and take notes, or even answer any questions that may arise. Additional digital resources or applications will be integrated as required throughout the course to support the tasks, develop skills, and enhance the students' personal and professional productivity. Moreover, considering the virtual conditions in which the course will take place, the instructors intend to provide students with clear and detailed directions for the activities to be performed and for the online platforms to be used.

Tasks and Techniques and their Rationale

Real-world tasks were selected based on the results gathered from the needs analysis process. According to Nunan (1989), TBLT activities are “designed to practice or rehearse those tasks that are found to be important in a needs analysis and turn out to be important and useful in the real world” (as cited in Richards & Rodgers, 2001, p. 231). Based on this, the syllabus took into account the following prioritization of speaking and listening activities reported by students: conversations with foreigners; meetings, debates, and group discussions; international presentations and conferences; job interviews; and telephone calls. In the case of reading and writing, the main activities included reading articles and technical reports; reading manuals, specifications and standards; reading textbooks; writing resumes; and writing emails. The syllabus design covered most of these activities and arranged them into three main meaningful frameworks for students: the academic setting, the professional environment, and the international context.

As for pedagogical tasks, the activities were also selected based on the needs analysis survey. For example, the questionnaire detailed key communication subskills and text patterns that students would like to address. For example: describing the sequence of a process, giving instructions and directions, describing a product, and expressing figures were all related to speaking; understanding fast talkers, identifying main ideas, and understanding audios and

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videos corresponded to listening; making a critical judgement about a text, identifying main ideas and specific details in a text, and guessing the meaning of unknown words were related to reading; and writing complex sentences, organizing ideas in a logical order, and using a wide variety of vocabulary were reported for writing. The section on learning styles highlighted the students' interest in conversations or dialogues (role-plays), reading comprehension of technical texts, writing exercises, and multimedia exercises (audios, videos, games, etc.). The needs analysis also provided data on multiple intelligences, which refer to "a learner-based philosophy that characterizes human intelligences as having multiple dimensions that must be acknowledged and developed in education" (Richards & Rodgers, 2001, p. 115). The results showed that the students' preferences were more related to the following categories: intrapersonal (group or pair work), spatial-visual (use of visual aids such as diagrams, graphs, images, etc.) and logical-mathematical (interest in experiments, technical simulations, and problem solving). As teaching can be more motivating for students when these differences are acknowledged, the syllabus focuses on collaborative work to promote interaction and scaffolding among students with different backgrounds, specializations, and proficiency levels. Additionally, the syllabus incorporates the complete task classification proposed by Willis (1996) and Pica et al. (1993) to promote a variety of online activities: listing, ordering, comparisons, personal experiences, creative tasks, jigsaws, information gaps, problem solving, decision making, and opinion exchanges (as cited in Richards & Rodgers, 2001, p. 234). The specific use of the activities depends on how they can properly fit each macro skill and real-world task.

Finally, it is worth noting that the combination of real-world tasks and pedagogical tasks will be developed following the TBLT sequence, consisting of pre-tasks, the task cycle, the post-task, and the language focus. Attendance, active participation, critical thinking, and respectful feedback are expected of students at all times.

Role of the Learners

Richards and Rodgers (2001) propose three specific learner roles in TBLT: group participant, monitor, and risk-taker and innovator (p. 235). Firstly, the authors suggest that learners who are accustomed to whole-class or individual work may need to adapt to other techniques such as pair- or small-group work. In the case of the Electrical Engineering students, the needs analysis questionnaire indicated that most of them feel comfortable working in pairs or small teams. For this reason, the teachers will design a wide variety of tasks to promote interactive and meaningful communication among students. Secondly, learners are also expected to self-monitor and notice how language is used by paying attention not only to the message but to the form embedded in the language. In fact, for this course, the students will be exposed to authentic language in use by means of readings and videos related to their field, and even teacher modeling of speaking tasks for them to become familiar with more complex language structures (e.g., grammar, pronunciation, vocabulary, etc.). Therefore, they are required to pay close attention to all of these language features to notice gaps, and they are also expected to become independent language users and monitor their own progress during the course. Finally, the authors mentioned that learners should be risk-takers and innovators despite lacking linguistic knowledge or experience to complete the tasks in place. They also recommended that students develop skills such as restating, paraphrasing, and asking for clarification, which are some useful strategies to communicate and acquire the language progressively. Thus, the Electrical Engineering students should be able to challenge themselves and take risks for learning to take place.

Role of the Teachers

With regard to teacher roles, Richards and Rodgers (2001) point out three main roles that instructors should assume in TBLT. One of the teacher roles is to be selectors and sequencers of tasks, which entails “selecting, adapting, and/or creating the tasks themselves and then forming these into an instructional sequence in keeping with learners needs, interests, and language skill level” (Richards & Rodgers, 2001, p. 236). Concerning this role, the student-teachers will take the findings of the needs analysis questionnaire into consideration to design an appropriate sequence of authentic tasks and materials. Learners’ wants such as interacting with an English-speaking person, attending a job interview, reading technical documentation, and writing emails are some examples of real tasks that the instructors will adapt and utilize in class during the ESP course. This is in keeping with the need for addressing the learners’ needs, wants, and lacks to keep them engaged and motivated. The second role, as indicated by the authors, is that teachers must prepare learners by introducing the topic, ensuring that learners understand the instructions, and either teaching key language or activating schemata to help learners accomplish the tasks in the best way possible. For this course, the strategies mentioned above will be implemented from the beginning and with the help of the co-teaching model, the two teachers will be committed to supporting each other, for example, by delivering teaching materials on time and modeling useful language and instructions. The third role identified is consciousness raising, which means that the instructor should implement a series of form-focusing techniques to draw the learners’ attention to key language features. A wide variety of techniques will be utilized to help learners on this respect throughout the ESP course. As an example, the teachers will teach strategies like identifying typographical and contextual clues as well as differentiating fact from opinion, in the case of reading. This is expected to help learners notice and improve the way in which they process information and communicate with

others. Although the TBLT approach is considered a student-centered approach that places students as protagonists of knowledge, the teachers' role is of paramount importance for the successful development of the tasks, which will ultimately help students achieve their learning goals.

F. Assessment

Assessment is an essential part of any ESP program, and it demands that instructors make informed decisions regarding what to assess and how to assess it. In addition to the needs analysis process and the diagnostic test carried out as an initial stage for this research, the ESP course for Electrical Engineering students will also implement assessment instruments to evaluate the students' performance, the course itself, and the student-teachers' performance. The assessment tasks that have been selected can be categorized as formal and informal, formative and summative, and task-based assessment. The following subsections provide in-depth insight into the rationale behind the assessment tasks selected by the researchers.

Formal and Informal Assessment

A combination of formal and informal assessment will be implemented in this course. Brown (2004) defines formal assessments as "systematic, planned sampling techniques constructed to give teacher and student an appraisal of student achievement" (p. 6). In other words, this type of assessment is used to evaluate to what extent the learner has acquired the expected knowledge and skills specified in the course goals and objectives. The ESP course will include four formal assessments in which the students' reading, speaking, writing, and technical vocabulary skills will be evaluated to gauge their progress in the language and to identify their strengths and weaknesses. Furthermore, two additional formal assessments will be administered at the end of the units for the students to evaluate the course effectiveness and the teachers' performance.

As for informal assessment, Brown (2004) indicates that it “can take a number of forms, starting with incidental, unplanned comments and responses, along with coaching and other impromptu feedback to the student” (p. 5). Thus, informal assessment will be based on the teachers’ day-to-day observations and interactions with the students, and it may come in the form of praise, recast, or feedback to encourage the learners to continue improving their skills. Likewise, the teachers will provide written and oral corrective feedback when appropriate. For instance, feedback may be necessary when communication is impaired by the lack of linguistic knowledge. Delayed feedback may also be required in cases where the communication cannot be interrupted and when the student’s confidence and performance may be affected.

Formative and Summative Assessment

Formative and summative assessment will be employed in this ESP course. Formative assessment “can help teachers identify specific gaps in learner competences as well as track learner L2 development over time” (Shehadeh and Coombe, 2012, p. 288). Therefore, the instructors will carry out formative assessments throughout the course to identify the learners’ areas of improvement, providing them with feedback to enhance their skills and motivation towards the learning process. According to Ellis et al., (2019), formative assessment can provide valuable information on “how the task itself might be improved for future use” (p. 21). Therefore, conducting this type of assessment as the course unfolds will allow the teachers to receive feedback on the effectiveness of the syllabus and teaching materials so that adjustments can be made for subsequent tasks if required.

As opposed to formative assessment, summative assessment “aims to measure, or summarize, what a student has grasped, and typically occurs at the end of a course or unit of instruction” (Brown, 2004, p. 6). In other words, this type of assessment seeks to evaluate the learners’ level of competence to perform certain tasks at the end of a term. For this particular

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ESP course, summative assessment will take place at the end of each unit not only to gain insights into the students' proficiency level and their achievements but also to provide information about the overall impact and effectiveness of the course.

Task-Based Assessment

Due to the nature of the ESP course, the assessment will be based on activities that resemble the learners' target situations, measuring performance in terms of task completion and observable outcomes (Ellis et al., 2019, p. 20; Long, 2014, p. 332). This means that the Electrical Engineering students will be required to perform real-life tasks set in their academic and professional context, and their success in the ESP course will depend on their ability to complete such tasks.

Description of the Instruments Designed

Students' Performance: Achievement Tests

The assessment plan for the students' performance is distributed as follows: a reading test (25%) for Unit 1, a speaking test (25%) for Unit 2, a written assignment (10%) and an oral presentation (15%) for Unit 3, and a course portfolio and a technical glossary related to all the units (25%).

Unit 1: Reading Test

Since the first unit is all about enhancing the learners' reading skills by teaching them comprehension strategies, the instructors decided that the first assessment to be administered in this ESP course is a reading test. The main purpose of this assessment is to evaluate the learners' ability to identify main ideas, locate specific details, and make a critical judgement about a given text. The researchers have included this type of assessment to have the learners apply all the reading strategies that will be taught throughout the unit. Furthermore, this test will be administered in response to the Electrical Engineering students' request to cover reading

skills in this course, which was identified by the needs analysis as a relevant need for the academic field.

Unit 2: Speaking Test

Particularly for the speaking test, after completing Unit 2, the students will have learned how to interact with other English-speaking professionals in a work-related context, including activities such as having a conversation with conference participants, attending a job-interview, and making telephone calls to set up a meeting. Based on this, the achievement test designed for this unit will ask the students to role play these situations studied in class. The students will be presented with these three main situations from which they will have to choose one at random. Then, they will do a role play based on the prompt that they choose. This will allow the learners to put into practice the language and strategies studied in class. With this speaking test, the student-teachers will corroborate that the learners have grasped the knowledge and experience required to interact spontaneously in any of the said scenarios. An analytic rubric similar to that used for the diagnostic test is used for scoring the language constructs assessed: content, fluency, grammar, pronunciation, and vocabulary. Before the tests, the teachers will ask some warm-up questions or make small talk to reduce the students' anxiety and help them become comfortable with the situation.

As part of the rationale for this speaking test, the researchers considered the following aspects to ensure the principle of validity:

- Language proficiency is measured in the ESP context by using relevant situations faced by Electrical Engineers in real life according to the needs analysis.
- The students are specifically asked to demonstrate their oral interaction abilities, not other skills.

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- The test uses constructs with a relative weight assigned to each.
- The test is well-structured in terms of format and provides detailed instructions and a rubric supported by CEFR descriptors.

With regard to reliability, the assessment considerations included the following:

- Warm-up questions are used before the test to reduce the test-takers' anxiety.
- Special requirements such as the use of proper equipment, a stable internet connection, and a quiet location, are highlighted beforehand as part of the instructions.
- The test is scheduled on a specific date in order not to overload the students.
- The test is graded by the two researchers using a rubric to avoid any subjectivity.

A preliminary sample of this speaking test, as well as the instructions and the rubric, is provided in Appendix J.

Unit 3: Written Assignment

The third assessment task will be email writing. Electrical Engineering students will be asked to write a formal email to apply for a Master's degree at a top international university. The learners should be able to use appropriate language to describe their academic and professional experience in detail, as well as the arguments as to why they should be admitted. With this task, the learners will show command of the technical language, useful expressions, and email writing structure learned in Unit 3.

Unit 3: Oral Presentation

To complement the email writing task, students will also be required to describe a solar power generation process orally in a meeting as a business idea to provide a sustainable power solution to indigenous communities in Costa Rica. The students will pretend that they are in a video conference with potential investors that would like to acquire their products or services.

This will be the last chance for the learners to demonstrate what they have learned in the course and how they have improved their speaking skills.

All Units: Course Portfolio and Technical Glossary

A course portfolio and a technical glossary will be the last assessment task that students will need to hand in on the last day of class. On the one hand, the in-class portfolio will be a very useful resource for students to organize the teaching materials provided every week, and this will also help them reflect on their progress in the language. On the other hand, the technical glossary will also prove to be very helpful for learners, as they will be able to keep track of the new vocabulary and expressions they have learned. Moreover, technical vocabulary was identified as one of the skills the Electrical Engineering students were most interested in to succeed in their academic and professional fields. The experience will be more significant if they create the glossary on their own instead of the teachers giving the technical glossary to them.

ESP Course Assessment: All Units

The ESP course assessment aims to obtain feedback on the learners' perception about the usefulness and the quality of the English for Electrical Engineers course. According to Graves (2000), the purpose of evaluating a course is to help teachers make decisions on both an ongoing and final basis about the course. It helps to gauge the students' affective needs, learning needs, and language needs while the course is in progress so that the course can be modified, as appropriate, to promote learning (p. 215). Therefore, the course assessment will take place at the end of each unit for the instructors to make the necessary adjustments to the subsequent units and gather relevant data for future syllabus planning. The assessment instrument considers aspects such as course organization, methodology, usefulness of the materials and tasks, level of difficulty, and the learners' overall satisfaction with the program, among others. The course assessment survey consists of three sections. The first part includes

closed-ended questions in a Likert scale to measure the students' level of agreement with a series of statements related to the above-mentioned aspects. The second part includes closed-ended questions in a Likert scale to rate different learning preferences based on their usefulness. In the third part, the students will be able to further elaborate by answering additional open-ended questions dealing with the positive aspects of the course, the areas of improvement and recommendations, and any other comments based on their experience since "a good evaluation emphasizes the successes and discusses less successful aspects" (Dudley-Evans & St. John, 1998, p. 129). Thus, course assessment will be particularly beneficial for the student-teachers to determine the perceived effectiveness of the course so that improvements can be made as needed. Appendix K shows the assessment instrument to be used for the ESP course evaluation.

Student-Teachers' Performance: All Units

The purpose of this assessment instrument is to collect data on the learners' view of each teacher's performance throughout the course. Performance evaluation works as a development tool for all teachers, as it is intended to provide feedback and guidance to help them identify their strengths and areas of growth to enhance their skills and improve their professional practice (Almy, 2011, p. 3; Tucker & Stronge, 2005, p. 6). In other words, the students' feedback will allow the instructors to determine whether they are meeting performance expectations to either continue implementing their good practices or focus on increasing their teaching quality. This formal assessment will be carried out at the end of each unit for the students to assess the instructors in terms of preparedness and organization, clarity of explanations and instructions, and classroom management, among others. The students will be presented with ten statements, and they will need to rate the teacher's performance using a scale to indicate the frequency with which the teacher meets the criteria. They may select any of

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the following options: *never*, *rarely*, *usually*, and *always*. Finally, additional open-ended questions will allow the students to share their personal experience with the teacher's performance, as well as any other relevant comments in more detail. The assessment instrument for the student-teachers' performance is included in Appendix L.

G. Contents

This section presents the contents to be developed as part of the three units of the course.

Unit 1: Powering-up Reading Skills

Goal: By the end of the unit, the students will be able to successfully demonstrate understanding of technical readings for academic purposes by identifying main ideas, locating specific details, and making a critical judgement through the use of top-down and bottom-up strategies.

General Objectives:

By the end of the lesson, the students will be able to:

1. effectively identify the main ideas in a technical text about the integration of energy storage systems and renewable energy through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.
2. accurately locate relevant specific details in a technical text about a satellite project through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.
3. successfully make a critical judgement about technical texts related to Power Systems, Telecommunications, and Computing and Networking through the use of reading comprehension strategies such as identification of facts and opinions.

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
1	Identify the main ideas in a technical text about the integration of energy storage systems and renewable energy through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.	R, W, S	Vocabulary: Key vocabulary related to the field of Electrical Engineering: <i>artificial intelligence, capacitor, converter, cost-effective, energy storage system, power grid, renewable energy, etc.</i> Useful expressions: Giving an opinion: <i>In my opinion, ...</i> <i>It seems to me that ...</i> <i>I (dis)agree with you on....</i> Negotiation of meaning: <i>Could you repeat that again, please?</i> <i>Did you say...?</i> <i>Do you mean...?</i> Grammar: Verb tenses: Simple past tense Pronunciation: /-ed/ endings Pronunciation of key words	Cognitive: - Predicting - Inferencing - Classifying Creative: - Brainstorming Linguistic: - Skimming and scanning - Using context Intrapersonal: - Individual student work Interpersonal: - Cooperating Affective: - Personalizing	1 lesson

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
2	Locate specific details in a technical text about a satellite project through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.	R, W, S	Vocabulary: Key vocabulary related to the field of Electrical Engineering: <i>architecture, assembly, carbon dioxide, data logger, launch, microcontroller, milestone, nanosatellite, onboard, pyranometer, satellite, sensor, slope, spacecraft, station, testing, transceiver, etc.</i> Useful expressions: Giving an opinion: <i>In my opinion, ...</i> <i>It seems to me that ...</i> <i>I (dis)agree with you on....</i> <i>An example could be...</i> Negotiation of meaning: <i>Could you repeat that again, please?</i> <i>Did you say...?</i> <i>Do you mean...?</i> Grammar: Verb tenses: The present perfect Pronunciation: <i>/-s/ endings, /-ed/ endings</i> Pronunciation of key words	Cognitive: - Predicting - Inferencing - Classifying - Discriminating Creative: - Brainstorming - Practicing Linguistic: - Skimming and scanning - Using context Intrapersonal: - Individual student work Interpersonal: - Cooperating Affective: - Personalizing	1 lesson

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
3	Make a critical judgement about technical texts related to Power Systems, Telecommunications, and Computing and Networking through the use of reading comprehension strategies such as identification of facts and opinions.	R, W, S	Vocabulary: <i>Ampere, automation, dynamo, electric current, gradient, heat, high-voltage lines, silicon, etc.</i> Verbs and adverbs that suggest belief, doubt or possibility: <i>believe, think, appears, seems, apparently, probably, potentially, and possibly</i> Denotative and connotative language Useful expressions: Giving an opinion: <i>I'd definitely say that...</i> <i>I could be wrong, but...</i> Negotiation of meaning Grammar: Simple past versus present perfect (regular and irregular verbs) Pronunciation: <i>/-s/ endings, /-ed/ endings</i> Pronunciation of key words	Cognitive: - Predicting - Inferencing - Classifying Linguistic: - Skimming and scanning - Using context Intrapersonal: - Individual student work Interpersonal: - Cooperating	1 lesson

Unit 2: Empowering Communication at Work

Goal: By the end of the unit, the students will be able to actively interact with prospective English-speaking professionals by role-playing work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting.

General Objectives:

By the end of the lesson, the students will be able to:

1. successfully role-play a small-talk conversation for networking with other participants at an international conference on Electrical Engineering by using appropriate starters, exchanging opinions, and sharing contact information before leaving the conversation.
2. successfully role-play a job interview at a company that requires electrical engineers by discussing their own academic or work experience, skills and achievements, and professional goals based on their résumé.
3. appropriately make a telephone call to coordinate a technical site visit by using proper openings and closings, scheduling the date (e.g., suggesting and agreeing on the date), and making and responding to suggestions politely (safety measures).

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
1	Role-play a small-talk conversation for networking with other participants at an international conference on Electrical Engineering by using appropriate starters, exchanging opinions, and sharing contact information before leaving the conversation.	S, L	Vocabulary: <i>Attendees, badge, business cards, electronics, robotics, small talk, venue, etc.</i> Useful expressions: Starting a conversation, keeping the discussion moving, or leaving a conversations Exchanging opinions: <i>What do you think about...?</i> <i>What is your opinion about...?</i> <i>One reason could be,...</i> <i>Here's an example.</i> Negotiation of meaning: <i>What does ... mean?</i> <i>What do you mean by...?</i> <i>Could you please define...?</i> Grammar: Simple present tense Pronunciation: <i>/-s/ endings, /-ed/ endings</i> Intonation and fluency	Cognitive: - Predicting - Inferencing - Classifying Creative: - Brainstorming Linguistic: - Conversational patterns - Practicing - Selective listening Intrapersonal: - Individual student work Interpersonal: - Cooperating - Role-playing Affective: - Personalizing	1 lesson

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
2	Role-play a job interview at a company that requires electrical engineers by discussing their own academic or work experience, skills and achievements, and professional goals based on their résumé.	W, S, L	Vocabulary: <i>Education, work experience, soft/hard skills, achievements, goals, etc.</i> Useful expressions: Describing qualifications, giving an opinion, negotiating meaning, and showing interest. <i>How long have you...? What would you like to do? I'd like to... Sure! What I mean is...</i> Grammar: Collocations: <i>Have experience with (sth.) Have training in (a field) Have the ability to (do sth.) Have knowledge of (a skill)</i> <i>Be good at / Be interested in / Be able to / Be certified in...</i> Modal auxiliaries (would) Pronunciation: <i>/-s/ endings, /-ed/ endings</i> Would (silent /l/) / Contractions Intonation and fluency Pronunciation of key words	Cognitive: - Predicting - Classifying - Note taking Creative: - Brainstorming Linguistic: - Conversational patterns - Practicing - Selective listening Intrapersonal: - Individual student work Interpersonal: - Cooperating - Role-playing Affective: - Personalizing	1 lesson

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
3	Make a telephone call to coordinate a technical site visit by using proper openings and closings, scheduling the date (e.g., suggesting and agreeing on the date), and making and responding to suggestions politely (safety measures).	S, L	Vocabulary: Safety equipment and measures: <i>helmet, vest, boots, gloves, safety glasses, warning, protection, signs, hazard, code, standard, etc.</i> Formulaic expressions and phrasal verbs: <i>hold on, speak up, call back</i> Useful expressions: Scheduling a meeting/site visit: <i>Could we meet on... at...?</i> <i>Sounds good. Let's do it.</i> <i>I'm afraid I can't make it.</i> <i>How about.... instead?</i> Making/responding to suggestions: <i>Please remember to...</i> <i>You should....</i> <i>Certainly! Thank you.</i> Grammar: - Imperatives - Modals: <i>would, should, could, and may</i> Pronunciation: - Silent /l/ in modals	Cognitive: - Predicting - Inferencing - Classifying Creative: - Brainstorming Linguistic: - Conversational patterns - Using context - Practicing Intrapersonal: - Individual student work Interpersonal: - Cooperating - Role-playing Affective: - Personalizing	1 lesson

Unit 3: Engineering the Future

Goal: By the end of the unit, the students will be able to effectively describe orally and in writing their interest in participating in an international trade fair, an innovative product or system in the field of Electrical Engineering, and a business idea for a solution to a problem.

General Objectives:

By the end of the lesson, the students will be able to:

1. properly write an email to express their interest in participating in an international trade fair or exchange program by analyzing illustrative texts and by following the basic stages of the writing process (planning, drafting, editing, and final drafting).
2. successfully describe a hydroelectric, wind, or geothermal power generation, transmission, and distribution process orally in a meeting by identifying the main technical components of the system, explaining the steps required for its operation, and using a mind map as a guide for the presentation while working in groups.
3. effectively design and present a business idea in the field of Electrical Engineering, including information about the entrepreneurs, the problem to be solved, and the value proposition or competitive advantages of the proposed product or service.

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
1	Write an email to express their interest in participating in an international trade fair or exchange program by analyzing illustrative texts and by following the basic stages of the writing process (planning, drafting, editing, and final drafting).	R, W, S	Vocabulary: Product attributes: advanced, <i>automated, cost-saving, high-tech, hybrid, innovative, user-friendly, wireless, etc.</i> Useful expressions: Salutations, closings, and formulaic expressions for emails: <i>Please find attached...</i> <i>I am attaching...</i> <i>I'd like to confirm...</i> Transitions and connectors Grammar: Verb tenses Pronunciation: Pronunciation of key words (vowels and consonants) Intonation and fluency	Cognitive: - Predicting - Inferencing - Concept mapping Creative: - Brainstorming Linguistic: - Practicing Intrapersonal: - Individual student work Interpersonal: - Cooperating Affective: - Personalizing	1 lesson

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
2	Describe a hydroelectric, wind a hydroelectric, wind, or geothermal power generation, transmission, and distribution process orally in a meeting by identifying the main technical components of the system, explaining the steps required for its operation, and using a mind map as a guide for the presentation while working in groups.	R, W, S, L	Vocabulary: <i>Dam, generation, distribution, transmission, powerhouse, reservoir, rotor, solar panel, turbine, utility pole, etc.</i> Sequence connectors: <i>First, second, then, next, finally</i> Key technical verbs: <i>attach, convert, drill, release, etc.</i> Useful expressions: Giving an opinion, negotiating meaning, and showing interest. Signposting for presentations Grammar: Passive voice Imperatives for instructions or steps Pronunciation: <i>/-s/ endings, /-ed/ endings</i> Pronunciation of key words (vowels and consonants) Intonation and fluency	Cognitive: - Predicting Creative: - Brainstorming Linguistic: - Conversational patterns - Practicing Intrapersonal: - Individual student work Interpersonal: - Cooperating Affective: - Personalizing	1 lesson

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General Objective	Task	Skills	Language Focus	Strategies	Time Allotted
3	Design and present a business idea in the field of Electrical Engineering, including information about the entrepreneurs, the problem to be solved, and the value proposition or competitive advantages of the proposed product or service.	R, W, S, L	Vocabulary: Project management: <i>added value, budget, critical path, deliverable, entrepreneur, execution, stakeholder, value proposition, etc.</i> Product attributes: <i>cutting-edge, efficient, promising, etc.</i> Useful expressions: Giving an opinion, negotiating meaning, showing interest, describing a team, describing a value proposition. <i>Our team is made up of... Our proposal/solution helps people/companies that... We have developed... Studies have shown...</i> Grammar: Gerunds after prepositions: <i>excited about, responsible for, insist on, etc.</i> Modal auxiliaries: would Pronunciation: /-s/ endings, /-ed/ endings Silent // Intonation and fluency	Cognitive: - Predicting Creative: - Brainstorming Linguistic: - Conversational patterns - Practicing Intrapersonal: - Individual student work Interpersonal: - Cooperating Affective: - Personalizing	1 lesson

Conclusions of the Course Design Stage

The primary objective of the needs analysis was to identify and describe the English language needs and learning styles of students from the School of Electrical Engineering at UCR with the aim of designing a tailored-made ESP course. All the students and primary stakeholders surveyed as part of this data exploration and collection process provided key contributions that led to a better understanding of the target population and its language needs. The results of the needs analysis evidenced that the main language need for academic purposes include two receptive macro skills: reading and listening. For professional purposes, the main need corresponds to speaking, a productive macro skill. The researchers also found out that the students are more interested in the skills and activities that would be required for a working environment as this will allow them to have better job opportunities. Pronunciation and the use of technical vocabulary were also relevant micro skills identified in the results. In addition, valuable information was gathered in terms of subskills, specific activities, topics of interest, and learning styles, which were taken into account by the researchers for the design of the ESP course.

The diagnostic test was also an insightful experience to assess the students' level of proficiency and their areas of strength and weakness, thus complementing the results previously obtained from the questionnaires and interviews. This instrument assessed the four macro skills of the English language, and its design, administration, and analysis of results were framed in accordance with the assessment principles of validity and reliability. Furthermore, the CEFR guidelines were used as a key source of reference for establishing the constructs and the parameters for assessing the different skills and identifying the perceived levels of proficiency. When carrying out the specific test tasks, the majority of the students performed at the following suggestive levels according to the CEFR: Independent User for the receptive skills of reading

and listening, and Basic User for the productive skills of writing and speaking. These results correlate with the lacks identified through the needs analysis questionnaire, as students had reported that speaking and writing represented the main lacks for them. The diagnostic test also highlighted the strategies that were more challenging for the students, information that was already considered by the researchers in the ESP syllabus design.

As it is evident, the needs analysis clearly constituted a cornerstone for the design of an ESP course addressed to the Electrical Engineering students. It thoroughly described the students' needs, wants, and lacks in their academic and professional field, and the researchers took advantage of all this information to elaborate a syllabus that meets all those primary needs in each of its units, resulting in a final product that could be motivating and meaningful for the target population. ESP Dynamo was the result of a comprehensive data gathering process in which the researchers were able to apply all the knowledge acquired during the coursework of the Master's Program in Teaching English to propose a language teaching solution to the target population.

Chapter III: Literature Review

A number of studies have been explored to identify what different authors say about the main topic of this research. Based on this, the guiding sub-question for this literature review is the following: According to the literature, what teaching practices can help to improve the speaking skills of intermediate Electrical Engineering students? For the purposes of this research, the contributions made by the authors regarding teaching practices have been summarized and discussed in relation to two central points: first, an overall definition of teaching practices and, second, examples of speaking activities for intermediate learners, collaborative learning, grouping techniques, error correction versus corrective feedback, and online language teaching. Two additional key concepts are taken into account by the researchers as they

provide a solid framework for a better understanding of teaching practices in the context of this study: Task-Based Language Teaching (TBLT) and English for Specific Purposes (ESP).

It is also worth mentioning that, according to the results of the diagnostic test in the needs analysis, the target population's proficiency level in speaking was estimated as that of *Independent Users* based on the CEFR scale, largely corresponding to the range of Intermediate Mid and Intermediate High in the American Council on the Teaching of Foreign Languages (ACTFL) scale (see Appendix M). Since *intermediate* is the more common term found in the literature, it will be used in this part of the research.

Definition of Teaching Practices

The word “practice” can be understood as “the full range of actions or interactions that members of a culture carry out, individually or with others” (Moran, 2001, p. 25). This definition evinces that people are engaged in practices as part of everyday life, for instance, doing exercise, buying something, eating, and communicating with other people, among others. All these activities are meaningful since they usually lead to goals to be achieved in specific contexts. In light of these considerations, the term “practice” becomes relevant from a pedagogical perspective because teaching can be seen as a purposeful social practice by itself and, at the same time, it involves a wide variety of activities, henceforth understood as teaching practices, which must be planned, rehearsed, and carried out by instructors with the aim of engaging students in learning and reaching the stated goals of a course or study plan.

For example, Cishe et al. (2015) suggest that teaching practices are important for understanding and improving educational processes since they are closely linked to the teachers' strategies for coping with challenges in their daily professional life. Teaching practices also shape the learning environment and influence learner motivation and achievement (p. 1). A similar approach is provided by Khader (2012, as cited in Alsowat, 2020, p. 77), who defines

teaching practices as “a set of instructional methods and strategies employed in the classroom to achieve the desired teaching objectives.” In line with these authors, Martinez (2012) indicates that teaching practices are a “set of activities undertaken by teachers, as part of their work in the classroom or in direct connection with it, so that students achieve the learning purposes set out in the curriculum” (p. 1). These authors agree upon the fact that teaching practices comprise all the strategies, methods, and activities carried out by the teacher with the aim of helping the students to achieve the course objectives. Thus, teaching practices involve any course of action adopted by teachers in their role as course designers, content facilitators, or assessors in both face-to-face and online classes.

It also follows from Martínez’s (2012) definition that the decisions made by instructors in relation to teaching practices are fundamental because they can influence student motivation in ways that either facilitate or impede learning. Consistent with this, Scrivener (2012) notes that “the classroom management choices you make play a large part in creating the individual working atmosphere of your class” (p. 1). This points to a close relationship between teaching practices and classroom management techniques since they both aim to develop an engaging and motivating learning environment. Based on this, teaching practices pose a challenge for instructors as the success of a course in terms of achieving objectives and motivating students will highly depend on the decisions made for their selection and implementation in class.

Examples of Teaching Practices

This literature review aims to raise awareness of a specific repertoire of language-teaching practices that could eventually help to improve the English-speaking skills of intermediate Electrical Engineering students. To achieve this aim, the researchers of this study have organized the reviewed authors’ contributions around five themes: speaking activities for

intermediate students, collaborative learning, grouping techniques, feedback or error correction, and online language teaching.

Speaking Activities for Intermediate Students

Speaking is a macro skill that consists of producing utterances to convey meaning. In relation to this, Florez (1999, as cited in Bailey, 2005, p. 2) defines speaking as an interactive process that involves producing information on one end of the transmission and receiving and processing the information on the other end. This meaning-generation process entails the combination of physical, mental, social, and cultural factors, going beyond the physical production of speech sounds towards covering other linguistic and extralinguistic dimensions indicated by Moran (2001), for instance, vocabulary, tone, pronunciation, rate of speech, gestures, eye contact, and appropriateness for different situations, among other critical features (pp. 65-70). Speaking is also closely related to the macro skill of listening because, except for scenarios such as monologues or a public speech, “it is very difficult to isolate oral production tasks that do not directly involve the interaction of aural comprehension” (Brown, 2004, p. 140). Therefore, due to the number of variables involved, creating and implementing a course syllabus that promotes speaking skills can be a challenging task for teachers; however, suggestions have also been provided on speaking activities that may function as a guide or point of reference for planning instruction.

Specifically for intermediate students, Bailey (2005) claims that “these learners already know a great deal of English, but still need to know more” (p. 91). Among the additional skills needed, intermediate students require to widen their vocabulary, improve their grammar and pronunciation, and manage a larger number of language functions to increase their confidence while communicating orally. Bailey (2005) also emphasizes three principles for teaching speaking to intermediate learners: negotiation of meaning, transactional and interpersonal

speech, and personalization of language exercises. Additionally, the author suggests challenging and interactive activities such as role-plays, pictured-based exercises, and logic puzzles (pp. 96-109) since they constitute an ideal vehicle to practice communication strategies; allow students to check meaning with each other, ask questions, and seek clarification; help develop real-life scenarios; and foster a classroom environment where oral mistakes can be seen as learning opportunities to polish the students' speaking skills.

Additional studies also agree on the principles and activities suggested in the above proposal (Bygate, 1987; Dudley-Evans & St. John, 1998; Nunan, 1989). Regarding the first principle, learners need to develop skills for negotiation of meaning, which refers to "the skill of making sure the person you are speaking to has correctly understood you and that you have correctly understood them" (Bygate, 1987, as cited in Nunan, 1989, p. 30). Based on this, the adjustment of language and the use of conversation strategies to make exchanges more comprehensible for the interlocutors, such as asking for repetition or clarification, rephrasing statements, or using confirmation or comprehension checks, become essential for oral communication.

As for the second principle, transactional encounters refer to communication to get something done, for example, a telephone call to schedule either a job interview or a technical meeting, and they require the use of predictable speech patterns as in the case of telephone transactions like using proper openings and closings, agreeing on a date, requesting information, and making and responding to suggestions politely, among others. In contrast, interpersonal encounters involve communication for social purposes and the use of more fluid and unpredictable speech patterns as in a casual conversation (Bailey, 2005, p. 97). A similar categorization was proposed by Brown and Yule (1983, as cited in Nunan, 1989, p. 27), who state that a transactional function is primarily concerned with the transfer of information, while

an interactional function is related to the maintenance of social relationships. Other authors (Bygate, 1987; Dudley-Evans & St. John, 1998) refer to this categorization from a more general perspective under the concept of “spoken interaction,” including any situations where listening and speaking are both required and suggesting additional skills and features to achieve effective communication. Specifically, Bygate (1987) highlights that the management of interaction involves knowing “what to say, how to say it, and whether to develop it, in accordance with one’s intentions, while maintaining the desired relations with others” (p. 6). These findings are supported by Dudley-Evans and St. John (1998), who refer to the importance of paraphrasing and summarizing to show understanding, body language as a way to convey a cultural dimension, questioning as a means of controlling communication, the use of suitable topics to build relationships, and turn-taking strategies for conversations and meetings, among others (pp. 105-111). All these studies denote that successful oral communication involves developing skills for transactional and interpersonal or interactional scenarios, not merely focusing on how to produce and understand language patterns, but also on how to adapt them to the different circumstances; therefore, it is crucial for teachers to provide intermediate students with multiple opportunities to develop their linguistic repertoire further and to explore linguistic variation across different social and cultural contexts through classroom practice.

The third principle, personalization, is defined as “the process of making activities match the learners’ own circumstances, interests and goals” (Bailey, 2005, p. 97). This description is consistent with the aims of ESP courses and the TBLT approach, which seek to meet the students’ specific needs to make the teaching process more motivating and relevant for the learner.

Considering these principles for teaching speaking to intermediate learners, instructors can resort to several types of activities. The first type includes strategic activities such as role-

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plays, which allow the students to take the part of other people and interact as if they were in a real-life setting relevant to their field and needs. According to Brown (2004), role-playing frees students to be somewhat creative in their linguistic output; it also allows rehearsal time so that students can map out what they are going to say; it has the effect of lowering anxieties as students can, even for a few moments, take on the persona of someone other than themselves; and it provides the opportunity to use discourse that might otherwise be difficult to elicit (p. 174). Along a similar line, O'Malley and Valdez (1996) add that role-plays "provide a format for using elements of real-life conversations, such as repetitions, interruptions, hesitations, distractions, changes of topic, facial expressions, gestures, and idiolects," and they "have been shown to reduce anxiety, increase motivation, and enhance language acquisition" (p. 85). All these favorable conditions suggest that role-playing is a pedagogical activity suitable to take the learners beyond simple responsive teaching practices towards a more complex, challenging, and creative approach, similar to the conditions found in real-world scenarios but still in a safe atmosphere and with the support of teachers or peers. Moreover, although role-plays can be guided to a certain extent through the use of cue cards with general instructions, the students are mainly required to elicit unpredictable responses and to put into practice their linguistic and extralinguistic abilities.

Another teaching practice addressed to intermediate students is picture-based activities, a technique for eliciting creative oral production through the use of visuals (e.g., photos, diagrams, charts, calendars, etc.) (Bailey, 2005). According to the author, "intermediate learners have many strengths in terms of grammar and vocabulary that they already know. You can design activities in which their receptive vocabulary can become productive vocabulary through discussion and use" (p. 104). Picture-based activities meet this requirement since they provide learners with an opportunity to brainstorm ideas as well as to activate background knowledge of

language structures. Although Bailey (2005) highlights the use of picture cues for collaborative story telling at an intermediate level, and O'Malley and Valdez (1996) claim that picture cues "can be used to elicit the following language functions: describing, giving information, or giving an opinion" (p. 79), this teaching practice is not necessarily linked to any particular language function since picture cues can also be used for illustrating topics of interest, supporting topics that are difficult to explain or that go beyond the teacher's own expertise, and promoting critical-thinking tasks in conversations and discussions, among others (Bailey, 2005, p. 57). In addition, it is important to highlight that "graphs and diagrams are an important part of science and technology" (Parkinson, 2013, p. 167), a fact that supports the relevance of visual elements for the specific field under study, for example, in tasks such as describing the sequence of a process or describing a product, identified in the needs analysis as necessary for the Electrical Engineering students in the ESP course.

A further type of activity for intermediate students is logic puzzles, which may also be turned into information-gap or jigsaw activities. Logic puzzles require students' interaction with the aim of reaching a solution to a problem or completing sets of information that one speaker has available and the other does not (Bailey, 2005; O'Malley & Valdez, 1996). Thus, this teaching practice provides opportunity for intermediate students to reach agreements based on available information or to negotiate meaning, and the tasks may be customized by teachers in many different ways to make them more challenging as required by the students' specific English learning needs.

Further research on speaking activities for an intermediate level of proficiency revealed additional tasks and suggestions to develop oral communication skills. In particular, Harmer (1998) refers to the use of discussions as a way to improve spontaneous fluent language, stressing the need to prepare students through a sequence that allows building up the

discussion in stages: engagement with the topic, study of facts or figures as language input, activation or discussion, and feedback (p. 91). Similarly, O'Malley and Valdez (1996) highlight the requirement of adequate preparation when referring to debates and oral interviews as speaking activities for intermediate learners. Concerning debates, the authors indicate that "teachers need to make sure that students have been given all the necessary resources and information in order to research and present their side of the issue" (pp. 87-88). In the case of oral interviews, it is necessary to prepare a list of guiding questions or tasks that "should be appropriate for the language proficiency and developmental level of the student, reflect the students' interests and classroom activities, and avoid cultural bias" (p. 78). The emphasis on preparation, specifically for these two activities, may suggest that they require higher performance levels from the students; therefore, the teacher plays a key role in supporting and guiding them towards taking reasonable risks with sufficient confidence.

Finally, an additional teaching activity that is mostly related to monologues and not so much to interaction is oral presentations. Although this teaching practice is suggested for all levels, it becomes relevant in the case of intermediate speakers because, at this level, they can already be prepared to deliver a full speech confidently with their available linguistic means. According to Brown (2004), "in the academic and professional arenas, it would not be uncommon to be called on to present a report, a paper, a marketing plan, a sales idea, a design of a new product, or a method" (p. 179). It follows that an English course for intermediate students would be incomplete without oral presentations that can provide practice in describing, explaining, or discussing issues; asking and responding to questions; agreeing and disagreeing; and using visual aids as support. Key features of oral presentations suggested by Dudley-Evans and St. John (1998) for ESP courses include structuring to define the introduction, the content, and the conclusion; visuals to support spoken language; voice work related to pronunciation,

intonation, speed of delivery, tone, and pausing; and signposting to guide the audience through the presentation (p. 113). Taking these features into account is important since oral presentations require detailed preparation in advance and, to do this, students should be given guidelines on how long to speak, how to choose topics, and what areas to address (O'Malley & Valdez, 1996, p. 87). Thus, encouraging the use of a familiar topic and a structured guide can help the students increase their levels of confidence for public speaking.

In short, an ESP course that promotes speaking skills for intermediate Electrical Engineering students should be focused on widening their vocabulary, strengthening their grammar and pronunciation, and extending their scope of language functions so that the students can express themselves more confidently, accurately, and fluently. To achieve this challenge, teachers can strategically put into practice role-plays, picture-based activities, logic puzzles, discussions, debates, interviews, and oral presentations. The first step is to be critically aware of the paramount potential of these activities within the context of meaning negotiation, transactional and interpersonal speech, and content personalization, which are guiding principles for teaching speaking at the intermediate level. Then, teachers can be prepared to maximize, minimize, adapt, or supplement these activities to meet the students' specific learning needs and prepare them for the real world.

Collaborative Learning

Several studies advocate the use of the collaborative learning approach to help students achieve their learning goals (Barkley et al., 2014; Dillenbourg et al., 1996; Gerlach, 1994; Panitz, 1999; Pattanpichet, 2011; Roberts, 2004). To ensure the effectiveness of this approach, it is necessary to explore its characteristics to discover what features could make it suitable to enhance the learners' speaking skills in an online ESP course.

To start with, Barkley et al. (2014) claim that “collaborative learning has its home in social constructivism, which assumes that knowledge is socially produced by consensus among peers” (p. 9). Social constructivists suggest that students learn through interacting with others since groups construct knowledge collaboratively and create a culture of shared meanings (Barkley et al., 2014, p. 17). They also explain that “students come to group learning with diverse backgrounds, but their knowledge often overlaps enough to allow for a common base for communication,” which is the case of the population selected for the present study, as they are all Electrical Engineering students, but they are specialized in different areas: Electronics and Telecommunications, Power Systems, and Computing and Networking. The authors point out that this scenario poses a great advantage since “students can pool and share knowledge such that they know more as a group than they do as individuals.” Such scholars view this as a form of “collective intelligence” and hence “believe that individuals best acquire knowledge through social or group interactions in which peers collectively engage in knowledge construction (Palinscar et al., 1989, as cited in Barkley et al., 2014, p. 17). Thus, the fact that knowledge is constructed through social interaction and discussion implies that teachers must create the appropriate conditions for meaningful learning to happen in the classroom. In this respect, Smith and MacGregor (1992, as cited in Gerlach, 1994) point out that “learning depends on rich contexts that ask students to collaborate with peers to identify and solve problems by engaging in higher-order reasoning and problem-solving skills” (p. 9). Following the same line of thought, other scholars also view collaborative learning as an approach that involves the mutual engagement of participants to solve a problem (Dillenbourg et al., 1996; Panitz, 1996; Roberts, 2004). This means that teachers must design challenging tasks that require learners to collaborate by articulating their viewpoints and applying existing knowledge to solve real problems. Additionally, Smith and MacGregor (1992, as cited in Barkley et al.,

2014) state that, in most collaborative learning situations, students work “in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product” (p. 4). For instance, students may be presented with case studies or specific problems where they are required to discuss possible solutions and reach a consensus. Consequently, it is the teacher’s responsibility to provide learners with opportunities to work together toward the stated objectives so that they can exchange information and ideas to construct knowledge and make meaning of the task in place.

In the same vein, collaborative learning is an approach that demands an active role not only on the part of the learner but on the teacher’s as well. It has become clear so far that the students are the protagonists of their learning process, as the role of the learner is that of a group member required to work with the others. Even though it may seem that teachers play a passive role in a collaborative learning environment, they are indeed held accountable for their role. According to collaborative-learning supporters (Cranton, 1996; Smith, 1996, as cited in Barkley et al., 2014, p. 7), the teacher is viewed as the content expert and “responsible not only for designing and assigning structured learning tasks but also for managing time and resources, monitoring students’ learning, and checking to see that students are on task and that the group process is working well.” In sum, the teachers’ role in the collaborative approach is of paramount importance, relying on their expertise to guide students and facilitate their learning so that they can eventually become independent users of the language.

Previous research has also supported the effectiveness of collaborative learning to enhance learners’ speaking skills (Pattanpichet, 2011). This author conducted an experimental study that collected both quantitative and qualitative data with the aim of investigating the effects of collaborative learning in a group of 35 undergraduate students at Bangkok University. The quantitative data was collected from oral performance tests taken by the participants before

and after the course, as well as from the results of a questionnaire survey completed by the students at the end of the course. The qualitative data was obtained from the students' diaries, which they had to fill after each assignment, and a semi-structured interview, which was conducted at the end of the course. It is worth mentioning that the interviewer was a research assistant who was hired specifically for this task to avoid bias. The results revealed an improvement in the students' speaking performance and positive feedback from the participants about the use of collaborative-learning activities. According to this study, working collaboratively created a sense of unity among the group members and lowered their anxiety levels, which made the class more enjoyable. In addition, the authors pointed out that collaborative learning in the classroom resembles "real-life social and employment situations in which students interact, negotiate, and share ideas with one another" (Pattanpichet, 2011, p. 7). Therefore, these features made this approach ideal for the learners both to enhance their speaking skills and to develop social skills that may be required for a future job. The study also found that this approach requires teachers to design highly structured tasks and monitor group work constantly to avoid wasting time giving directions and to encourage passive learners to do their fair share of work. Finally, the author recommended considering the group composition carefully, which based on his findings should not exceed four members to ensure efficiency in the tasks. This study points to the effectiveness of collaborative learning in an EFL context. Nonetheless, for the authors, the results cannot be considered conclusive and should be tested on a larger sample of participants from different cultural backgrounds, educational levels, and ages to add more validity to these claims.

To sum up, the collaborative-learning characteristics discussed above seem to be appropriate for students and teachers to improve speaking skills in an ESP context. Since collaborative learning is based on social constructivism, existing literature suggests that

teachers should create the appropriate conditions for learners to work in small groups and articulate their points of view to come to an agreement, for example, by having them solve a problem or create a product together. In this approach, the learner's role is central, but this does not diminish the role of the teacher, who works as a facilitator or moderator during the tasks. Finally, research has provided evidence of the usefulness of this approach to improve the learners' speaking and social skills. Therefore, due to the nature of collaborative learning, this approach can be considered pertinent and beneficial for an ESP population such as the one involved in the present study.

Grouping Techniques

Different authors recommend using a combination of grouping techniques to develop the learners' speaking skills (Gerlach 1994; Scrivener 2012; Ur, 2016). Scrivener (2012) suggests the implementation of whole-class work to encourage students to speak and recommends a series of techniques to do so. In particular, he claims that teachers can create the conditions for speaking by promoting a safe learning environment where students feel relaxed, creating reasons for students to speak by asking them questions and having them solve problems, inspiring reactions and ideas by using pictures, and managing turn-taking by deciding who should speak every time, among other ideas. Other authors, however, are more inclined to implementing group or pair work. According to Brown (2001), group work is a "generic term covering a multiplicity of techniques in which two or more students are assigned a task that involves collaboration and self-initiated language" (p. 177). Similarly, Mills and Alexander (2013) define small group teaching as "any teaching situation in which dialogue and collaboration within the group are integral to learning" (p. 4). These authors agree on the fact that small group work entails communication and collaboration among peers. In this sense, the term group work may often be directly correlated with collaborative work, although it is not always the case. While it is

true that all collaborative work is done in a group of two or more people, not all group work is inherently collaborative (Scheuermann, 2018). That is to say, having students work in groups does not necessarily mean that they will work as a team to complete a certain task since they may just want to “divide and conquer” to solve it by breaking it down and sharing the answers with their group at the end. For this reason, group work can be a suitable technique as long as it creates a sense of positive interdependence and teamwork among its members, both key features of collaborative work, which can be achieved by “ensuring that the project is sufficiently complex that it benefits from multiple minds and requires a range of knowledge and skills” (Western University, n.d.). Barkley et al., (2014) warn that “shifting responsibility to students and having the classroom vibrate with lively, energetic small-group work are attractive, but it is educationally meaningless if students are not achieving intended instructional goals” (p. 4). Therefore, it is vital to set the appropriate expectations prior to assigning learners to work in groups and explain the benefits of this grouping technique. Tiberius (1999) recommends implementing small group work whenever possible since it allows for greater involvement and speaking time with their peers, more opportunity to develop their interpersonal skills and learn from one another, more commitment and responsibility for their own learning, more circumstances conducive to learning to listen as well as to receive and offer criticism, and more opportunity for self-evaluation in comparison with peers, among others (p. 75). Scrivener also encourages the use of pair and group work in the classroom and points out that it is part of the teacher’s job to keep these grouping techniques interesting and to encourage quieter students to speak in their groups. Ur (2016) proposes using group work or pair work for oral fluency tasks so that all the students have the opportunity to talk, which otherwise would not be attainable with a large group of students. The author also recommends the use of group work in activities such as brainstorming, where a better result can be obtained if compared to individual student

work. Ur claims that pair work leads to better results than group work, for example with three or four students, as pairs are easier to organize and control. She goes on by adding that the amount of active participation is the main advantage of pair work since there are fewer chances that a student will play a passive role. However, the author does recommend using group work when a teacher has a large class. This helps to keep the number of groups manageable and to maintain conditions that both increase the learners' talking time and allow shier students to practice more comfortably than if they were asked to participate in a whole-class discussion. Finally, Smith and MacGregor (1992, as cited in Gerlach, 1994) also support the use of group work and recommend "having students work in groups of two or more to explore an idea, solve a problem, or create a product" (p. 10) to facilitate interaction and produce more positive results. In synthesis, the aforementioned claims indicate that the use of whole-class, pair, and small group work has plenty of benefits and is vital not only to promote active participation but also to enhance the learners' language skills. These findings suggest that teachers can use a wide variety of techniques to guide a whole-class discussion and engage learners in conversation when appropriate. Likewise, the use of pair and small group work is aimed at facilitating interaction among team members, which is very likely to help learners improve their communicative skills.

Error Correction Versus Corrective Feedback

Error correction and feedback are key for the development of speaking skills in the EFL classroom. According to Pawlak (2012), many specialists distinguish between error correction and corrective feedback, but he uses these terms interchangeably to refer to the "teachers' responses to incorrect language forms in their learners' speech or writing..." (pp. 5-6). This definition is in line with other definitions such as that by Sheen and Ellis (2011, as cited in Pawlak, 2012, p. 6), who state that "corrective feedback (CF) refers to the feedback that

learners receive on the linguistic errors they make in their oral and written production in a second language (L2).” These linguistic errors may be the incorrect use of grammatical structures, vocabulary, and pronunciation, among others. For the researchers of the present study, it is essential to explore the literature to assess the effectiveness of existing error correction and feedback strategies for improving learners’ speaking proficiency.

Corrective feedback plays a critical role in improving learners’ language performance, and teachers must carefully consider the conditions for its provision. According to Ur (2016), teachers should correct learners, as “making mistakes and having them corrected is one major avenue through which we learn...” (p. 21). In line with this claim, Lyster et al. (2013) note that oral corrective feedback is indisputably better than no feedback and that learners often prefer receiving corrective feedback over having their errors ignored. This implies that learners need to be corrected to be able to modify their output and improve their speaking skills. To this end, Ur states that teacher correction must be pointed out in context, not in isolation. Likewise, Spada and Lightbown (1993, as cited in Lyster & Saito, 2010a, p. 278) hold that teachers should draw the learners’ attention to errors “within the context of meaningful and sustained communicative interaction” without altering the communicative flow of the class. In other words, these authors recommend teachers to provide immediate corrective feedback to learners whenever possible in a way that does not interrupt or inhibit them. Although corrective feedback may be delayed in some cases to avoid disruption, Ur (1996, as cited in Salikin, 2001) suggests that teachers correct learners’ spoken errors immediately when these “destroy or break down communication” (p. 117). Similarly, based on a series of studies, Hadley (2001) states that “errors that interfere with comprehension of meaning as well as those that are (1) of high frequency, (2) stigmatizing, or (3) the subject of pedagogical focus should receive the most attention” (p. 268). Hence, these authors agree upon the relevance of providing immediate corrective feedback in context when

the learners' errors may lead to a communication breakdown, especially when these errors are recurring or the learner may be stigmatized, and when the errors are related to the topic or the contents of the class. Lastly, implementing delayed corrective feedback for language improvement is advisable to avoid causing a disruption or destroying the learners' confidence while talking. These findings should help teachers to guide their selection of corrective feedback techniques to fit the type of error and learning situation.

To support the effectiveness of corrective feedback, a number of researchers have conducted studies that evince its positive impact in improving the learners' use of the target language (Ammar & Spada, 2006; Li, 2010; Lyster et al., 2013; Lyster & Mori, 2006; Lyster & Saito, 2010a; Lyster & Saito, 2010b; Mitchel & Myles, 2004). In one study, Lyster and Saito (2010a) propose considering mediating variables such as feedback types (i.e., explicit correction, recasts, and prompts), instructional setting, learners' age, and linguistic targets to evaluate the success of the feedback provided. According to the authors, feedback moves can be classified into three types: explicit correction, recasts, or prompts. They explain that explicit correction occurs when the teacher provides the correct form and also indicates what the student said incorrectly. Recasts are more implicit since the teacher only reformulates the student's utterance partially or completely but does not explain what exactly was wrong with the learner's production, meaning that students need to figure it out on their own. In the case of prompts, the authors point out that these include a variety of signals to push learners to self-repair, namely elicitation, metalinguistic clues, clarification requests, and repetition. According to the same investigation, feedback is often differentiated by researchers in terms of explicitness, which they define as "the perceptual salience (e.g., intonation) and linguistic marking (by metalanguage) with which the negative information is delivered" (Ortega 2009, as cited in Lyster & Saito 2010a, p. 280). One of the conclusions of this study is that recasts may be beneficial to

treat learners' phonological errors due to the relative saliency of this corrective move, whereas prompts may be more suitable for correcting grammatical errors. The authors also concluded that teachers should not be limited to one type of corrective move or the other but instead should "adopt a wide variety of feedback techniques (i.e., not only recasts but also explicit correction and prompts). Mitchell and Myles (2004) further elaborate on this topic and discuss the results of a study conducted by Lyster and Ranta in 1997 in a Canadian immersion context. Based on that study, recasting seemed to have been an effective error correction strategy since the students later repaired more than 60% of their phonological errors. Nonetheless, this was not the case of grammar repair, as only 22% of the spoken grammar mistakes were corrected, and many of these repairs took place after the teachers used the negotiation of form strategy to correct their erroneous utterances. What these studies suggest is that learners are often able to notice the recasts to their phonological errors more easily than the recasts to their grammatical errors, and that other error correction strategies which involve a higher level of explicitness, such as prompts, seem to be more effective for the latter type. While recasts occur when the teacher implicitly reformulates a student's utterance, prompts may take other forms such as the use of elicitation to have students reformulate their utterances, metalinguistic clues to explain the nature of the error, or clarifications requests or repetitions by the teacher to indicate that the utterance is erroneous.

In another study, Ammar and Spada (2006) investigated the potential benefits of recasts and prompts for a group of sixty-four students in an intensive English as a Second Language (ESL) course in Montreal, Canada. They worked with two experimental groups (one for recasts and one for prompts) and a control group. The results yielded that prompts and recasts were equally effective for high-proficiency learners, but prompts turned out to be more effective for low-proficiency students. Thus, the use of these error correction strategies must be evaluated

on a case-by-case basis, depending on the population with which the teacher is to work. In the context of the present study, feedback in the form of recasts and prompts can be expected to be appropriate for a group of intermediate learners based on Ammar and Spada's (2006) findings, both to have the learners notice pronunciation and grammar issues and to eventually correct those inaccuracies.

In the same vein, a meta-analysis conducted by Lyster and Saito (2010b) confirmed the effectiveness of corrective feedback in response to students' non-target-like production, especially due to its contribution to enhancing learners' oral production over time. Based on this study, prompts were found to be more effective than recasts mainly for younger learners; nevertheless, further research is required to identify the learner variables behind this finding, including their proficiency level, level of anxiety, and L1 background, among others.

Lyster and Mori (2006) developed a comparative analysis of teacher-student interaction in a French immersion and a Japanese immersion program to investigate the immediate effects of corrective feedback on the learners' uptake and repair. The results of this classroom study pointed to the effectiveness of recasts in combination with prompts rather than providing no feedback at all.

Furthermore, Li (2010) conducted a meta-analysis of 33 studies involving a total of 1,773 L2 learners. One of the objectives of the analysis was to find out whether explicit feedback was more effective than implicit feedback. According to the author, "implicit feedback refers to any corrective move that does not overtly inform the learner of the unacceptability of his/her erroneous production; explicit feedback, in contrast, draws the learner's attention to the error he/she commits" (Li, 2010, p. 337). The findings indicated that explicit feedback had better immediate and short-term results, but implicit feedback had more durable effects on the learners.

On the whole, the literature indicates that error correction or corrective feedback plays a pivotal role in improving learners' speaking skills. The reviewed studies have pointed to the effectiveness of different types of error correction in various contexts. Some authors suggest that corrective feedback be provided immediately as long as the learner is not abruptly interrupted, causing negative effects on the learner's motivation and their ability to keep the flow of the intervention. At the same time, many scholars warn that learners' errors should be corrected immediately when these are frequent or stigmatizing, and also when the error is related to the pedagogical focus of the class. It has become clear so far that, although there are plenty of corrective feedback moves, the use of each strategy depends on different variables. Particularly, feedback in the form of recasts and prompts has been suggested to correct the learners' pronunciation and grammar inaccuracies, respectively. In sum, a wide variety of research studies and meta-analyses conducted in different contexts support the use of error correction or corrective feedback to help learners improve their overall speaking proficiency in English, having direct implications for the way that the researchers of this study should treat the learners' errors in the online ESP course for Electrical Engineering students.

Online Language Teaching

Although online education has been around for some time, the proliferation of online language teaching programs in the past few years has posed a great challenge to teachers and students who are new to this modality. Teaching online means delivering a course partially or entirely through the internet, either via synchronous sessions – engaging with the course content and each other simultaneously, in an asynchronous modality – engaging with the course at different times, or a combination of both (University of Waterloo, 2020). Online language teaching may be challenging or even overwhelming for some teachers due to its inherent differences compared to face-to-face teaching. Even though online collaborative

learning seems to comprise the same features as face-to-face collaborative learning, they typically unfold differently. In fact, according to Major (2010, as cited in Barkley et al., 2014, p. 5), “online instructors believe that online design requires more planning and structure than onsite to be effective.” A possible reason behind this is that teachers need to deal with the technological component; that is, they may face more challenges in adapting the teaching materials to the online teaching setting since traditional activities and techniques used in the face-to-face environment may no longer work or be as efficient in the online classroom environment. Russel and Murphy-Judy (2020), observe that “to be proficient at online language teaching, instructors must acquire a broad base of knowledge across three domains: knowing how to teach language (language pedagogy), knowing how to teach online (online pedagogy), and knowing how to use educational technologies to deliver online teaching (pedagogy for educational technology)” (Teaching in Online and Blended Environments section). It is undeniable that online language teaching requires instructors to be technology proficient since this influences the effectiveness of the course. This view has been widely supported by other authors in the literature (Alolaywi, 2021; B. Zou et al., 2021; C. Zou et al., 2021; Pawan et al., 2016; Shi et al., 2017). Thus, it is imperative that language teachers stay up to date with new educational technology tools and approaches to help learners fulfill their learning objectives in online environments.

Despite the challenges previously mentioned, there is a series of strategies to cope with online language teaching. Boettcher and Conrad (2016) share some recommendations for teachers transitioning to the online modality and also for more experienced teachers who want to reinvent themselves. They suggest “designing options and choices within learning experiences, assignments, and special projects” (p. 55). The authors emphasize the importance of supporting learners’ personal and professional goals that are related to the course objectives

with the purpose of making the lessons more meaningful to keep the students engaged with the assignments. Boettcher and Conrad (2016) go on by adding that it is a good practice to make the learners' thinking visible, as this "requires students to create, talk, write, explain, analyze, judge, report, and inquire" (p. 56). This not only helps students learn new vocabulary and concepts but also develops their fluency and accuracy in the language.

Gonzalez-Lloret (2016) supports the integration of technology in TBLT and states that tasks in virtual environments encourage negotiation of meaning, allow learners to interact without fear, and "generate opportunities for social language and casual conversation, which are both essential components in the repertoire of a language learner" (p. 240). The author also points out that, when engaged in role-play gaming, learners need to use verbal communication to find something, talk with someone, or follow instructions, among others. This implies that online language learning can be as communicative as face-to-face learning. In a further contribution to the discussion, Gonzalez-Lloret and Ortega (2014) suggest that technology-mediated tasks that are properly motivated by the TBLT theory "can help minimize students' fear of failure, embarrassment, or losing face; they can raise students' motivation to take risks and be creative while using language to make meaning" (p. 4). In a similar vein, Meskill and Anthony (2015) hold that, despite the skeptical opinions about online learning pointing to the loss of the fast-paced, stimulating interaction that characterizes face-to-face language classrooms, there are a series of affordances that can mitigate the absence of live interaction. The authors state that a major affordance of this modality is that "language learners who otherwise do not react well under the pressure of real-time comprehension and production in live classrooms particularly enjoy online language learning" (p. 2) and that they can put their skills into practice in an environment where they feel "safe, valued and, perhaps most importantly, members of a learning community" (p. 10). This means that all students can benefit

from the online language modality, especially introverted students, as it can allow them to feel more confident and gradually develop teamwork, public speaking, and interpersonal skills in a safe learning environment.

In addition to the benefits mentioned above, there are other factors that contribute to the effectiveness of online teaching to improve speaking skills. According to Meskill and Anthony (2015), online venues are beneficial for tracking learner progress since they allow teachers to have digital records of student performance, for example, in the form of graded exercises or other kinds of individual work. The authors admit that these kinds of records of learner growth and development supply archived information upon which subsequent instruction may be based, which is something that even the most expert teachers may have difficulty tracking in a regular face-to-face environment. Furthermore, having these digital records “can serve as a guide for learners themselves to gain sense of their strengths, weaknesses and overall progress” (Meskill & Anthony, 2015, p. 7). It is important to note that oral synchronous environments allow for the sessions to be recorded and archived for later reference by learners and instructors, if necessary. This recordable evidence of student learning provides instructors with formative assessment information about both individual learners and the group as a whole which “steers subsequent instructional moves and activities” (p. 14), and these records can be “continually consulted with the luxury of time for review and reflection...” (p. 15). The literature also suggests that most oral synchronous online environments or web-conferencing platforms allow participants to use whiteboards for displaying and manipulating documents, chat boxes, breakout rooms for pair and group discussions, audio and video camera connectivity, and application sharing features to display content from their desktops (B. Zou et al., 2021; Meskill & Anthony, 2015; Pawan et al., 2016). Likewise, a major affordance of this modality in language learning is that students are able to receive feedback once an activity or game is completed

online since some sites work under the trial and error principle, which means that learners are not allowed to continue with the next task until they have successfully completed the previous one (immediate feedback), and other sites give feedback to students once the whole task is completed, where the problematic aspects are pointed out (Nayman & Bavlı, 2022). Therefore, although new technologies for language learning may seem very exciting, the instructors must pay close attention to the rationale behind their use to ensure that these help learners develop the target language.

In synthesis, while it is true that online language teaching requires more planning and preparation, teachers are responsible for investigating current practices and strategies to make the learning experience as enjoyable as possible and inspire learners to hone their speaking skills. This can be achieved by providing learners with opportunities to use their creativity and background knowledge so that they can solve problems and create products that are meaningful to them. Giving the students real choices in the online classroom can allow them to take ownership of their learning experience and stay motivated. Similarly, using technology in the classroom entails negotiation of meaning and interaction to be able to complete the tasks, leading to continuous practice and development of the students' communicative skills in a more relaxed environment. To serve this purpose, technology-mediated TBLT tasks in online language may help students interact without fear and may even raise their enthusiasm and creativity, especially for introverts who may feel anxious in the traditional face-to-face environment. In addition, the fact of having a digital record of student performance in the online modality provides an important insight into the learners' progress in the language and the next steps to follow by the instructor. Lastly, the different functionalities and games available in synchronous online environments constitute a powerful tool for instructors to encourage participation and help learners improve their speaking skills.

Conclusions of the Literature Review

After consultation with literature sources, the teaching practices that can help to improve the speaking skills of the intermediate Electrical Engineering students in the present study cover a broad array of strategies, methods, and activities that can be carried out by teachers to reach the course objectives. In this study, the contributions made by the authors lie on five strategic themes: speaking activities for intermediate students, collaborative learning, grouping techniques, feedback or error correction, and online language teaching. As for the first teaching practice, the literature reveals that speaking activities such as role-plays, picture-based exercises, logic puzzles, discussions, debates, oral interviews, and oral presentations can function as suitable options for intermediate learners, mainly because they are consistent with the key principles of meaning negotiation, transactional and interpersonal speech, and personalization of language exercises. Collaborative learning, which consists of having learners work in groups to reach a consensus and create new knowledge, has also been identified by scholars as a promising instructional approach to enhance the learners' speaking skills. In terms of grouping techniques, the authors recommend whole-class activities, but especially pair and small group work to promote active participation. For error correction, existing literature suggests providing immediate feedback (a combination of recasts and prompts) whenever possible without interrupting the learner, particularly when the errors may cause a breakdown in communication, be stigmatizing, or directly related to the focus of the lesson. Finally, for online language teaching, it has been pointed out that the integration of technology and meaningful interaction into the classroom can promote the development of the learners' oral skills as much as on-site interaction if a set of criteria for ensuring engagement are met. Although each English course depends on the particular context in which it is developed, raising awareness of this repertoire of teaching practices can shed light on conditions that could lead to the improvement

of the speaking skills of intermediate learners. Thus, this literature review section helped to identify and assess a series of teaching practices and their effectiveness for an actual online task-based ESP course, providing a theoretical framework that supports the decisions made by the researchers during the practicum of the present study.

Chapter IV: Evidence-Based Reflection on the Practicum

Based on the findings of the literature review, this section provides an evidence-supported reflection on the researchers' ESP practicum teaching experience. The guiding sub-questions for this reflection include the following:

1. What is the impact of the selected teaching practices on the students' speaking skills as perceived by the student-teachers based on the evidence observed during the course?
2. What is the impact of the selected teaching practices on the students' speaking skills as perceived by the supervisors?
3. What are the students' perceptions about the usefulness of the selected teaching practices for the improvement of their speaking skills?

For analysis purposes, the researchers, who are also the student-teachers of the practicum, refer to the specific teaching practices explored in the literature review: speaking activities for intermediate learners, collaborative learning, grouping techniques, error correction versus corrective feedback, and online language teaching, considering the particular TBLT and ESP conditions in which the course for Electrical Engineering students evolved over a 14-week period. From the qualitative point of view, it should be noted that, by *impact*, the researchers mean the positive or negative effects of these teaching practices on the students' speaking performance throughout the English course as perceived by the participants of this study. The impact of the investigation was measured through the identification and analysis of recurring trends (i.e., consistencies and frequencies) in the data, which was supported by the following

sources of evidence: video recordings, lesson plans and handouts (see Appendix N), the supervisors' oral and written feedback based on the class observation forms (see Appendix O), and the students' feedback from course evaluation surveys and assessment tasks (see Appendix P). The specific data collection methodologies and the instruments that were used are described in each of the following sections.

Impact of the Selected Teaching Practices on the Students' Speaking Skills as Perceived by the Student-Teachers

This section describes how the student-teachers perceived the effects of the teaching practices implemented in class to improve the students' speaking skills. To obtain this data, the student-teachers used a qualitative content analysis, which included watching the video recordings of the classes and taking observation notes in an unstructured manner for reflective and analytical purposes. These qualitative data records in the form of notes provided rich descriptions or accounts of what happened in each class, paying special attention to the students' performance and motivation during the different types of speaking activities, the students' interaction with other classmates in terms of collaborative work, the students' participation while working in groups, feedback or clarifications to address language errors or questions made by the students, and effectiveness or technical problems related to online tools used in class, among others. Then, to achieve researcher triangulation, the student-teachers compared their notes and discussed highlights, patterns of students' performance, recurrent classroom events, and actions perceived as necessary to upgrade the students' speaking skills. In addition, to strengthen objectivity of the student-teachers' perceptions, data was triangulated with the feedback given by the supervisors in each class and the information collected from the students' surveys at the end of each unit.

The video recordings and the observation notes were supplemented by the lesson plans and handouts developed for the ESP course since they also constitute a record of the teaching practices selected for each class and integrate the decisions and adaptations made by the student-teachers after insightful reflection on their own classroom practices.

Speaking Activities for Intermediate Learners

The results of the needs analysis led the researchers to prioritize speaking in the course syllabus designed for the Electrical Engineering students. While the four macro skills (speaking, listening, reading, and writing) were covered throughout the course, two units out of three were exclusively dedicated to speaking as a major need: Unit 2 (Empowering Communication at Work) and Unit 3 (Engineering the Future). The researchers' plan was to include a large variety of speaking activities that could benefit the students in terms of language improvement, preparation for academic and future professional contexts, and increased confidence and motivation. For instance, in Unit 2, the goal was to improve the students' skills to actively interact with prospective English-speaking professionals by role-playing work-related scenarios such as a small-talk conversation for networking at a conference, a job interview at a company that requires electrical engineers, and a telephone call to set up a technical site visit. In the case of Unit 3, the goal was to describe an innovative product or system in the field of Electrical Engineering (specifically a power generation process) by presenting a business idea to solve a technical problem during a meeting. To develop these simulated real-life scenarios, the researchers took advantage of speaking activities that promoted meaning negotiation, interactional and transactional speech, and content personalization, all of which were consistent with the key principles highlighted by Bailey (2005) for teaching English speaking skills at an intermediate level.

From the speaking activities listed in the literature review as key teaching practices, role-plays were clearly strategic in the ESP course. This activity was selected as the main task in all the lessons of Unit 2, which were related to the conference, the job interview, and the telephone call. Based on the student-teachers' observations for Unit 2, during role-plays, the students generally demonstrated a lot of interest and motivation by remaining on task, showing eagerness to participate, and constantly asking questions aimed at improving their language skills. This behavior was observed in the video recordings of the test corresponding to Unit 2, Lesson 4, where most of the students also demonstrated a greater command of vocabulary (e.g., safety helmet, dielectric boots, smart cities, Artificial Intelligence algorithm, analytical thinker, team-player, cutting-edge technology, etc.) and formulaic expressions (e.g., "What brings you to this conference?", "That was a nice presentation, wasn't it?", "I have experience in power generation," "Let's schedule a meeting," "Are you free on October 20th?", "Would you be interested in participating in this project?", "I think I would be a good fit for this position," "It was great talking to you," "If you have any questions, please contact me," etc.). Additionally, the students were able to use more complex grammar structures and to shift tenses more easily if compared to the diagnostic test of the needs analysis and the first two lessons of the course. There was also a noticeable improvement in terms of pronunciation when the student-teachers compared the students' performance with that of the diagnostic test and the first lesson. As a result, the students seemed more confident and were able to speak more fluently than in earlier stages of the course. This suggests that, in accordance with previous studies (Brown, 2004; O'Malley and Valdez, 1996), the role-plays offered the students an opportunity to demonstrate linguistic and extralinguistic abilities to succeed in common situations likely to be encountered as future professionals. Different pedagogical strategies were implemented by the student-teachers with the aim of making role-plays in class successful. As an example, from the

beginning of the course, the student-teachers motivated the students to turn their cameras on by indicating the importance of gestures, facial expressions, and eye contact during conversations. In addition to these extralinguistic abilities, the use of culture notes in handouts gave the students suggestions about how to act in the different scenarios (e.g., topics considered polite for making small talk in different cultures, recommendations on how to prepare for a job interview, and the use of titles for addressing people in business situations, among others). Another strategy was the explicit teaching of useful vocabulary and expressions during the pre-tasks so that the students could resort to these language tips to sustain interaction while performing the main task (e.g., expressions to make small talk, to give an opinion, to negotiate meaning, to show interest, to take turns, and to give suggestions, among others). A further strategy was to take advantage of every opportunity in class to make the students speak. In particular, after interacting in pairs or small groups during a pre-task either to complete or to arrange a short dialogue from the handouts, the students were also encouraged to take turns to practice that conversation orally so that they could fully exploit the written exercise by also using it as a reference for additional oral practice. Giving the students sufficient rehearsal time was another strategy to encourage them to speak in a safe and supportive environment with the help of the student-teachers and the classmates. As a final strategy, the student-teachers stepped up every lesson to set more complex and challenging tasks to have the students recycle the knowledge acquired in previous classes and elicit unpredictable speech. For instance, in the small-talk conversation for networking at a conference, the students were given a basic structure of the steps to be followed (i.e., starting a conversation, keeping the discussion moving, and leaving the conversation), but they also had to demonstrate their ability to build spontaneous interaction based on the other interlocutors' contributions. Similarly, for the job interview, the student-teachers shared a list of guiding questions and responses to elicit

particular information, as suggested by O'Malley and Valdez (1996); however, in addition to this basic framework, the exchanges demanded creative and immediate responses from the students as the interview evolved. With all these conditions and strategies in mind, the impact of role-plays on the students' speaking skills was perceived as positive by the student-teachers because the learners demonstrated active participation, motivation, confidence, and continuous improvement of their English skills.

Another successful speaking activity put into practice in the ESP course was oral presentations. As found in the needs analysis, Electrical Engineering students may be exposed to multiple scenarios at school or at work in which the delivery of an oral speech is required. Based on this, the student-teachers dedicated the last unit of the syllabus to this teaching practice considering that it requires more challenging language skills and functions than those learned in Unit 2 through role-plays. These skills and functions include the presentation and discussion of a technical topic by following an organized content structure (i.e., an introduction, a body, and a conclusion), the use of visual aids, the development of critical-thinking skills, and abilities such as voice work, speed of delivery, and signposting to guide the audience. Thus, the first presentation in the ESP course required the oral description of a power generation, transmission, and distribution process by referring to its main components and the steps needed for its operation. The students worked in groups to make decisions on the ideas that each person was going to present, and they had to imagine that they were attending a meeting with a company interested in clean and sustainable electrical projects in Costa Rica. The second oral presentation was more related to describing a business idea for a solution to a problem during a meeting. In this case, group work was also required since the students had to present the idea themselves as a team of entrepreneurs and describe the proposed product or service in terms of technical features, social and environmental impact, and competitive advantages in the

market, among others. For both oral presentations and for the assessment task to evaluate this unit, the student-teachers decided to contextualize the activities in a Costa Rican scenario by referring to the country's renewable power resources (hydroelectric, wind, geothermal, and solar) and to solutions to problems affecting Costa Rican society (e.g., indigenous communities lacking access to solar panels) so that the students could feel more motivated and familiar with real-life topics. Based on the student-teachers' observations and recordings for Unit 3, the students interacted actively, negotiated, made decisions, and presented their ideas with high levels of fluency, accuracy, and confidence in comparison with the early stages of the course. For example, in the diagnostic test, one of these students was able to convey simple information of immediate relevance for him, but it was evident that he had trouble with grammar (e.g., conjugation of the third person singular, simple past, and present perfect tense), pronunciation (e.g., stress on the wrong syllable and incorrect realization of speech sounds), and a limited vocabulary repertoire. However, in the oral assessment at the end of Unit 3, he was able to produce more complex constructions with a good pronunciation and advanced vocabulary, including: "Our team is made up of Electrical Engineers with vast experience in the field of Solar Energy" and "It is important to know how the solar power is generated; the most common way to generate solar power is using photovoltaics." Consistent with previous studies that suggest the use of oral presentations for intermediate-level learners (Brown, 2004; Dudley-Evans & St. John, 1998; O'Malley & Valdez, 1996), the practicum experience seems to confirm that intermediate speakers are able to deliver a full speech confidently with all the available linguistic and extralinguistic resources if they have sufficient preparation. The students' motivation and effort also seem to confirm that succeeding at the skill is paramount for these speakers. From the student-teachers' perspective, this activity proved its effectiveness as a valuable opportunity

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for students to use the skills, functions, and strategies acquired and to demonstrate their achievements by the end of the course.

A further teaching practice that ensured motivation and improved language use in this ESP course was picture-based activities. In addition to developing a consistent format and a visual style for all the materials, including handouts, presentations, and assessment tasks, the student-teachers took advantage of visuals mainly to generate critical-thinking skills, to illustrate topics, and to practice content organization. For example, most warm-up activities developed in class used pictures and graphs to brainstorm ideas, to predict language, and to generate discussion. Other examples of visuals included authentic materials to support the work-related scenarios simulated in the role-plays (e.g., job ads, résumés, and emails); pictures to reinforce technical vocabulary (e.g., occupational safety equipment and components of power generation plants); diagrams and information gap activities showing components, relationships, or sequences (e.g., diagrams to explain the steps of power generation, transmission, and distribution processes); and mind maps to organize ideas for oral presentations. The student-teachers decided to give relevance to visuals because, in the needs analysis, the Electrical Engineering students indicated a greater interest in activities related to the spatial-visual intelligence, including the use of visual aids such as diagrams, graphs, and images. Then, during the practicum experience, the students seemed to be highly motivated while participating in picture-cued activities to elicit creative oral production in the form of conversations, discussions, and presentations. It is also important to highlight that, like in the case of the diagrams used to explain the power generation processes in Unit 3, visuals were also transformed into logic puzzles or information gap activities. A great deal of interaction was observed among the learners during these activities as they attempted to reach a solution to a technical problem or to complete a set of information related to Electrical Engineering. This

suggests that picture-cued activities were an effective and useful approach implemented in class and, in accordance with Bailey (2005), O'Malley and Valdez (1996), and Parkinson (2013), the students' performance during the course seems to confirm the importance of this strategy in ESP courses addressed to intermediate learners in technical or scientific fields.

To sum up, these results shed light on the speaking activities that can be useful for intermediate-level language instruction. The student-teachers perceived that role-plays, oral presentations, and picture-cued activities, which may improve the speaking skills of the Electrical Engineering students according to the literature review, had a positive impact and helped to meet the speaking needs identified in the needs analysis. These activities required higher levels of performance in every class but, at the end, the students revealed their potential for accomplishment through active participation and interaction, improved oral speech, and increased confidence. Based on the observations and recordings of these activities for Units 2 and 3, in every class, the students spoke with fewer pauses and hesitations, an improved repertoire of grammar patterns and vocabulary, better pronunciation and intonation, more detailed viewpoints on challenging and specialized topics, and a greater use of language strategies, as reported in the previous examples. The students also showed higher levels of motivation in every new class, and they were able to see the results of their previous work throughout the ESP course. Thus, the selected speaking activities seem to have provided the students with helpful tools and key strategies to continue practicing and improving for future challenges.

Collaborative Learning

Integrating collaborative learning in an online English course is of great help for learners to improve their speaking skills. Based on the premise that learning is a social process that takes place collectively, collaborative learning proposes the use of small groups for learners to

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engage in discussion and reach a consensus, with the aim of improving their critical-thinking and oral communication skills. In line with this statement, in the initial needs analysis, the researchers found that the majority of the participants involved in this study expressed their preference for group or pair work (47%) rather than individual work (39%), making the collaborative learning approach particularly suitable for the selected population. Additionally, due to the scope and nature of academic and professional activities of electrical engineers, which involve problem-solving and critical-thinking skills, collaborative learning was expected to be effective, which had direct implications for the development of the course materials. This led the student-teachers to design higher-order reasoning and problem-solving tasks, such as the creation of a business solution in the field of Electrical Engineering and the development of a power generation project for indigenous communities in Costa Rica, to take advantage of the students' background knowledge and possible work experience to boost their communicative skills.

Even though the purpose of Unit 1 was to help the group of Electrical Engineering students understand technical readings for academic purposes, based on the collected evidence, the unit also allowed for cooperation among group members given that they needed to discuss their points of view and agree on the answers to the reading exercises assigned. For instance, in the case of Unit 1, Lesson 2 (pre-task 1), the students were assigned to breakout rooms where they had to skim the technical article *Project Irazú: Advances of a Store & Forward CubeSat Mission for Environmental Monitoring in Costa Rica* individually and then discuss in groups which of the options provided in the handout was the gist of the text. Afterwards, in pre-tasks 2 and 3, as well as in the main task, the students worked in groups of three or four to complete a series of matching, multiple-choice, identification, and true/false exercises based on the technical article. To this end, the students were required to discuss their points of view to

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select the most suitable answer and reach a consensus before marking or writing it on the handout. As can be seen, collaboration was a constant component of the activities leading to the comprehension of the selected article and a key part of their success. This points to collaborative-learning's compatibility with the learners' wants and needs due to the favorable conditions it offers to exploit the learners' background knowledge and possible work experience in the Electrical Engineering field.

In the case of Unit 2, the students were asked to work in small groups with the purpose of learning and practicing key language to complete the main tasks. As part of this unit, the students were required to role-play a small-talk conversation for networking at an international conference (Lesson 1), a job interview at a company that requires electrical engineers (Lesson 2), and a telephone call to coordinate a technical site visit (Lesson 3). Then, in Lesson 4, the evaluation consisted of role-playing one of the previously mentioned scenarios. In the four lessons, the student-teachers asked the learners to complete the pre-tasks in groups of three or four while, during the main tasks, the learners were required to work in pairs to plan and rehearse their role-plays. Thus, these tasks clearly required mutual support and agreement to successfully achieve the main objective of the lessons, and group work, as suggested in collaborative learning, was very appropriate in this context.

In addition, Unit 3 comprised a series of oral presentations resembling real-life activities, where the students had to make decisions and assign responsibilities to each group member to fulfill the main objective of each lesson. As an illustration, in Lesson 2, the students were expected to orally describe a hydroelectric, wind, or geothermal power generation process in a work meeting. To achieve this goal, the student-teachers asked the students to work in groups to complete the pre-tasks that would help them become familiar with the process and the language employed in this context. Then, when giving the instructions for the main task, the

student-teachers asked the students to decide which member of the group was going to present each idea. This implies that the students had to decide what pieces of information they were going to present as a whole group, and they also had to prepare for their individual contributions during the presentation. The same occurred in the evaluation that took place in Lesson 4, given that the learners were encouraged to design an innovative business idea to be presented at an international trade fair and also provide a sustainable power solution to indigenous communities in Costa Rica. The students interacted in small groups to brainstorm ideas and use their critical-thinking skills to devise a solution to the problem in place.

Finally, in accordance with the literature, teachers play an active role in the ESP course. As part of the practicum experience, the student-teachers aimed to design highly structured and well-organized task cycles to give the students choices and useful strategies to achieve meaningful learning. Specifically, the student-teachers assigned tasks related to real-life situations that electrical engineers may encounter at school or at work (e.g., reading technical articles, attending a job interview, scheduling a worksite visit, or presenting a business idea). A series of concepts and recommendations, such as culture capsules, were provided for the learners to be ready to approach any of these scenarios and to make the lessons more interesting and attractive to them. Likewise, according to the expected roles of teachers in collaborative learning (Barkley et al., 2014), the student-teachers were responsible for managing class time, facilitating learning resources, and monitoring the students' progress throughout the lessons. To ensure that the students were actively participating and that they had sufficient time to complete the tasks, the student-teachers moved across the breakout rooms to closely monitor group work and answer any arising questions. Thus, these practices denote that the student-teachers' role in this course was central to the development of the learners' speaking skills as they sought to provide support during learner-centered activities.

In synthesis, the Electrical Engineering students involved in this study were motivated to complete their tasks using the collaborative learning approach, which seemed to be very appropriate and helpful for them. The students were encouraged to work in small groups to construct knowledge together by searching solutions to problems and creating products. Due to the learner-centeredness component associated with this approach, the student-teachers' role was mainly that of an observer and facilitator of learning, which was essential for the enhancement of the learners' performance. From the student-teachers' perspective, the collaborative approach seemed to help the learners to overcome their fear of public speaking by reducing their anxiety levels and increasing their self-confidence while working in groups, thus leading to the improvement of their speaking skills.

Grouping Techniques

Effective grouping is crucial in ESP courses as it fosters communication and interaction among learners. In view of the different recommendations provided by various scholars (Gerlach 1994; Scrivener 2012; Ur, 2016), the student-teachers implemented a variety of grouping techniques throughout the course: whole-class, pair, and small group work.

In the present study, the student-teachers resorted to whole-class discussions either at the beginning of the lesson (during the warm-up activity) or at the end of the tasks. To illustrate, the warm-up activities designed by the student-teachers generally involved answering questions on a specific topic or brainstorming ideas based on visual aids. Thus, the student-teachers asked the questions or showed the pictures to the students and then led a whole-class discussion by having volunteers share their contributions. Additionally, whole-class work was the grouping of choice to check answers during the different pre-tasks, tasks, and post-tasks with the aim of saving time and allowing all the students to participate freely. The main drawback of this grouping technique was that the shier students sometimes refrained from

contributing to the discussion, thus limiting participation to fewer students, and making it necessary for the student-teachers to invite the non-volunteers to participate by calling them by their name. Overall, however, the strategic use of whole-class work for specific activities proved helpful to have learners brainstorm ideas and share their views, while it also allowed the student-teachers to save time for the pre-tasks and the main tasks, which demanded more time and effort.

At other points in the lesson, pair and small group work predominated in this English course, with the student-teachers relying heavily on small group work (three or four people) in the majority of the lessons to facilitate interaction and learning and to have better control of the time and the group dynamics. For example, Unit 2 required the learners to work in pairs to plan and present a role-play as the main task of the learning cycle. Specifically, in Lesson 1, the students learned how to make small talk with a stranger at an international conference on Electrical Engineering. They first worked in groups of three or four to complete three pre-tasks, but then they worked in pairs for the main task to plan a role-play in which they pretended to be conference attendees networking at an event. In the case of Lesson 2, the students had to work in groups of two or three to learn relevant vocabulary. Later, they were asked to role-play a job interview in pairs to achieve the main objective of the lesson. In Lesson 3, the students were required to simulate a telephone call between an electrical engineer and an engineering consultant scheduling a worksite visit. While the learners had the chance to work in groups during the pre-tasks to become familiar with the language used in these contexts, they were eventually able to plan and present the situation in front of the class while working in pairs. Finally, the assessment for Unit 2 consisted of role-playing one of the situations practiced in the previous lessons, which also required group and pair work as part of the planning and rehearsal stages. It is also worth mentioning that, based on the student-teachers' observations, working in

pairs and small groups seemed to be particularly beneficial for more introverted students, who were afraid of public speaking in the first classes but then showed a significant improvement in subsequent lessons and evaluations. For instance, the shier learners, who showed difficulties in terms of grammar, pronunciation, and fluency during the needs analysis stage and the first two lessons, started to play a more active role and take the initiative in group discussions through the learning cycles, where they evinced a significant improvement of the above-mentioned issues. Thus, the researchers can conclude that these grouping techniques helped the learners build self-confidence and eventually improve their speaking skills.

Based on this, the results obtained from the ESP practicum experience indicate that the use of different grouping techniques seems to have been effective. The student-teachers aimed at promoting a safe learning environment for the learners to contribute during whole-class discussions in specific situations such as warm-ups, which primarily involved answering questions or reacting to pictures, and at the end of the tasks, which allowed checking the students' responses to certain exercises after reaching a consensus in their respective groups. Likewise, from the student-teachers' perspectives after analyzing the evidence, pair and small group work seems to have been useful to give all the students opportunity to talk in their groups and practice real-life situations while discussing and solving problems together. The researchers believe that having the opportunity to interact with different classmates in every class also allowed the shier learners to lower their anxiety levels and gradually overcome their fear of public speaking, leading to a considerable perceived improvement of their oral communication skills.

At the same time that they prove beneficial in many ways, the grouping techniques described above may pose certain challenges for teachers. For example, the use of whole-class discussions may occasionally leave lower-performing students out of the discussion, especially

during the initial stages of the course, as they may not feel confident to speak yet. In the same vein, the higher-performing students may be able to make more contributions and dominate the conversation, hence intimidating the lower-performing ones. In addition, pair and small group work are not exempted from monopolized participation. The student-teachers were able to observe some group interactions in which one or two of the students in the group played a relatively passive role, which was one of the limitations pointed out by Ur (2016) earlier in this paper. In general, however, the different grouping techniques planned served their purpose during the stages of the lesson, with pair and small group work being the most frequently used techniques and the ones that obtained the most positive results throughout this ESP course. Then, it can be concluded that, whole-class, pair, and small group work techniques seem to be highly effective in online ESP courses for intermediate learners; however, future research should further investigate strategies to encourage active participation from all group members at all times.

Error Correction Versus Corrective Feedback

Error correction or corrective feedback is a way to have learners notice incorrect structures and develop linguistic competence. To this end, the student-teachers involved in this research put into practice a series of scholar-recommended strategies identified in the literature review (Gerlach 1994; Scrivener 2012; Ur, 2016). For instance, the student-teachers corrected most of the learners' errors immediately, especially if these errors were repetitive or stigmatizing, or if they interfered with communication. In order not to interrupt or distract the learners, as recommended by the authors, the student-teachers tried to point out the errors and give feedback in a way that did not disturb the flow of communication, for example, by waiting until the learners finished their sentences to provide the correction. Another reason for providing

immediate corrective feedback was to give it in context with the aim of making it meaningful for the learners.

Different types of feedback such as explicit correction, prompts, and recasts were employed to help the learners modify their output. In some cases, when the learners' errors were more complex (e.g., verb tenses, subject-verb agreement, and question-formation errors, among others), the student-teachers chose to provide explicit error correction to make sure that the learners understood what they said incorrectly and how to repair. This type of feedback seems to have been particularly effective to correct vocabulary errors since the student-teacher could supply a more appropriate word based on the context and explain why one word was more suitable than the other. Generally, the learners attended to the explicit corrective moves provided by the student-teachers. However, they did not necessarily modify their output in all cases. As observed by the student-teachers, the students were very interested in learning new vocabulary, especially technical language related to their field, and they used the language acquired in subsequent lessons during group discussions and presentations, but certain grammar mistakes made by the students, such as the omission of the subject in a sentence or the incorrect conjugation of the simple present third-person singular, the simple past, and the present perfect tense, were very repetitive and difficult to tackle throughout the course in spite of explicit correction, as they seemed to have fossilized in some of the students. In the case of prompts, primarily in the form of elicitation, metalinguistic clues, and repetition, they were used by the student-teachers to have the learners notice grammar errors, whereas recasts were generally used to correct errors in pronunciation through implicit reformulation of the learners' ill-formed utterances. From the student-teachers' perspective, the learners also seemed very receptive to these types of feedback. The student-teachers frequently spotted grammar errors and corrected them through the use of different types of prompts and, in many cases, the learners

were able to notice these inaccuracies and attempted to repair them immediately. As for recasts, when the learners mispronounced a word and the student-teachers provided the correct pronunciation, it was usually clear for the learners that they were being corrected and often attempted to repair by pronouncing the word once or twice to make sure that they did it correctly. An example of this was observed in Unit 2, Lesson 4, when the lead student-teacher asked one of the students to help her read an email aloud (Handout 4), and he mispronounced the words “schedule” and “infrastructure.” The student-teacher waited for the student to finish reading the email, provided the correct pronunciation of the words and then asked him to self-repair a couple of times. The student did repeat the word several times until he was able to say it correctly. The effectiveness of this corrective move can be attributed to the relative saliency with which it is delivered (Lyster & Saito, 2010a) and also to the learners’ motivation to learn the correct pronunciation of unknown words. It was noticeable how several students, who were struggling with pronunciation during the first two lessons, started to modify their output and improve their speaking skills after the third class. The outcomes observed in the present study suggest that the provision of corrective feedback allowed for students to make progress in terms of vocabulary, grammar, and pronunciation throughout the lessons. This seems to have led to a significant improvement in terms of fluency since the students started to feel more confident to speak and showcase what they had learned. These results are consistent with the study conducted by Lyster and Saito (2010a) as well as the one conducted by Mitchell and Myles (2004) because these evince the effectiveness of using explicit correction and prompts to correct grammar errors and recasts to correct pronunciation issues. Therefore, the use of prompts in combination with recasts seemed to be highly effective to enhance the learners’ speaking skills.

In cases where feedback was considered disruptive, the student-teachers would write down a list of frequent errors so that they could be reviewed at the end of the activity or the class. Due to time constraints, it was not always possible to review the feedback at the end of the lesson. Consequently, the student-teachers shared PowerPoint slideshows called “English Tips” with the students via Google Classroom, including feedback on the learners’ grammar, pronunciation, and vocabulary errors. As an example, the student-teachers prepared a slideshow with grammar corrections such as “Did you find the word?” instead of “Do you found the word?”, or “I am interested in (something)” instead of “I have interest on (something).” Error correction on pronunciation was intended to help the learners with troublesome words such as “circuit,” “control,” “equipment,” “machine,” “photovoltaic,” and “schedule,” among others. Certain speech sounds, such as /ð/, /θ/, /f/, /ʒ/, /tʃ/, and /dʒ/, were particularly challenging for the group of Electrical Engineering students. Feedback on the correct pronunciation of the “ed” endings in words such as “focused,” “graduated,” and “skipped” was also provided by the student-teachers. To make this feedback comprehensible for the learners, the student-teachers hyperlinked the words in the slides to online dictionaries where the learners could play the correct pronunciation of the words and repeat or record themselves after listening. In addition, the student-teachers provided feedback on the correct use of vocabulary; for instance, they clarified the difference between “engineer” and “engineering,” “major” and “career,” “safety” and “security,” “job” and “work,” “make” and “do,” “university” and “college,” and “good evening” and “good night.” Thus, delayed feedback also played an important role in this course so that the learners could reflect on their errors and improve week over week.

As a result of the different error correction practices implemented throughout the course, the student-teachers observed a significant improvement in the learners’ oral production when

comparing the first and the last lesson. This suggests that corrective feedback, either immediate or delayed, does have a positive impact on the development of the learners' speaking skills.

Online Language Teaching

Teaching English in an online environment was perceived as a challenging yet rewarding experience for the student-teachers. It is true that online language teaching is much more time-consuming than regular face-to-face lessons and requires more preparation on the part of the instructor; however, the student-teachers explored a wide variety of strategies and technological tools to create more opportunities for the learners to talk, analyze, report, and socialize, as suggested in the literature review, and to make the lessons more engaging through video conferencing tools, videos, multimedia games, online dictionaries, forums, and repositories, among others.

Web-conferencing tools offer unique features that help to foster the students' speaking skills in oral synchronous lessons. In this particular context, the student-teachers took advantage of the breakout rooms function of the Zoom platform to split the class into smaller groups. Using this function appeared to be even more effective than creating groups in a face-to-face environment because the system would automatically assign the learners to the groups at random if the student-teachers chose that option. In general, this option saves time both for the teachers and the learners. For example, traditional face-to-face grouping strategies, such as dividing the class into groups by numbering all the students according to the desired number of groups and then asking all of the ones, twos, threes, and so on to get together may demand more time that could otherwise be used to give instructions or answer any questions that the learners may have before assigning them to their respective groups. Based on the practicum experience, the breakout-room feature also prevents distractions that often take place in an actual face-to-face classroom; that is, the students can talk without being exposed to the

classroom noise and interruptions. The only drawback of this online feature is that, depending on the size of the group, it may be more difficult for teachers to ensure equal participation and interaction among the learners in their groups since teachers do not have a way to know what is happening in the other rooms while they are visiting one group. To cope with this, teachers need to be mindful of time in order to be able to visit each group at least twice during the time assigned for each task. In this way, teachers can engage students in meaningful discussion by making sure that they understood the activity, providing extra information or explanations related to the content and the language required to complete the task, and asking follow-up questions to elicit participation when necessary. In addition, the video and audio capabilities available in Zoom allow for an experience close to face-to-face communication where meaningful learning can take place as long as their use is constantly encouraged by the teacher, and the students' devices work properly to be able to use them. Moreover, the screensharing option enables both the teachers and the students to view and interact with the class materials such as handouts, slide shows, videos, and collaborative games and tools, just to mention a few examples. The easiness and immediacy associated with this feature, which is available in most web-conferencing tools, make the screensharing option and online teaching modality in general a very practical and attractive tool for students and teachers. Finally, it is worth noting that the video recordings of the virtual sessions are very convenient particularly for teachers to collect evidence on the learners' strengths and weaknesses and to design appropriate tasks to address any recurring issues in the subsequent lessons. Considering the aspects discussed above, it can be said that the functionalities of web-conferencing tools such as Zoom favor the conditions for students to have spontaneous discussions and dialogue where they can improve their speaking skills in a practical and distraction-free environment.

To integrate technology into the virtual environment, the student-teachers used different online platforms such as Google Classroom, Google Drive, Google Forms, Jamboard, Wordwall, VisualCV, Educaplay, VoiceThread, Padlet, and YouTube. These platforms were useful to engage the learners and promote interaction among them during the synchronous and asynchronous sessions. Google Classroom was a useful medium to upload the classroom materials as well as the feedback collected from the virtual sessions every week. Then, Jamboard, which is a collaborative whiteboard, allowed the learners to interact by discussing two questions in groups as part of the warm-up for Unit 2, Lesson 3. The students were assigned to breakout rooms in groups of three or four and were asked to write some ideas on the Jamboard slide to use it as visual support when discussing the questions as a whole group. In the case of online tools for game-based learning, Wordwall and Educaplay are fun and user-friendly platforms that require a lot of interaction between learners to negotiate meaning and reach a consensus, and these characteristics made them particularly suitable to help the Electrical Engineering students practice and enhance their oral communicative skills. The student-teachers also created a WhatsApp chat room to send important communication or reminders to the students. As for online English dictionaries, the main options were Cambridge Dictionary, Merriam-Webster, WordReference, Collins Online Dictionary, Oxford Dictionary, and TheFreeDictionary.com. These were shared with the students at the beginning of the course, and the student-teachers emphasized the importance of checking the dictionary whenever the students were in doubt. The group of Electrical Engineering students found this recommendation particularly helpful to check the pronunciation of unknown words prior to their oral presentations. In addition, to help the students become acquainted with the online dictionaries and make it easier for them, the student-teachers hyperlinked the words in the language pills, that is, the feedback on pronunciation provided after each class, and the link

would redirect them to the dictionary where they could listen to the correct pronunciation. Third, the student-teachers aimed to make their digital handouts and slideshows appealing by using Unsplash, Slidesgo, Canva, and Flaticon and by converting them to PDF format, which the learners were able to edit easily as evidenced in the video recordings of the lessons. Since all these language learning materials were meant to be an opportunity to foster motivation and interaction, it was vital to make sure that they were as learner-friendly and enjoyable as possible.

In the student-teachers' experience during the ESP course, the use of these e-learning components facilitated communication between the learners and the student-teachers and, although the lessons took place in an online environment, the same level of interaction was required from the participants as in on-site classes. That is, the learners still needed to collaborate with their peers, and this required interaction and negotiation of meaning to complete the tasks in place. From the student-teachers' perspective, integrating technology into the classroom was decisive not only due to the learners' age (a generation that commonly uses mobile phones, computers, and social networks) but also due to the technical nature of the course (Electrical Engineering) for which technological tools are essential and used on a daily basis. As a consequence, the student-teachers used several online learning tools to make the lessons more attractive and motivating for the learners. According to the observations, the implementation of technology in online language teaching was perceived to have a positive impact on the learners' speaking performance.

Impact of the Selected Teaching Practices on the Students' Speaking Skills as Perceived by the Supervisors

The supervisors' perceptions of the impact of the selected teaching practices on the students' speaking skills were mainly obtained from the video recordings of the feedback

sessions conducted with the student-teachers after each class and from the Student Teacher Observation forms. Three supervisors from the Master's Program in Teaching English as a Foreign Language of the University of Costa Rica participated in the observations, and the aspects assessed covered lesson planning, materials, language use, personal characteristics of the instructor, teaching strategies, and class management, among others. For data analysis, the researchers used a qualitative approach, which entailed watching the videos of the feedback sessions and reviewing the data in the observation forms, mostly looking for key specific comments and for broader patterns, ideas, and trends in their perceptions. The information was refined through coding and categorization for each course unit and for each teaching practice referred to in this study. The comments made by the three supervisors were also compared to find similarities or contradictions. Finally, the researchers reflected on the strengths and weaknesses highlighted by the supervisors, developed explanations, and reported the outcomes for each teaching practice and their impact on the students' speaking skills.

Speaking Activities for Intermediate Learners

Based on the feedback from class observations, the supervisors perceived that the selected teaching practices had a favorable impact on the students' speaking skills. In regard to the variety of speaking activities used in class, the supervisors highlighted that the students were always on task, worked hard to complete the tasks successfully, looked motivated, and responded to questions or requests for participation with interest and positive contributions. These aspects were noticeable in Unit 1, Lesson 2, as the supervisor observed that "the students clearly enjoyed the different tasks and were motivated to complete them and to interact with other classmates" and that "they felt free to ask questions and provide information when asked." In the same vein, from the feedback provided by the supervisor on Unit 2, Lesson 4, one of the comments included: "very effective, well-designed pre-tasks for preparing the

students for the oral exam; they were engaging and generated rich interaction, production as well as good questions that helped the students focus on form on many occasions.” The supervisor also noted that there was a “very professional choice of materials with clear ESP focus and high interest for the students.” Following the same line, the feedback also highlighted the improvements achieved by the students at the end of the course, as demonstrated in the oral presentations on technical topics relevant to the Electrical Engineering field. In Unit 3, Lesson 3, one of the supervisors stated the following: “The students’ performance reflected how much they have benefited from the ESP course at this point.” The supervisor added that “the amount of professional language that they were able to produce and the image they projected in their presentations show that they are much farther along in their language use than at the beginning.” This view was also shared by the supervisor who observed Unit 3, Lesson 4, whose feedback included the following comment: “Students’ production has improved a lot!”. In addition, the supervisors referred to the key role played by visual materials for the different speaking activities, indicating not only that they achieved a consistent graphic identity that smoothly integrated useful information and tips, but also that they looked professional, were relevant for the population, and had a clear ESP focus. Therefore, the supervisors’ response towards the role-plays, oral presentations, and picture-cued activities used in class seems to reinforce the appropriateness of these activities for the purposes of the online task-based ESP course and for the proficiency level of the target population.

Suggestions given by the supervisors in relation to speaking activities in general were mainly related to the following: taking advantage of every opportunity to make the students speak, for instance, by encouraging the small groups to read aloud and to continue practicing pronunciation or intonation in case of finishing an exercise before the rest of classmates; making small talk with students present in the main room as the others returned from the group

activities in the breakout rooms; and managing the number of instructions and task complexity at all stages to reduce activities to the essential steps and to properly manage class time. The student-teachers put these recommendations into practice; however, time management was the most difficult to achieve considering the total number of students in the class, the high level of participation from the students, the increased content complexity required for every lesson, the number of activities required to complete the task cycle, and the time challenges imposed by the online teaching environment. Because of this, synchronous sessions, scheduled from 5:00 pm to 7:00 pm, required approximately from 15 to 45 additional minutes, forcing the student-teachers to use time that was originally intended for the asynchronous activities to be performed by the students from 7:00 pm to 8:00 pm.

Although the final accomplishments and levels of satisfaction outweighed the time management issues experienced by the student-teachers in most lessons related to speaking activities, this is a key area of improvement for future teaching experiences. Based on the supervisor's recommendations and the student-teachers' own analysis, possible time-management solutions include simplifying instructions or steps for the students as much as possible (e.g., providing the direct links to handouts or online resources through the chat instead of asking the students to search for them in additional web sites or search engines), testing the correct operation of online tools before the class to avoid unexpected technical issues, reading only the most relevant useful expressions required for the tasks when checking this information as a whole group, and promoting group activities at all times. Furthermore, in terms of task design, it is recommended that the lessons be planned by working backwards from the end to predict how much time is required for each step of the task cycle and make content choices based on this information. This allows the teacher to first identify the desired learning outcomes and then design the tasks that focus on those outcomes and distribute them along the time

available. The practicum experience also provided insight into the importance of carefully considering the complexity of the tasks, as observed by the supervisors. In order for the learners to be able to complete the task cycle on time, one of the workarounds suggested was to design very short and simple warm-ups and pre-tasks so that the learners could have more time to successfully complete the main task (planning and reporting). Alternatively, the teachers could add more complexity to the pre-tasks so that, when the learners get to the main task, they can be more prepared and only require some time to rehearse before the reporting stage. To achieve this, the teachers must ensure that the students have all the necessary materials and information prior to the main task. Likewise, it is recommended that the teachers look for ways to simplify the main task without altering the objectives of the lesson. These solutions may be implemented as an attempt to avoid activities taking longer than expected and to close the lesson satisfactorily without a sense of being in a rush, thus helping students focus on what they have learned and enjoyed during the speaking class.

Collaborative Learning

The collaborative practices selected by the student-teachers were mostly perceived as positive by the supervisors, who pointed out that the tasks developed in the sessions promoted interaction and important critical-thinking skills for the Electrical Engineering students and future professionals. Based on the feedback provided by the supervisors, an excellent class atmosphere was perceived because the students consistently agreed and disagreed respectfully to reach a consensus while completing the tasks in groups. From the feedback provided by the supervisors on Unit 1, Lesson 3, it was also noted that the lessons were very interactive given that students were always on task and engaged with the variety of activities designed by the student-teachers, which kept the learners speaking English all the time and asking multiple questions. This denotes that the students were truly motivated to learn and to

improve. Furthermore, the supervisors provided positive feedback on the elicitation techniques used by the student-teachers to guide discussions by asking follow-up questions (Unit 2, Lesson 2) and also on the “very effective and friendly techniques” used to get the students involved in the tasks (Unit 2, Lesson 1). Therefore, based on the supervisors’ feedback, it can be concluded that the implementation of the collaborative learning approach helped the student-teachers to create a motivating and safe learning environment for the students to feel comfortable expressing their ideas in English and to eventually improve their speaking proficiency.

Grouping Techniques

Based on the supervisors’ observations, the ESP course was characterized by active student participation and engagement either in whole-class discussions or in small group interactions. In fact, according to the feedback from Unit 1, Lesson 3, the supervisor in charge of the observation stated that there was an “excellent group work throughout the lesson with very active student participation.” Additionally, the student-teachers selected relevant topics and visual support for the population and asked suitable questions for the brainstorming sessions (prediction strategy), which were often completed as a whole class. Likewise, the supervisors reported that the learners were very participative and supportive while completing the pre-tasks and main tasks in the breakout rooms and while working in small groups. For instance, in Unit 2, Lesson 2, one of the supervisors praised the use of group work during pre-task 1: “Group work on jobs they would apply for: excellent job! The students provided their ideas with plenty of good evidence for their choices, complete sentences when needed, clear articulation, and mostly clear pronunciation.” An area of improvement pinpointed by the observers was reducing the cognitive load of instructions in terms of word choice and delivery, even if the proficiency level of the students in a group was relatively high. Provided that the vocabulary and pronunciation of difficult words had been reviewed, the supervisors suggested to have the students read the

instructions to help reduce the cognitive load. The supervisors also suggested to pay closer attention to the students' activity and comments to detect possible needs for assistance, for example, in cases where the students seemed to have trouble understanding the instructions. Additionally, they highlighted the importance of monitoring group work and bringing the students back to the main session if the groups completed the activities relatively quickly, particularly because the students may not interact further after finishing the tasks and, by doing this, the student-teachers may save valuable time for other parts of the lesson. However, as discussed earlier, the students usually needed more than the allotted time to complete certain activities, especially the main task, which required extra time for planning and rehearsing. As observed by the supervisors, despite splitting the students into smaller groups that were easier to manage, the large number of students, the increasing student participation, and the complexity of the tasks, made it difficult for the student-teachers to properly manage time in most lessons. Overall, and in spite of the areas of improvement previously highlighted, the use of pair, small, and whole-class work was largely perceived by the supervisors as appropriate and helpful for the development of the learners' speaking skills.

Error Correction Versus Corrective Feedback

Although the student-teachers aimed to carefully correct most of the students' errors throughout the ESP course, the supervisors identified a lack in teacher-provided error correction, primarily during the first two lessons. Therefore, they shared a series of recommendations that were immediately put into practice by the student-teachers in subsequent classes. As observed by the supervisors, the procedures should include details about when the student-teachers will take notes on salient errors and how these will be dealt with. Moreover, they offered recommendations on what types of student output required feedback and when to provide it. The supervisors also emphasized the importance of anticipating troublesome words

that require teaching prior to the main task. As an example, they advised anticipating what words would be difficult for the learners to pronounce before asking them to read aloud (e.g., bias and reliability). The supervisors advised to pronounce the words clearly, play the pronunciation in an online dictionary for additional input, and ask the whole class and then individual learners to repeat the words or expressions to check that the feedback was clearly perceived. In this sense, the student-teachers implemented these suggestions throughout the course and provided both immediate and delayed feedback to the whole class as much as possible to help the students improve their pronunciation. In Unit 1, Lesson 4, the supervisors observed the following: “Most students’ pronunciation mistakes were carefully corrected (automation / author / used).” Then, in Unit 2 Lesson 1, the supervisor in charge also pointed out that there was a “very effective, conscious correction in most cases.” Moreover, the student-teachers were expected to wrap up the lesson by having the learners pronounce difficult words and by preparing quick slides or handouts to provide feedback on frequent errors identified in class, which would help them sound more natural and professional. The student-teachers started to implement practices with the purpose of improving the students’ pronunciation, such as going over lists of difficult words and having the learners repeat them, showing them how to look up the words in an online dictionary and how to play the pronunciation. Modeling the correct pronunciation and asking the learners to repeat them before assigning them to breakout rooms seems to have been very helpful, as in many cases they were able to pronounce the words in a correct way during the tasks. The students who were not sure about the pronunciation of a word sometimes checked the online dictionary to practice a couple of times before their presentation. However, most of the time they relied on the student-teachers who were moving across the breakout rooms to ask questions related to pronunciation. Thus, it is important to reinforce independent learning so that students get used to looking for answers on

their own instead of relying on the teacher or a more proficient classmate in the group to which they are assigned. Even though the student-teachers were not successful in providing error correction at the initial stages of the course, they were able to improve their practices week over week with the guidance of the supervisors. These recommendations seemed to have positive results for both the student-teachers and the students involved in the present study.

Online Language Teaching

The supervisors who observed the ESP Dynamo course agreed on the overall effectiveness of the online teaching materials used to enhance the learners' speaking skills. Multiple positive comments on the organization, professional presentation, and overall usefulness of the technological tools and materials were provided.

The feedback given to the student-teachers pointed to an excellent use of technological tools and the provision of clear instructions on how to use them. For instance, the supervisors stated that the materials were very appealing and relevant for the target population, and that they contributed to the students' performance. Particularly, they stated that *Jamboard*, a collaborative digital whiteboarding tool, was visually appealing for the learners. The supervisors praised the use of other online tools such as *Wordwall* (matching exercise) and *Educaplay* (memory game) and specified that the activities carried out by the student-teachers were challenging yet enjoyable given that the students looked motivated while playing. From the feedback provided by the supervisors about the use of online tools in Unit 1, Lesson 3, one of the comments was: "What a nice warm up task with a drag and drop activity with an excellent visual! (wordwall.net); very effective way to quickly show the answers." The supervisors also recognized the effective use of the online timer *Time and Date* during the break and different online dictionaries to support pronunciation practice and error correction.

The supervisors also described the student-teachers' reaction to technical difficulties as timely and with a professional attitude in spite of hurdles. The limitations identified in this online English course were primarily related to the wait time at the beginning of the class for the learners to access the materials since it usually took them five to ten minutes to download the handouts and have them ready for use. Unfortunately, this behavior often consumed valuable time that could have been used in other parts of the lesson. To prevent this from happening and to save time, the supervisors advised the student-teachers to add systematic reminders at the beginning of the lesson for the learners to access the materials in Google Classroom and have them ready in advance. The student-teachers also provided the direct links to online tools through the class chat to avoid searching for those web sites. An additional limitation was that, on various occasions, the students did not show an appropriate posture or did not make eye contact when talking on camera. As a possible solution, the supervisors suggested to teach the learners how to effectively position their cameras with the purpose of improving their body language and eye contact during the role-plays and in real-life in case of an eventual job interview or meeting. These suggestions should be considered and anticipated in a virtual environment to take advantage of the time and resources available to foster the learners' skills.

In conclusion, based on the supervisors' comments, the technological tools and materials used in the classroom were visually appealing and engaging and were also perceived to have an appropriate difficulty level for the target population. Although the student-teachers sometimes faced a few technical issues and limitations, it was possible to learn from these experiences and take appropriate actions. Then, it is noteworthy that the supervisors' feedback pointed to the effectiveness of the selected online teaching practices and resources to improve the students' speaking skills.

Students' Perceptions about the Usefulness of the Selected Teaching Practices for Improvement of their Speaking Skills

The students' perceptions about the usefulness of the selected teaching practices for improvement of their speaking skills were collected from the online course evaluation surveys that the students had to complete after each unit. These surveys were administered via Google Forms, and each consisted of three sections. The first part used closed-ended questions in a Likert scale to assess the students' level of agreement with aspects such as course organization, methodology, usefulness of materials and tasks, level of difficulty, and the learners' overall satisfaction. The second part included closed-ended questions in a Likert scale to rate different learning preferences based on their level of usefulness. The third part, a set of open-ended questions, allowed the students to further elaborate their opinions on the positive aspects of the course, the areas of improvement and recommendations, and any other comments based on their experience. The student-teachers used a qualitative approach to analyze the information gathered from these surveys. For the close-ended questions, the researchers identified major trends based on the levels of agreement and satisfaction indicated by the students in both Likert scales. Furthermore, the information from the open-ended questions was subjected to a qualitative categorization or coding analysis that required scanning the students' responses several times to find prominent instances, repetitive ideas, or patterns that could help to throw light on the students' perceptions. To do this, the researchers used different colors to highlight key comments and linked them to emerging strengths of each teaching practice or to any noticeable areas of improvement. The comments from the open-ended questions were also triangulated with the results from the closed-ended questions to strengthen the findings. These practical steps to analyze data qualitatively allowed the researchers to provide a meaningful account of the students' general perceptions.

Speaking Activities for Intermediate Learners

The results of the course evaluation forms at the end of each unit provided insightful information about the students' perceptions of the selected teaching practices. With regard to the speaking activities developed over the course, it is possible to identify a high level of student satisfaction. For example, from a list of twelve statements to evaluate aspects such as objectives, organization, activities, materials, contents, and workload, among others, the highest levels of agreement reported by most participants corresponded to the variety of activities developed in class to encourage participation. They also highlighted the use of appealing and appropriate course materials; the usefulness and relevance of the contents for academic and professional development; the opportunity given by the units to improve their language; and the development of critical, diverse, and innovative thinking. In addition, when asked about the level of usefulness of a series of class techniques based on their learning preferences, conversations with classmates, oral presentations, group or pair work, and the use of visual aids and multimedia occupied the highest-ranking positions. These findings evince a close relationship with their reported interest in activities that encourage participation, and they also support the student-teachers' decision of selecting role-plays, oral presentations, and picture-cued activities as key teaching practices for the ESP course.

Furthermore, with regard to the aspects that the students found the most worthwhile in the units dedicated to speaking, the majority highlighted the value of conversations and role-plays in Unit 2 as an opportunity to face real-life scenarios for their future professional life, with more than half indicating that the job interview was one of the most valuable topics for them. Some of the students' comments about the most worthwhile aspects referred to "the strategies for a job interview, the CV, the technical vocabulary, the presentations and conversations with classmates"; "the exercises on how to initiate and sustain a conversation at a conference"; and

“the tips to set a meeting with other professionals in the area.” The students also acknowledged the importance of adequate preparation for the main tasks, the useful vocabulary and expressions to start a conversation and to keep it going, and all the different dynamics and strategies that were developed in groups to improve their language skills. In the case of Unit 3, oral presentations also led to a favorable impression on the students’ part, who emphasized how this speaking activity is significantly relevant for the field of Electrical Engineering. In fact, the oral descriptions about the power generation systems and the business ideas were reported as highly rewarding activities for them.

Although the students’ perception shows a high degree of satisfaction and motivation with the speaking activities, the learners also provided important feedback and suggestions that can be taken into account for future ESP experiences. For instance, the students said that speaking activities should provide a relaxed and fun environment to practice but, at the same time, they should be dynamic, challenging, and specifically related to their technical field. Moreover, teachers should prioritize class discussions, conversations, role-plays, oral presentations, and any other group activities since they force the students to improvise and to think in English, help them to lose their fear of public speaking, and give them an opportunity to share knowledge and help each other through more interaction. Finally, the students also suggested that sufficient time should be allowed to design, practice, and deliver their role-plays and oral presentations in class. Being aware of all these recommendations directly from the students is important to create more engaging and effective learning scenarios for oral production.

After exploring the students’ perceptions about the usefulness of the selected activities for improvement of their speaking skills, the collected data showed favorable results consistent with the opinions shared by the student-teachers and the supervisors. Therefore, it is possible to

infer that the impact of the selected activities for the intermediate Electrical Engineering students met the language needs and course expectations.

Collaborative Learning

Collaborative learning played an important role in this course as perceived by the students. According to the course evaluation results, the majority of the learners agreed with the statement that the three units promoted critical, diverse, and innovative thinking. One of the students' responses in the course evaluation for Unit 3 was: "The fact that we needed to start from zero on every presentation gave us the opportunity to develop critical thinking." This indicates that the student-teachers' goal of implementing activities that fostered critical-thinking and problem-solving skills was achieved. The learners did not perceive the course as threatening or stressful in any way and rather pointed out that it offered them a relaxed learning environment to put their skills into practice. As for the type of activities that can be associated with collaborative learning, most students reported that they enjoyed designing and presenting a business idea in groups, which they considered especially valuable and relevant for the engineering field. Nevertheless, two students pointed out that it was necessary to allow more time to prepare their business ideas. Lastly, the participants stated that it was essential to continue encouraging participation in class so that the students could lose their fear of public speaking. Thus, it is clear from the responses that the students supported the effectiveness of the collaborative learning strategies used by the student-teachers throughout the English course, and that they appreciated the student-teachers' efforts to create a friendly and safe learning environment for them to speak. They also seemed extremely motivated by the level of interaction and participation that the student-teachers stimulated. All these responses suggest that this approach had positive repercussions for the learners' ability to improve their speaking skills.

Grouping Techniques

Concerning the grouping techniques, the feedback gathered from the course evaluation indicated that the majority of the students preferred group or pair work over individual work. Particularly, the students mentioned that the group activities where they had conversations or created presentations with their classmates were very helpful. One student noted the importance of working in groups by saying that group activity was the most valuable dynamic in the course because the students could help each other. Additionally, in the course evaluation corresponding to Unit 1, another student pointed out that the aspects that he found the most worthwhile were the exercises where they had to discuss in pairs or groups. For that reason, it can be said that the learners perceived the grouping techniques used in the course as very appropriate to promote learning and improve their communicative skills.

Error Correction Versus Corrective Feedback

In terms of error correction or corrective feedback, the majority of the students expressed their preference for immediate corrective feedback; however, a considerable number of students also agreed with the practice of receiving delayed feedback individually or corrections made as a group. When asked what aspects of the course they found the least worthwhile, one participant indicated that the lack of immediate feedback, especially in the case of oral presentations, was a limitation due to time constraints. Additionally, most of the students indicated that the language tips posted in Google Classroom were of great help to improve their speaking skills. In general terms, the students showed a positive attitude towards corrective feedback during the sessions. Their improvement was noticeable over time as they significantly expanded their linguistic repertoire with new vocabulary and phrases of common use in academic and work-related environments.

Online Language Teaching

As for the overall effectiveness of the online language teaching strategies and practices implemented by the student-teachers, most students found that multimedia exercises (audios, videos, and games) and the use of visual aids (diagrams, graphs, and images) were useful for them. To illustrate, the students particularly appreciated the use of the video about tips on how to network at a conference as well as the one on how to prepare for a job interview. Likewise, the learners found the diagrams about the power generation process very appealing and practical for their professional field, especially because many of them were not familiar with the technical terms in English. In addition, based on the learners' reactions towards the online games used in class, it can be said that they truly enjoyed these activities. The level of interaction required from the students to play collaborative games online was very high given that it was necessary for them to discuss their views before selecting the answers, which motivated them to continue learning and improving their speaking skills.

Although the learners' responses to the online environment were mostly positive, the student-teachers encountered several challenges that led to time management issues. As an example, in Unit 2, Lesson 3, the student-teachers used Google Jamboard, which is a collaborative online board, with the purpose of having the learners brainstorm answers to a couple of questions as a warm-up activity. Nevertheless, the student-teachers failed to allow other users to collaborate in the platform before assigning the students into breakout rooms. When the learners arrived at their groups and realized that they did not have permission to edit the slides, they did not know how to proceed and started to make small talk about topics not necessarily related to the lesson, which caused an important delay until the lead teacher was able to visit every group to announce that the students had already been allowed to edit and write their answers in Jamboard. Another limitation occurred in Unit 2, Lesson 4, where the

student-teachers asked the learners to access a Google Sheets file and brainstorm ideas in groups. The purpose of the game was that the students could brainstorm as much information as possible related to the previous three lessons in order to prepare for the test, but unfortunately the outcome was unexpected. The learners were not able to add their answers to the sheet due to the properties of the platform, as the text was deleted when new text was typed in a cell unless there was a double click to activate editing. Due to the overall complexity of the platform, this exercise took longer than expected, which reduced the time for the learners to complete the pre-tasks and the test. In this regard, several students referred to the length of the online synchronous sessions and the student-teachers' time management as aspects that needed improvement in the course evaluations. Therefore, the student-teachers recommend to test the platforms that are to be used for the first time about two or three times before the actual class to make sure that they work properly or are suitable for the activity and to avoid these types of difficulties.

Conclusions

The needs analysis of the present study revealed that speaking was a top-priority macro skill for the academic and professional field of Electrical Engineering with a prominent position as a language need for multiple academic and job-related scenarios. At the same time, speaking was identified as the skill that most students and professionals in this field struggled with. Therefore, the aim of this research was to identify and describe what teaching practices can help to improve the speaking skills of intermediate Electrical Engineering students at the University of Costa Rica in an online task-based ESP course. In the quest for solving this major pedagogical inquiry, the researchers consulted a number of studies as part of the literature review. The contributions made by the authors were subdivided into five main teaching practices: speaking activities, collaborative learning, grouping techniques, corrective feedback

or error correction, and online language teaching. The theoretical and conceptual findings from the literature resulted in an analytical and pedagogical framework that led to an evidence-supported reflection on the ESP practicum experience. Through this reflection, the researchers sought to assess the impact of the selected teaching practices on the students' speaking skills from the perspective of the student-teachers, the course supervisors, and the participating Electrical Engineering students.

As for the first teaching practice, the results of this study seem to confirm that speaking activities such as role-plays, oral presentations, and picture-cued exercises are essential for intermediate learners and can be successfully adapted to an online task-based ESP context. These speaking activities can promote meaning negotiation, transactional and interpersonal speech, and personalized content, which are key cornerstones for teaching speaking at an intermediate level. By implementing these activities in a way that demands higher levels of performance, the students can be taken beyond simple responsive practices towards a more complex, challenging, and creative approach, exposing them to conditions similar to those found in real-life scenarios, but still in a safe environment with the support of teachers and peers. In addition, to achieve a successful use of these speaking activities in an online task-based ESP context, the results of the practicum experience seem to confirm that teachers can implement pedagogical strategies such as the following: motivating students to turn on their cameras to pay attention to the extralinguistic component of interactions, making students aware of cultural aspects about how to act in different face-to-face and online scenarios, teaching useful vocabulary and expressions as preparation for the speaking tasks developed in class, providing learners with sufficient rehearsal time, setting more complex and challenging tasks in every lesson to have the students recycle the knowledge acquired in previous classes and elicit unpredictable speech, exposing students to as many scenarios as possible related to their

academic and professional field, and contextualizing the activities to the society or real life of the participants to make language classes more relevant. To develop speaking activities, teachers can also take advantage of visual aids to generate ideas and critical-thinking skills, illustrate technical topics, and practice content organization. To sum up, based on the literature and the practicum experience, role-plays, oral presentations, and picture-cued activities can open a window of favorable opportunities to improve the students' oral performance and to increase their motivation and confidence.

This research study also shows that using collaborative learning in combination with the task-based approach to improve the learners' speaking skills can yield positive results. As discussed in the literature review, this instructional approach is rooted in constructivism, which sees learning as a social process that entails working in small groups in an attempt to reach a consensus and create knowledge. Allowing the learners to construct knowledge together (in groups of two or three) by solving complex tasks where critical-thinking skills are required can make their learning experience more meaningful and enjoyable. The sense of unity, as well as the low anxiety levels associated with this approach, makes collaborative learning particularly suitable for learners who need to build self-confidence since it requires higher levels of interaction among peers, leading to improved speaking and social skills. While collaborative learning is considered a learner-centered approach, the role of the teacher is crucial to help learners enhance their skills. The teacher is not only the content expert but also a learning facilitator and observer. Moreover, previous research has identified a strong correlation between the implementation of the collaborative learning approach and the improvement in the participants' oral skills. The results of previous studies in this field are consistent with the findings of the practicum experience. Having the Electrical Engineering students work collaboratively in pairs or small groups seems to have yielded positive results since the students

had plenty of opportunities to exchange ideas and learn from each other while solving complex tasks. The students' positive attitude towards group collaboration eventually allowed them to speak English with more confidence and helped many of them to overcome their fear of public speaking. Lastly, the role of the student-teachers was key to ensure the successful implementation of the collaborative learning approach. Therefore, both the existing literature and the results of the practicum lead to the conclusion that the use of collaborative learning in an online task-based ESP course can be beneficial for learners to improve their speaking skills in a friendly and supportive environment with the help of their peers and teachers.

In terms of grouping techniques, the study found that whole-class, pair, and small group work were indeed effective for speaking lessons as proposed by related literature. In the case of whole-class work, the findings of the literature review indicate that teachers are responsible for creating a safe learning environment where students have reasons to speak. To achieve this, teachers can generate discussion by asking questions and showing pictures that inspire learners to communicate their ideas orally. In the practicum experience, this technique was especially useful during warm-ups to activate the learners' schemata and at the end of the tasks to check their understanding. As for small group work, previous studies recommend using this technique to encourage shier learners to brainstorm ideas and contribute to the group discussions. In this sense, the practicum revealed that having the students work in groups of two or three was favorable to enhance their speaking skills. For example, small groups proved very useful for tasks where the students were required to design a business idea or create a product to solve a problem in the field of Electrical Engineering. In addition, working in smaller groups did allow the learners to interact with their classmates in a more relaxed environment than in a whole-class discussion. Previous studies also indicate that pair work is an appropriate technique as it ensures that both students contribute equally. In the present study, this

technique was indeed beneficial for role-plays because the learners could rehearse and pretend that they were having a conversation in a real-life context, namely a small-talk conversation at a conference, a job interview, and a telephone call. Thus, in the ESP practicum for Electrical Engineering students, whole-class, pair, and group work proved useful to encourage the learners' participation and led to a significant improvement in their communication skills by the end of the course, pointing to their successful implementation.

The overall effectiveness of error correction or corrective feedback as a teaching practice can also be confirmed based on the results of this study. According to existing literature, corrective feedback may be immediate or delayed depending on the situation, but it should always be provided at some point during the class. A number of authors recommend providing feedback on learners' errors in context and not in isolation; nevertheless, it should be delayed in cases where the teacher's intervention may inhibit the learners' ability to express their ideas. Previous studies also show that it is necessary to correct learners' language errors when these cause a breakdown in communication, as well as when they are frequent or stigmatizing or correspond to the pedagogical focus of the class in which they occur. Additionally, the implementation of prompts in combination with recasts rather than no feedback at all has been supported widely in the literature. This teaching practice was fundamental during the ESP practicum to help the learners achieve their learning goals and, either immediate or delayed, corrective feedback was consistently provided at different points of the lessons. Although the learners did not always modify their output, there was a significant improvement in their speaking skills by the end of the practicum if compared with the initial stages of the course. Additionally, the findings of this research seem to confirm the effectiveness of implementing a combination of explicit error correction, prompts, and recasts rather than no oral corrective feedback at all. The results suggest that the use of explicit error correction was indeed helpful to

have the learners notice and correct grammar, vocabulary, and pronunciation errors due to its level of explicitness. Even though recasts are less explicit, they served the purpose of correcting the learners' pronunciation mistakes, and learner uptake took place in most cases. Finally, since prompts involve a series of strategies to help learners notice their inaccuracies and push them to self-correction, the student-teachers were able to observe overall positive results in using elicitation, metalinguistic clues, and repetition to correct grammar mistakes. In sum, this study suggests that providing error correction or corrective feedback in an online ESP course can favor the learners' development of speaking skills, given that it provides relevant information about non-target-like structures and how to correct them.

The evidence from this study also suggests that online language teaching is not only a condition in which an ESP course may take place, but also an effective medium for learning and enhancing speaking skills nowadays. It is noteworthy that teachers require a skillset to be able to adapt traditional classroom materials and activities to the virtual environment. This does not mean that only technology proficient teachers can teach online. Although the use of technology in the online classroom may seem overly complicated, the recommendation is to investigate about the best current practices that can help learners improve their performance in virtual environments. Some scholars emphasize the design of meaningful tasks that students can relate to, such as activities or situations that they may face in an academic or work-related context. Encouraging learners to think creatively and solve problems will keep them motivated and eager to learn more. The literature also indicates that integrating technology into the TBLT classroom can foster meaning negotiation through casual conversations while either playing or completing a task, contributing to the learners' continuous improvement of their speaking skills. To achieve this, it is key to design technology-mediated tasks that motivate learners to take risks and be creative. Likewise, offering a safe learning environment where the learners feel

valued and part of a learning community allows for successful development of the learners' speaking skills in virtual settings. Drawing on the results of the study, it can be concluded that most activities or situations that the students may face in an academic or work-related context such as conferences, job interviews, or telephone calls can be easily adapted to the online environment and can generate favorable results in terms of language improvement. In the same vein, encouraging the learners to think creatively and to solve problems generally kept them motivated and eager to learn despite not actually being together at the same location. As stated above, the results of this investigation also confirm the findings of previous studies concerning the use of technology in the classroom. The archiving feature of web-conferencing tools, which allows tracking the learners' progress in the language, has been found to be a great advantage for teachers to make informed decisions about the specific learning lacks to be addressed in subsequent lessons. Based on the practicum experience, it was also noticeable how meaning negotiation took place in almost every activity involving pair or group work while using technology. Zoom, the web-conferencing platform used in this study, as well as other technological tools implemented during the practicum, favored the conditions for the learners to speak and improve their oral communication skills, especially the whiteboard, breakout rooms, audio and video camera, application sharing options, and games, among others. In a nutshell, the findings of this study suggest that teaching a task-based ESP course in an online environment offers a wide array of resources that may benefit learners seeking to increase their speaking skills for academic and professional purposes.

In addition to all these valuable findings collected from the literature and the practicum experience, the triangulation of the perceptions of the student-teachers, the supervisors, and the Electrical Engineering students strongly point to the selected teaching practices having had a positive impact on the students' speaking skills and the working atmosphere of the lessons. All

actors involved agreed upon the fact that, to a great extent, the choices made for the ESP Dynamo course successfully provided the students with a broader repertoire of vocabulary and expressions, grammar structures, pronunciation tips, useful language functions, and other linguistic and extralinguistic abilities that took the students to higher levels of language performance, motivation, and satisfaction.

A further pedagogical implication of this study is that it has allowed the student-teachers to explore and implement a large variety of teaching practices, class strategies, and suggestions for improving the speaking skills of intermediate learners, not only making the student-teachers more knowledgeable and experienced in ways to develop the students' oral proficiency, but also demonstrating that it is possible to carefully plan and adapt these teaching practices to particular situations and new technologies, as in the case of an online task-based ESP course.

Despite the many positive results reported, the practicum also posed limitations to the student-teachers. The main limitation was related to time management. Factors such as the total number of students in the class, the high level of participation from the students in most activities, the increased content complexity required for every lesson, the number of activities needed to complete the task cycle, and the time challenges imposed by the online teaching environment hindered the student-teachers' attempt to end the synchronous lessons on time. The circumstances became even more challenging when the students asked for additional time to design or rehearse the main tasks (e.g., the role-plays or the oral presentations) or when the student-teachers encountered unforeseen technical issues (e.g., difficulties using online tools in class). However, based on the supervisors' recommendations and the student-teachers' own retrospective, some practical solutions may include simplifying instructions or steps for the students as much as possible, testing the correct operation of online tools before the class, referring only to the most relevant useful expressions when checking this information before the

tasks, using group activities at all times, and planning the lessons backwards to calculate the time required for each step of the task cycle. Additional suggestions include using a timer for class breaks, asking particular students to collaborate with ideas or answers instead of calling for volunteers, using visuals when referring to difficult technical topics, letting the students know the specific time allotted for each activity as part of the instructions, and having the handouts and web links ready to be shared through the class chat, among others. Even though the overall course accomplishments seem to prevail over the time management issues experienced by the student-teachers in most speaking lessons, these solutions may help not only to avoid teaching activities taking longer than expected, but also to close the lessons as smoothly as possible without leaving a sense of being in a rush.

To conclude, this research can significantly shed light on future similar contexts related to oral communication skills for intermediate students, teaching practices in online environments, task-based language teaching, and ESP courses for populations related to engineering or other similar technical fields. The study represents a milestone in the field of online task-based ESP teaching and a contribution to the literature niches of each variable covered.

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Appendix A

Research Instrument: Questionnaire for Students

CUESTIONARIO PARA ESTUDIANTES DE LA ESCUELA DE INGENIERÍA ELÉCTRICA (UCR)

Este cuestionario es parte del proyecto final de graduación desarrollado en el curso PF-0309 Diseño de Práctica Profesional de la Maestría en Enseñanza del Inglés de la Universidad de Costa Rica. El objetivo es recolectar datos sobre las necesidades del idioma inglés de los estudiantes de la Escuela de Ingeniería Eléctrica. La información proporcionada será estrictamente confidencial. Gracias por su amable colaboración.

INSTRUCCIONES GENERALES: Por favor responda las siguientes preguntas según se requiera.

I. INFORMACIÓN GENERAL

Nombre completo: _____

Teléfono: _____

Correo electrónico: _____

Lugar de residencia: _____

Año de carrera del cual lleva actualmente más cursos: ☐ 1º año ☐ 2º año ☐ 3º año ☐ 4º año ☐ 5º año
 Otro: _____

Énfasis al que pertenece: ☐ Electrónica y Telecomunicaciones ☐ Sistemas de Energía ☐ Computación y Redes
 Otro: _____

II. CONOCIMIENTO PREVIO Y ACTUAL DEL IDIOMA

1. ¿De qué manera ha adquirido conocimiento del idioma inglés? (Puede marcar más de una opción.)

A. Escuela o colegio público	☐
B. Escuela o colegio privado	☐
C. Cursos de inglés ▪ Indique el último nivel aprobado: _____ ▪ Indique la institución académica: _____ ▪ Indique el tiempo de estudio: _____	☐
D. En forma independiente	☐
E. Estadía en un país de habla inglesa ▪ Indique el tiempo de estadía: _____	☐
F. No cuenta con instrucción previa en el idioma inglés	☐

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2. ¿Cómo describe su nivel actual de dominio del inglés en cada una de las siguientes habilidades?

	Escuchar	Hablar	Leer	Escribir
Avanzado: Comprendo y me expreso con mucha facilidad en ámbitos laborales, académicos y sociales, utilizando estructuras complejas, diferentes tiempos verbales y amplio vocabulario.	☐	☐	☐	☐
Intermedio: Comprendo y genero ideas completas o detalladas para describir rutinas y procesos en ámbitos laborales, académicos y sociales.	☐	☐	☐	☐
Básico: Comprendo y genero frases simples sobre mí, mi familia, necesidades básicas, etc.	☐	☐	☐	☐
Principiante: Solo comprendo y produzco palabras o frases muy simples (uso extremadamente limitado).	☐	☐	☐	☐

III. NECESIDADES DEL IDIOMA INGLÉS

3. ¿Con qué frecuencia requiere utilizar el idioma inglés en su carrera universitaria?

A. Más de cinco días por semana	☐
B. De tres a cinco días por semana	☐
C. De uno a dos días por semana	☐
D. Nunca/No aplica	☐

4. Actualmente, ¿qué nivel de dificultad representan para usted las siguientes habilidades en idioma inglés?

	Muy fácil	Fácil	Difícil	Muy difícil
A. Escuchar	☐	☐	☐	☐
B. Hablar	☐	☐	☐	☐
C. Leer	☐	☐	☐	☐
D. Escribir	☐	☐	☐	☐
E. Gramática	☐	☐	☐	☐
F. Vocabulario técnico	☐	☐	☐	☐
G. Pronunciación	☐	☐	☐	☐

5. ¿Cuáles habilidades en inglés considera prioritarias para fines académicos como actual estudiante de Ingeniería Eléctrica? Enumere del 1-7 donde 1 es la más prioritaria y 7 es la menos prioritaria.

A.	Escuchar	
B.	Hablar	
C.	Leer	
D.	Escribir	

E.	Gramática	
F.	Vocabulario técnico	
G.	Pronunciación	

6. ¿Cuáles habilidades en inglés considera prioritarias para fines laborales como futuro profesional de Ingeniería Eléctrica? Enumere del 1-7 donde 1 es la más prioritaria y 7 es la menos prioritaria.

A.	Escuchar	
B.	Hablar	
C.	Leer	
D.	Escribir	

E.	Gramática	
F.	Vocabulario técnico	
G.	Pronunciación	

7. En lo personal, ¿cuáles habilidades le gustaría mejorar en un curso de inglés para estudiantes de Ingeniería Eléctrica? Enumere del 1-7 donde 1 es la más prioritaria y 7 es la menos prioritaria.

A.	Escuchar	
B.	Hablar	
C.	Leer	
D.	Escribir	

E.	Gramática	
F.	Vocabulario técnico	
G.	Pronunciación	

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8. ¿Sobre cuáles actividades específicas le gustaría aprender más en un curso de inglés? (Marque únicamente las opciones que considera más importantes).

ESCUCHAR Y HABLAR	A. Conversar con extranjeros	☐
	B. Asistir a presentaciones y conferencias internacionales	☐
	C. Participar en reuniones, debates y discusiones en grupo	☐
	D. Guiar visitas técnicas a sitios de trabajo con personas extranjeras	☐
	E. Realizar llamadas telefónicas	☐
	F. Realizar entrevistas laborales	☐
	G. Comercializar productos o servicios en países extranjeros	☐
	H. Otros: _____	☐

LEER Y ESCRIBIR	I. Artículos e informes técnicos	☐
	J. Manuales, especificaciones y normas técnicas	☐
	K. Libros de texto técnicos	☐
	L. Sitios web de entidades u organizaciones	☐
	M. Correos electrónicos	☐
	N. Curriculum vitae	☐
	O. Formularios	☐
	P. Foros de programación	☐
	Q. Cotizaciones	☐
	R. Otros: _____	☐

9. ¿Cuáles actividades de comprensión auditiva y expresión oral en inglés considera prioritarias para que usted pueda desenvolverse en el área de ingeniería eléctrica? (Marque únicamente las opciones que considera más importantes).

ESCUCHAR Y HABLAR	A. Saludar y despedirse	☐
	B. Dar instrucciones y direcciones	☐
	C. Describir la secuencia de un proceso	☐
	D. Solicitar aclaraciones	☐
	E. Dar recomendaciones	☐
	F. Describir un producto	☐
	G. Expresar cifras (temperatura, altura, precios, etc.)	☐
	H. Realizar comparaciones	☐
	I. Identificar ideas principales (en conversaciones, presentaciones, audios, videos, etc.)	☐
	J. Identificar detalles específicos (en conversaciones, presentaciones, audios, videos, etc.)	☐
	K. Entender diferentes acentos	☐
	L. Entender personas que hablan rápido	☐
	M. Comprender audios o videos relacionados con su disciplina	☐
	N. Otros: _____	☐

10. ¿Cuáles actividades de comprensión de lectura y expresión escrita en inglés considera prioritarias para que usted pueda desenvolverse en el área de ingeniería eléctrica? (Marque únicamente las opciones que considera más importantes).

LEER Y ESCRIBIR	A. Identificar las ideas principales de un texto.	☐
	B. Encontrar información específica en un texto.	☐
	C. Descifrar el significado de palabras desconocidas utilizando el contexto de lectura.	☐
	D. Identificar distintas partes de un texto (introducción, desarrollo y conclusión).	☐
	E. Emitir un juicio crítico sobre el tema de un texto.	☐
	F. Escribir palabras en inglés con ortografía correcta.	☐
	G. Usar los signos de puntuación correctamente.	☐
	H. Escribir oraciones complejas con claridad.	☐
	I. Usar amplia variedad de vocabulario en mis textos.	☐
	J. Organizar mis ideas en orden lógico y estructurado.	☐
	K. Usar conectores adecuados para distintos tipos de texto.	☐
	L. Otros: _____	☐

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11. ¿Cuáles temas específicos de su disciplina serían más relevantes para usted en un curso de inglés? (Marque únicamente las opciones sobre las que le gustaría aprender).

A.	Aplicaciones biomédicas	☐
B.	Telecomunicaciones	☐
C.	Diseño e instalaciones eléctricas	☐
D.	Computación y redes	☐
E.	Robótica e inteligencia artificial	☐
F.	Sistemas de potencia	☐
G.	Energía renovable	☐
H.	Instrumentación, máquinas y equipos	☐
I.	Electrónica	☐
J.	Electromecánica	☐
K.	Manufactura	☐
L.	Automatización de procesos	☐
M.	Transporte	☐
N.	Industria espacial	☐
O.	Infraestructura y construcción	☐
P.	Seguridad y salud ocupacional	☐
Q.	Venta de productos y servicios	☐
R.	Consultoría	☐
S.	Administración de proyectos	☐
T.	Otros: _____	☐

12. ¿Cuáles son algunos ejemplos de interacciones con otras personas para los cuales usted requiere el uso del idioma inglés como estudiante de Ingeniería Eléctrica?

13. ¿Cuáles son algunos ejemplos de documentos o materiales para los cuales usted requiere el uso del idioma inglés como estudiante de Ingeniería Eléctrica?

14. ¿Cuáles son algunos ejemplos de actividades en inglés que deben realizar los profesionales de Ingeniería Eléctrica en el ámbito laboral?

IV. ESTILOS DE APRENDIZAJE

15. De las siguientes actividades, ¿cuáles le gustaría que se llevaran a cabo en un curso de inglés? (Marque únicamente las opciones que considera más importantes).

A.	Ejercicios multimedia (audios, videos, juegos, etc.)	
B.	Conversaciones o diálogos	
C.	Presentaciones orales de un tema asignado	
D.	Ejercicios de lectura de textos técnicos	
E.	Ejercicios de escritura	
F.	Trabajos individuales	
G.	Trabajos grupales o en parejas	
H.	Competiciones	
I.	Experimentos o simulaciones técnicas	
J.	Solución de problemas	
K.	Uso de diagramas, gráficos, imágenes, etc.	
M.	Actividades que impliquen movimiento	
N.	Otros: _____	

16. En el caso de un curso de inglés dirigido específicamente a estudiantes de Ingeniería Eléctrica, ¿cuáles serían sus expectativas o sugerencias para el curso?

* **Información adicional:** Si desea realizar consultas o comentarios adicionales sobre este cuestionario, comuníquese al correo ingles.engineer@gmail.com. Muchas gracias.

Appendix B**Research Instrument: Interview for Stakeholders (Director and Professors)****ENTREVISTA PARA DIRECTOR DE LA ESCUELA Y PROFESORES
DE LA ESCUELA DE INGENIERÍA ELÉCTRICA (UCR)**

La presente entrevista es parte de un análisis de necesidades desarrollado en el curso PF-0309 Diseño de Práctica Profesional de la Maestría en Enseñanza del Inglés de la Universidad de Costa Rica. El objetivo es recolectar datos para la implementación de un curso de inglés diseñado para estudiantes de la Escuela de Ingeniería Eléctrica. La información proporcionada será estrictamente confidencial. La entrevista tiene una duración de 15-30 minutos. Gracias por su amable colaboración.

I. INFORMACIÓN PERSONAL

Nombre: _____

Teléfono: _____

Correo electrónico: _____

Ocupación: _____

II. GENERALIDADES DE LA CARRERA

1. ¿Podría dar una descripción general de la carrera de Ingeniería Eléctrica? (ejemplo: número de estudiantes, principales subdisciplinas, tareas que realiza un ingeniero eléctrico, etc.)

2. ¿Cuáles son los objetivos generales de la carrera de Ingeniería Eléctrica respecto a la preparación de estudiantes para satisfacer demandas del mercado?

3. ¿Cuáles son algunos ejemplos de empleos o principales empresas a los cuales pueden optar los estudiantes graduados de Ingeniería Eléctrica?

III. USO DEL IDIOMA INGLÉS (ACADÉMICA Y PROFESIONALMENTE)

4. ¿Cuál es la importancia del idioma inglés en el área de Ingeniería Eléctrica, considerando necesidades actuales de los estudiantes y necesidades futuras como profesionales?

5. ¿Los estudiantes de Ingeniería Eléctrica reciben cursos de inglés en la universidad como parte del plan de estudios? (en caso de una respuesta negativa, continúe en el punto 3)

- a. ¿Tiene usted información sobre el contenido desarrollado en estos cursos?

- b. ¿Tiene conocimiento del resultado o de opiniones expresadas por los estudiantes con respecto a estos cursos?

6. ¿Cuáles cursos del plan de estudios requieren el uso del idioma inglés?

7. ¿Cuál es su impresión del nivel de inglés de los estudiantes de Ingeniería Eléctrica?

8. ¿Con qué frecuencia considera que los estudiantes de Ingeniería Eléctrica requieren académicamente el idioma inglés? ¿Con qué frecuencia lo requieren los profesionales?

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9. ¿Cuáles habilidades en inglés considera prioritarias para los estudiantes y profesionales de Ingeniería Eléctrica? (Puede señalar más de una opción)

	Estudiantes	Profesionales
A. Escuchar		
B. Hablar		
C. Leer		
D. Escribir		
E. Gramática		
G. Vocabulario técnico		
H. Pronunciación		

10. ¿Cuáles actividades específicas en inglés deben realizar los estudiantes como parte de la carrera de Ingeniería Eléctrica? (dar ejemplos para cada habilidad si fuese necesario)

11. ¿Cuáles actividades específicas en inglés deben realizar los estudiantes como futuros profesionales de Ingeniería Eléctrica?

12. ¿Tiene conocimiento (por parte de colegas o estudiantes) sobre las principales deficiencias en el idioma inglés tanto en cursos universitarios como en el campo laboral de la Ingeniería Eléctrica? ¿De qué manera puede esto influir en la contratación o el desempeño de los graduados?

13. ¿Cuáles son algunos ejemplos de materiales o sitios web utilizados por estudiantes y profesionales de Ingeniería Eléctrica donde se requiere el uso del idioma inglés? (¿Es posible tener acceso a dichos materiales?)

14. En el caso de un curso de inglés dirigido específicamente a estudiantes de Ingeniería Eléctrica, ¿cuáles serían sus sugerencias o expectativas del curso?

15. ¿Podría recomendarnos algunos profesores o coordinadores de programas a los que podríamos recurrir para realizar esta misma entrevista o recopilar información adicional?

* Información adicional: Para consultas relacionadas con esta entrevista, comuníquese con andrea.moralesoliverio@ucr.ac.cr o maria.arayaporras@ucr.ac.cr. Los resultados del estudio se presentarán a futuro como parte del Trabajo Final de Graduación. Muchas gracias.

Appendix C

Research Instrument: Interview for Stakeholders (Professionals)

ENTREVISTA PARA PROFESIONALES DE INGENIERÍA ELÉCTRICA (UCR)

La presente entrevista es parte de un análisis de necesidades desarrollado en el curso PF-0309 Diseño de Práctica Profesional de la Maestría en Enseñanza del Inglés de la Universidad de Costa Rica. El objetivo es recolectar datos para la implementación de un curso de inglés diseñado para estudiantes de la Escuela de Ingeniería Eléctrica. La entrevista tiene una duración de 15-30 minutos. La información proporcionada será estrictamente confidencial. Gracias por su amable colaboración.

I. INFORMACIÓN PERSONAL

Nombre: _____

Teléfono: _____

Correo electrónico: _____

Ocupación: _____

Lugar de trabajo: _____

Años de experiencia laboral
en Ingeniería Eléctrica: _____

II. GENERALIDADES DE LA CARRERA

1. ¿Podría dar una descripción general de la carrera de Ingeniería Eléctrica? (ejemplo: importancia, subdisciplinas, tareas que realiza un ingeniero eléctrico, etc.)

2. ¿Cuáles son algunos ejemplos de empleos o principales empresas a los cuales pueden optar los Ingenieros Eléctricos?

III. USO DEL IDIOMA INGLÉS (ACADÉMICA Y PROFESIONALMENTE)

3. ¿Cuál es la importancia del idioma inglés en el área de Ingeniería Eléctrica, considerando necesidades de los estudiantes y necesidades como profesionales?

4. ¿Con qué frecuencia considera que los profesionales de Ingeniería Eléctrica requieren el idioma inglés?

5. ¿En cuáles habilidades en inglés considera que se presentan las mayores dificultades para los profesionales de Ingeniería Eléctrica?

6. ¿Tiene conocimiento sobre deficiencias en el uso del idioma inglés en el campo laboral de la Ingeniería Eléctrica? ¿De qué manera puede esto influir en la contratación o el desempeño de los profesionales?

7. ¿Cuáles habilidades en inglés considera prioritarias para los estudiantes y profesionales de Ingeniería Eléctrica? (Puede señalar más de una opción)

	Estudiantes	Profesionales
A. Escuchar		
B. Hablar		
C. Leer		
D. Escribir		
E. Gramática		
G. Vocabulario técnico		
H. Pronunciación		

8. ¿Cuáles actividades específicas de escuchar y hablar considera prioritarias para desenvolverse en el área de Ingeniería Eléctrica?

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

9. ¿Cuáles actividades específicas de leer y escribir considera prioritarias para desenvolverse en el área de Ingeniería Eléctrica?

10. ¿Cuáles son algunos ejemplos de documentos, materiales específicos, o sitios web de consulta para los que se requiere el uso del idioma inglés? (¿Es posible tener acceso a dichos materiales?)

11. ¿Cuáles temas específicos de su disciplina considera que serían más relevantes para un curso de inglés?

12. En el caso de un curso de inglés dirigido a estudiantes de Ingeniería Eléctrica, ¿cuáles serían sus sugerencias?

* Información adicional: En caso de consultas relacionadas con esta entrevista, comuníquese con andrea.moralesoliverio@ucr.ac.cr o maria.arayaporras@ucr.ac.cr. Los resultados del estudio se presentarán a futuro como parte del Trabajo Final de Graduación. Muchas gracias.

Appendix D

Sample Authentic Materials: IEEE Standards

An American National Standard

IEEE Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage

1. Scope

This recommended practice presents uniform methods for testing insulation with direct voltages higher than 5000 V.¹ It applies to large ac rotating machines rated at 10000 kVA or greater and rated at 6000 V or higher.² It covers acceptance testing of new equipment in the factory or in the field after erection, and routine maintenance testing of machines that have been in service.

2. Purpose

The purpose of this recommended practice is:

- 1) To provide uniform procedures for performing high direct voltage acceptance tests and routine maintenance tests on the main ground insulation of windings of large ac machines
- 2) To provide uniform procedures for analyzing the variations in measured current so that any possible relationship of the components of these variations to the condition of the insulation can be more effectively studied
- 3) To define terms which have a specific meaning as used in this document

3. Definitions

The following definitions are based on those in common use which have been modified to be more specific for the purpose of this recommended practice.

absorption current (or component): A reversible component of the measured current, which changes with time of voltage application, resulting from the phenomenon of "dielectric absorption" within the insulation when stressed by direct voltage. See IEEE Std 62-1958, Guide for Making Dielectric Measurements in the Field, Section 6.

acceptance proof test: A test applied to new insulated winding before commercial use. It may be performed at the factory or after installation, or both. See American National Standard General Requirements for Synchronous Machines, ANSI C50.10-1977.

¹For insulation resistance measurements at direct voltages below 5000 V, see IEEE Std 43-1974, Recommended Practice for Testing Insulation Resistance of Rotating Machinery.

²These methods have been found applicable to equipment of smaller size and lower voltage.

IEEE Std 95-1977

IEEE RECOMMENDED PRACTICE FOR INSULATION TESTING OF

breakdown voltage: The voltage at which a disruptive discharge takes place through or over the surface of the insulation.

capacitive current (or component): A reversible component of the measured current on charge or discharge of the winding which is due to the geometrical capacitance, that is, the capacitance as measured with alternating current of power or higher frequencies. With high direct voltage this current has a very short time constant and so does not affect the usual measurements. See IEEE Std 62-1958, Section 6.

controlled overvoltage test (dc leakage, measured current, or step voltage test): A test in which the increase of applied direct voltage is controlled and measured currents are continuously observed for abnormalities with the intention of stopping the test before breakdown occurs. See Section 6.2.

electric strength (dielectric strength): The maximum potential gradient that the material can withstand without rupture.

high direct voltage: A direct voltage above 5000 V supplied by portable test equipment of limited capacity.

leakage (conduction) current: The non-reversible constant current component of the measured current which remains after the capacitive current and absorption current have disappeared. Leakage current passes through the insulation volume, through any defects in the insulation, and across the insulation surface.

maintenance proof test: A test applied to an armature winding after being in service to determine that it is suitable for continued service. It is usually made at a lower voltage than the acceptance proof test.

measured current: The total direct current resulting from the application of direct voltage to insulation and including the leakage current, the absorption current, and, theoretically, the capacitive current. Measured current is the value read on the microammeter during a direct high voltage test of insulation.

overvoltage (overpotential): A voltage above the normal rated voltage or the maximum operating voltage of a device or circuit. A direct test overvoltage is a voltage above the peak of the alternating line voltage.

polarization index: The ratio of the insulation resistance of a machine winding measured at 1 min after voltage has been applied divided into the measurement at 10 min. See IEEE Std 43-1974.

proof test (withstand test): A "fail" or "no fail" test of the insulation system of a rotating machine made to demonstrate whether the electrical strength of the insulation is above a predetermined minimum value.

4. Preparations for Test: Test Connections

4.1 Proof Test Preparations

The preparations required for proof tests are simpler than when current measurements are made in conducting controlled overvoltage tests. If proof tests are to be made without current measurement, only those sections marked by an asterisk need to be consulted.

4.2 Air-Cooled Machines

4.2.1 Temperature of the Winding

4.2.1.1

A direct voltage test should be made at winding temperatures not in excess of 40°C unless otherwise agreed upon between the user and the manufacturer.

Adapted from:

IEEE. (1977, April 29). 95-1977 - IEEE Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage. IEEE Xplore. <https://doi.org/10.1109/IEEESTD.1977.82914>

Sample Authentic Materials: Technical Datasheets

Megger.**BITE® 2 and BITE 2P**
Battery Impedance Test Equipment**Test Procedure**

The BITE 2 and BITE 2P work by applying a capacitively coupled ac test signal across the battery string while on-line. The receiver and potential probe are placed at the cell terminals to measure the signal and resulting voltage drop for each cell/jar. During each measurement, impedance is calculated following Ohm's Law, displayed on the LCD and stored. The instruments also measure, display and record dc voltage and interconnection (strap) resistance to help determine the overall condition of the entire battery string's electrical path from terminal plate to terminal plate. The also measure ac ripple current, a charger parameter.

The BITE 2 and BITE 2P receiver stores the readings in its internal memory. These measurements, along with other maintenance data such as ambient and pilot cell temperatures and ac ripple current, assist in determining the overall condition of battery systems. Figure 3 shows a typical test setup.

Interpretation of Readings

Data produced by the BITE 2 and BITE 2P can be interpreted in several modes: instantaneous, short-term and long-term time frames. An impedance distribution plot, as shown in Figure 4, assists in the analysis.

Instantaneous Interpretation

The operator can enter a baseline value from either the impedance measurements obtained at commissioning or from the Megger website. The percent changes from baseline for warning and fail levels are entered, but 20 percent and 40 percent are the default settings. The LCD on the receiver will display the status of the cell for a few seconds before proceeding to the next cell. The status of each cell/jar will be printed on the Battery Analysis Report.

Short-Term Interpretation

Impedance readings for individual cells can be used in the short term to compare with the average impedance readings for the entire battery string. Individual cell values with deviations of more than $\pm 15\%$ for flooded lead-acid, $\pm 35\%$ for VRLA, and 50% for NiCd cells from the battery string average typically indicate a problem with that cell. Megger recommends additional investigation of such cells including a verification of intercell connections and a single cell load-cycle test.

Long-Term Interpretation

Impedance readings for the entire battery can be used in the long term to determine replacement criteria. Battery cell impedance values should be recorded and compared to previous readings to determine the position of the cell on the curve of impedance versus cell life as shown in Figure 2. Based on experience, a variation of $\pm 20\%$ from baseline for flooded lead-acid, $\pm 40\%$ for VRLA and 50% for NiCd cells indicate significant change in the electrical path to warrant serious evaluation of the condition of the battery system. Megger maintains a database of impedance values by some manufacturers and battery size/type. For comparison purposes, this information is available upon request.

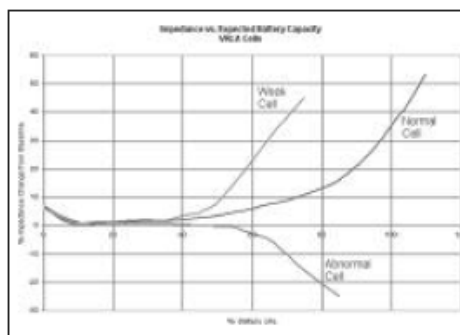


Figure 2. Impedance increases with battery age (and weakness)

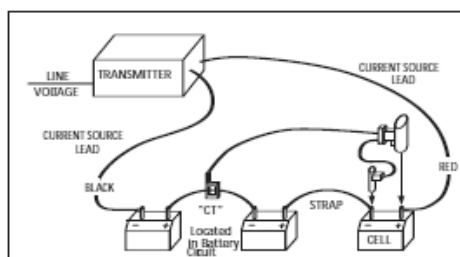


Figure 3. A typical test setup

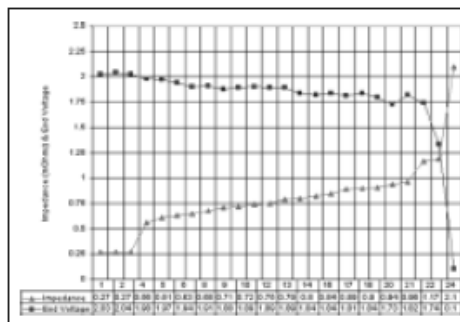


Figure 4. Ascending impedance compared to load test

SPECIFICATIONS**Application**

The BITE 2 and BITE 2P test lead-acid and nickel-cadmium cells up to 7000 Ah.

Maximum Total Voltage at Current Source Leads

275 V dc (larger battery systems can be sectioned to accommodate this specification)

Transmitter**Supply Voltage**

100 to 130 V, 50/60 Hz, 200 VA max
210 to 250 V, 50/60 Hz, 200 VA max

Source Output Current

10 A nominal, 50/60 Hz operation

Megger

Maximum Battery String Test Voltage
275 V dc at source lead terminals (section the battery if >275 Vdc)

Display
Digital LCD meter, 0 to 15 A

BITE 2P Printer
Built-in thermal, with 4.25 in. (110 mm) printing width

Charger
Supply Voltage
100 to 130 V, 50/60 Hz, 14 VA
210 to 250 V, 50/60 Hz, 14 VA

Output
6.50 V dc @ 1.10 A dc charging (max)
9.60 V dc open circuit

Receiver
Accuracy
ac impedance 5% +1 LSD
dc voltage $\pm(0.5\%$ of rdg +1 LSD)

Precision
Better than 0.5% one sigma

Voltage Range and Resolution
1 to 2.500 V dc, 1 mV resolution
2.5 to 25.00 V dc, 10 mV resolution

Impedance Range and Resolution
0 to 1.000 m Ω , 1 $\mu\Omega$ resolution
1 to 10.00 m Ω , 10 $\mu\Omega$ resolution
10 to 100.0 m Ω , 0.1m Ω resolution

Setting Time per Reading
3 seconds maximum

Display
LCD, 2 x 16 characters

BITE* 2 and BITE 2P
Battery Impedance Test Equipment

Supply
4.8 V dc, 800 mAh, quick charge nickel-cadmium battery pack

Battery Pack Life, Full Charge
5 hours continuous

Maximum Cell/Jar Test Voltage
25 V dc between receiver and potential probe

Temperature
Operating: 32 to 105° F (0 to 40° C)
Storage: -5 to 130° F (-20 to 55° C)
Humidity: 20 to 90% RH, noncondensing

Clamp Range
Standard CT
2.0 in. (50 mm) maximum opening

Optional Miniature CT
0.5 in. (12 mm) maximum opening

Optional RopeCT™
12 in. (300 mm) opening, approx.

Safety
Designed to meet IEC 61010-1

Dimensions
Transmitter
BITE 2: 6.5 H x 14 W x 10.6 D in. (16.5 H x 35.6 W x 27 D cm)
BITE 2P: 7.5 H x 18.5 W x 14.6 D in. (19 H x 47 W x 37 D cm)

Receiver (irregular shape)
7.25 H x 11.25 W x 2 D in. (18 H x 29 W x 5 D cm)

Weight
Transmitter
BITE 2: 17 lb (7.7 kg)
BITE 2P: 18 lb (8.2 kg) alone, 32 lb (14.5 kg) packed

Receiver
1.6 lb (0.7 kg)

ORDERING INFORMATION

Item (Qty)	Cat. No.	Item (Qty)	Cat. No.
BITE 2, 110/230 V ac, 50/60 Hz, CE-Marked	246002B	ac line cord, 8 ft (2.5 m)	17032-7
BITE 2P, 110/230 V ac, 50/60 Hz, CE-Marked	246004	Canvas carrying case for BITE2	218746
		Manual for BITE2 and BITE2P	AVTM246004
		Accessory bag for BITE2	29996
Included Accessories		Optional Accessories	
Transmitter for BITE2	P30044-300	Current sensor 0.5 in. (12 mm) opening with 2.5 ft (0.8 m) lead	246034
Transmitter for BITE2P	P30044-100	Current sensor, RopeCT™ 24 in. (60 cm) length	246050
Receiver	P30620-3	Current sensor, RopeCT™ 36 in. (90 cm) length	246051
Source Leads, 20 ft (6 m), fused	29386-2	CT extension cable, 20 ft (6 m)	246033
Current sensor, 2 in. (50 mm) opening with 5 ft (1.5 m) lead	33863	Current source leads, 10 ft (3 m), fused	246147
CT extension cable, 20 ft (6 m)	33864-1	Current source leads, 30 ft (9.1 m), fused	246347
Communication cable, 6 ft (1.8 m)	35340	Current source leads, 40 ft (12.2 m), fused	246447
Charger cable	35341	Bar code wand with preprinted code sheet	246201
Thermal paper	26999	Transit case for BITE2	35491
ProActiv™ Battery Database Management Software	BI-90001		

UK
Archcliffe Road, Dover
CT17 9EN England
T +44 (0) 1 304 502101
F +44 (0) 1 304 207342
UKsales@megger.com

UNITED STATES
4271 Bronze Way
Dallas, TX 75237-1019 USA
T 1 800 723 2861 (USA only)
T +1 214 333 3201
F +1 214 331 7389
USsales@megger.com

OTHER TECHNICAL SALES OFFICES
Norristown USA, Sydney AUSTRALIA,
Toronto CANADA, Trappes FRANCE,
Kingdom of SAUDI ARABIA, Mumbai INDIA,
Johannesburg SOUTH AFRICA, and
Conjuro THAILAND

ISO STATEMENT
Registered to ISO 9001:2000 Cert. no. 10006.01
BITE2_2P_DS_en_V15
www.megger.com
Megger is a registered trademark

Adapted from:
Megger. (n.d.). *BITE 2 and BITE 2P Battery Impedance Test Equipment*.
https://idiseafood.com/vnt_upload/service/quanhe/BITE2_2P_New_1371788257.pdf

Appendix E

Participants' Individual Profiles

Student N. 1

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: communicating with foreign people and companies - Students: reading field-related books and datasheets in English
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: speaking
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, telephone calls, work interviews, and sale of products or services abroad - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, websites, emails, résumés, forms, programming forums, and quotations. - Wants to improve speaking and listening skills.
f. Experience with language and perceived proficiency	- Public primary school and high school. - Self-learning process. - Basic User (listening, speaking, reading and writing)
g. Description of their lacks	- Difficulties with listening, speaking, reading, writing, grammar, technical vocabulary, and pronunciation

Student N. 2

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: conversations and conferences with foreign people, reading technical texts and documentation, and writing emails are common tasks. - Students: technical articles, manuals, datasheets, conferences, and videos
c. Description of their needs	- Priority for professional purposes: listening - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates, group discussions, sales of products or services abroad - Reading and writing: articles, technical reports, manuals, specifications, technical standards. emails, résumés, and programming forums - Wants to improve speaking and writing
f. Experience with language and perceived proficiency	- Private primary school and high school. - Independent User (listening, speaking, reading and writing)
g. Description of their lacks	- Difficulties with grammar and technical vocabulary

Student N. 3

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: speaking with foreign engineers and technicians, consulting forums, attending international conferences and trainings, reading manuals, etc. - Students: reading datasheets and articles for research purposes
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, meetings, debates, group discussions, and telephone calls - Reading and writing: articles, technical reports, manuals, specifications, technical standards, textbooks, and websites - Wants to improve speaking and listening.
e. Experience with language and perceived proficiency	- Public primary school and high school - Self-learning process - Basic User (listening, speaking, and writing) and Independent User (reading)
f. Description of their lacks	- Difficulties with the language in general, especially with speaking and technical vocabulary

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 4

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Computing and Networking
b. Positions at work (tasks) and academic activities	- Professionals: interacting with foreigners to quote or implement a project, and using programming language (English) - Students: conferences, workshops, and round tables based on readings or videos previously assigned. Simulation software and field-related texts and books
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: listening
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, telephone calls, and work interviews - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, résumés, and programming forums - Wants to improve pronunciation and technical vocabulary
e. Experience with language and perceived proficiency	- Public high school during the first two years - Self-learning process - Elementary level in listening, speaking, reading, and writing.
f. Description of their lacks	- Difficulties with listening, speaking, writing, grammar, and pronunciation

Student N. 5

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: writing emails, reading technical datasheets, and interacting with foreign clients - Students: attending online conferences and reading books, especially related to robotics and artificial intelligence
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: speaking
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions - Reading and writing: articles and technical reports, textbooks, and websites - Wants to improve speaking and writing
e. Experience with language and perceived proficiency	- Private primary school and high school. - Independent User (speaking, reading, and writing) and Proficient User (listening)
f. Description of their lacks	- Difficulties with reading, writing, grammar, and technical vocabulary primarily

Student N. 6

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Computing and Networking
b. Positions at work (tasks) and academic activities	- Professionals: discussing project implementation with foreign clients and colleagues - Students: searching for field-related information in general. Reading IEEE publications and datasheets
c. Description of their needs	- Priority for professional purposes: technical vocabulary - Priority for academic purposes: technical vocabulary
d. Description of their wants	- Listening and speaking: international presentations and conferences, meetings, debates and group discussions, telephone calls, interviews, sale of products or services - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, emails, résumés, and quotation - Wants to improve technical vocabulary and listening.
e. Experience with language and perceived proficiency	- Private primary school and high school - Self-learning process through music and videogames. - Basic User (listening and speaking) and Independent User (reading and writing)
f. Description of their lacks	- Difficulties with listening, speaking, and grammar

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 7

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Power Systems
b. Positions at work (tasks) and academic activities	- Professionals: English is essential to interact with foreigners and look for job opportunities abroad - Students: searching for information related to advances in science and technology in more developed countries (articles, books, datasheets, etc.)
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations, and conferences - Reading and writing: articles and technical reports, manuals, specifications, and technical standards - Wants to improve speaking and writing
e. Experience with language and perceived proficiency	- Public primary school and high school - Self-learning process - Basic User (speaking), Independent User (listening and writing), and Proficient User (reading)
f. Description of their lacks	- Difficulties primarily with speaking

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 8

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Power Systems
b. Positions at work (tasks) and academic activities	- Professionals: attending meetings, giving instructions, writing reports, etc. - Students: participating in seminars and reading books as well as field-related information
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, and sale of products or services abroad - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, and programming forums - Wants to improve speaking and pronunciation.
e. Experience with language and perceived proficiency	- Public primary school and high school - English course (6 months) - Self-learning process - Independent User (listening and speaking) and Proficient User (reading and writing)
f. Description of their lacks	- Difficulties with speaking and technical vocabulary primarily

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 9

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Computing and Networking
b. Positions at work (tasks) and academic activities	- Professionals: attending meetings, programming, and writing technical reports - Students: reading technical books, texts, and manuals of electronic devices. Interacting with foreigners in programming forums and conferences
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, meetings, debates and group discussions, telephone calls, and work interviews - Reading and writing: manuals, specifications, and technical standards, textbooks, and programming forums - Wants to improve speaking and listening.
e. Experience with language and perceived proficiency	- Public primary school and high school. - Elementary level in speaking. Basic User (listening, reading, and writing)
f. Description of their lacks	- Difficulties with listening, speaking, technical vocabulary, and pronunciation

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 10

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Power Systems
b. Positions at work (tasks) and academic activities	- Professionals: it is essential to interact with foreigners in English - Students: most didactic material and videos are in English
c. Description of their needs	- Priority for professional purposes: listening - Priority for academic purposes: listening
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, and telephone calls - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, and websites - Wants to improve listening and speaking
e. Experience with language and perceived proficiency	- Public primary school and high school. - Elementary level in listening and speaking. Basic User (writing) and Independent User (reading)
f. Description of their lacks	- Difficulties with listening, speaking, grammar, technical vocabulary, and pronunciation

Student N. 11

Criteria	Description
a. General information	- Electrical engineering student (5th year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: speaking with foreign clients and colleagues and understand their requests - Students: speaking with foreign professors as well as reading articles and technical datasheets
c. Description of their needs	- Priority for professional purposes: listening - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, meetings, debates and group discussions, technical visits with foreigners to a work site, and work interviews - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, forms, and quotations - Wants to improve listening and speaking
e. Experience with language and perceived proficiency	- Public primary school and high school. - Basic User (listening, speaking, and writing) and Independent User (reading)
f. Description of their lacks	- Difficulties with listening, speaking, grammar, vocabulary, and pronunciation

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 12

Criteria	Description
a. General information	- Electrical engineering student (1st year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Main fields of interest: biomedical applications, telecommunications, computing and networking, electronics, electromechanics, space industry, and project management. Research is essential in these areas - Debates using appropriate technical language. Google Scholar and other platforms are necessary for research purposes
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, and telephone calls - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, websites, and programming forums - Wants to improve technical language and reading
e. Experience with language and perceived proficiency	- Self-learning process - Basic User (listening, speaking, and writing) and Independent User (reading)
f. Description of their lacks	- Difficulties with the language in general, especially with speaking and technical vocabulary

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 13

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Power Systems
b. Positions at work (tasks) and academic activities	- Professionals: meetings, conversations, presentations, debates, reports, conferences, etc. - Reading books and articles to discuss and debate in class
c. Description of their needs	- Priority for professional purposes: grammar - Priority for academic purposes: listening
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, technical visits with foreigners to a work site, telephone calls, work interviews, sale of products or services abroad - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, websites, emails, résumés, programming forums, and quotations - Wants to improve technical vocabulary and pronunciation
e. Experience with language and perceived proficiency	- Public primary school and high school - No previous English instruction - Elementary level in listening, speaking, reading, and writing
f. Description of their lacks	- Difficulties with listening, speaking, reading, writing, grammar, technical vocabulary, and pronunciation

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 14

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Computing and Networking
b. Positions at work (tasks) and academic activities	- Professionals: meetings with English-speaking people - Students: programming forums and almost every material is in English
c. Description of their needs	- Priority for professional purposes: listening - Priority for academic purposes: speaking
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, telephone calls, and work interviews - Reading and writing: articles and technical reports, textbooks, emails, résumés, and programming forums. - Wants to improve listening and speaking
e. Experience with language and perceived proficiency	- Self-learning process - Elementary level in writing. Basic User (speaking and reading) and Independent User (listening)
f. Description of their lacks	- Difficulties with speaking, reading, writing, grammar, and technical vocabulary

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 15

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: interacting with other professionals from different countries - Students: work interviews, presentations, scientific articles
c. Description of their needs	- Priority for professional purposes: reading - Priority for academic purposes: speaking
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, technical visits with foreigners to a work site, telephone calls, work interviews, sale of products or services abroad - Reading and writing: articles and technical reports, textbooks, websites, emails, and résumés - Wants to improve speaking and listening
e. Experience with language and perceived proficiency	- Public primary school and high school - Self-learning process - Basic User (speaking and writing) and Independent User (listening and reading)
f. Description of their lacks	- Difficulties with speaking, writing, grammar, and technical vocabulary

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 16

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Power Systems
b. Positions at work (tasks) and academic activities	- Professionals: talks and presentations as well as reading manuals and specifications - Students: reading articles published by the IEEE
c. Description of their needs	- Priority for professional purposes: grammar - Priority for academic purposes: writing
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, technical visits with foreigners to a work site, telephone calls, sale of products or services abroad - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, websites, programming forums, and quotations - Wants to improve grammar and pronunciation
e. Experience with language and perceived proficiency	- Public primary school and high school - Elementary level in speaking and writing - Basic User (listening and reading)
f. Description of their lacks	- Difficulties with speaking, writing, grammar, and pronunciation

Student N. 17

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Computing and Networking
b. Positions at work (tasks) and academic activities	- Professionals: it is essential for them to communicate with foreign colleagues and clients - Students: understanding videos, talks, articles, or books in English to be able to debate topics with classmates. Most of the articles and relevant studies in the field are only in English
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: international presentations and conferences, technical visits with foreigners to a work site, and work interviews - Reading and writing: articles and technical reports, textbooks, websites, résumés, forms, and programming forums - Wants to improve reading and writing
e. Experience with language and perceived proficiency	- Public primary school and high school - Self-learning process - Elementary level (listening, speaking, and writing). Basic User (reading)
f. Description of their lacks	- Difficulties with listening, speaking, reading, writing, grammar, technical vocabulary and pronunciation

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 18

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Power Systems
b. Positions at work (tasks) and academic activities	- Professionals: giving presentations as well as writing emails, reports, and project proposals - Students: reading research articles and manuals
c. Description of their needs	- Priority for professional purposes: writing - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, meetings, debates and group discussions, and present projects - Reading and writing: articles and technical reports, manuals, specifications, and technical standards. Writing letters - Wants to improve writing and technical vocabulary
e. Experience with language and perceived proficiency	- English course (2 years) - Self-learning process - Basic User (writing), Independent User (speaking and reading), and Proficient User (listening)
f. Description of their lacks	- Difficulties with technical vocabulary, writing, and grammar

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Student N. 19

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: having conversations with foreign colleagues and clients/supervisors - Students: English is necessary for the internship, trainings, and the courses in the major. They also need to read technical books, manuals, and datasheets
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: speaking
d. Description of their wants	- Listening and speaking: conversations with foreigners, meetings, debates and group discussions, and work interviews - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, websites, and quotations - Wants to improve speaking and listening
e. Experience with language and perceived proficiency	- Private primary school and high school. - Basic User (speaking and writing) and Independent User (listening and reading)
f. Description of their lacks	- Difficulties with grammar, technical vocabulary, speaking, writing, and pronunciation

Student N. 20

Criteria	Description
a. General information	- Electrical Engineering student (4th year) - Power Systems
b. Positions at work (tasks) and academic activities	- Professionals: communicating with foreigners who work on the same project, corresponding via email, and reading manuals - Students: Experts use a slideshow or videos in English when giving technical presentations. They read books, reports, and journal articles
c. Description of their needs	- Priority for professional purposes: listening - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, meetings, debates and group discussions, telephone calls, work interviews, sale of products or services abroad - Reading and writing: manuals, specifications, and technical standards, textbooks, websites, and emails - Wants to improve speaking and listening
e. Experience with language and perceived proficiency	- Public primary school and high school - Elementary level in speaking, listening, reading, and writing
f. Description of their lacks	- Difficulties with listening, speaking, technical vocabulary, and pronunciation

Student N. 21

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Computing and Networking
b. Positions at work (tasks) and academic activities	- Professionals: utilizing different programs, reading articles, and interacting with managers or colleagues - Students: reading scientific articles
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, technical visits with foreigners to a work site, and work interviews - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, résumés, and quotations - Wants to improve speaking and pronunciation.
e. Experience with language and perceived proficiency	- Semi private primary school and high school. - English course (1 year and 9 months). - Independent User (speaking, reading, and writing) and Proficient User (listening)
f. Description of their lacks	- Difficulties with speaking, writing, technical vocabulary, and pronunciation

Student N. 22

Criteria	Description
a. General information	- Electrical engineering student (4th year) - Computing and Networking
b. Positions at work (tasks) and academic activities	- Professionals: meeting with managers, and attending work interviews. Environments and operating systems in English - Students: conferences, explanatory videos, books, datasheets, and PowerPoint presentations in English
c. Description of their needs	- Priority for professional purposes: speaking - Priority for academic purposes: listening
d. Description of their wants	- Listening and speaking: international presentations and conferences, meetings, debates and group discussions, telephone calls, and work interviews - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, emails, and programming forums - Wants to improve speaking and writing.
e. Experience with language and perceived proficiency	- Public primary school and high school. - Self-learning process. - Stay in an English-speaking country (1 month) - Basic User (speaking and writing) and Independent User (listening and reading)
f. Description of their lacks	- Difficulties with speaking, grammar, and technical vocabulary

Student N. 23

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: communication in English is essential in multinationals - Students: scientific articles published by the IEEE, talks, conferences, etc.
c. Description of their needs	- Priority for professional purposes: listening - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, and work interviews - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, and textbooks - Wants to improve speaking and technical vocabulary.
e. Experience with language and perceived proficiency	- Public primary school and high school - Self-learning process - English course - Basic User (speaking), Independent User (listening and writing), and Proficient User (reading)
f. Description of their lacks	- Difficulties with speaking, technical vocabulary, and pronunciation

Student N. 24

Criteria	Description
a. General information	- Electrical Engineering student (3rd year) - Electronics and Telecommunications
b. Positions at work (tasks) and academic activities	- Professionals: work interviews - Students: homework, presentations, and videos.
c. Description of their needs	- Priority for professional purposes: grammar - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners and international presentations and conferences. - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, textbooks, websites, emails, and résumés. - Wants to improve pronunciation and writing.
e. Experience with language and perceived proficiency	- Private primary school and high school. - Self-learning process. - Basic User (writing), Independent User (speaking), and Proficient User (listening and reading)
f. Description of their lacks	- Difficulties with grammar, technical vocabulary, speaking, writing, and pronunciation

Student N. 25

Criteria	Description
a. General information	- Electrical engineering student (3rd year) - Power Systems
b. Positions at work (tasks) and academic activities	- Professionals: reading manuals and technical standards, having conversations with foreign colleagues, and participating in conferences and trainings. - Students: speaking with foreigners related to the field, reading books, articles, and reports, and understanding presentations in English.
c. Description of their needs	- Priority for professional purposes: reading - Priority for academic purposes: reading
d. Description of their wants	- Listening and speaking: conversations with foreigners, international presentations and conferences, meetings, debates and group discussions, and technical visits with foreigners to a work site. - Reading and writing: articles and technical reports, manuals, specifications, and technical standards, and textbooks. - Wants to improve speaking and reading.
e. Experience with language and perceived proficiency	- Public primary school and high school. - Self-learning process. - Basic User (speaking and writing) and Independent User (listening and reading)
f. Description of their lacks	- Difficulties with grammar and technical vocabulary

Appendix F

Research Instrument: Diagnostic Test

Prueba de diagnóstico en inglés para estudiantes de la Escuela de Ingeniería Eléctrica (UCR)

Esta prueba de diagnóstico es parte del proyecto final de graduación desarrollado en el curso PF-0309 Diseño de Práctica Profesional de la Maestría en Enseñanza del Inglés de la Universidad de Costa Rica. El objetivo es recolectar datos sobre el nivel de dominio del idioma inglés de los estudiantes de la Escuela de Ingeniería Eléctrica. Los resultados serán estrictamente confidenciales. Gracias por su amable colaboración.

INSTRUCCIONES GENERALES

1. Lea cuidadosamente las instrucciones.
2. La prueba de diagnóstico consta de las siguientes partes y tendrá un valor total de 90 puntos:
 - a. Sección I: Información General
 - b. Sección II. Comprensión de Lectura (25 puntos)
 - c. Sección III. Escritura (25 puntos)
 - d. Sección IV. Comprensión Auditiva (15 puntos)
 - e. Sección V. Expresión Oral (25 puntos) - Ver apartado 8
3. La prueba estará habilitada desde el día jueves 27 de mayo hasta el día viernes 28 de mayo de 2021 a las 11:59 horas. Tiene un máximo de 3 horas para realizar el examen, por lo que debe administrar bien su tiempo.
4. Asegúrese de estar en un lugar silencioso y sin interrupciones para realizar la prueba.
5. En Google Classroom encontrará todos los materiales requeridos para realizar la prueba:
 - a. Prueba de diagnóstico (Formulario de Google)
 - b. Dos lecturas en PDF: Reading 1 y Reading 2
 - c. Tres archivos de audio: Listening 1, Listening 2 y Listening 3
6. Para la **Sección II. Comprensión de Lectura**, haga clic con el botón derecho del mouse sobre el enlace y seleccione la opción "Abrir enlace en una ventana nueva". De este modo, podrá mantener la lectura abierta a un lado de la pantalla y al otro lado el examen.
7. En la **Sección IV. Comprensión Auditiva**, escuche los audios un máximo de dos veces.

8. La **Sección V. Expresión Oral** se evaluará por aparte mediante una cita virtual programada. En los próximos días, se le enviará a su correo electrónico el enlace de Zoom y otros detalles adicionales.
9. Para que el resultado refleje verdaderamente su nivel actual de inglés, se les solicita NO usar ningún tipo de diccionario, traductor, material de consulta, o cualquier otro tipo de apoyo durante la prueba.
10. Si no sabe o no está seguro de una respuesta, por favor déjela en blanco.
11. Una vez finalizado el tiempo, recuerde hacer clic en ENVIAR lo que usted haya completado hasta ese momento.
12. Si desea realizar consultas o comentarios adicionales, comuníquese al correo ingles.engineer@gmail.com.

I. GENERAL INFORMATION

Instructions: Please complete the following personal information as required.

Instrucciones: Por favor complete los siguientes datos personales.

Full name: _____
Telephone number: _____
E-mail: _____

II. READING COMPREHENSION**Reading 1: Technical Datasheet**

Instructions:

1. Open the file "Reading 1."
2. Read the technical datasheet "Altos® Double-Jacket / Dielectric Gel-Free Cables, 2-288 Fibers."
3. Answer the questions as required.

Instrucciones:

1. Abra el archivo "Reading 1".
2. Lea la hoja de datos "Altos® Double-Jacket / Dielectric Gel-Free Cables, 2-288 Fibers".
3. Responda las preguntas según se solicita.

Reading 2: IEEE Article

Instructions:

1. Open the file "Reading 2."
2. Read the article "Study on a Wave Energy Based Power System."
3. Answer the questions as required.

Instrucciones:

1. Abra el archivo "Reading 2".
2. Lea la hoja de datos "Study on a Wave Energy Based Power System".
3. Responda las preguntas según se solicita.

Reading 1: Technical Datasheet

ALTOS® Double-Jacket/Dielectric Gel-Free Cables, 2-288 Fibers

An Evolant® Solutions Product

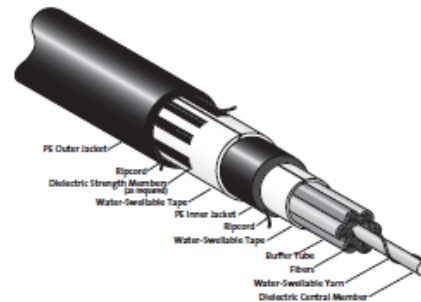
Corning
Cable Systems

Description

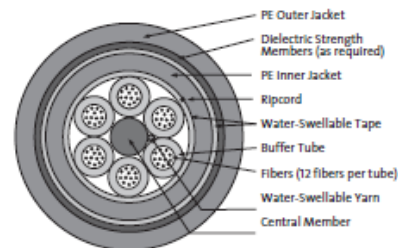
ALTOS® Double-Jacket, Dielectric Gel-Free Cables are designed for duct and aerial (lashed) installation. The double-jacket construction adds a layer of protection for harsh environments. The loose tube cable design provides stable performance over a wide temperature range and is compatible with any telecommunications-grade optical fiber.

Features / Benefits

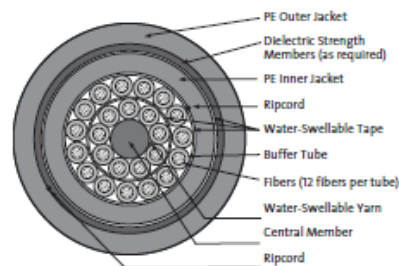
- Gel-free design is fully waterblocked using craft-friendly water-swellaable yarns and tapes, making cable access simple and requiring no clean up
- Flexible, craft-friendly buffer tubes are easy to route in closures
- Standard buffer tube size reduces the number of access tools required by a craft-person
- SZ-stranded, loose tube design isolates fibers from installation and environmental rigors and facilitates access
- Dielectric strength members have no preferential bend and require no bonding or grounding
- PE jacket is rugged, durable and easy to strip
- Meets industry standards and specifications including ICEA-640 and Telcordia GR-20



ALTOS Double-Jacket, Dielectric Gel-Free Cable | Drawing ZA-2825



72-Fiber ALTOS Double-Jacket, Dielectric Gel-Free Cable | Drawing ZA-2826



288-Fiber ALTOS Double-Jacket, Dielectric Gel-Free Cable | Drawing ZA-2827



Product Specifications

ALTOS® Double-Jacket/Dielectric Gel-Free Cables, 2-288 Fibers

An Evolant™ Solutions Product

Corning
Cable Systems

Specifications

Maximum Tensile Loads	Short-Term: 2700 N (600 lbf)
	Long-Term: 600 N (135 lbf)
Storage Temperature	-40° to +70°C (-40° to +158°F)
Installation Temperature	-30° to +70°C (-22° to +158°F)
Operating Temperature	-40° to +70°C (-40° to +158°F)

Fiber Count	Maximum Fibers per Tube	Number of Tube Positions	Nominal Weight kg/km (lb/1000 ft)	Nominal Outer Diameter mm (in)	Minimum Bend Radius Loaded cm (in)	Minimum Bend Radius Installed cm (in)
2-60	12	5	121 (81)	13.7 (0.54)	20.6 (8.1)	13.7 (5.4)
61-72	12	6	137 (92)	14.4 (0.57)	21.6 (8.5)	14.4 (5.7)
73-96	12	8	173 (116)	16.3 (0.64)	24.5 (9.6)	16.3 (6.4)
96-120	12	10	216 (145)	18.3 (0.72)	27.5 (10.8)	18.3 (7.2)
121-192	12	16	224 (150)	19.8 (0.78)	29.7 (11.7)	19.8 (7.8)
193-216	12	18	246 (165)	20.6 (0.81)	30.9 (12.2)	20.6 (8.1)
217-240	12	20	268 (180)	21.5 (0.85)	32.3 (12.7)	21.5 (8.5)
240-288	12	24	324 (218)	23.7 (0.93)	35.6 (14.0)	23.7 (9.3)



Adapted from:

Corning. (n.d.). ALTOS® Double-Jacket/Dielectric Gel-Free Cables, 2-288 Fibers. Product Specifications. <https://www.corning.com/>

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

- A. **SCANNING.** Scan **the complete text and examine the diagrams.** Then, choose the correct answer for each question. (5 points)

ESCANEO: Escanee **el texto completo y observe los diagramas.** Luego, seleccione la respuesta correcta a cada pregunta. (5 puntos)

1. How many jackets does the fiber optic cable have?
 - a. Two
 - b. Four
 - c. Six
2. What is the main function of the jackets?
 - a. Duct and aerial installation
 - b. Protection from the environment
 - c. Telecommunications
3. Where are the fibers located?
 - a. Inside the buffer tubes
 - b. Outside the inner jacket
 - c. Next to the ripcord
4. What type of yarns and tapes does the cable have?
 - a. Stranded
 - b. Water-swellable
 - c. Dielectric
5. What size is the nominal outer diameter of a fiber optic cable with 260 fibers?
 - a. 13.7 mm
 - b. 18.3 mm
 - c. 23.7 mm

Reading 2: IEEE Article

Proceedings of the 2008 International Conference on Electrical Machines

Paper ID 1199

Study on a Wave Energy Based Power System

Loránd SZABÓ, Claudiu OPREA, Clement FEȘTILĂ, Éva DULF

Technical University of Cluj
15, Daicoviciu str., 400020 Cluj, Romania
Tel: (+40)-264-401827, Fax: (+40)-264-593117
e-mail: Lorand.Szabo@mae.utcluj.ro

Abstract—Huge quantities of clean energy can be obtained from the waves of the oceans and seas. As wave energy extraction technology is currently in a preliminary state of development any new results in this field should be of real interest. A direct driven wave power conversion system to be placed in the Black Sea near the Romania shores was proposed and analyzed. The paper focuses on its linear generator, respectively on its power electronic and control system.

I. INTRODUCTION

The energy of the oceans and seas is a huge, yet unexploited renewable energy source on our planet the dynamic evolution of the ocean energy industry is emerging. An important feature of ocean energy resources is their high density, the highest one among the renewables [1].

The most well developed technologies for deriving electrical power from the ocean include tidal power, wave power and ocean thermal energy conversion. From these possibilities, the wave energy conversion seems to have the greatest general application [2].

The World Energy Council has estimated the global ocean wave power over 2 TW (which means 17,500 TWh/year) [3]. From this, it has been estimated that the practical economic contribution of the wave energy converters could be 2,000 TWh/year, similar to current installed nuclear or hydroelectric generation capacity.

Such generating capacity could result in up to 2 billion tones of CO₂ emissions being displaced from fossil fuel generation per year, similar to current emissions from electricity generation in the US [4].

The first wave energy device patent was registered in 1799 by Girard in Paris! Still then more than 1500 wave energy device patents had been registered. Historically, there have been two booms of interest in the research of wave energy, corresponding to the 1970's oil crisis and pollution concerns as well as concerns regarding natural resource reserves since the mid-1990's [5].

There are several *compelling* arguments for using the wave energy technology [6]:

- i.) By its high power density, it is one of the lowest cost renewable energy sources.
- ii.) The wave energy is more predictable than solar and wind energy, offering a better possibility of being dispatched to an electrical grid system.

iii.) The conversion of ocean wave energy to electricity is believed to be one of the most environmentally benign ways to generate electricity; hence, it does not render any waste that has to be stored or destroys the environment.

iv.) The wave energy conversion devices can be located far enough away from the shore (offshore) that they are generally not visible.

These are also some challenges when *deploying* wave power devices:

- i.) To convert efficiently the continuous wave motion into electricity. The wave power is available at low-speed, high forces. The motion of forces is not in a single direction. Usually the electric generators operate at higher speeds and require a constant input.
- ii.) The wave power converter devices has to survive storm damage and saltwater corrosion.
- iii.) High total cost of the generated electricity. Wave power will only be competitive when the total cost of generation is reduced, or when other energy sources will not be available. The total cost includes the wave power converter's costs, installation & maintenance cost, and electricity delivery costs.

Wave power plants as all the power plants in general, require some sort of control. In the first place, start up, close down and emergency procedures have to be designed and implemented. Secondly, control is required to deal with variable *grid* requirements and the wide variations in power available to the plant.

The latter point is particularly *critical* in wave energy plants, since the oscillatory wave power is quite random and so difficult to predict as power, voltage and frequency. Hence the design of the control system for such wave power plant is critical [7].

The greatest power in the wave fronts is in the Atlantic Ocean South-West of Ireland, in the Southern Ocean and off Cape Horn. Large portions of the world's potential wave energy resources are also found in sheltered waters and calmer seas, which often exhibit a milder, but still steady wave climate, as the Baltic, the Mediterranean, or the Black Sea.

In [8] the way of computing the monthly mean power density of the wave energy in the Black Sea near the Romanian shores was presented in details.

II. THE DIRECT DRIVEN WAVE ENERGY CONVERSION SYSTEM

- 13 The design requirement of a wave energy converter is to generate useful electricity supply from the kinetic and potential energy of irregular ocean waves. Numerous wave energy conversion (WEC) devices have been proposed, that rely on different modes of wave motion or electrical generation systems to achieve these design objectives [9].
- 14 The direct driven power take off system, which is intended to be used by us is the simplest possible. It uses a floating buoy joined together without intermediate mechanical systems with a linear generator. It works upon the difference in height between wave top and wave bottom [10].
- 15 The buoy, floating on the water's surface follows the motion of the wave [11]. The buoy is connected to a linear generator fixed on a concrete foundation, which stands on the bottom of the ocean (see Fig. 1).

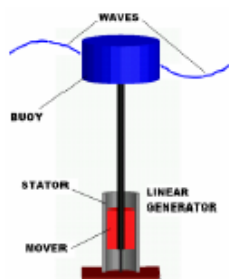


Fig. 1. The WEC system

- 16 The system is mechanically simple, with few moving parts. By optimizing the shape and operation of the buoy 90% absorption efficiency can be achieved [12].
- 17 Based on the particularities of the waves in the Black Sea, respectively on the selected wave power take off system the following main design data was established for the linear generator of the direct driven power take off system to be set up near the Romania shore of the Black Sea: 20 kW power, 120 V maximum voltage, 1 m/s speed and 1 m maximum stroke.

III. THE LINEAR GENERATOR

- 18 Based on the previous experiences and the given requirements a novel permanent magnet tubular linear generator was designed and analyzed [13]. Its main structure is given in Fig. 2.

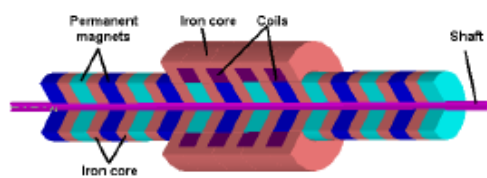


Fig. 2. The structure of the tubular linear generator

The mover consists of iron core rings fixed on a shaft alternated with permanent magnet rings magnetized in alternated radial direction. In the outer part is placed the winding and the stator iron core. This part of the generator is built up modularly. Each module has a ring type iron core having U-shaped cross-section with a coil inside.

In the structure given in Fig. 2 four coils are coupled together forming a single phase of the machine. Mounting three correctly shifted such groups of modules together a three-phase generator can be built up. By moving the armature with the permanent magnets, a varying magnetic flux will pass through the windings, generating emf.

The main characteristics of the linear generator in study were obtained via finite element method (FEM) based numeric field computations [14]. Both steady state regimes (where the speed of the generator is constant) and transient regimes (where the speed is continuously varying) were taken in study.

Due to the lack of space from the plenty results obtained via FEM based simulations here, in Fig. 3, only the flux plots in two positions of the mover are given.

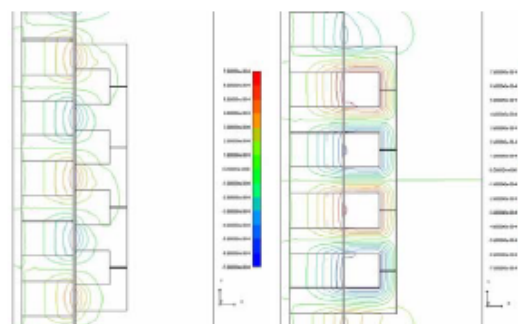


Fig. 3. The field lines obtained via field computations

By transient motion simulation the generated waveforms were computed for constant speed of the mover, respectively for one having sinusoidal variation, which is more similar to the actual movement of the waves. The generated voltage at a sinusoidal varying speed of the mover is given in Fig. 4.

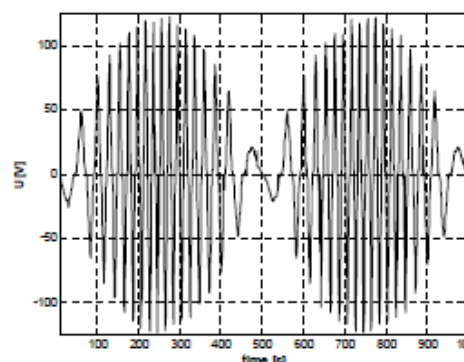


Fig. 4. The generated voltage

B. SCANNING. Scan **the complete text** and choose the correct answer for each question. (4 points)

ESCANEO: Escanee **el texto completo** y seleccione la respuesta correcta a cada pregunta. (4 puntos)

6. Who has estimated that the global ocean wave power is over 2 terawatts per year?
 - a. The 2008 International Conference on Electrical Machines
 - b. The Technical University of Cluj
 - c. The World Energy Council
7. When was the first patent of a wave energy device registered in history?
 - a. 1799
 - b. 1500
 - c. 1970
8. Where does the wave energy study described by the authors take place?
 - a. the Baltic Sea
 - b. the Black Sea
 - c. the Atlantic Ocean
9. Which figure shows a simple and full image of the wave energy device proposed by the authors?
 - a. Figure 1
 - b. Figure 2
 - c. Figure 3

C. TYPOGRAPHICAL CLUES. Read **paragraphs 1 to 6**. Choose the best option to complete each of the following statements. The parentheses in each item specify the part of the text where you can find the typographical clue. (4 points)

CLAVES TIPOGRÁFICAS: Lea los **párrafos 1 al 6**. Seleccione la mejor opción para completar las siguientes oraciones. Los paréntesis en cada ítem especifican la parte del texto en donde puede encontrar la clave tipográfica. (4 puntos)

10. The comma in **paragraph 2, line 4** ("An important feature of ocean energy resources is their high density, the highest one among the renewables.") introduces _____.
 - a. a definition
 - b. a clarification
 - c. a series of items

11. The parentheses in **paragraph 4, line 2** ("the global ocean wave power over 2 TW (which means 17,500 TWh/year))" indicate _____.
- an explanation
 - a definition
 - a range of numbers
12. The capital letters used in CO₂ in **paragraph 5, line 2** ("Such generating capacity could result in up to 2 billion tons of CO₂ emissions...") indicate _____.
- a contraction
 - possession
 - a formula
13. The apostrophe in **paragraph 6, line 5** ("...the 1970's oil crisis and pollution concerns") indicates _____.
- possession
 - a reference
 - a contraction
- D. **MEANING IN CONTEXT.** Choose the option that best fits the meaning of these words taken from **paragraphs 7 to 10**. Use the context clues in the reading to guess the meaning. The words are in *italics* in the reading. (4 points)
- DEDUZCA EL SIGNIFICADO POR EL CONTEXTO:** Seleccione la opción que mejor se ajusta al significado de las siguientes palabras tomadas de los **párrafos 7 al 10**. Use el contexto de la lectura para responder. Las palabras están en *cursiva* en la lectura. (4 puntos)
14. *compelling* (**paragraph 7, line 1**)
- strong
 - unusual
 - intense
15. *deploying* (**paragraph 8, line 1**)
- moving
 - testing
 - adopting
16. *grid* (**paragraph 9, line 5**)
- web
 - structure
 - network
17. *critical* (**paragraph 10, line 1**)
- dangerous
 - important
 - decisive

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- E. **MAIN IDEAS.** Read the following statements. Mark TRUE if they refer to true main ideas from the entire text or FALSE if they are not main ideas from the entire reading. (4 points)

IDEAS PRINCIPALES: Lea las siguientes oraciones. Marque TRUE (VERDADERO) si la oración se refiere a ideas principales en toda la lectura, o FALSE (FALSO) si no son ideas principales en toda la lectura. (4 puntos)

18. Power, voltage and frequency are difficult to predict in wave power plants.

- a. True
- b. False

19. Large quantities of clean energy can be obtained from the waves of the oceans and seas.

- a. True
- b. False

20. A simple wave converter system, consisting of a buoy joined to a generator, can generate a useful electricity supply from the kinetic and potential energy of ocean waves.

- a. True
- b. False

21. Finite-element method computations provided the main characteristics of the linear generator by considering steady-state regimes (with constant speed) and transient regimes (with varying speed).

- a. True
- b. False

- F. **FACT AND OPINION.** Read the following excerpts. Then, choose if the statement is a FACT or an OPINION. (4 points)

HECHOS Y OPINIONES: Lea las siguientes citas textuales. Luego, elija FACT si el enunciado es un hecho u OPINION si el enunciado es una opinión. (4 puntos)

22. "The most well-developed technologies for deriving electrical power from the ocean include tidal power, wave power and ocean thermal energy conversion". From these possibilities, the wave energy conversation seems to have the greatest general application." (**paragraph 3**)

- a. Fact
- b. Opinion

23. "iii. The conversion of ocean wave energy to electricity is believed to be one of the most environmentally benign ways to generate electricity." (**paragraph 7**)

- a. Fact
- b. Opinion

- ### III. WRITING.

Instrucciones: Lea el siguiente párrafo y escriba un correo con la información requerida. Extensión: 10 líneas mínimo y 15 líneas máximo. (25 puntos)

26. UCR is currently offering Electrical Engineering students the opportunity to apply for a student exchange program to study at one of their partner universities in the United States. As part of the process, students are required to send an application email to the exchange program at the target university. Write an email to let them know why you are interested and how you would benefit if selected. Be sure to include the following information:
- Write the email subject on the first line.
 - Introduce yourself.
 - Describe your academic qualifications.
 - Refer to your plans and expectations from an educational and professional perspective.

[illegible]

IV. LISTENING COMPREHENSION:

Instructions: Listen to the following audios and then choose the best option for each question. You may listen to each audio a maximum of two times. (15 points)

Instrucciones: Escuche los siguientes audios y luego elija la opción que mejor corresponda para cada pregunta. Puede escuchar cada audio un máximo de dos veces. (15 puntos)

Listening 1: Solar Panels (Part 1)

Instructions: Listen to Richard Komp explain how solar panels work. First, read all the questions and options. Then, listen and choose the correct answer. (5 points)

Instrucciones: Escuche a Richard Komp explicar cómo funcionan los paneles solares. Primero lea todas las preguntas y opciones. Luego escuche y elija la opción correcta. (5 points)

Retrieved from: <https://ed.ted.com/lessons/how-do-solar-panels-work-richard-komp>

27. According to Komp, solar panels are composed of _____.
- a. solar cells
 - b. solar energy
 - c. electrical energy
 - d. conductive layers
28. The four bonds that connect each silicon atom to their neighbor keep the electron _____.
- a. moving around
 - b. fixed in position
 - c. wandering across the P/N junction
 - d. sandwiched between conductive layers
29. A P-type silicon has _____ electrons.
- a. extra
 - b. no extra
 - c. extra spaces for
 - d. no extra spaces for
30. What happens right after a silicon cell is struck by photons? The electron _____.
- a. leaves a hole
 - b. goes only one way
 - c. moves to the N-side
 - d. moves to the P-side

31. Where do mobile electrons go after being collected at the top of the cell? They _____.
a. flow through an internal circuit
b. flow through an external circuit
c. go back where they came from
d. return through a conductive aluminum sheet

Listening 2: Solar Panels (Part 2)

Instructions: Listen to the second part of the audio and then choose the best option for each question. (5 points)

Instrucciones: Escuche la segunda parte del audio y luego elija la opción que mejor corresponde para cada pregunta. (5 points)

Retrieved from: <https://ed.ted.com/lessons/how-do-solar-panels-work-richard-komp>

32. According to the audio, what would be required to be completely reliant on solar energy demand?
a. Using cells with a design that captures a broader range of the sun's light.
b. Building larger systems to generate the same amount of solar power in less sunny locations.
c. Pairing the panels with a solar battery that can help store up the energy of sunny days for a cloudy one.
d. Finding a method to take solar energy from sunny to cloudy areas in such a way as to avoid loss or waste.
33. Based on the recording, which is one factor that limits a cell's ability to convert sunlight into electricity?
a. Wavelength
b. Temperature
c. Shading
d. Reflection
34. What does the speaker imply about the efficiency of solar panels? Solar panels _____.
a. require difficult extraction procedures
b. have a low conversion efficiency and competitiveness
c. is one of the most popular sources of renewable energy
d. can be turned into electricity in an efficient and cost-effective way
35. What is Komp's opinion about innovations? He believes that _____.
a. solar energy will become less expensive every day
b. solar panels are likely to become popular in the near future
c. floating solar panels will replace the conventional power system
d. floating solar panels allow for clean energy generation without the use of land

36. What is the main idea of the audio?

- a. Komp is skeptical about full reliance on solar power due to physical and logistic limitations like uneven distribution and cell inefficiency.
- b. According to Komp, lack of space for solar cell infrastructure remains limited even as quality and costs improve.
- c. Komp is positive that with sufficient financial support, the entire world could rely on solar power in spite of existing limitations.
- d. Komp believes that better quality and lower prices will lead to solar cells powering the entire world in a few years.

Listening 3: Electrical and Electronics Engineering

Instructions: Listen to an audio from a television news broadcast. First, read each statement carefully. Then, choose TRUE or FALSE based on the information provided in the audio. (5 points)

Instrucciones: Escuche el audio de un programa de televisión. Primero, lea cada ítem cuidadosamente. Luego, marque TRUE (VERDADERO) o FALSE (FALSO) con base en la información del audio. (5 points)

Retrieved from: https://www.youtube.com/watch?v=fhAZ2tZj84A&ab_channel=CareerOneStop

37. Electronics engineers design, develop, and supervise device manufacturing for use in fields such as telecommunications.

- a. True
- b. False

38. Electrical engineers develop and install electrical equipment such as navigation systems, and they may also test satellites and flight systems.

- a. True
- b. False

39. Being able to understand technical manuals and guidelines is a key requirement for engineers.

- a. True
- b. False

40. Since engineers always work in teams, they require excellent communication skills.

- a. True
- b. False

41. Not holding a graduate degree decreases their chances of getting a job.

- a. True
- b. False

V. SPEAKING

Instructions:

- This section of the diagnostic test will be conducted as a virtual interview via Zoom.
- It is the student's responsibility to have the proper equipment and Internet connection to complete the test.
- Make sure you are in a quiet, undisturbed location.
- Check that your computer, tablet, or cell phone has a charged battery and that the microphone and video are working properly.
- Log into Zoom at the scheduled time and date. To do so, click on the link sent by the professors to your registered email.
- Punctuality is appreciated as appointments are scheduled every 10 minutes, so a delay will affect students and teachers.
- It is recommended to log in 10 minutes before the time indicated in the appointment.
- Wait in the waiting room until the teachers give you access.
- Check that you can hear and be heard.
- Identify yourself by showing your ID card to the camera.
- Students will be provided with a series of questions to be answered as required.
- Students have a maximum of 7 minutes to answer all the questions. The professor may grant the students 1 or 2 minutes to organize the ideas. After that time, the teachers will indicate that the deadline has passed and will end the session with the students.
- Tests will be recorded as a backup of having performed the test.
- If a student fails to log into the session at the scheduled time and date, he or she will not be able to take the test.
- The speaking test is 25 points.

Instrucciones:

- Esta sección de la prueba de diagnóstico se realizará como una entrevista virtual vía Zoom.
- Es responsabilidad del estudiante tener el equipo y la conexión de Internet adecuados para completar la prueba.
- Asegúrese de estar en un lugar silencioso y sin interrupciones.
- Compruebe que su computadora, tableta o teléfono celular tiene la batería cargada y que el micrófono y el video funcionan correctamente.
- Ingrese a Zoom a la hora y la fecha programadas. Para ello, haga clic en el enlace enviado por los profesores a su correo electrónico registrado.
- Se agradece la puntualidad ya que las citas están programadas cada 10 minutos, por lo que un atraso afectaría a los estudiantes y profesores.
- Se recomienda conectarse 10 minutos antes de la hora indicada en la cita.
- Manténgase en la sala de espera hasta que los profesores le den acceso.
- Verifique que puede escuchar y ser escuchado.
- Identifíquese mostrando su cédula o carné estudiantil a la cámara.
- Se proporcionará a los estudiantes una serie de preguntas que deben contestar según se les solicite.
- Los estudiantes disponen de un máximo de 7 minutos para responder la totalidad de las preguntas. El profesor podrá conceder 1 o 2 minutos adicionales para organizar las ideas. Transcurrido el tiempo, los docentes procederán a indicarles que ya se cumplió el plazo y finalizarán la sesión con los estudiantes.
- Las sesiones serán grabadas como respaldo de haber realizado la prueba.
- Si un estudiante no se conecta a la sesión en la fecha y hora previstas, no podrá realizar la prueba.
- Esta sección tiene un valor de 25 puntos.

Oral Interview (Sample Questions)

Warm-up:	- How are you? - What's your name? - Where are you from?
Level check: Basic: 0-10 points	1. Describe yourself: - Can you tell me a little about yourself? 2. Describe your academic field: - What are you studying? / What is your emphasis or specialization? 3. Describe your likes/dislikes: - What do you like and dislike about Electrical Engineering? 4. Describe a hobby that you have: - What do you usually do in your free time? 5. Describe a past experience: - Where did you learn English? - What did you do yesterday? 6. Describe a plan: - What are you going to do this weekend?
Independent: 11-20 points	1. How long have you studied Electrical Engineering? 2. Can you tell me about a significant experience while studying Electrical Engineering? 3. What problems have you experienced with virtual education? 4. Why is English important for electrical engineers? 5. What specific activities would you like to learn more about in an English course? 6. Where would you like to work in the future? Why? 7. What are the advantages of studying English for electrical engineers? 8. What are some examples of activities performed by electrical engineers at work? 9. Describe some safety measures required when working with electricity. 10. Describe the steps to present a lab report at school. 11. What recommendations would you give to send a formal email?

Proficient (Probe): 21-25 points	1. Why is it important to study Electrical Engineering? 2. What are some of your academic and professional goals? 3. Can you predict what will happen with power generation/telecommunications/artificial intelligence in the future in Costa Rica and globally? 4. Why is renewable energy important for generating electricity?
Wind-down:	- Do you have any questions you want to ask me? - Thank you very much. We will let you know about the results from this interview as soon as possible. - It was interesting to talk with you.

Appendix G

Writing Assessment Rubric

Assessment criteria	Proficient (C1 - C2) 5 points	Independent (B1 - B2) 3 points	Basic (A1 – A2) 1 point	Total Score
Organization	Can produce a clear, smoothly flowing, well-structured text, showing controlled use of organizational patterns, connectors and cohesive devices.	Can link a series of shorter discrete elements into a connected, linear text.	Can link words or groups of words with very basic linear connectors like “and,” “but,” “because,” and “then.”	
Content	The email is well developed, using clearly appropriate explanations, exemplifications and/or details.	The email is generally well developed, using appropriate and sufficient explanations, exemplifications and details.	Inadequate connection of ideas. Insufficient explanations, exemplifications and/or details.	
Grammar	Maintains consistent and highly accurate grammatical control of even the most complex language forms. Errors are rare and concern rarely used forms.	Shows a relatively high degree of grammatical control. Does not make errors which cause misunderstandings.	Shows only limited control of a few simple grammatical structures and sentence patterns in a memorized repertoire. Errors may cause misunderstandings.	
Mechanics	Correct use of English writing conventions: capitals, punctuation, and spelling.	Some problems with writing conventions or punctuation; occasional spelling errors.	Uses general writing conventions but has errors; spelling problems distract the reader; punctuation errors interfere with ideas.	
Style and quality of expression	Precise vocabulary usage. Can express oneself with clarity, using language flexibly and effectively.	Good vocabulary usage. Can use formality and conventions appropriate to the context most of the time.	Problems with vocabulary. Can write a short and simple piece of writing with some difficulties.	
Total Score/ Comments:				

Appendix H

Speaking Assessment Rubric

	Score	Criteria
Content	0.2	- Ability to ask and answer questions about personal details. Simple communication totally dependent on repetition, rephrasing and repair. - Poor development of information and knowledge of the topic.
	0.4	- Ability to ask and answer questions and respond to simple statements, mainly on familiar topics or areas of immediate need. - Little information and knowledge of the topic.
	0.6	- Ability to maintain a simple conversation on topics that are familiar or of personal interest, and to provide a brief description or narration. - Fair development of information and knowledge of the topic.
	0.8	- Ability to develop relevant ideas and viewpoints on most general and specialized topics, and to give a detailed description or narration. - Sufficient information and knowledge of the topic.
	1	- Ability to develop a wide range of ideas and viewpoints on complex topics, even integrating subthemes.
Fluency	0.2	- Very short, isolated, pre-packaged utterances. - Long pauses to search for expressions or to repair communication. - Hesitant and incomplete statements.
	0.4	- Short utterances. - Some pauses, false starts and reformulation. - Flow of speech disrupted by several gaps.
	0.6	- Fair stretches of language. - Occasional use of pauses for planning followed by recovery, especially in longer stretches of free production.
	0.8	- Long stretches of language with few hesitations. - Few pauses for searching for expressions. - Continuous flow of speech.
	1	- Fluent and spontaneous speech, almost effortlessly. - Smooth flow of speech with no hesitations.
Grammar	0.2	- Limited control of a few simple grammatical structures and sentence patterns. - Very inaccurate communication. Meaning disrupted by too many errors and structural problems.
	0.4	- Use of some simple grammatical structures and sentence patterns. - Inaccurate communication. Meaning disrupted by some errors and structural problems.
	0.6	- Reasonable repertoire of patterns related to predictable situations. - Accurate communication with a few errors and structural problems.
	0.8	- Relatively high degree of grammar accuracy. Use of some complex sentence forms. - Very accurate communication with minor structural problems that do not affect meaning. Self-correction.
	1	- High degree of grammar accuracy. Use of complex sentence forms. - Errors are rare and difficult to spot. Self-correction.

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	Score	Criteria
Pronunciation	0.2	- Poor pronunciation. Too many errors.
	0.4	- Several pronunciation and intonation problems. Meaning is often unclear.
	0.6	- Some pronunciation and intonation problems. Meaning is understood but with problems.
	0.8	- Minor pronunciation errors but immediately continued.
	1	- Few errors. Native-like pronunciation.
Vocabulary	0.2	- Very basic repertoire of words and simple phrases related to personal details and particular concrete situations. - Meaning disrupted by too many errors.
	0.4	- Basic groups of words and memorized phrases to communicate limited information on simple everyday situations. - Many vocabulary errors. Meaning is often unclear.
	0.6	- Sufficient vocabulary to get by. Some hesitation and circum-locutions. - Some vocabulary errors, but meaning is clear.
	0.8	- Sufficient vocabulary to give descriptions and express viewpoints on most general and specialized topics. - Lack of errors. Meaning is clear.
	1	- Good command of a broad range of vocabulary to express himself on a wide range of general, academic, and professional topics. - Lack of errors. Meaning is clear.
Total Score	1-10	- Basic User (A1 - A2)
	11-20	- Independent User (B1 - B2)
	21-25	- Proficient User (C1)

Appendix I

Students' Syllabus



University of Costa Rica

Master's Program

Instructors: Andrea Morales Oliverio and María Araya Porras

II-2021 - Online modality

I. Course Description

ESP Dynamo: An Online English Course for Electrical Engineering Students is an English for Specific Purposes (ESP) course designed as part of the final graduation project for the Master's Program in Teaching English as a Foreign Language at the University of Costa Rica (UCR). The main purpose is to meet the specific English language needs, lacks, and wants, as well as address the learning styles and preferences of Electrical Engineering students for an adequate and effective performance in academic and future work-related settings. The four macro skills (speaking, listening, reading, and writing) will be covered throughout the course, with emphasis on productive skills.

This course is addressed to a group of 20-25 students from the School of Electrical Engineering at UCR with a perceived Independent level of proficiency in English (B1 and B2). The course will be taught over 16 weeks in the second cycle of 2021, three hours a week. The course schedule is Tuesdays from 5:00 pm to 7:00 pm (synchronous session via Zoom) and from 7:00 pm to 8:00 pm (asynchronous modality). The course will be taught by two student-teachers acting as language instructors under the supervision of professors from the Master's program. The course has no co-requisites, and it will be offered in a 100% online modality.

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Students will be provided with the materials every week by the instructors. A certificate of completion will be granted to students with a passing grade of 80 or higher at the end of the course.

II. Statement of Goals and Objectives**Unit 1: Powering-up Reading Skills*****Goal 1***

By the end of the unit, the students will be able to successfully demonstrate understanding of technical readings for academic purposes by identifying main ideas, locating specific details, and making a critical judgement through the use of top-down and bottom-up strategies.

General Objectives

By the end of the lesson, the students will be able to:

1. effectively identify the main ideas in a technical text about the integration of energy storage systems and renewable energy through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.
2. accurately locate relevant specific details in a technical text about a satellite project through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.
3. successfully make a critical judgement about technical texts related to Power Systems, Telecommunications, and Computing and Networking through the use of reading comprehension strategies such as identification of facts and opinions.

Unit 2: Empowering Communication at Work**Goal 2**

By the end of the unit, the students will be able to actively interact with prospective English-speaking professionals by role-playing work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting.

General Objectives

By the end of the lesson, the students will be able to:

1. successfully role-play a small-talk conversation for networking with other participants at an international conference on Electrical Engineering by using appropriate starters, exchanging opinions, and sharing contact information before leaving the conversation.
2. successfully role-play a job interview at a company that requires electrical engineers by discussing their own academic or work experience, skills and achievements, and professional goals based on their résumé.
3. appropriately make a telephone call to coordinate a technical site visit by using proper openings and closings, scheduling the date (e.g., suggesting and agreeing on the date), and making and responding to suggestions politely (safety measures).

Unit 3: Engineering the Future**Goal 3**

By the end of the unit, the students will be able to effectively describe orally and in writing their interest in participating in an international fair, an innovative product or system in the field of Electrical Engineering, and a business idea for a solution to a problem.

General Objectives

By the end of the lesson, the students will be able to:

1. properly write an email to express their interest in participating in an international fair or exchange program by analyzing illustrative texts and following the basic stages of the writing process (planning, drafting, editing, and final drafting).
2. successfully describe a hydroelectric, wind, or geothermal power generation, transmission, and distribution process orally in a meeting by identifying the main technical components of the system, explaining the steps required for its operation, and using a mind map as guide for the presentation while working in groups.
3. effectively design and present a business idea in the field of Electrical Engineering, including information about the entrepreneurs, the problem to be solved, and the value proposition or competitive advantages of the proposed product or service.

III. Methodology

Activities and Tasks

To achieve the course goals and objectives, the students will have to carry out activities and tasks related to different academic and professional settings in the field of Electrical Engineering, for example, reading technical documentation, interacting in an international conference, participating in a job interview, making a telephone call, writing a formal email, and presenting a product and a business idea. Therefore, during the online sessions, the students will be able to put into practice their language skills through reading comprehension exercises, conversations or dialogues (role-plays), oral presentations, writing assignments, and listening comprehension activities. Moreover, the students will be exposed to online resources and multimedia exercises (audios, videos, games, etc.), pair- and group activities, visual aids, technical simulations, and problem-solving cases, among others. Thus, ESP Dynamo will provide practice opportunities and a supportive classroom environment to foster creativity, active interaction, confidence, and motivation. Attendance, active participation, critical thinking, and respectful feedback are expected of students at all times.

IV. Assessment

The students' performance will be assessed as follows:

Type of Assessment	Percentage
a. Unit 1: Reading test	25%
b. Unit 2: Speaking test	25%
c. Unit 3: Written assignment	10%
d. Unit 3: Oral presentation	15%
e. All units: Course portfolio and technical glossary	25%
Total	100%

V. Contents

The following units will be studied as part of the ESP Dynamo course:

1. Unit 1: Powering-up Reading Skills
2. Unit 2: Empowering Communication at Work
3. Unit 3: Engineering the Future

Appendix J**Assessment Instrument for Students' Performance (Achievement Test)**

University of Costa Rica
Master's Program in TEFL
Morales, A.; Araya, M.

Unit 2 - Lesson 4

Students' Performance Test

This test is part of the assessment plan of ESP Dynamo: An Online English Course for Electrical Engineering Students. The main purpose of the test is to evaluate the students' ability to role-play work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting by producing chunks of language of different lengths, fluent speech, correct grammatical structures, appropriate pronunciation, and an adequate repertoire of vocabulary.

General Instructions:

1. Turn on your camera and audio settings.
2. Each group of students will be assigned a role-play situation at random.
3. Each group has maximum of five minutes to perform the role-play. The teachers will give the students five minutes for planning and organizing ideas before the role-play.
4. Remember to find a balance when interacting by giving your peer opportunities for participating. A student should not monopolize the conversation.
5. If you have a question, use the "raise hand" tool or submit your question to the teachers via chat. The teachers will help you as soon as possible.
6. This session will be recorded as a backup of having performed the test.
7. The speaking test is 25 points (25%). A minimum passing grade of 7 is required.



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Unit 2 - Lesson 4

Students' Performance Test – Situation 1

Instructions: Work in groups. Imagine you are attending an international conference on Electrical Engineering. It is the first coffee break and you see a lot of people talking to each other. Role-play a conversation between conference attendees. Rehearse with your partner(s) and be ready to present in front of the class.

Key words: *experience, motivation, expectation, goals, opinion, topic, agree/disagree, agenda, participants, speaker, research, event, venue, talk, networking, business cards, social media.*

Follow these steps for making small talk:

Student A and B: Conference attendees

1. Greet the other attendee and introduce yourself.
2. Ask each other questions about motivation for attending the conference, opinion about the conference topics, academic/professional experience, and nationality, among others.
3. Show interest during the conversation, make eye contact, and listen carefully.
4. When appropriate, talk about something interesting or surprising about who you are or what you do.
5. Exchange your business cards or contact information (e.g., email address or social networks), and set up a future meeting for developing a future technical project for your country, if applicable.



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Morales, A.; Araya, M.

Unit 2 - Lesson 4

Students' Performance Test – Situation 2

Instructions: Work in groups. Imagine you are at a job interview. Role-play a conversation between the employer and the job applicant. Rehearse with your partner(s) and be ready to present in front of the class.

Key words: *résumé, profile, academic/professional experience, soft and hard skills, motivation, goals, availability, training, ability, knowledge, qualifications, position, degree, major, certificate.*

Follow these steps for the job interview:

Student A: Employer

1. You are a very formal manager looking for a new electrical engineer to work at [name of the company].
2. Welcome the job applicant and introduce yourself.
3. Provide a brief description of the company and the position. Then, ask questions about the applicant's personal information, experience, skills, and goals. Answer any questions the applicant may have.
4. Show interest during the conversation, make eye contact, and listen carefully.
5. Ask the job applicant about his/her availability and provide information about any future steps of the application and hiring process, if applicable.

Student B: Job Applicant

1. You are looking for a position as an electrical engineer. You really want to get a job and give a good impression during the interview.
2. Greet the interviewer and introduce yourself.
3. Answer the questions with your own ideas. Tell the interviewer about your profile, experience, skills, and goals. Ask the interviewer a question about the job.
4. Show interest during the conversation, make eye contact, and listen carefully.
5. Tell the interviewer about your availability and provide your résumé or any additional information. Ask the interviewer about any future steps of the application and hiring process, if applicable.



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Unit 2 - Lesson 4

Students' Performance Test – Situation 3

Instructions: Work in groups. Imagine you are making a telephone call to coordinate a technical site visit. Role-play a conversation between an engineer and an English-speaking consultant. Rehearse with your partner(s) and be ready to present in front of the class.

Key words and expressions: *agenda, site visit, inspection, hazard, safety measure, personal protective equipment, availability, inconvenience, head offices, chip assembly plant, power plant, telecommunications facility.*

Follow these steps for the telephone call:

Student A: Electrical engineer

1. You are an electrical engineer working at [name of the company]. You need to call an engineering consultant to coordinate a site visit.
2. Introduce yourself, identify the company you work for, and state the reason for the call.
3. Propose a date and a time (offer at least two different options to arrange the meeting), and make suggestions about the safety equipment and measures required for the visit.
4. Show interest during the conversation, make eye contact, and listen carefully.
5. Summarize the details of the meeting for confirmation and use a closing phrase with a future focus to finish the call.

Student B: Engineering consultant

1. You are a consultant from [name of the company]. You will receive a call to schedule a site visit to ensure regulatory compliance with international standards.
2. Greet the engineer, introduce yourself, and identify the company you work for.
3. Propose a date and a time (negotiate at least two different options to arrange the meeting) and ask for suggestions about the safety equipment and measures required for the visit.
4. Show interest during the conversation, make eye contact, and listen carefully.
5. Confirm the details of the meeting and use a closing phrase with a future focus to finish the call.



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Unit 2 - Lesson 4

Speaking Assessment Rubric

Student's Name: _____ Role-Play Situation: _____

Score	Content
1	- Ability to ask and answer questions about personal details. Simple communication totally dependent on repetition, rephrasing and repair. - Poor development of information and knowledge of the topic.
2	- Ability to ask and answer questions and respond to simple statements, mainly on familiar topics or areas of immediate need. - Little information and knowledge of the topic.
3	- Ability to maintain a simple conversation on topics that are familiar or of personal interest, and to provide a brief description or narration. - Fair development of information and knowledge of the topic.
4	- Ability to develop relevant ideas and viewpoints on most general and specialized topics, and to give a detailed description or narration. - Sufficient information and knowledge of the topic.
5	Ability to develop a wide range of ideas and viewpoints on complex topics, even integrating subthemes.
Score	Fluency
1	- Very short, isolated, pre-packaged utterances. - Long pauses to search for expressions or to repair communication. - Hesitant and incomplete statements.
2	- Short utterances. - Some pauses, false starts and reformulation. - Flow of speech disrupted by several gaps.
3	- Fair stretches of language. - Occasional use of pauses for planning followed by recovery, especially in longer stretches of free production.
4	- Long stretches of language with few hesitations. - Few pauses for searching for expressions. - Continuous flow of speech.
5	- Fluent and spontaneous speech, almost effortless. - Smooth flow of speech with no hesitations.

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Score	Grammar
1	- Limited control of a few simple grammatical structures and sentence patterns. - Very inaccurate communication. Meaning disrupted by too many errors and structural problems.
2	- Use of some simple grammatical structures and sentence patterns. - Inaccurate communication. Meaning disrupted by some errors and structural problems.
3	- Reasonable repertoire of patterns related to predictable situations. - Accurate communication with a few errors and structural problems.
4	- Relatively high grammar accuracy. Use of some complex sentence forms. - Very accurate communication with minor structural problems that do not affect meaning. Self-correction.
5	- High degree of grammar accuracy. Use of complex sentence forms. - Errors are rare and difficult to spot. Self-correction.
Score	Pronunciation
1	Poor pronunciation. Too many errors.
2	Several pronunciation and intonation problems. Meaning is often unclear.
3	Some pronunciation and intonation problems. Meaning is understood but with problems.
4	Minor pronunciation errors but immediately continued.
5	Few errors. Clear and correct pronunciation.
Score	Vocabulary
1	- Very basic repertoire of words and simple phrases related to personal details and particular concrete situations. - Meaning disrupted by too many errors.
2	- Basic groups of words and memorized phrases to communicate limited information on simple everyday situations. - Many vocabulary errors. Meaning is often unclear.
3	- Sufficient vocabulary to get by. Some hesitation and circumlocutions. - Some vocabulary errors, but the meaning is clear.
4	- Sufficient vocabulary to give descriptions and express viewpoints on most general and specialized topics. - Lack of errors. The meaning is clear.
5	- Good command of a broad range of vocabulary to express on a wide range of general, academic, and professional topics. - Lack of errors. The meaning is clear.
Total:	Comments:

Score obtained: _____

Percentage: _____

Final grade: _____

Appendix K

Assessment Instrument for ESP Course Evaluation after Unit 1, 2, and 3



University of Costa Rica

Master's Program

Instructors: Andrea Morales Oliverio and María Araya Porras

II-2021 - Online modality

ESP Course Evaluation

The purpose of this evaluation form is to gain insight into the students' opinion about the usefulness and the quality of the English course for Electrical Engineering Students. The information gathered in this questionnaire is strictly confidential.

Part I

Instructions: Please indicate your level of agreement with the statements below.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. The objectives of Unit X were clear, precise, and specific.				
2. The course was well organized and easy to follow.				
3. Unit X included a variety of activities and strategies to encourage participation.				
4. The course materials used in Unit X were appealing and appropriate.				
5. The course evaluation for Unit X was related to the tasks done in class.				
6. The contents of Unit X were useful and relevant for my <u>academic</u> development.				
7. The contents of Unit X were useful and relevant for my <u>professional</u> development.				
8. The workload of Unit X was manageable.				
9. The level of difficulty of Unit X was appropriate.				

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	Strongly Disagree	Disagree	Agree	Strongly Agree
10. Unit X gave me the opportunity to improve my language skills.				
11. Unit X promoted critical, diverse, and innovative thinking.				
12. Overall, I feel satisfied with the course so far.				

Part II

Instructions: Please rate the following learning preferences based on their level of usefulness for you, where 1 is “the least useful” and 4 is “the most useful.”

	1	2	3	4
1. Multimedia exercises (audios, videos, games, etc.)				
2. Conversations with my classmates				
3. Oral presentations				
4. Forums				
5. Pronunciation exercises				
6. Language tips posted in Google Classroom				
7. Use of visual aids (diagrams, graphs, images, etc.)				
8. Individual work				
9. Group or pair work				
10. Corrections made individually right at the moment (immediate feedback)				
11. Corrections made individually after class (delayed feedback)				
12. Corrections made as a group (whole-class)				

Part III**Instructions:** Please answer the following questions.

1. What aspects of Unit X did you find the most worthwhile? Provide examples.

2. What aspects of Unit X did you find the least worthwhile? Provide examples.

3. What specific recommendations would you provide to improve Unit X and the course in general?

4. Do you have any additional comments?

5. In general, what grade from 1 to 10 would you give to Unit X of the ESP Dynamo Course (with 1 being the lowest and 10 being the highest score)?

1	2	3	4	5	6	7	8	9	10

Thank you for your participation!

Appendix L**Assessment Instrument for Student-Teachers' Performance**

University of Costa Rica

Master's Program

Instructors: Andrea Morales Oliverio and María Araya Porras

II-2021 - Online modality

Teacher Evaluation

Teacher's name: _____

This survey aims to obtain information about the instructors' performance during the English course for Electrical Engineering Students (specifically during the development of Unit X).

Part I

Instructions: Please choose the option that best describes your teacher's performance for each of the following statements:

Teacher's performance	Never	Rarely	Usually	Always
1. The teacher is well prepared and organized for every class.				
2. The teacher explains the course material and activities clearly.				
3. The teacher is always willing to answer questions.				
4. The teacher uses examples to make materials easy to understand.				
5. The teacher provides useful feedback on my performance.				
6. The teacher is knowledgeable about the topics presented in the course.				
7. The teacher appropriately manages class time and pacing.				

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Teacher's performance	Never	Rarely	Usually	Always
8. The teacher appears enthusiastic to promote interest and participation in the course.				
9. The teacher shows interest in helping the students to create a positive learning environment.				
10. The teacher challenges the students to do their best work.				

Part II

Instructions: Answer the following questions.

1. Please comment on what the teacher has done well so far and/or what she can improve.

2. In general, what grade from 1 to 10 would you give to the teacher's performance (with 1 being the lowest and 10 being the highest score)?

1	2	3	4	5	6	7	8	9	10

Thank you for your feedback!

Appendix M

Official Correspondence Between ACTFL and CEFR Ratings

Figure A1

Official Correspondence Between ACTFL and CEFR Ratings for Speaking

ONE-DIRECTIONAL ALIGNMENT: Receptive Skills – Reading and Listening		ONE-DIRECTIONAL ALIGNMENT: Productive Skills – Speaking and Writing	
Rating on ACTFL Assessment (LPT, RPT or L&Rcat)	Corresponding CEFR Rating	Rating on ACTFL Assessment (OPI, OPIc or WPT)	Corresponding CEFR Rating
Distinguished	C2		
Superior	C1.2	Superior	C2
Advanced High	C1.1	Advanced High	C1
Advanced Mid	B2	Advanced Mid	B2.2
Advanced Low	B1.2	Advanced Low	B2.1
Intermediate High	B1.1	Intermediate High	B1.2
Intermediate Mid	A2	Intermediate Mid	B1.1
Intermediate Low	A1.2	Intermediate Low	A2
Novice High	A1.1	Novice High	A1
Novice Mid	0	Novice Mid	0
Novice Low	0	Novice Low	0
0	0	0	0

Adapted from:

American Council on the Teaching of Foreign Languages, ACTFL. (n.d.). *Assigning CEFR Ratings to ACTFL Assessments*. ACTFL Language Connects. https://www.actfl.org/sites/default/files/reports/Assigning_CEFR_Ratings_To_ACTFL_Assessments.pdf

Appendix N**Lesson Plans, Handouts, and Key Answer Sheets for the ESP Dynamo Course****Table A1***Summary of Units and Lessons*

Unit 1: Powering-up Reading Skills
a. Lesson 1: Identifying main ideas
b. Lesson 2: Identifying specific details
c. Lesson 3: Identifying facts and opinions
d. Lesson 4: Assessment task for Unit 1
Unit 2: Empowering Communication at Work
a. Lesson 1: Conference
b. Lesson 2: Job Interview
c. Lesson 3: Telephone Call
d. Lesson 4: Assessment task for Unit 2
Unit 3: Engineering the Future
a. Lesson 1: Writing an email
b. Lesson 2: Description of a project or system
c. Lesson 3: Business idea
d. Lesson 4: Assessment task for Unit 3



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Unit 1: Powering-up Reading Skills

Lesson 1: Identifying main ideas

Date: August 24, 2021

Unit Goal: By the end of the unit, the students will be able to successfully demonstrate understanding of technical readings for academic purposes by identifying main ideas, locating specific details, and making a critical judgement through the use of top-down and bottom-up strategies.

General Objective: By the end of the lesson, the students will be able to effectively identify the main ideas in a technical text about the integration of energy storage systems and renewable energy through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.

Specific Objectives: By the end of this lesson, the students will be able to...

1. effectively brainstorm general ideas about the topic of the technical article by individually completing an online matching exercise about energy storage systems, renewable energy, and artificial intelligence;
2. appropriately identify the topic of the reading by skimming key paragraphs from the technical article while interacting in groups;
3. appropriately locate specific information within the text by scanning key paragraphs from the technical article while interacting in groups;
4. correctly recognize the function of punctuation marks used as typographical clues in the technical article by completing a multiple-choice exercise in groups;
5. correctly identify rhetorical patterns (e.g., listing, definition, and problem-solution, among others) through key words used as contextual clues in the technical article by answering a multiple-choice exercise in groups;

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6. successfully classify statements as true or false based on the main ideas of the technical article by using previously studied reading strategies (skimming, scanning, and typographical and contextual clues) while interacting in groups;
7. correctly select key technical vocabulary and sample sentences by scanning the complete article individually in order to create a list, and
8. correctly discriminate the pronunciation of the -ed endings of regular verbs in simple past tense by classifying a list of verbs from the technical article as /t/, /d/, or /id/.

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Brainstorming and making predictions T reviews the objective of the class and then shares a link to an online matching exercise via the Zoom chat. T briefly explains the technical procedure for accessing the platform and gives instructions for the exercise. Ss access the online platform WordWall.net through this link: https://wordwall.net/play/20623/407/779 and complete the activity individually. Once Ss are finished, T shares the screen and asks some volunteers to help her associate the pictures to their respective definitions. (Handout 1) Then, T asks Ss to discuss what all these pictures have in common and try to predict the content of the reading. Ss are assigned to breakout rooms in pairs. T monitors the Ss while interacting. Finally, T has learners share their predictions in a whole-class discussion. T introduces the technical article that they will read and the reasons for its selection (<i>the topic contains plenty of technical vocabulary; it is related to the field of EE; it was one of the topics that most Ss were interested in according to N.A.</i>;	S, L	Giving an opinion: - In my opinion, ... - Based on the pictures, I would say that... - It seems to me that... - For example, ... Vocabulary: Artificial intelligence Energy storage system Hydroelectric power Power grid Solar energy Wind energy	Cognitive: - Predicting Creative: - Brainstorming Interpersonal: - Cooperating	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	<i>and it will be used to practice reading strategies).</i>				
2-3	Pre-task 1: Skimming and scanning T asks Ss to open the reading file (Reading 1-1) as well as Handout 2. The T explains that the first step to find the main idea of a text is identifying the topic. Then, T reviews what a topic is and how it can be found in a text. T draws the Ss' attention to the skimming and scanning strategies included in the handout. In groups, Ss are asked to put into practice the skimming strategy by previewing three key extracts from the technical article (abstract, introduction, and conclusion) and identifying its gist. To this end, they are required to write the topic of the paragraphs in the handout. Additionally, Ss scan these paragraphs and highlight aspects such as headings, words in special print, the first and the last sentence, and repeated words or phrases that help them identify the topic.	R, W, S, L	Giving an opinion - What do you think the topic of this paragraph is? - In my opinion, ... - I'd definitely say that ... - I could be wrong, but ... - It seems to me that ... - How about you? - I (do not) agree with you. Negotiation of meaning: - Did you say...? / Do you mean...? - Could you repeat that again, please? Vocabulary: Cooling Cost-effective Efficiency Heating Large-scale Matrix Power grid Practicality Renewable energy Supercapacitor	Linguistic: - Skimming - Scanning - Practicing - Using context Interpersonal: - Cooperating Cognitive: - Inferencing	15 min

Obj.	Procedure	Skills	Language Focus	Strategies	Time
4-5	Pre-task 2 and 3: Typographical and contextual clues T draws Ss' attention to Handouts 3 and 4. T briefly explains the concepts of typographical clues (specifically, punctuation) and contextual clues (key words for identifying rhetorical patterns). Then, Ss are asked to complete a multiple-choice exercise in groups. Ss need to identify the function of different typographical and contextual clues found in specific paragraphs from the technical article. (Handouts 5 and 6) T moves across the breakout rooms to check Ss' understanding and interaction and to provide support if needed.	R, S, L	Vocabulary: Fluctuations Grid-connected Intermittency Island operation Peak Randomness Topological power converters Volatility	Linguistic: - Practicing - Using context Cognitive: - Inferencing Interpersonal: - Cooperating	15 min
6	Task: In groups, Ss classify a series of statements as true and false based on the main ideas of the reading. (Handout 7) Ss are encouraged to put into practice the different reading strategies studied in class (skimming, scanning, and typographical and contextual clues) to locate the required information and discriminate the statements in the handout.	R, S, L	Giving an opinion - What do you think number X is? Is it true or false? - In my opinion, ... - I'd definitely say that ... - I could be wrong, but ... - It seems to me that ... - How about you? - I (do not) agree with you.	Linguistic: - Practicing - Skimming - Scanning - Using context Cognitive: - Inferencing Interpersonal: - Cooperating	60 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	The T monitors the activity and gives support as required. Ss share their answers as a whole group at the end of the activity.		Negotiation of meaning: Did you say...? / Do you mean...? Could you repeat that again, please?		
7	Post-task: Vocabulary: For the asynchronous session, Ss are asked to scan the complete article and select key technical terms with their respective meaning and an example sentence to create a list in Handout 8.	R, W	Vocabulary: - Technical language identified by the students	Linguistic: - Scanning Affective: - Personalizing Intrapersonal: - Individual student work	30 min
8	Post-task: Pronunciation: T briefly explains the pronunciation of the -ed endings in simple past regular verbs and asks Ss to classify a list of verbs extracted from the reading depending on their pronunciation (/id/ /t/ /d/) using Handout 8. This activity will be reviewed at the beginning of the next session.	R, W	Pronunciation: - Simple past tense - /-ed/ endings - Pronunciation of key words	Cognitive: - Classifying Linguistic: - Practicing Intrapersonal: - Individual student work	30 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Reminders: As a whole class, T reviews the exercises assigned as homework in Class 1 (identification of topic, difficulties, and clues in short technical texts) and provides feedback.

Homework: Ss need to complete the post-tasks for next class.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking
Ss:	The students	W:	Writing	L:	Listening

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

REFERENCES:

Abdalla, A. N., Nazir, M. S., Tao, H., Cao, S., Ji, R., Jiang, M., & Yao, L. (2021). Integration of Energy Storage System and Renewable Energy Sources Based on Artificial Intelligence: An Overview. *Journal of Energy Storage*, 40(2352–152X), 1–13.

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Unit 1- Lesson 1

Handout 1 – Warm-up

Instructions: Match the pictures with their corresponding definitions based on your previous knowledge. Then, discuss what all these images have in common and jot down some ideas to discuss with the rest of the class.

1.



Definition

a. Wind Energy ()

2.



b. Energy Storage System ()

c. Hydroelectric Power ()

3.



d. Artificial Intelligence ()

e. Power Grid ()

f. Solar Energy ()

4.



5.



6.





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Unit 1- Lesson 1

Handout 2A - Pre-task 1

What is the topic?

- Identifying the topic is one of the first steps to help you get the full meaning of a text so that you can easily determine the author's main idea.
- English is a topic-centered language, and all the details relate to that topic. Writers in English almost always mention the topic at or near the beginning of a passage.
- Good readers look for the topic when they read. The topic is the **person, place, idea, object, or event that the author wants to explore with readers.**

How to find the topic?

To find the topic, you can use the following strategies:

- Look for a heading or title.
- Look for pictures and words in special print, such as **bold**, *italics*, or **color**.
- Read the first and last sentences of the paragraph.
- Look for repeated words or phrases in a paragraph.
- Look for words or phrases mentioned at the beginning of the paragraph and then referred to throughout the passage by pronouns or synonyms.
- Skim and scan the text to find relevant information. **Skimming** is looking rapidly through a text to determine its central idea (gist), while **scanning** is searching for specific information.

Example:

It is believed that at some point in the future, speech recognition will transform into speech understanding. The software that allows computers to decode what someone has said may one day allow them to understand not just the words, but the meaning behind them. It is true that this will require much more powerful computers and much more sophisticated software. But an enormous technological shift of this nature will transform the computers we use today into real thinking machines and make communication between humans and computers a two-way intelligent conversation.

Ask: "Who or what is the paragraph about?"

Answer: Speech recognition technology



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Unit 1- Lesson 1

Handout 2B - Pre-task 1

Instructions: In groups, open the reading file (Reading 1.1). Skim paragraphs 1, 4, and 55, and write their topic below. Make sure the topic is neither too broad nor too narrow. Also, scan the paragraphs and highlight the aspects below. Then, discuss your answers with a partner.

- the heading (if any)
- words in special print, such as bold, italics, or color
- the first and last sentence of each paragraph
- repeated words in the paragraphs
- words or phrases mentioned at the beginning and then referred to by pronouns or synonyms



Note: You can either highlight the details in the PDF version of the article or take notes about the line of the paragraph where the information is located.

Paragraph 1

A B S T R A C T

Energy storage technology plays a role in improving new energy consumption capacities, ensuring the stable and economic operation of power systems, and promoting the widespread application of renewable energy technologies. Several new developments, ideas, approaches, and technologies have been introduced into this area from fields including materials, knowledge manage, electricity, control, and artificial intelligence. Based on the technical characteristics of renewable energy, this study reviews the roles, classifications, design optimisation methods, and applications of energy storage systems in power systems. First, we introduce the different types of energy storage technologies and applications, e.g. for utility-based power generation, transportation, heating, and cooling. Second, we briefly introduce the states of an energy storage system, along with its operation processes and energy storage capacity. Third, a comprehensive review is conducted on artificial intelligence applications in regards to optimisation system configuration, and energy control strategy, along with the applicability of different energy storage technologies. Finally, several issues and insights are discussed, offering new inspiration and concepts for the future study of integrated energy storage systems.

Topic:



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Handout 2C - Pre-task 1

Paragraph 5

To encourage the AI energy industry to update and aggressively support the production of sustainable energy sources, this study initially presents energy storage technologies, and then outlines the present states of energy storage applications. As an important and regulated tool in the grid, energy storage is a significant element in the promotion of renewable energy absorption, enhancement of power grid control capacities, and assurance of safe and cost-effective grid services. The details of AI applications cover many aspects concerning the integration of energy storage and renewable energy in terms of the parameter estimation, optimal design, and operation control. Finally, a comprehensive analysis addresses the prospects for problems existing in the integration system, and considers future research directions.

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Handout 2D - Pre-task 1

Paragraph 55

5. Conclusion and future trends

With the vigorous developments in clean energy, the environmental pollution problems caused by fossil fuel energy have been effectively suppressed, and energy transformation has become a general trend. However, during the gradual developments in new energy, adverse impacts from such large-scale new energy access have gradually emerged, i.e. regarding the safety and stability of the power grid and its economic operation. An energy storage network adds greatly to the cost of RESs, but is projected to decrease steadily over the next few years [143]. Therefore, the effective use of ESSs is an important topic for making it easier for clean energy to penetrate into industries. Based on the decision matrix, battery, and supercapacitor, the HSS and SMES have shown promising characteristics, even though both technologies are still emerging in terms of their economics, efficiency, and practicality [144]. The ESS is a cost-effective and practical solution for the REPS battery.

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Unit 1- Lesson 1

Handout 3 - Pre-task 2

Typographical clues: Punctuation

Authors use typographical clues as design elements to help the readers understand the text. For example, punctuation marks are signs or symbols given to a reader to show how a sentence is constructed and how it should be read to make its meaning clear. Punctuation tells the reader when to stop, pause, connect, disconnect, and notice ideas. Let's see some examples and their main functions:

Punctuation Marks	Function	Examples
Apostrophe (')	to indicate a contraction (a shortened form of words)	I'll, didn't, what's
	to signal a possessive form	the engineer's reports
	to signal the plural form of special terms, such as dates or letters	the 1960's, the X's
Brackets []	to indicate changes made to a quoted passage	"[T]he power generator...
	to add editorial comments	The man said, "They will NOT be produced [my emphasis]."
Colon (:)	to introduce a short quotation, a list, an explanation, a summary, a subtitle, a definition, etc.	You need the basic protection equipment: the helmet, the safety vest, and dielectric boots.
Comma (,)	to separate items in a series	The three main fields are Power Systems, Telecommunications, and Computing.
	to introduce clarifying comments after words such as <i>namely</i> , <i>that is</i> , <i>for example</i>	Fossil fuels, for example, coal, oil, and natural gas, release carbon dioxide.
	to provide a restatement	Pirris, a power generation plant, is located in Costa Rica.
	to join two sentences (before words such as <i>but</i> , <i>and</i> , <i>nor</i> , <i>for</i> , <i>or</i> , <i>yet</i> , and <i>so</i>).	We are making good progress, but we still have a long way to go.

Punctuation Marks	Function	Examples
Hyphen (-)	to join the elements in compound words	2-year program, high-voltage systems
	to express a range of numbers	Pages 90-100
Parenthesis ()	to add clarifications, definitions, and interruptions.	Alternating current (an electric current that periodically reverses its direction)
Quotation Marks (" ")	to identify the titles of shorter pieces of writing	The article "5G in Costa Rica" was assigned for homework.
	to indicate a direct quotation (someone else's exact words)	The man said, "Be careful with electrical hazards."
	to use technical terms related to a certain profession or field of study	This high-pressure pipe is known as "penstock."
Semicolon (;)	to separate items in a series if one or more includes commas	Statistics were given for the following cities: London, England; Ontario, Canada; and Paris, France.
	to separate two related sentences	Mark studied Physics; Andrew preferred Engineering.
	to be used before conjunctions such as besides, moreover, however, therefore, nevertheless, in fact, etc.	Her research was a success; in fact, she received a prize.



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Unit 1- Lesson 1

Handout 4 - Pre-task 2

Contextual clues: Rhetorical patterns

Authors often use contextual clues to organize information in a logical, structured manner.

The following is a quick list of some of the most common rhetorical patterns and the key words used as contextual clues to help the reader understand the text.

Rhetorical pattern	Key words
Listing	- and, too, in addition, moreover, also, furthermore, as well as, besides
Definition	- verb to be (is/are) - verbs such as mean, define, represent, consider, call, name
Comparison and contrast	- <i>Comparison</i> → similarly, like, the same as, compared to, in the same way, likewise, have in common, share, resemble - <i>Contrast</i> → but, yet, on the other hand, however, instead, nevertheless, on the contrary, in contrast, all but, whereas
Cause and effect	- because, for this reason, due to, cause, on account of, if this...then this, as a result, since, consequently, therefore, thus, in effect, resulting in, the outcome is, lead to
Process Analysis	- how to, in the process of, the following steps, first, second, third...
Problem-Solution	- problem, question, puzzle, need, difficulty, dilemma, challenge, issue, answer, propose, suggest, solve, resolved, improve, plan, respond to
Purpose	- because, in order to, with the objective/purpose of, aim at, intend to - infinitives of purpose (e.g., to save)
Argument	- should, must, need to, if...then...



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Unit 1- Lesson 1

Handout 5 - Pre-task 2

Let's practice...

Part 1.

Instructions: Work in pairs. Read page 1-2 and 10-11 of the technical article and choose the correct answer for the following questions.

1. The use of commas in **paragraph 1, line 5-6** ("... this study reviews the roles, classifications, design optimization methods, and applications of energy storage systems in power systems.") indicates _____.
 - a. a definition
 - b. a clarification
 - c. a series of items
2. The parentheses in **paragraph 2, line 12-13** ("As ESSs have certain randomness and intermittency issues (regardless of whether using grid-connected or island operation), there will be voltage and frequency fluctuations...") signal _____.
 - a. a definition
 - b. a clarification
 - c. an interruption
3. The use of a hyphen in **paragraph 3, line 2** ("Researchers have studied the integration of renewable energy with ESSs [10], wind-solar hybrid power generation systems...") indicates _____.
 - a. a compound word
 - b. a range of numbers
 - c. a break within words
4. The apostrophe in **paragraph 3, line 35-36** ("... maintains the system's efficient and stable operation in both grid-connected and island modes") indicates _____.
 - a. a contraction
 - b. a plural form
 - c. a possessive form

5. The commas in **paragraph 57, line 3** ("Multi-target challenges, such as economic and technical constraints, should be considered in optimisation algorithms [149].") are used to _____.
 - a. join two sentences
 - b. separate items in a series
 - c. introduce a clarifying comment
6. The semicolon in **paragraph 57, line 29** ("the ESS has a certain guiding effect on the practical application of energy storage; however, a single ESS reduces the system economy [156].") is used to _____.
 - a. introduce an explanation
 - b. separate items in a series
 - c. separate two related sentences
7. The colon in **paragraph 56, line 15** ("An ESS architecture can be divided into four major areas: the ESS scale, range of topological power converters, control systems, and energy management.") is used to introduce _____.
 - a. a list
 - b. a summary
 - c. an explanation
8. The comma in **paragraph 58, line 3** ("the research on the optimization and integration of energy storage system and renewable energy resources are not systematic and deep enough, and the related theories are not mature enough...") indicates
 - a. join two sentences
 - b. separate items in a series
 - c. introduce a clarifying comment



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Handout 6 - Pre-task 2

Let's practice...

Part 2.

Instructions: Work in pairs. Read page 1-2 and 10-11 of the technical article and choose the correct answer for the following questions. The following key words work as contextual clues because they help you identify the rhetorical pattern of the text and their function.

1. What is the function of the underlined contextual clues below?

"First, we introduce the different types of energy storage technologies and applications, e.g., for utility-based power generation, transportation, heating, and cooling. Second, we briefly introduce the states of an energy storage system, along with its operation processes and energy storage capacity. Third, a comprehensive review is conducted on artificial intelligence applications in regard to optimisation system configuration, and energy control strategy, along with the applicability of different energy storage technologies." (paragraph 1, lines 6-11)

- a. Cause and effect
- b. Process analysis
- c. Problem-solution

2. What is the function of the underlined contextual clue below?

"The renewable energy output has volatility and intermittency [7], which is not conducive to the stable operation of the power grid, and seriously affects the integration of wind and solar power generation. Nevertheless, the installed capacity of renewable energy and distributed energy storage has continued to increase [8,9]." (paragraph 2, line 19)

- a. Argument
- b. Cause and effect
- c. Comparison and contrast

3. What is the function of the underlined contextual clue below?

“The emergence of new technologies has brought greater challenges to the consumption of renewable energy and the frequency and peak regulation of the power grid, and the operation of the power grid has become more complicated.” **(paragraph 3, line 4)**

- a. Argument
- b. Process analysis
- c. Problem-solution

4. What is the function of the underlined contextual clue below?

“The application of energy storage technology can help distribute energy peaks and modulate frequency, smooth fluctuations, and help output high-quality electrical energy. In addition, energy storage technology can provide a short-term energy supply that can be seamlessly switched off-grid, and the economic benefits are also considerable [15–17].” **(paragraph 3, line 19)**

- a. Listing
- b. Purpose
- c. Definition

5. What is the function of the underlined contextual clue below?

“To encourage the AI energy industry to update and aggressively support the production of sustainable energy sources, this study initially presents energy storage technologies, and then outlines the present states of energy storage applications.” **(paragraph 5, line 1)**

- a. Definition
- b. Purpose
- c. Argument

6. What is the function of the underlined contextual clue below?

“A battery-supercapacitor system is the most commonly used HESS.” (paragraph 56, line 3)

- a. Listing
 - b. Purpose
 - c. Definition
7. What is the function of the underlined contextual clue below?

“...a predictive control strategy should be integrated in a control approach based on optimization...” (paragraph 57, line 6)

- a. Listing
- b. Purpose
- c. Argument

8. What is the function of the underlined contextual clue below?

“Thus, predictive management strategies and control strategies focused on AI should be built to further increase the penetration of renewable energy for RESs with ESSs [10].” (paragraph 57, line 17)

- a. Cause and effect
- b. Problem-solution
- c. Comparison and contrast



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Unit 1- Lesson 1

Handout 7 - Task

Instructions: Work in pairs. Read pages 1-2 and 10-11 of the technical article and identify if the main ideas below are true or false. Remember to put into practice the reading strategies of skimming, scanning, and typographical or contextual clues.

	True	False
1. The integration of energy storage and renewable energy technologies is a promising approach to ensuring efficiency and cost-effectiveness in the field of power systems.	☐	☐
2. Providing reliable power support in areas with high power requirements has become the top priority in the past few years.	☐	☐
3. Energy storage systems are becoming more effective and reliable every day, and they will soon replace fossil-based energy.	☐	☐
4. Artificial intelligence (AI) algorithms have aided the modelling, optimization, and enhancement of the hybrid system's performance, which has reduced the operational costs in comparison to conventional systems.	☐	☐
5. The study reviews the different storage technologies, the current state of energy storage applications, the integration of energy storage and renewable energy through AI applications, and the challenges to be considered in future research.	☐	☐
6. Although renewable energy may be expensive, its cost is expected to decrease gradually over time.	☐	☐
7. Battery and supercapacitors are relatively unexpensive, and the use of the energy storage system is beneficial in terms of costs, reaction time, reliability, power efficiency, among others; however, its design is lacking in stability and power quality.	☐	☐
8. Artificial intelligence optimization needs to be implemented in order to integrate renewable energy systems with energy storage systems and overcome economic and technical challenges.	☐	☐



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Handout 8A – Post-Task

Part 1.

Instructions: Individually, scan the complete article and create a list of technical vocabulary that you were not familiar with before. Complete this table with the required information. You may use the dictionary for this activity.

Vocabulary	Meaning	Example sentence

Note: Feel free to insert additional cells if you have more than six new words.



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Handout 8B - Post-Task

Part 2.

Instructions: Work individually. Review the following information about the correct pronunciation of the simple past.



Remember...

The pronunciation of words ending in “ed” depends on the final consonant sound. There are three ways to pronounce “ed” at the end of a word in English:

/ɪd/ /t/ /d/

- If the verb ends in –d or –t, the –ed ending is pronounced as a new syllable, /ɪd/. Example: demonstrate → demonstrated
- If the verb ends in a vowel sound or a voiced (vibrating) consonant (l, n, r, b, g, m, z, s, v), then the –ed ending sounds like a /d/ and does not create a new syllable. Example: happen → happened
- If the verb ends in an unvoiced (nonvibrating) consonant (p, k, f, gh, sh, ch, ss, c, x), then the –ed ending sounds like a /t/ and does not create a new syllable. Example: work → worked



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Handout 8B – Post-Task

Let's practice...

Instructions: Work individually. The following verbs were extracted from the technical article you read. Classify the verbs in the chart below depending on the pronunciation of their “ed” ending. You may use an online dictionary to listen to the sound.

introduced – based – conducted – exchanged – used- divided – determined – achieved
– addressed – assisted – optimized – considered – improved – calculated – stored

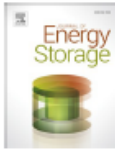
<i>/ɪd/</i>	<i>/t/</i>	<i>/d/</i>

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Integration of energy storage system and renewable energy sources based on artificial intelligence: An overview

Ahmed N. Abdalla^{a,*}, Muhammad Shahzad Nazir^b, Hai Tao^c, Suqun Cao^{a,*}, Rendong Ji^a, Mingxin Jiang^a, Liu Yao^d

^a Faculty of Elect. Information Engineering, Huaiyin Institute of Technology, Huai'an, Jiangsu 223003, China
^b Faculty of Automation, Huaiyin Institute of Technology, Huai'an, Jiangsu 223003, China
^c Department of Computer Science, Baofu University of Arts and Sciences, 721013, China
^d Faculty of Management Eng., Huaiyin Institute of Technology, Huai'an 223003, China

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ABSTRACT

Energy storage technology plays a role in improving new energy consumption capacities, ensuring the stable and economic operation of power systems, and promoting the widespread application of renewable energy technologies. Several new developments, ideas, approaches, and technologies have been introduced into this area from fields including materials, knowledge manage, electricity, control, and artificial intelligence. Based on the technical characteristics of renewable energy, this study reviews the roles, classifications, design optimisation methods, and applications of energy storage systems in power systems. First, we introduce the different types of energy storage technologies and applications, e.g. for utility-based power generation, transportation, heating, and cooling. Second, we briefly introduce the states of an energy storage system, along with its operation processes and energy storage capacity. Third, a comprehensive review is conducted on artificial intelligence applications in regards to optimisation system configuration, and energy control strategy, along with the applicability of different energy storage technologies. Finally, several issues and insights are discussed, offering new inspiration and concepts for the future study of integrated energy storage systems.

1. Introduction

In recent years, with increasing pressures from both energy consumption and environmental governance, the demand for energy systems in human society has been constantly increasing [1,2]. Controlling the cost of electricity, replacing aging infrastructure, improving the flexibility and reliability of power systems, reducing carbon dioxide emissions, mitigating changes in the atmospheric environment, and providing reliable power support to remote areas with increasingly higher power requirements have become the keys to this energy revolution [1,3]. An energy storage system (ESS) adopts clean energy to meet requirements for energy-saving and emissions reductions, and therefore has been developed vigorously in recent years. As ESSs have certain randomness and intermittency issues (regardless of whether using grid-connected or island operation), there will be voltage and frequency fluctuations [4,5]. In the process of vigorously developing renewable energy sources (RESs), these adverse effects have gradually become more prominent [6]. The renewable energy output has volatility and

intermittency [7], which is not conducive to the stable operation of the power grid, and seriously affects the integration of wind and solar power generation. Nevertheless, the installed capacity of renewable energy and distributed energy storage has continued to increase [8,9].

Researchers have studied the integration of renewable energy with ESSs [10], wind-solar hybrid power generation systems, wind-storage access power systems [11], and optical storage distribution networks [10]. The emergence of new technologies has brought greater challenges to the consumption of renewable energy and the frequency and peak regulation of the power grid, and the operation of the power grid has become more complicated. Energy storage technology can quickly and flexibly adjust the system power and apply various energy storage devices to the power system, thereby providing an effective means for solving the above problems. Research has been conducted on the reliability of wind, solar, storage, and distribution networks [12,13]. According to the International Renewable Energy Agency, by 2030, the installed capacity of energy storage in the world will increase by 42% to 68% (based on values from 2017). By 2025, India and China will become the fastest-growing countries for energy storage installations, and Japan

^{*} Corresponding authors at Faculty of Elect. Information Engineering, Huaiyin Institute of Technology, Huai'an, Jiangsu 223003, China.
E-mail addresses: dramaiden@gmail.com (A.N. Abdalla), caosunqun@hyit.edu.cn (S. Cao).

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Nomenclature			
AI	Artificial Intelligence	P_{FC}	Fuel cell electric power output W
ANFIS	adaptive neuro-fuzzy inference systems	P_l	Distributed power output power W
CSP	concentrating solar thermal	P_p	Pump output power W
ESS	energy storage system	P_{ref}	Load demand W
GA	genetic algorithm	Q_w	Flow rate volume passing the turbine m ³ /s
HESS	hybrid energy storage system	V_A and V_B	Volumes of the compressed gas mol
IRENA	International Renewable Energy Agency	V_t	Voltage across the capacitor Volt
NSGA	non-dominated sorting genetic algorithm	m_t	Flywheel mass kg
PSO	particle swarm optimization algorithm	m_p	Pump mass kg
PV	Photovoltaic	p_A and p_B	Pressures outside of the vessel kPa
RESs	renewable energy sources	η_{FC}	Fuel cell efficiency %
SOC	State of charge	η_p	Hydraulic turbine efficiency %
Symbols		ΔP	Power shortage W
Symbols	Description Unit	h	Height m
Δt	Step of charging (or discharging) time; s	C	Capacitance Farad
η_c	Energy storage efficiency of the ESS %	E	Stored or released electricity energy kWh
η_d	Distributed energy efficiency of the ESS %	PES	the operating ESS (charge/discharge) power W
E_t	Flywheel stores energy J	Q	Charge stored in the capacitor C
E_{SC}	Superconductor energy stored per coil volume J/m ³	g	Gravitational acceleration m/s ²
E_{SC}	Supercapacitor stored energy J	r	the radius of the flywheel m
E_{com}	Compressed air energy kPa.mol ⁻¹	β	Magnetic flux density T
E_p	Stored pump energy J	μ	Permeability H/m
		ρ	Water density kg/m ³
		ω	the angular velocity rad/s

and Australia will become the countries with the largest shares of energy storage installations [14]. The application of energy storage technology can help distribute energy peaks and modulate frequency, smooth fluctuations, and help output high-quality electrical energy. In addition, energy storage technology can provide a short-term energy supply that can be seamlessly switched off-grid, and the economic benefits are also considerable [15–17]. Therefore, it is expected that renewable energy (such as wind and solar energy) will gradually replace fossil-based energy, and will continuously increase its proportion of energy consumption [5,18,19]. However, the large-scale deployment of intermittent renewable energy with multiple time scales can not only profoundly affect the prediction and scheduling accuracy of the power system, but may also cause operational safety and power quality problems when power is exchanged with the power grid, leading to the need for traditional distribution [20–22]. Therefore, a control technology that considers both the sufficiency of the power generation capacity and flexibility of the power generation is urgently required for renewable energy to be used in operation control and energy management [23]. The use of an ESS complements the renewable energy generator set, ensures that it can work over a larger power range, maintains the system's efficient and stable operation in both grid-connected and island modes, and slows down the intermittent output of renewable energy that results in power fluctuations [23,24]. To further improve the economic and environmental benefits of ESSs, their use has been further expanded, such as in solar photovoltaic (PV), concentrated solar thermal, and thermal energy systems [25,26].

Planning, monitoring, and optimization have been leading strategies for the construction and systematic study of power systems [26,27]. A variety of artificial intelligence (AI) approaches are used for the modelling, optimisation, and enhancement of hybrid systems [28]. Neural network, Fuzzy logic control, and concurrent computation algorithms comprise a major branch of AI [28,29]. In [28], evaluates the performance of four well-known heuristic algorithms for optimizing the size of a PV/wind/FC hybrid system to continuously satisfy the load demand with the minimal total annual cost. In [29], introduced economic analysis of renewable energy to improve functionality of the hybrid system elements to provide more economical and dependable

electricity, as well as environmentally friendly sources. The formulation and solution of a design and optimisation strategy can be limited by resource supplies, infrastructure, performance, and/or mathematical models. Advances in computational science have made it possible to solve optimisation problems using a variety of optimisation and simulation methods [30]. Russell and Norvig [31] offered a view of the AI enterprise based around the idea of intelligent agents systems, where introduces analyses the past and future of AI, and provides some light amusement. Intelligent methods have shown effectiveness in regards to enhancing machine performance and providing economic advantages, along with other benefits that cannot be obtained from conventional approaches [32,33]. In [32], investigate the role of AI algorithms in modelling, sizing, control, and estimation of renewable energy specifically PV system output.

To encourage the AI energy industry to update and aggressively support the production of sustainable energy sources, this study initially presents energy storage technologies, and then outlines the present states of energy storage applications. As an important and regulated tool in the grid, energy storage is a significant element in the promotion of renewable energy absorption, enhancement of power grid control capacities, and assurance of safe and cost-effective grid services. The details of AI applications cover many aspects concerning the integration of energy storage and renewable energy in terms of the parameter estimation, optimal design, and operation control. Finally, a comprehensive analysis addresses the prospects for problems existing in the integration system, and considers future research directions.

2. Energy storage system types and characteristics

Owing to its continuous development and maturity, energy storage technology has been applied in various fields, such as those concerning electric vehicles, renewable energy power stations, RESs, distribution networks, and transmission grids [34]. Fig. 1 shows the characteristics of some common forms of energy storage [35], in which different forms of energy storage exhibit different technical characteristics, especially in terms of energy characteristics [36].

The specific technical characteristics of these forms are as follows.

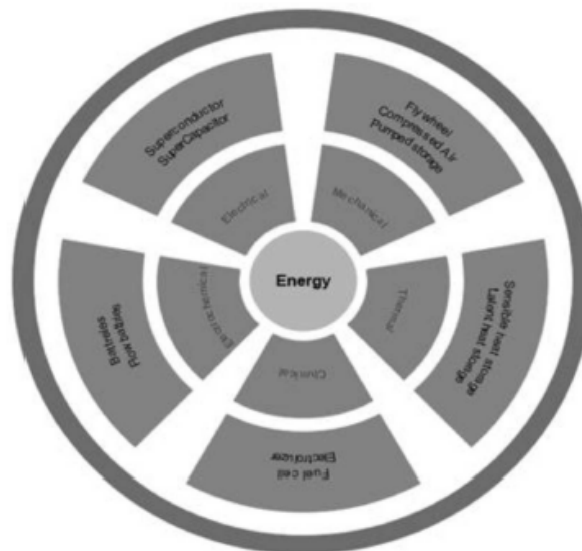


Fig. 1. Classification of energy storage systems (ESSs).

2.1. Mechanical energy

Mechanical energy storage realises energy storage and release through a conversion between mechanical energy and electrical energy i.e. the electrical energy stored in the form of mechanical energy. The main storage types are pumped energy storage, compressed air energy storage, and flywheel energy storage [37].

(a) Pumped storage: Pumped storage is currently the most mature technology, with the largest cumulative installed capacity and longest life cycle. Its working principle is to pump water from a downstream reservoir to an upstream reservoir when storing energy, and to use the water level difference between the upstream and downstream reservoirs for hydropower generation when releasing energy, so as to flexibly realise the flexible conversion between the potential energy of the water and electrical energy [38,39]. The stored pump energy (E_p) can be calculated as follows [38]:

$$E_p = m_p g h \quad (1)$$

In the above, m_p is the pump's total mass (kg); g is the gravitational acceleration (m/s^2); and h is the height (m).

The pump output power can be calculated as follows:

$$P_p = Q_w h \eta_p \rho g \quad (2)$$

Here, ρ is the water density (kg/m^3); Q_w is the volume flow rate passing the turbine (m^3/s); and η_p is the hydraulic efficiency of the turbine (%).

The advantages of pumped storage are its large capacity, long life, and low cost; it is a widely used energy storage technology that uses electrical energy to drive water resources to store potential energy, and then to convert the potential energy into electrical energy [40]. The cycle efficiency can reach 75%, which is mainly used for regulating peak

energy frequency and phase modulations, and providing spare capacity. However, it is not universally applicable, owing to constraints regarding the geological and geographical conditions and construction period.

(a) Compressed air: Compressed air energy storage uses excess electrical energy to compress air in a large storage space, and then releases the air to push a steam turbine to generate electricity when needed [41,42]. According to the different operating principles of the above process, compressed air ESSs can be divided into supplementary combustion and non-combustion types [43]. Compressed air energy storage is driven by compressed air and a motor; the compressed air is released to push the turbine to generate electricity, thereby realizing the conversion between internal energy and electrical energy. The compressed air energy stored in the storage vessel can be calculated as follows:

$$E_{com} = p_B V_B \ln \frac{p_A}{p_B} + (p_B - p_A) V_B \quad (3)$$

Where, p_A and p_B are constant pressures outside of the vessel; V_A and V_B are the volumes (mol) of the compressed gas, and correspond to the start and end of compression, respectively. In addition, $\frac{p_A}{p_B} = \frac{V_B}{V_A}$.

The advantages of compressed air energy storage are its large energy storage capacity, long cycles, high efficiency, and is mostly used in peak shaving, frequency control, distributed energy storage, and power generation equipment. In addition, highlights the need of various types of store energy in order to strengthen power networks and maintain load levels (permanent or portable, long- or short-term storage, maximum power required, etc.) [44]. The disadvantage is that it has high requirements for the geographical conditions of the construction site; moreover, the supplementary combustion type still requires fossil fuels, and there are gas pollution emission problems [45].

- 15 (a) Flywheel: A flywheel stores energy in the form of kinetic energy by accelerating a rotor (flywheel) [46]. Power electronic devices are used to switch the flywheel between generator and motor working modes to achieve the conversion between mechanical energy and electrical energy [47]. The stored flywheel energy (E_f) can be calculated as follows:

$$E_f = \frac{1}{2} m_f r^2 \omega^2 \quad (4)$$

- 16 Where, m_f represents the total flywheel mass (kg); r is the radius of the flywheel (m); and ω is the angular velocity (rad/s).

- 17 The evident advantages of flywheel energy storage are its high instantaneous power, high conversion efficiency, and fast response speed. It is more suitable for application scenarios with higher instantaneous power requirements [48]. At present, low-speed flywheel energy storage technology is relatively mature; in contrast, high-speed flywheel energy storage has more key technologies that require further breakthroughs, such as composite material structure technology, high-temperature superconducting magnetic bearing technology, and high-speed motor technology [49].

2.2. Electrical energy

- 18 Electrical energy is stored in the form of an electric or magnetic field in superconductor and supercapacitor storage units, which are presently relatively common [50,51]. Application of electrical energy storage, one sentence EES has numerous applications including portable devices, transport vehicles and stationary energy resources [51]

- 19 (1) Superconductor: Superconducting energy storage stores or releases electromagnetic energy directly through superconducting magnets. The superconductor (E_m) energy stored per coil volume (J/m^3) can be calculated [52] as follows: find exact reference

$$E_m = \frac{\beta^2}{2\mu} \quad (5)$$

Where, β is the magnetic flux density (T), and μ is the permeability (H/m).

- 20 The advantages of superconductors are their high energy storage efficiency, large energy and power density, and long service life. However, they are currently in the stages of technological research and development, and require higher manufacturing costs. Key technologies such as the superconducting strip technology, large-capacity power conversion systems, low-temperature systems, and current leads require further breakthroughs [53].

- 21 (1) Supercapacitor: Supercapacitors can be divided into electric double-layer capacitors and faraday capacitors, according to the different electrode materials and charging and discharging working principles [54]. The device uses an interface double layer formed between an electrode made of a special material and an electrolyte to store energy. The supercapacitor energy stored (E_{ca}) can be calculated as follows:

$$E_{ca} = \int_0^Q V_q dq = \frac{CV^2}{2} \quad (6)$$

- 22 In the above, V_q is the voltage across the capacitor (Volt), C is the

capacitance (Frad), and Q is the charge stored in the capacitor (C).

The advantages of supercapacitor energy storage include its high charge and discharge efficiency, long service life, high power density, and wide application temperature range [55]. It has broad application prospects for scenarios with high power requirements, but its main shortcoming is its low energy density. It is difficult to apply in scenarios with high energy demand, as the self-discharge energy from this method is approximately 5% per day [56].

2.3. Electrochemical energy

Electrochemical energy realizes a conversion between electrical and chemical energy based on a battery electrochemical reaction principle [57]. The most prominent advantages of electrochemical energy storage are its fast response, flexible installation, and short construction period, which provide broad development prospects for the future energy field. Electrochemical energy storage approaches mainly include lithium-ion batteries, lead-acid batteries, flow batteries, and sodium-sulphur batteries [58].

- (a) Lithium-ion battery technology is relatively mature and has a high energy density, and is considered as one of the most promising electrochemical energy storage approaches. According to the classification of the positive electrode materials, typical representative batteries include lithium iron phosphate batteries, ternary lithium batteries, and lithium manganate batteries [59, 60]. Among them, lithium iron phosphate batteries have been widely used in industrial production, owing to their relatively long service life and good economy. For large-capacity lithium-ion battery energy storage, it is necessary to further reduce manufacturing costs and improve the safety performance, which will help promote large-scale commercial applications [59].

- (b) The advantages of lead-acid battery technology are its low cost, high safety, recycling options, and high rate, but there are also problems, such as a low energy density and short cycle life [61]. To solve this problem, the carbon materials have been introduced to improve the negative electrodes of lead-acid batteries, aiming to form lead-carbon batteries with better performance. However, lead-carbon batteries contain a large amount of lead, and thus pollute the environment. In addition, there is no clear conclusion regarding the selection and quantification of negative carbon materials [62].

- (c) A flow battery is the most mature all-vanadium flow battery. Flow batteries electrochemically react with active substances in positive and negative electrolyte solutions, enabling the storage and release of electrical energy. They use vanadium ions of different valences as active substances, where investigate critical aspects related to interactions between cathode materials and electrolyte solutions in lithium-ion batteries [63]. In addition, flow battery technology has advantages such as high safety, high cycle times, independent energy capacity/power capacity design, and a low self-discharge rate. However, it has low energy density, and high manufacturing costs [64].

- (d) A sodium-sulphur battery has the advantages of a high energy density, long service life, and no self-discharge, etc.; however, it has special requirements for operating temperatures, as it needs to run at high temperatures (300–350°C) for safety control, in addition to issues regarding structural design, material selection, etc. Regarding these requirements, the key to the commercial application of sodium-sulphur batteries is the further improvement of their safety, reliability, and economy [65].

- (e) Table 1 shows a detailed comparison of electrochemical energy storage in terms of the operating voltage, energy density, cycle life and energy cost, system efficiency, and operating temperature.

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Table 1
Comparison of mainstream electrochemical energy storage parameters [66,67].

Performance	Lithium Ion Battery	Lead acid battery	Flow battery All vanadium	Zinc bromide	Sodium sulfur
Operating voltage (V)	3.3–3.7	2	1.5	1.82	1.8–2
Energy density (W·h per kg)	130–200	30–60	15–50	75–85	100–250
Cycle life (minute)	2500–5000	2000–4000	5000–10000	2000–5000	2500
Energy cost (\$ per kWh)	350–370	180–260	640–860	285–500	285–430
Efficiency (%)	85–98	80–90	60–75	65–75	70–85
Operating temperature (°C)	low temperature	15–25	5–40	20–50	300–350
Other features	Good performance, intolerant to overcharge and discharge	Good performance, low cost, recyclable	Good consistency, high reliability, long cycle life, large scale	Low cost, long life, high power	Instant charging, high energy, power discharge

2.4. Thermal energy

29 According to the characteristics of the different heat storage materials, thermal energy storage approaches can be divided into sensible heat storage, latent heat storage, and thermochemical heat storage [68].

30 (a) Sensible heat storage materials use their own specific heat capacity characteristics to store and release heat through temperature changes. Liquid sensible heat storage materials such as water and solid sensible heat storage materials such as crushed stone and soil are widely used in areas where a heat storage temperature is not required, such as in solar air conditioners [69, 70]. Their common features are their large heat storage per unit mass or volume, stable physical and chemical properties, and good thermal conductivity. However, because of the large volume required, such approaches cannot be used on a large scale. Materials such as molten salts, liquid metals, and organics can be used as sensible materials [71]. Molten salt has the advantages of a high heat capacity, wide temperature range, and low viscosity, making it a typical medium-and high-temperature heat transfer and heat storage material.

31 (b) The basic principle of latent heat storage is that two phases of a material are in a state of equilibrium and coexistence. When one phase is transformed into another phase, heat is absorbed or released. The heat absorbed per unit mass of material during the phase transition process is called the latent heat [72]. Latent heat storage is currently the most researched heat storage technology, mainly because the energy storage density of latent heat storage materials is significantly greater than that of sensible heat storage materials, and it has good practical research and development prospects. According to the phase change temperature of the materials, latent heat storage materials can be divided into low-temperature phase change materials and high-temperature phase change materials. Low-temperature phase change heat storage materials are mainly used for waste heat recovery in industry, solar energy storage and utilisation, and heating and air conditioning systems [73]. Ionic liquids and ionic liquids have great potential for becoming excellent medium-and low-temperature latent heat storage materials. High-temperature phase-change heat storage materials include high-temperature molten salts, mixed salts, metals, and alloys, which are mainly used in aerospace systems, power plants, and other fields [74].

2.5. Chemical energy

32 Chemical energy approaches, also known as thermochemical approaches, convert chemical energy into electrical or thermal energy [75]. An appropriate chemical reaction system is the key to this type of storage technology. However, the safety, economy, efficiency, and other issues need to be resolved, and most thermochemical thermal energy

systems are in the technological research and development stage [76].

2.5.1. Fuel cell

Fuel cells are a new type of energy conversion unit for directly converting the energy in natural gas and oxidants into electrical energy [77]. The power generation efficiency can reach more than 65%, with a high energy efficiency. The conversion efficiency of a fuel cell is high, and the waste heat generated during the power generation process is small [78].

Fuel cell electrolyte materials include solid oxides, proton exchange membranes, and acidic or alkaline materials. According to the differences in the materials, the operating characteristics of the fuel cells are also different. For example, when natural gas is used as a fuel to generate electricity, it must first be converted into hydrogen by processes such as catalytic hydrogen production, and must undergo impurity removal [79]. The produced hydrogen then enters an anode through a fuel port, where it undergoes an oxidation reaction to ionise the hydrogen ions. Finally, under the action of the catalyst, the oxygen undergoes a reduction reaction with the hydrogen ions of the anode, and produces water.

The mathematical models for the efficiency and output electric power are as follows:

$$V_{FC}(t) = \frac{P_{FC}(t)}{\eta_{FC}(t)I_{AFC}} \Delta t \quad (7)$$

$$\eta_{FC}(t) = -0.0023P_{FC}(t) + 0.674 \quad (8)$$

In the above, $V_{FC}(t)$ is the fuel consumption during the period t , $P_{FC}(t)$ and $\eta_{FC}(t)$ are the output electric power and efficiency of the fuel cell during the period, respectively.

2.5.2. Hydrogen energy storage

Hydrogen energy is expected to comprise one of the most important sources of energy in the future. The working theory of hydrogen energy storage is to transform electrical power into hydrogen fuel based on core technologies, such as those concerning the manufacture of hydrogen, storage of hydrogen, and supply of hydrogen fuel [80]. Hydrogen energy storage has been shown to be useful for a modern high-capacity ESS and has shown tremendous growth potential, owing to its excellent advantages such as its high energy density, low operational and maintenance costs, and environmental protection advantages [81]. Currently, hydrogen energy storage technologies still face challenges such as low energy conversion efficiencies and high production costs. Nevertheless, ongoing breakthroughs in materials and core innovations for the industrial use of hydrogen energy storage appear to be imminent [82].

2.6. Comparison of performance indicators for energy storage technologies

The selection of an appropriate type of energy storage must consider

the application requirements, e.g. the characteristics of the application presented in Fig. 2. This is conducive to increasing the application value of energy storage technology in power generation, transportation, heating, and cooling [83].

39 Table 2 displays different energy transfer parameters and features. ESSs can be broken down into mechanical energy storage, electromagnetic energy storage, electrochemical energy saving, and hydrogen energy storage [84]. The response time of electrochemical energy storage is on the order of milliseconds, the rated power can reach the megawatt level, and the cycle efficiency is the highest (reaching more than 80%); however, the service life is limited [85]. EES has numerous applications including portable devices, transport vehicles and stationary energy resources. Pumped storage and compressed air ESSs have long lives and large rated power, but also have long response times and strict site selection requirements, and require large-scale promotion in areas with high electricity loads [86]. If combined with lithium batteries, heat pumps, and other technologies, the cycle efficiency can be increased to 60%. Therefore, we should give full play to its advantages, so as to realise the thermoelectric coupling of the power supply unit, realise the peak shaving of the power grid, and ensure the safe and stable operation of the power grid [87].

3. Energy storage system evaluation

40 The ESS capacity has a great impact on the overall economics and operational safety of RESs, and must be optimised during the RES planning and design phase [90]. An ESS that is excessively small cannot improve the power quality and overall operating performance of a RES, whereas an ESS that is excessively large imposes higher investment and maintenance costs on the RES [91]. The types, quantities, and structures of power sources in RESs are diverse, and the equipment functions are also different. The load can be either an electric load or thermal load. Therefore, capacity planning for an ESS is closely related to the operation strategy for the RES. Comparison operation strategy of different energy storage technologies including the operation timing and start-stop duration of the distributed units in the RES system, as well as important advances and affects the ESS behaviours [92].

3.1. Energy storage system operation process

41 The power system energy shortage is owing to the large difference in the time sequence between the load curve and output curve of the renewable energy [93]. The ESS operation process should consider influencing factors such as the response rate, life limit, application cost,

and locations (such as for the power generation side, distribution side, and load side) for economic and stable operation. Therefore, the power shortage can be expressed as follows:

$$\Delta P(t) = \sum_{i=1}^n [P_i(t)] - P_{req}(t), n < m \quad (9)$$

In the above, $P_i(t)$ is the output power of the distributed power supply i in the RES at time t , and $P_{req}(t)$ represents the load demand of the RES at time t . When $\Delta P(t) > 0$, the ESS considers whether to store energy; when $\Delta P(t) < 0$, the ESS considers whether to release energy.

The behaviour of the load consumption should be as close as possible to the output of renewable energy, and a certain proportion of the load is considered to be flexible or transferable within a certain period of time [94].

3.2. State of the energy storage system

To introduce an ESS on the power supply side to improve the practicability and operation of the system, a demand response is used the inherent power consumption mode of the user side, thereby providing the user's energy consumption [95].

The charging [96] can be represented as follows:

$$SOC(t) = SOC(t-1) + \frac{P_{ES}(t) \cdot \eta_c \cdot \Delta t}{E_{ES}(t-1)} \quad (10)$$

The discharge can be represented as follows:

$$SOC(t) = SOC(t-1) + \frac{P_{ES}(t) \cdot \Delta t}{\eta_d \cdot E_{ES}(t-1)} \quad (11)$$

Here, $P_{ES}(t)$ is the operating (charge/discharge) power of the ESS at t ; $SOC(t)$ is the state of charge of the ESS at t ; Δt is the charging (or discharging) time; η_c is the energy storage efficiency of the ESS; and η_d is the energy efficiency of the ESS. Notably, the self-discharge rate of the energy storage device is not considered here.

3.3. Energy storage capacity

The difference between the output power of the power supply device and planned output in the system $\Delta P(t)$ determines the charging and discharging operation mode of the ESS, and the area enclosed by $\Delta P(t)$ and the coordinate axis is recorded as a parameter $\Delta E(t)$. Its positive and negative values indicate that the ESS is in the charged state and discharged state, respectively [97], the total amount of electricity that the

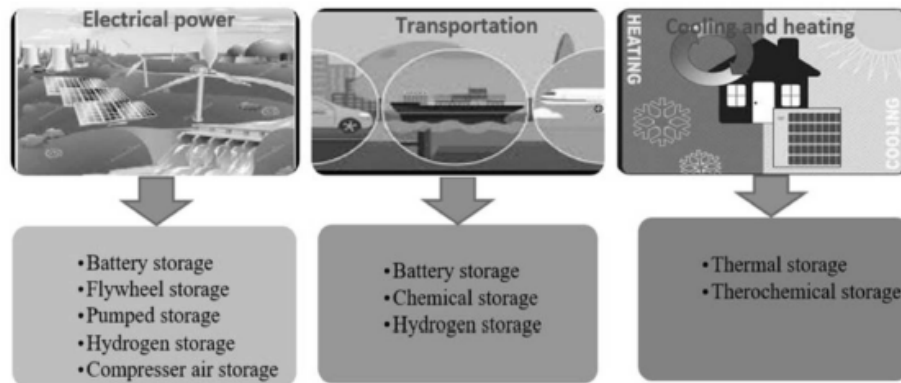


Fig. 2. Applications and possible hybrid approaches for common energy storage.

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Table 2
Comparison of performance indicators for energy storage technologies [88,89].

Energy	Energy storage category	Energy density (Wh per kg)	System lifecycle (time)	Efficiency (%)	Response time	Rated power
Mechanical	Pumped storage	0.5–3	Unlimited usage	70–85	4–10h	100–2000MW
	Compressed air	34	Unlimited usage	>70	6–20h	10–300MW
	Flywheel	100–130	10^5 – 10^7	70–90	> 15 min.	1–20MW
Electrical	Super capacitor	>50000	Unlimited usage	95	1–30s	10kW–1MW
	Superconductor	90000–100000	Unlimited usage	Upto 100		2–200 MW
Electrochemical	Lead-acid batteries	25–42	500–1200	75	20ms above	kW–MW
	Nickel-cadmium batteries	35–57	1000–3500	80	-	10MW
	Lithium Ion Battery	60–130	7000–10000	90	20ms above	kW–MW
	Sodium-sulfur battery	130	2500–4500	85		10MW
	NiMH batteries	50–60	>2500	85		100kW
Thermal	All vanadium liquid battery	50	1000–2500	80	20ms above	kW–MW
	Sensible heat storage	21	>10a	30–40	5%/min	7h Heat storage capacity
	The latent heat storage	0.3	Unlimited usage	-		
Chemical	Hydrogen storage	2.8–3.3	>2000h	25–45		30kW–100MW
	Fuel cell	150	>2000h	40–60		8–30kW

ESS needs to store (or release) in the time interval T is $E(T)$, and the expression of $E(T)$ is as follows:

$$E(T) = \int_0^{t+T} \Delta E(t) dt \quad (12)$$

47 In addition to electricity, the stored energy forms also include cold/heat and gas storage, where cold/heat and gas reserves can be converted from power to volume according to usage.

4. Artificial Intelligence technology

48 Researchers have introduced many algorithms and methods for optimisation modelling, state estimations, and behaviour expressions for the integration of renewable energy and ESSs. These can be summarised by three aspects, as shown in Fig. 3.

(1) Optimisation system configuration

This form of work aims to determine the optimum battery and ultra-capacitor configurations by considering the correlation of the energy management algorithm with the power matching during device operation, as well as the combined optimisation of power matching and energy management algorithms [98]. Particle swarm optimisation (PSO) algorithm, Harmony search algorithm, Artificial bee colony optimization, and hybrid optimisation methods are widely employed [99].

(1) Energy control strategy

This form of work focuses on the development of effective and intelligent management mechanisms for enhancing the robustness and reliability of the ESS, and the control system's adaptability under dynamic operational conditions [100]. A hybrid ESS (HESS) control

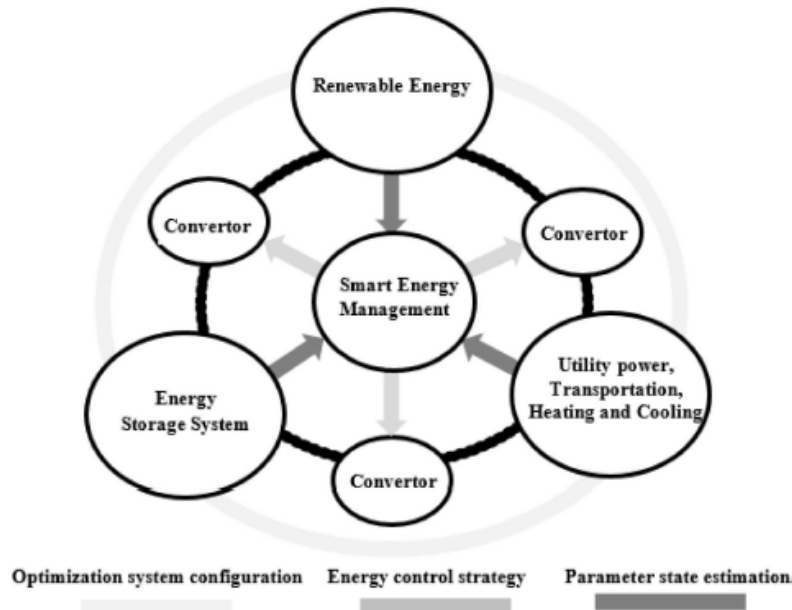


Fig. 3. Application of artificial intelligence (AI) technology based integration of renewable energy sources (RESs) and ESSs.

strategy is important for improving the use of resources and energy efficiency. The monitoring technique is typically complex, and must work constantly as the RE sources are intermittent and must achieve multiple goals. Widely used methods include dynamic programming, variable control, adaptive neuro-fuzzy inference systems control, and predictive control [101].

(1) Parameter state estimation

- 51 This type of research aims at developing high-precision, adaptive, and robust methods for system identifications and state assessments [100]. In addition, it is used to study the effects of stress factors on electrode materials and electrolytes from an electrochemical or material science perspective and the aging laws of power supplies based on signal analysis and features of the thermal and electrical behaviours, so as to investigate the connection(s) between the stress factors and aging mechanisms [102]. The most popular approaches include neural networks and Bayesian filters.

4.1. Optimisation system configuration

- 52 According to the 2005 energy policy formulated by the US Department of Energy, demand response is a service mechanism for encouraging users to change their demands for energy through methods such as financial incentives or education [103]. In particular, evaluation indicators (reliability, economic, and environmental) used to determine

the size of each component of hybrid renewable energy system [104]. In addition, more attention is necessary to understand the current status and development trends of optimal sizing for hybrid renewable energy systems. An important derivative of a power system is the demand-side management [105]. If the ESS is combined with the demand response and fully utilised, the energy consumption mode of the RES can be further optimised. Many studies have different indicators for evaluating ESS performance [106]. For example, electrochemical energy storage is mainly analysed from the perspectives of system efficiency and battery life [107]. Battery life indicators include the maximum charge currents of the battery, maximum discharge currents, and root mean square currents. The battery system efficiency indicators include the power converter and system energy loss [29,105]. In addition, for the optimisation of the RES and ESS capacity, common optimisation algorithms include PSO algorithms, genetic algorithms, and improved non-dominated sorting genetic algorithms, and researchers can choose an algorithm according to the actual situation of the calculation example and the characteristics of the algorithm itself [108,109]. In [108], investigate the strengths and shortcomings of the existing artificial intelligence-based methods for building energy systems. The PSO algorithm has a simple structure, fast convergence, easy implementation, and good intelligence. Table 3 reviews the important works in this field in terms of optimisation algorithms, storage types, RESs, and main evaluation indicators.

Table 3
Previous research on artificial intelligence (AI)-based energy storage optimisation.

Author	AI techniques	Energy storage type	Renewable energy	Factors	Findings
[110]	Agglomerative hierarchical clustering Algorithm	Battery	Solar, wind	Time	The author proposed agglomerative hierarchical clustering algorithm for optimizing integration of Solar/Wind with battery. Results show that time series data of (5–15 days) sufficiently to improve the system performance by 5%. An advantage for AHC compared to other clustering methods is the preservation of time chronology, which is important for energy storage applications.
[111]	Non-dominated sorting GA	Pumped storage, battery	Solar, wind	Cost and emissions	The GA algorithm optimize the integration of photovoltaic, wind, pumped-storage in terms of system economic and environmental performance.
[112]	PSO	battery and hydrogen	PV, Wind	costs, efficiency and lifetime	The PSO algorithm implemented in the energy management system to minimize the operating costs (29.36%) and maximize the system efficiency (27.21%) and improve the lifetime of the devices (43.43%).
[113]	PSO	Battery, thermal energy	PV, Wind	Power output	The proposed multi-objective PSO power optimization Moreover, the solution would increase the performance and the stability of the transmission channel use as comparing to solar, PV, thermal energy storage network, solar-photovoltaic battery and hydro-photovoltaic systems.
[114]	Hybrid PSO and Teaching Learning	Battery	Wind	Emission, time, and cost	A robust multi-target optimization based on a minimum optimization approach to resolve the complexities of REG is suggested. Numerical results indicate that a flexible multi-target dispatch model satisfies the demands of solutions when considering wind turbine instability. In the meantime, the comparable findings indicate the PSO-TLBO method's successful success in addressing the suggested shipping problems.
[115]	Harmony search optimization	Battery	PV	Time-of-use pricing	In case of renewable energy generation facilities such as wind and solar, the harmony algorithm proposed to find optimal ESS scheduling at demand-free time-of-use rates. Research concentrated on the ESS scheduling for retail consumers of PV generation systems under the same energy pricing strategy.
[116]	PSO	Electrochemical Energy Storage	PV	Power output	Ensure the energy storage systems are not overwhelmed and dismantled. Secondly, the voltage fluctuation following the connection of the electrochemical energy storage power station with the calculation of power flow and a discrete reactive power compensation on the bus line for adjustment of voltage fluctuation further.
[117]	Hybrid GA and ANN	Battery	PV	Cost, power output	The ANN / GA formula for optimum size of the solar spectrum and the power of the battery to satisfy demand for load. The average capital cost of the energy storage device must be a minimum and the system stability (usually calculated as load failure probability) is appropriate.
[118]	Bee colony algorithm, PSO	Fuel cell	PV, Wind	Power loss, voltage stability index, and emissions	The findings obtained with the artificial bee colony algorithm with multiple goals are of sufficient consistency and greater variety relative to the updated PSO process.

4.2. Energy control strategy

53 Energy storage has the advantage of two-way power regulation, i.e. it can absorb power when renewable power is at a surplus, and release power when the provided power is insufficient [119]. At present, it has been widely used in auxiliary wind power grid-connected power climbing control [120]. For large wind farms, the ESS is connected to the grid connection point of the wind farm, and the energy storage charging and discharging power are dynamically adjusted according to the control strategy, so that the grid connection power of the wind farm efficiently meets the climbing limit index [121]. Many control strategies exist for energy storage-assisted wind power control, including first-order filtering, slope limiters, and model predictive control [122]. In [122], develop heuristic optimization algorithm for maximizing economic profit from integration of RES and thermal power generation with pumped storage to reduce the impact associated with environmental emission and uncertainty.

54 In [123], an energy storage-assisted wind power climbing control method was based on a slope limiter, which limited the rate of change of the wind power grid-connected power to within a certain range. When the wind power climbing rate exceeded this slope, more or less wind power was stored or released by the energy storage. A wavelet filtering algorithm has good application value for hybrid energy storage-assisted wind power grid-connected power climbing [124,125]. In [124], residual forecast error signal is analysed to optimize the grid-scale energy storage units with wind power and decreasing the wind spillage using the discrete wavelet transform method. It divides the power requiring energy storage compensation into high-frequency and low-frequency parts through a real-time wavelet analysis of the wind power, and then assigns the power command of the high-frequency part to the super capacitor, and the low-frequency part to the lithium battery [126]. A model predictive control algorithm based on roughness penalty factor evaluation indicators has also been proposed; it achieves dual time scale climbing limit indicators, while improving the wind power smoothness of the grid-connected power and reducing the energy storage capacity. In [127], an optimal control strategy was proposed for a hybrid ESS, aiming to improve the power generation capacity of the wind power tracking plan. The strategy included two parts: internal energy coordination control and multi-objective optimization control, and used appropriate control methods under different ESS charge states to achieve optimised tracking control [128]. In fast frequency modulation and ultra-low frequency oscillation suppression, the energy storage control strategy will affect the energy storage capacity demand and control effects [129]. Therefore, according to the characteristics of the different frequency stability problems, it is necessary to design a reasonable control strategy for energy storage, enabling fast frequency modulation and the suppression of ultra-low frequency oscillations; this is conducive to improving the technical economy of the energy storage, and to improving the frequency modulation capability of the power system. In [130], an energy storage optimisation control method based on a prediction of wind power climbing events was used to classify climbing scenarios. Then a fuzzy logic strategy was used to dynamically adjust the grid-connected power climbing for different climbing scenarios [131]. In [132], the weight coefficient of the objective function is adjusted in real time to obtain the best PV power generation plan tracking effect, in accordance with the grid-connected power and minimum deviation of the power generation plan, and by introducing fuzzy control. In [133] optimize reliability level and operation cost for power management of storage mechanisms using fuzzy logic controllers. The hybrid green power systems consisting of wind turbines, photovoltaic collectors integrated with power storage system including battery stack, super-capacitor, hydrogen tank, and fuel cell. Table 4 introduces important works in terms of control strategies, and the main findings.

Table 4

Previous research on AI technique-based energy storage system control.

Author	Method	Result/Finding
[117]	Hybrid differential evolution optimization and ANN.	On a power network consisting of a synchronous generator, a photovoltaic power and a battery power storage system the effectiveness of this proposed controller is validated. Controller parameters are adjusted online by training of the ANN with the data sets created during the optimization phase of the two controllers using the DEO with low and high disturbance
[130]	Fuzzy logic controller	FLC membership capabilities are designed to mitigate green energy hybrid system operating expense based on weekly and regular data predictions for water, electricity, and environmental parameters, including wind speed, sunshine and air temperature using frog-spring shuffle algorithms. The accounting of power grid costs has been reported to have significant impact on the efficiency of energy storage components for the HRES on-grid service as the configured weekly and frequent FLCs minimize operating hours of fuel cells and electrical gasses and fewer SOC variability in the battery stack.
[133]	PSO	A new ESS control system with a multi-agent configuration was introduced for 100 megawatt, and the control effect was confirmed on the basis of simulation analysis and testing.
[134]	ANN and Dynamic programming	The ESS power flow is balanced by minimizing power loss and increasing battery life by minimizing battery current volume and variations.
[135]	Polyline Fuzzy Neural Network	In terms of the appropriate frequency, the definition of widespread wind storage inertia is evaluated. The PFNN approach suggests adjusting frequency frequencies as the energy storage device input and state as output.
[136]	Hierarchical Control	Through balance regulation the simulated impedance is dynamically balanced to remove the effect of the incorrect line impedance on the exactness of the current portion. Then each power storage unit can adjust current by SoC balance control according to its capacity and charge status (SoC), decrease SoC error, and gradually perform DESU SoC balance during loading and discharge.
[137]	FBC and ANN	A neural network is proposed to manage the SOC battery in the combined wind / PV system operating range. Furthermore, FBC keeps the battery current and the DC voltage smooth.
[138]	FLC/GA	The FLC/GA recommended that wind production fluctuate to energy demand. The configured FLC / GA decreases the voltage fluctuation by 43.46%.
[139]	FLC	The FLC recommended use of Wind and PV hybrid to store battery electricity, depending on the cost of use. The suggested program reduces the overall savings from the traditional conventional approach by 13 %.
[140]	FLC/ANN	The ANFIS system to control hybrid Wind and PV for battery and hydrogen energy storage considering the system efficiency. The system efficiency improved by 0.6% and 0.4% for battery and hybrid battery/hydrogen respectively.
[141]	ANN	The ANN control hybrid Wind and PV for battery and hydrogen energy storage

(continued on next page)

Table 4 (continued)

Author	Method	Result/Finding
[130]	FLC/PSO	considering the system response. The proposed ANN was response capability is faster as compared to fuzzy logic controller.
[142]	ANN	The FLC/PSO algorithm to control wind energy with battery and hydrogen energy storage considering the operational cost and battery SOC. The proposed system weekly operation cost reduced by 18.72% and battery SOC improved by 16.89%. The proposed method based on sizing and control approaches for a flow battery energy storage system integrated with large wind farm. The results present that the power flow control strategy does have an important effect on the proper sizing of the rated power and energy of the system.

5. Conclusion and future trends

With the vigorous developments in clean energy, the environmental pollution problems caused by fossil fuel energy have been effectively suppressed, and energy transformation has become a general trend. However, during the gradual developments in new energy, adverse impacts from such large-scale new energy access have gradually emerged, i.e. regarding the safety and stability of the power grid and its economic operation. An energy storage network adds greatly to the cost of RESs, but is projected to decrease steadily over the next few years [143]. Therefore, the effective use of ESSs is an important topic for making it easier for clean energy to penetrate into industries. Based on the decision matrix, battery, and supercapacitor, the HSS and SMES have shown promising characteristics, even though both technologies are still emerging in terms of their economics, efficiency, and practicality [144]. The ESS is a cost-effective and practical solution for the REPS battery.

Owing to the relative maturity of battery and supercapacitor technology, the costs are quite small, and devices are widely available in various sizes. A battery-supercapacitor system is the most commonly used HESS; the fuel cell-supercapacitor, battery-flywheel, and 'battery-SMC' approaches are less familiar, and can be used to model corresponding configurations in detail. The main benefits of an ESS can be summarised as follows: decreased costs for storage devices, increased storage life, decreased reaction time, increased reliability, increased power efficiency, and improved pulse loads [145]. Several tests indicate that the reliability of the storage is enhanced, and that the construction technique is roughly simple [127,146]. However, the ESS design has not been fully addressed in the context of system stability and/or improvements in power quality. There is a void in the multi-target modelling approach used to scale ESSs for various variables [146, 147]. An ESS architecture can be divided into four major areas: the ESS scale, range of topological power converters, control systems, and energy management. Specific methods of ESS capability scaling have been discussed in the literature. To determine the energy storage capacity, different objective functions are used. The lifespan in storage is an important consideration for determining the scales of chemical and electrochemical storage [148].

The latest control strategy development concerns developing new optimisation algorithms for overcoming complex optimisation issues. Multi-target challenges, such as economic and technical constraints, should be considered in optimisation algorithms [149]. Furthermore, as the RES output power is strongly dependent on meteorology and the demand is constantly fluctuating, a predictive control strategy should be integrated in a control approach based on optimisation, so that controls with a higher level of performance and robustness can be achieved [150]. There is minimal research, however, focusing on RESs with ESS

optimisation-based control strategies and/or predictive control strategies [122,151]. For an RES, it is essential to provide consumers with high-quality electricity. In action, an RES supplies specific types of loads, for instance, unbalanced loads, non-linear loads, and pulse loads [152, 153]. If only the ESS is used in an RES with the above loads, there will be an insufficient dynamic response to the loads, and the lifetime. The use of AI can provide correct contextual solutions under these situations, and improve the lifetimes of storage systems. Thus, predictive management strategies and control strategies focused on AI should be built to further increase the penetration of renewable energy for RESs with ESSs [10]. Giving full play to the advantages of the various types of AI, cooperating with existing ESSs in the power system, and achieving multi-objective power system optimisation control should be the research directions for future energy storage applications [154]. In addition, although real-time control of the energy storage charging and discharging power can be achieved based on the differences between the current new energy actual output and planned output, it is also necessary to consider future new energy outputs, and the remaining power of the ESSs. In [155], the ESS has a certain guiding effect on the practical application of energy storage; however, a single ESS reduces the system economy [156]. In addition, the above energy storage control algorithms are based on wind power history and real-time or ultra-short-term prediction information, aiming to achieve wind power grid-connected power that meets the corresponding climbing limit index, and to improve the friendliness of grid-connected wind power [157,158]. Owing to the lack of prospective consideration of future climbing events, the above method cannot adequately address future severe climbing events, such as rapid wind climbing or large-scale climbing [158,159]. When the corresponding event occurs, the state of charge of the energy storage owing to the large charge or discharge power (or the long duration of the energy storage) can easily reach its upper or lower limit.

At present, the research on the optimization and integration of energy storage system and renewable energy resources are not systematic and deep enough, and the related theories are not mature enough, and there are still many problems to be solved urgently. In view of the research content and the prospects for future research are as follows:

- (1) Consider the influence of multiple factors on the operating characteristics in the congested area in the analysis of working conditions. The operation of the congested area is affected by factors such as weather, commuting peaks, weekends and holidays.
- (2) The design of a complete energy storage system not only includes research on the technical and theoretical feasibility of the system, but should also requires effective evaluation in terms of engineering economy, environmental impact, and safety to determine the feasibility of the aquifer compressed air energy storage technology.
- (3) Refine the energy transmission process of the power supply network and the control strategy model of the wayside energy storage system, for example, consider the change of the impedance of the power supply network with distance, and modify the power control model of the wayside energy storage system to a voltage and current dynamic model, etc.
- (4) In the optimization energy storage model, an integer idle speed control strategy is used to reduce the size of the solution space. Considering the restriction on the value range of decision variables, or try different driving strategy optimization methods to analyze its impact on the results of energy-saving optimization.
- (5) Adjustment of the operation diagram mainly focuses on energy conservation and considers some safety and service quality constraints. However, the formulation of the actual operation diagram also involves issues such as operational service quality, management costs, etc., usually multi-objective optimization.

- 64 (6) Combining the characteristics of the above optimization algorithms, based on the exhaustive search and heuristic search, the relevant intelligent solution algorithm is designed to provide a basis for obtaining the approximate optimal solution of the energy-saving operation and controlling strategy.
- 65 (7) The hierarchical energy-saving optimization model for dispatching control combined with energy storage, and formulate the optimization of single train driving strategy, integrated optimization of inter-station operation time and division, and optimization of multi-train operation diagrams under the application conditions of trackside energy storage system.
- 66 (8) Finally, AI has helped energy storage technology to assist the power grid more practically in practical engineering applications and the maturity of energy storage technology, improved standard specification systems.

Declaration of Competing Interest

The authors declare no conflict of interest.

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Morales, A.; Araya, M.

Unit 1- Lesson 1

Answer Key: Handout 1 – Warm-up

Instructions: Match the pictures with their corresponding definitions based on your previous knowledge. Then, discuss what all these images have in common and jot down some ideas to discuss with the rest of the class.

1.



Definition

a. Wind Energy (2)

2.



b. Energy Storage System (6)

c. Hydroelectric Power (4)

3.



d. Artificial Intelligence (1)

e. Power Grid (5)

f. Solar Energy (3)

4.



5.



6.





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Unit 1- Lesson 1

Answer Key: Handout 2A - Pre-task 1

What is the topic?

- Identifying the topic is one of the first steps to help you get the full meaning of a text so that you can easily determine the author's main idea.
- English is a topic-centered language, and all the details relate to that topic. Writers in English almost always mention the topic at or near the beginning of a passage.
- Good readers look for the topic when they read. The topic is the **person, place, idea, object, or event that the author wants to explore with readers.**

How to find the topic?

To find the topic, you can use the following strategies:

- Look for a heading or title.
- Look for pictures and words in special print, such as **bold**, *italics*, or **color**.
- Read the first and last sentences of the paragraph.
- Look for repeated words or phrases in a paragraph.
- Look for words or phrases mentioned at the beginning of the paragraph and then referred to throughout the passage by pronouns or synonyms.
- Skim and scan the text to find relevant information. **Skimming** is looking rapidly through a text to determine its central idea (gist), while **scanning** is searching for specific information.

Example:

It is believed that at some point in the future, speech recognition will transform into speech understanding. The software that allows computers to decode what someone has said may one day allow them to understand not just the words, but the meaning behind them. It is true that this will require much more powerful computers and much more sophisticated software. But an enormous technological shift of this nature will transform the computers we use today into real thinking machines and make communication between humans and computers a two-way intelligent conversation.

Ask: "Who or what is the paragraph about?"

Answer: Speech recognition technology



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Unit 1- Lesson 1

Answer Key: Handout 2B - Pre-task 1

Instructions: In groups, open the reading file (Reading 1.1). Skim paragraphs 1, 4, and 55, and write their topic below. Make sure the topic is neither too broad nor too narrow. Also, scan the paragraphs and highlight the aspects below. Then, discuss your answers with a partner.

- the heading (if any)
- words in special print, such as bold, italics, or color
- the first and last sentence of each paragraph
- repeated words in the paragraphs
- words or phrases mentioned at the beginning and then referred to by pronouns or synonyms



Note: You can either highlight the details in the PDF version of the article or take notes about the line of the paragraph where the information is located.

Paragraph 1

A B S T R A C T

Energy storage technology plays a role in improving new energy consumption capacities, ensuring the stable and economic operation of power systems, and promoting the widespread application of renewable energy technologies. Several new developments, ideas, approaches, and technologies have been introduced into this area from fields including materials, knowledge manage, electricity, control, and artificial intelligence. Based on the technical characteristics of renewable energy, this study reviews the roles, classifications, design optimisation methods, and applications of energy storage systems in power systems. First, we introduce the different types of energy storage technologies and applications, e.g. for utility-based power generation, transportation, heating, and cooling. Second, we briefly introduce the states of an energy storage system, along with its operation processes and energy storage capacity. Third, a comprehensive review is conducted on artificial intelligence applications in regards to optimisation system configuration, and energy control strategy, along with the applicability of different energy storage technologies. Finally, several issues and insights are discussed, offering new inspiration and concepts for the future study of integrated energy storage systems.

Possible topic: The implementation of artificial intelligence (AI) to improve renewable energy.



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Unit 1- Lesson 1

Answer Key: Handout 2C - Pre-task 1

Paragraph 5

To encourage the AI energy industry to update and aggressively support the production of sustainable energy sources, this study initially presents energy storage technologies, and then outlines the present states of energy storage applications. As an important and regulated tool in the grid, energy storage is a significant element in the promotion of renewable energy absorption, enhancement of power grid control capacities, and assurance of safe and cost-effective grid services. The details of AI applications cover many aspects concerning the integration of energy storage and renewable energy in terms of the parameter estimation, optimal design, and operation control. Finally, a comprehensive analysis addresses the prospects for problems existing in the integration system, and considers future research directions.

Possible topic: Integration of energy storage systems and renewable energy through artificial intelligence (AI).



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Answer Key: Handout 2D - Pre-task 1

Paragraph 55

5. Conclusion and future trends

With the vigorous developments in clean energy, the environmental pollution problems caused by fossil fuel energy have been effectively suppressed, and energy transformation has become a general trend. However, during the gradual developments in new energy, adverse impacts from such large-scale new energy access have gradually emerged, i.e. regarding the safety and stability of the power grid and its economic operation. An energy storage network adds greatly to the cost of RESs, but is projected to decrease steadily over the next few years [143]. Therefore, the effective use of ESSs is an important topic for making it easier for clean energy to penetrate into industries. Based on the decision matrix, battery, and supercapacitor, the HSS and SMES have shown promising characteristics, even though both technologies are still emerging in terms of their economics, efficiency, and practicality [144]. The ESS is a cost-effective and practical solution for the REPS battery.

Possible topic: The development of new energy storage technology.



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Answer Key: Handout 3 - Pre-task 2

Typographical clues: Punctuation

Authors use typographical clues as design elements to help the readers understand the text. For example, punctuation marks are signs or symbols given to a reader to show how a sentence is constructed and how it should be read to make its meaning clear. Punctuation tells the reader when to stop, pause, connect, disconnect, and notice ideas. Let's see some examples and their main functions:

Punctuation Marks	Function	Examples
Apostrophe (')	to indicate a contraction (a shortened form of words)	I'll, didn't, what's
	to signal a possessive form	the engineer's reports
	to signal the plural form of special terms, such as dates or letters	the 1960's, the X's
Brackets []	to indicate changes made to a quoted passage	"[T]he power generator...
	to add editorial comments	The man said, "They will NOT be produced [my emphasis]."
Colon (:)	to introduce a short quotation, a list, an explanation, a summary, a subtitle, a definition, etc.	You need the basic protection equipment: the helmet, the safety vest, and dielectric boots.
Comma (,)	to separate items in a series	The three main fields are Power Systems, Telecommunications, and Computing.
	to introduce clarifying comments after words such as <i>namely</i> , <i>that is</i> , <i>for example</i>	Fossil fuels, for example, coal, oil, and natural gas, release carbon dioxide.
	to provide a restatement	Pirris, a power generation plant, is located in Costa Rica.
	to join two sentences (before words such as <i>but</i> , <i>and</i> , <i>nor</i> , <i>for</i> , <i>or</i> , <i>yet</i> , and <i>so</i>).	We are making good progress, but we still have a long way to go.

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Punctuation Marks	Function	Examples
Hyphen (-)	to join the elements in compound words	2-year program, high-voltage systems
	to express a range of numbers	Pages 90-100
Parenthesis ()	to add clarifications, definitions, and interruptions.	Alternating current (an electric current that periodically reverses its direction)
Quotation Marks (" ")	to identify the titles of shorter pieces of writing	The article "5G in Costa Rica" was assigned for homework.
	to indicate a direct quotation (someone else's exact words)	The man said, "Be careful with electrical hazards."
	to use technical terms related to a certain profession or field of study	This high-pressure pipe is known as "penstock."
Semicolon (;)	to separate items in a series if one or more includes commas	Statistics were given for the following cities: London, England; Ontario, Canada; and Paris, France.
	to separate two related sentences	Mark studied Physics; Andrew preferred Engineering.
	to be used before conjunctions such as besides, moreover, however, therefore, nevertheless, in fact, etc.	Her research was a success; in fact, she received a prize.



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Answer Key: Handout 4 - Pre-task 2

Contextual clues: Rhetorical patterns

Authors often use contextual clues to organize information in a logical, structured manner.

The following is a quick list of some of the most common rhetorical patterns and the key words used as contextual clues to help the reader understand the text.

Rhetorical pattern	Key words
Listing	- and, too, in addition, moreover, also, furthermore, as well as, besides
Definition	- verb to be (is/are) - verbs such as mean, define, represent, consider, call, name
Comparison and contrast	- <i>Comparison</i> → similarly, like, the same as, compared to, in the same way, likewise, have in common, share, resemble - <i>Contrast</i> → but, yet, on the other hand, however, instead, nevertheless, on the contrary, in contrast, all but, whereas
Cause and effect	- because, for this reason, due to, cause, on account of, if this...then this, as a result, since, consequently, therefore, thus, in effect, resulting in, the outcome is, lead to
Process Analysis	- how to, in the process of, the following steps, first, second, third...
Problem-Solution	- problem, question, puzzle, need, difficulty, dilemma, challenge, issue, answer, propose, suggest, solve, resolved, improve, plan, respond to
Purpose	- because, in order to, with the objective/purpose of, aim at, intend to - infinitives of purpose (e.g., to save)
Argument	- should, must, need to, if...then...



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Answer Key: Handout 5 - Pre-task 2

Let's practice...

Part 1.

Instructions: Work in pairs. Read page 1-2 and 10-11 of the technical article and choose the correct answer for the following questions.

1. The use of commas in **paragraph 1, line 5-6** ("... this study reviews the roles, classifications, design optimization methods, and applications of energy storage systems in power systems.") indicates _____.
 - a. a definition
 - b. a clarification
 - c. a series of items
2. The parentheses in **paragraph 2, line 12-13** ("As ESSs have certain randomness and intermittency issues (regardless of whether using grid-connected or island operation), there will be voltage and frequency fluctuations...") signal _____.
 - a. a definition
 - b. a clarification
 - c. an interruption
3. The use of a hyphen in **paragraph 3, line 2** ("Researchers have studied the integration of renewable energy with ESSs [10], wind-solar hybrid power generation systems...") indicates _____.
 - a. a compound word
 - b. a range of numbers
 - c. a break within words
4. The apostrophe in **paragraph 3, line 35-36** ("... maintains the system's efficient and stable operation in both grid-connected and island modes") indicates _____.
 - a. a contraction
 - b. a plural form
 - c. a possessive form

5. The commas in **paragraph 57, line 3** ("Multi-target challenges, such as economic and technical constraints, should be considered in optimisation algorithms [149].") are used to _____.
- a. join two sentences
 - b. separate items in a series
 - c. introduce a clarifying comment
6. The semicolon in **paragraph 57, line 29** ("the ESS has a certain guiding effect on the practical application of energy storage; however, a single ESS reduces the system economy [156].") is used to _____.
- a. introduce an explanation
 - b. separate items in a series
 - c. separate two related sentences
7. The colon in **paragraph 56, line 15** ("An ESS architecture can be divided into four major areas: the ESS scale, range of topological power converters, control systems, and energy management.") is used to introduce _____.
- a. a list
 - b. a summary
 - c. an explanation
8. The comma in **paragraph 58, line 3** ("the research on the optimization and integration of energy storage system and renewable energy resources are not systematic and deep enough, and the related theories are not mature enough...") indicates _____.
- a. join two sentences
 - b. separate items in a series
 - c. introduce a clarifying comment



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Answer Key: Handout 6 - Pre-task 2

Let's practice...

Part 2.

Instructions: Work in pairs. Read page 1-2 and 10-11 of the technical article and choose the correct answer for the following questions. The following key words work as contextual clues because they help you identify the rhetorical pattern of the text and their function.

1. What is the function of the underlined contextual clues below?

"First, we introduce the different types of energy storage technologies and applications, e.g., for utility-based power generation, transportation, heating, and cooling. Second, we briefly introduce the states of an energy storage system, along with its operation processes and energy storage capacity. Third, a comprehensive review is conducted on artificial intelligence applications in regard to optimisation system configuration, and energy control strategy, along with the applicability of different energy storage technologies." (paragraph 1, lines 6-11)

- a. Cause and effect
- b. Process analysis
- c. Problem-solution

2. What is the function of the underlined contextual clue below?

"The renewable energy output has volatility and intermittency [7], which is not conducive to the stable operation of the power grid, and seriously affects the integration of wind and solar power generation. Nevertheless, the installed capacity of renewable energy and distributed energy storage has continued to increase [8,9]." (paragraph 2, line 19)

- a. Argument
- b. Cause and effect
- c. Comparison and contrast

3. What is the function of the underlined contextual clue below?

“The emergence of new technologies has brought greater challenges to the consumption of renewable energy and the frequency and peak regulation of the power grid, and the operation of the power grid has become more complicated.” (paragraph 3, line 4)

- a. Argument
- b. Process analysis
- c. Problem-solution

4. What is the function of the underlined contextual clue below?

“The application of energy storage technology can help distribute energy peaks and modulate frequency, smooth fluctuations, and help output high-quality electrical energy. In addition, energy storage technology can provide a short-term energy supply that can be seamlessly switched off-grid, and the economic benefits are also considerable [15–17].” (paragraph 3, line 19)

- a. Listing
- b. Purpose
- c. Definition

5. What is the function of the underlined contextual clue below?

“To encourage the AI energy industry to update and aggressively support the production of sustainable energy sources, this study initially presents energy storage technologies, and then outlines the present states of energy storage applications.” (paragraph 5, line 1)

- a. Definition
- b. Purpose
- c. Argument

6. What is the function of the underlined contextual clue below?

“A battery-supercapacitor system is the most commonly used HESS.” (paragraph 56, line 3)

- a. Listing
- b. Purpose
- c. Definition

7. What is the function of the underlined contextual clue below?

“...a predictive control strategy should be integrated in a control approach based on optimization...” (paragraph 57, line 6)

- a. Listing
- b. Purpose
- c. Argument

8. What is the function of the underlined contextual clue below?

“Thus, predictive management strategies and control strategies focused on AI should be built to further increase the penetration of renewable energy for RESs with ESSs [10].” (paragraph 57, line 17)

- a. Cause and effect
- b. Problem-solution
- c. Comparison and contrast



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Answer Key: Handout 7 - Task

Instructions: Work in pairs. Read pages 1-2 and 10-11 of the technical article and identify if the main ideas below are true or false. Remember to put into practice the reading strategies of skimming, scanning, and typographical or contextual clues.

	True	False
1. The integration of energy storage and renewable energy technologies is a promising approach to ensuring efficiency and cost-effectiveness in the field of power systems.	☒	☐
2. Providing reliable power support in areas with high power requirements has become the top priority in the past few years.	☐	☒
3. Energy storage systems are becoming more effective and reliable every day, and they will soon replace fossil-based energy.	☐	☒
4. Artificial intelligence (AI) algorithms have aided the modelling, optimization, and enhancement of the hybrid system's performance, which has reduced the operational costs in comparison to conventional systems.	☒	☐
5. The study reviews the different storage technologies, the current state of energy storage applications, the integration of energy storage and renewable energy through AI applications, and the challenges to be considered in future research.	☒	☐
6. Although renewable energy may be expensive, its cost is expected to decrease gradually over time.	☐	☒
7. Battery and supercapacitors are relatively unexpensive, and the use of the energy storage system is beneficial in terms of costs, reaction time, reliability, power efficiency, among others; however, its design is lacking in stability and power quality.	☒	☐
8. Artificial intelligence optimization needs to be implemented in order to integrate renewable energy systems with energy storage systems and overcome economic and technical challenges.	☒	☐



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Answer Key: Handout 8A – Post-Task

Part 1.

Instructions: Individually, scan the complete article and create a list of technical vocabulary that you were not familiar with before. Complete this table with the required information. You may use the dictionary for this activity.

Vocabulary	Meaning	Example sentence
Heating	the process of making something warm, esp. a building, or the equipment used for this.	He takes care of the heating and air-conditioning.

Note: Feel free to insert additional cells if you have more than six new words.



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Answer Key: Handout 8B - Post-Task

Part 2.

Instructions: Work individually. Review the following information about the correct pronunciation of the simple past.



Remember...

The pronunciation of words ending in “**ed**” depends on the final consonant sound. There are three ways to pronounce “**ed**” at the end of a word in English:

/id/ /t/ /d/

- If the verb ends in –d or –t, the –ed ending is pronounced as a new syllable, /id/. Example: demonstrate → demonstrated
- If the verb ends in a vowel sound or a voiced (vibrating) consonant (l, n, r, b, g, m, z, s, v), then the –ed ending sounds like a /d/ and does not create a new syllable. Example: happen → happened
- If the verb ends in an unvoiced (nonvibrating) consonant (p, k, f, gh, sh, ch, ss, c, x), then the –ed ending sounds like a /t/ and does not create a new syllable. Example: work → worked



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Answer Key: Handout 8B – Post-Task

Let's practice...

Instructions: Work individually. The following verbs were extracted from the technical article you read. Classify the verbs in the chart below depending on the pronunciation of their “ed” ending. You may use an online dictionary to listen to the sound.

introduced – based – conducted – exchanged – used- divided – determined – achieved
– addressed – assisted – optimized – considered – improved – calculated – stored

/ɪd/	/t/	/d/
conducted divided assisted calculated	introduced based addressed	exchanged used determined achieved optimized considered improved stored



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Unit 1: Powering-up Reading Skills

Lesson 2: Identifying specific details

Date: September 1, 2021

Unit Goal: By the end of the unit, the students will be able to successfully demonstrate understanding of technical readings for academic purposes by identifying main ideas, locating specific details, and making a critical judgement through the use of top-down and bottom-up strategies.

General Objective: By the end of the lesson, the students will be able to accurately locate relevant specific details in a technical text about a satellite project through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, and guessing meaning from typographical and contextual clues.

Specific Objectives: By the end of this lesson, the students will be able to...

1. effectively brainstorm general ideas about the content of the technical article as a whole group and make predictions based on the title, images, and keywords;
2. appropriately identify the gist of the reading, the level of formality, and the relevance to their field of study by skimming the technical article in groups;
3. appropriately identify specific pieces of information within the text by scanning key sections from the reading to complete a matching exercise in groups;
4. correctly identify the meaning of underlined words and expressions by using typographical clues (e.g., headers, images, styles and font, graphic elements, or punctuation) and contextual clues (e.g., definitions, synonyms, inferences, examples, or explanations) from the technical article to complete a multiple-choice and a fill-in-the gaps exercise in groups;

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5. successfully classify statements as true or false based on specific details from the technical article by using previously studied reading strategies (skimming, scanning, and typographical and contextual clues) while interacting in groups;
6. effectively give their opinion about the impact and the significance of the satellite project described in the article by interacting with a partner orally;
7. correctly select key technical vocabulary by scanning the technical article individually in order to create three vocabulary lists corresponding to the emphases of their major: power systems, telecommunications, and computing; and
8. appropriately recognize the use of the present perfect tense by analyzing sentences containing the tense in the text and correctly unscrambling sentences using present perfect.

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up Brainstorming and making predictions T reviews the objective of the class and introduces the reading by indicating the reasons for its selection (<i>the topic is a milestone for CR; it is related to the field of EE; it is motivating for Ss; and it will be used to practice reading strategies</i>). T asks questions about recent technological innovations in the field of EE in Costa Rica. (Handout 1A) T asks Ss to brainstorm ideas and predict the content of the reading by showing images taken from the technical article. (Handout 1B) T directs the Ss' attention towards the title and asks them to write a list of key vocabulary to be found in the reading based on their predictions. (Handout 1C) T reviews the ideas as a whole group. Note: All the handouts are available in Google Classroom (access code 2yteyhw). T shares the link via the Zoom chat.	R, W, S, L	Giving an opinion: In my opinion, ... Based on the pictures, I would say that... It seems to me that... An example can/could be... Vocabulary: Advances CubeSat Data logger Ground station JTAG Microcontroller Monitoring Network Onboard data memory Onboard program memory Power switches Sensors Store & Forward Technological innovation Temperature sensor Transceiver USART	Cognitive: - Predicting - Taking Notes Creative: - Brainstorming Intrapersonal: - Individual student work Interpersonal: - Cooperating	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
2	Pre-task 1: Skimming T asks Ss to open the reading file (Reading 1-2) as well as Handout 2. Then, T asks one of the Ss to read the definition of skimming. T models the strategy visually by using the pen in Zoom to show the students what it means to skim. In groups, Ss to preview the technical article by skimming it and identify the gist. Ss also determine the level of formality and the usefulness of the text. T provides Ss with useful language to give opinions and to negotiate meaning. This information is reviewed as a whole class before the activity. After the activity, T reviews the ideas provided by Ss in a whole-class discussion.	R, S, L	Giving an opinion - What do you think the gist of this paragraph is? - In my opinion, ... - I would say that... - It seems to me that... - An example can/could be... - How about you? - I (do not) agree with you. Negotiation of meaning: Did you say...? / Do you mean...? Could you repeat that again, please? Vocabulary: Baseline Carbon dioxide Carbon neutral Construction Design Launch Lowlands Operation Satellite Turn into	Linguistic: - Skimming - Discriminating Interpersonal: - Cooperating	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: Scanning T distributes Handout 3 and asks one of the Ss to read the definition of scanning. T models the strategy visually by using the pen in Zoom to show the students what it means to scan. In groups, Ss are required to search for specific information within the text and complete a matching exercise. T monitors the activity and reminds Ss of useful language. At the end, Ss share their answers as a whole group.	R, S, L	Giving an opinion - In my opinion, ... - I would say that... - It seems to me that... - An example can/could be... - How about you? - I (do not) agree with you. Negotiation of meaning: Did you say...? / Do you mean...? Could you repeat that again, please? Vocabulary: Architecture Assembly Component CubeSat Date of publication Deliverable Lead Nanosatellites Scientific report Spacecraft Store and Forward (CS&E)	Linguistic: - Scanning Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Telecommunications Testing		
4	Pre-task 3: T provides Ss with Handouts 4A and 4B and briefly explains the concepts of typographical clues (headers, images, styles and font, graphic elements, or punctuation) and contextual clues (definition clues, synonyms, inferences, examples, or explanations). Then, T asks Ss to complete a multiple-choice and a fill-in-the-gaps exercise in groups (Handouts 4C and 4D). Ss are asked to name the specific typographical or contextual clue that helped them to understand the meaning of the underlined words and expressions in the text.	R, S, L	Vocabulary: Automation Biomass growth Carbon sequestration Climate CO₂ Data collection Data-logger Dendrometer Diameter Dynamics Ecologger Fixation Forest plantation Frequency Growth Incoming/Outcoming Measure Milestone Nanosatellite On a daily basis Pyranometer Slope Soil moisture station Solar radiation Topography Variables Weather station	Cognitive: - Inferencing - Practicing - Using context Interpersonal: - Cooperating	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
5	Task: T asks Ss to read the technical article (pages 1-8) for 10 minutes. Then, Ss classify the statements in Handout 5 as true or false based on specific details from the reading. Ss are required to use previously studied reading strategies (skimming, scanning, and typographical and contextual clues) while interacting in groups. T monitors the activity and reminds Ss of useful language. T reviews the exercise by asking Ss to share their answers as a whole group.	R, S, L	Giving an opinion - What do you think...? - In my opinion, ... - I would say that... - It seems to me that... - An example can/could be... - How about you? - I (do not) agree with you. Negotiation of meaning: Did you say...? / Do you mean...? Could you repeat that again, please? Vocabulary: Battery system Communications Data transfer Electrical power Emerging space nation Experimental plot Microcontroller Migrate	Linguistic: - Skimming - Scanning - Using context Cognitive: - Practicing Interpersonal: - Cooperating	60 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
			On-board computer Real-time Research facility Solar panels Testing Transceiver Vacuum cycle Vibration		
6	Post-task: Ss read Section 5 “Lessons Learned” from the technical article as supporting information to give an opinion. Then, in pairs, Ss share their opinions about Project Irazú as the first satellite developed in Costa Rica (Handout 6). Ss can also leave a short comment about this project in a forum available in Google Classroom. Ss may consider the impact of this milestone on the field of EE, its contribution to the country’s carbon neutrality goal, and the significance for other future technological projects.	R, W, S L	Vocabulary: Key technical vocabulary	Linguistic: - Using context - Skimming and Scanning Creative: - Brainstorming Interpersonal: - Cooperating Affective: - Personalizing	30 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
7-8	Post-task: Grammar and vocabulary: Individually, Ss select key technical vocabulary from Section 4 of the technical article to create a list related to Power Systems, Communications, and Computing. (Handout 6) Finally, Ss review the use of the present perfect by analyzing sentences containing the tense and correctly unscrambling sample sentences from the reading. (Handout 7)	R W	Grammar: The present perfect Note: Throughout the lesson, T pays attention to the following key details to provide Ss with suitable feedback after class, if required: - Verb tenses - /-s/ endings, /-ed/ endings - Pronunciation of key technical words	Cognitive: - Classifying Linguistic: - Practicing - Using context - Skimming and Scanning Creative: - Brainstorming Intrapersonal: - Individual student work	30 min

Reminders:

- As a whole class, T reviews the exercises assigned as homework in Class 2 (pronunciation of -ed endings) and provides feedback.
- Have a 10-minute break.

Homework: Ss need to complete the post-tasks for next class.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking	EE:	Electrical Engineering
Ss:	The students	W:	Writing	L:	Listening		

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

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Unit 1 - Lesson 2

Handout 1A - Warm-up

Part 1

Instructions: Think about the following questions and share your ideas with the rest of the class:

- Have you heard about any recent technological innovations or projects developed in the field of Electrical Engineering in Costa Rica?
- Can you give some examples?
- What is your opinion about these innovations as a future electrical engineer? Do you think these new inventions and projects are promising for the country?



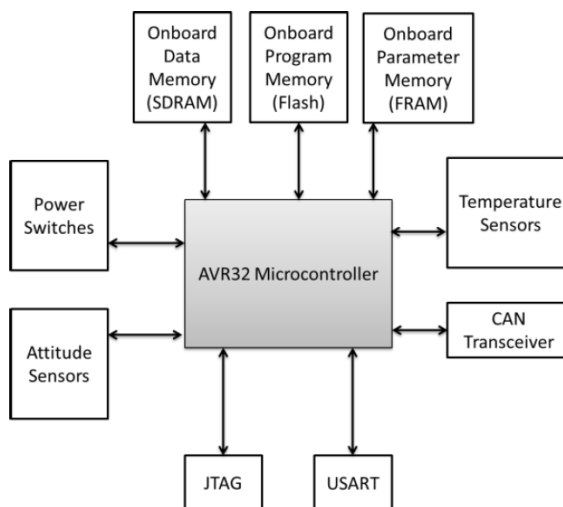
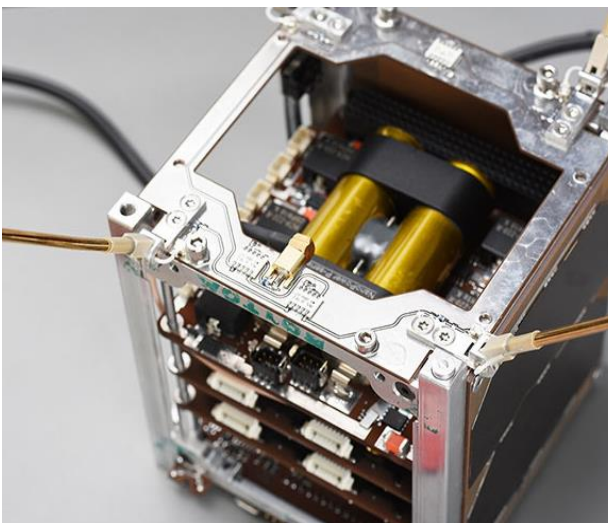
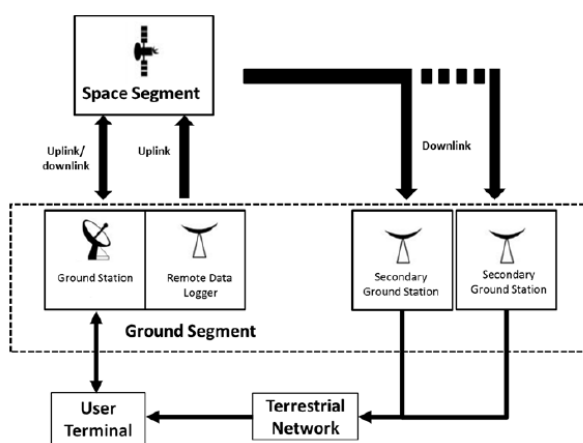
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Handout 1B - Warm-up

Part 2

Instructions: Make predictions about the content of the technical reading based on the following pictures:



What do you think the reading is going to be about?



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Handout 1C - Warm-up

Part 3

Instructions: Read the main title of the reading and write a list of key vocabulary or expressions that you think will be found in the text.

Project Irazú: Advances of a Store & Forward CubeSat Mission for Environmental Monitoring in Costa Rica

Predicting Key Vocabulary

▪ ▪ ▪ ▪ ▪ ▪ ▪

Useful Language



Giving an opinion	Negotiation of meaning
▪ In my opinion, satellites are a key technological innovation. ▪ I would say that satellites can help us predict the weather. ▪ It seems to me that space projects can be successfully developed here. ▪ An example can/could be satellites for telecommunications.	▪ Did you say “a CubeSat mission”? ▪ Do you mean a satellite station? ▪ Could you repeat that again, please?



Handout 2 - Pre-task 1

What is skimming?

Looking rapidly through a text to determine its central idea (gist), for example to decide if a research paper is relevant to our own work.

Instructions: Open the reading file (Reading 1-2). In groups, preview the text of the complete article by skimming it and identify the gist. Then, answer the following questions and take notes as required.

What do you think the gist of the text is?

1. ☐ Costa Rica's goal of turning into a carbon neutral country.
2. ☐ A baseline for training engineers in skills to execute space projects.
3. ☐ Design, construction, launch, and operation of the first Costa Rican satellite.
4. ☐ The transmission of biomass and carbon dioxide data from remote lowlands.

Is the text formal or informal?

Do you think this text could be relevant to your field of study?



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Handout 3 - Pre-task 2

What is scanning?

Looking rapidly through a text to search for a specific piece of information (e.g., a name or a date) or to get an initial impression of whether a text belongs to a specific field or is suitable for a given purpose.

Instructions: In pairs, scan the text and images on pages 1-3. Then, match each item from column A with the correct answer from column B.

Column a

1. Date of publication of the article
2. Main author of the article
3. Institutions leading Project Irazú
4. Definition of a CubeSat
5. Steps of the CubeSat Store and Forward (CS&F) system
6. Institutions in charge of approving the project
7. Phase in which the article was written
8. Acronym used for Phase D
9. A deliverable of Phase F
10. Components of the CS&F system
11. Image showing the architecture of the CS&F system
12. Definition of a Store and Forward protocol

Column b

- a. In Phase D (August 2016 to March 2018)
- b. In Figure 1
- c. A new breed of nanosatellites
- d. The remote station, the satellite, and the communication station
- e. Marco Gómez
- f. A technique used in telecommunications created in the 1970s
- g. A final scientific report
- h. ACAE and TEC
- i. Uploading scientific data to a spacecraft, storing it in its internal memory, and transferring it to a ground station
- j. Assembly, Integration, and Testing (AI&T)
- k. In September 2017
- l. NASA, Kyutech, Delft University of Technology, and Ad Astra Rocket Company



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Unit 1 - Lesson 2

Handout 4A - Pre-task 3

What are typographical clues?

Design elements used by the author to help the readers visually organize information and to direct their attention to specific textual content. They include the following:

Headings	Titles and subtitles
Images	Graphs, pictures, and tables
Styles and fonts	Boldface , <i>italics</i> , <u>underlining</u> lowercase, UPPERCASE Times New Roman, Broadway , <i>Script</i> LARGE , medium, small
Spacing	Space between words, letters, lines, and paragraphs
Graphic elements	▪ Bullets (• ✓) ▪ Symbols (° # % + @ * ± ® ™) ▪ Numbers (25, ½, 50%, 10 million)
Punctuation marks	Signs and symbols that show how a text is constructed and how it should be read to make its meaning clear: apostrophe ('), brackets [], colon (:), comma (,), hyphen (-), parentheses (), quotation marks (" "), slash (/), semicolon (;), period (.), question mark (?), and exclamation mark (!)
Abbreviations	A shortened form of a word or a word or phrase: Eng., i.e., e.g., abbrev.
Acronym	A word formed from the initial letters of other words: NASA



Handout 4B - Pre-task 3

What are contextual clues?

Hints provided by the author to help the reader understand a difficult word. Some examples include the following:

Definition	▪ A definition of a term or a restatement in simple words ▪ It usually has words such as <i>is</i>, <i>are</i>, <i>means</i>, <i>refers to</i>, <i>is/are known to</i>, <i>is/are called</i>, and <i>that is</i>. ▪ It can also be set within commas. Example: Fluoroscopy, a technique that uses X-rays to obtain real time moving images of the interior of an object, is a common practice.
Synonym	▪ A word or expression that has the same or a similar meaning. ▪ It is often introduced by words such as <i>or</i>, <i>in like manner</i>, and <i>similarly</i>. Example: In a blizzard, snow accumulates <u>or</u> piles up.
Antonym	▪ A word or expression that has an opposite meaning. ▪ It is often introduced by words such as <i>but</i>, <i>however</i>, <i>in contrast</i>, <i>instead</i>, <i>even though</i>, and <i>although</i>. Example: <u>Although</u> some people are loquacious, others hardly talk at all.
Inference clue	▪ A meaning inferred by the reader based on his/her prior knowledge. Example: It is safer to increase the temperature gradually than to set it to the maximum too fast.
Example	▪ A specific example to illustrate an unknown word. ▪ It can be introduced by <i>such as</i>, <i>for example (e.g.)</i>, <i>as an illustration</i>, and <i>that is (i.e.)</i> Example: Piscatorial creatures, <u>such as</u> salmon and trout, live in the coldest parts of the ocean.
Explanation	▪ An unknown word or expression is explained or put in simple words within the same sentence or in a sentence immediately following. Example: The structure is beginning to corrode. It shows signs of pitting and being eaten away gradually.



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Unit 1 - Lesson 2

Handout 4C - Pre-task 3

Let's practice...

Part 1:

Instructions: In groups, read page 4 of the technical article and choose the correct answer for the following questions.

- The use of italics in **paragraph 9, lines 1-4** (*"To monitor the carbon sequestration, which is an environmental service, of a forest plantation and to study the dynamics of biomass growth and its relationship with environmental variables on a daily basis."*) indicates _____.
 - a literary work
 - a definition
 - emphasis of key information
- The commas in **paragraph 10, line 3** ("... the scientific mission team is developing new technologies to improve efficiency, frequency, and automation of data collection to measure tree growth.") indicate _____.
 - a definition
 - a clarification
 - a series of items
- The use of italics in **paragraph 11, line 4** ("To understand how tree diameter growth varies and how precise the daily measurement needs to be, a pilot study was established in March 2016 in a commercial *Gmelina arborea* (fast growing tree) forest plantation...") indicates _____.
 - a literary work
 - a text from another language
 - emphasis of key information
- The capital letters used in CO₂ in **paragraph 11, line 20** ("These results demonstrated a remarkably high rate of diameter growth and equivalent fixation of CO₂.") indicate _____.
 - a contraction
 - possession
 - a formula

5. The apostrophe in **paragraph 12, line 6** ("The region's topography is relatively flat, with an average slope of $1.24^\circ (\pm 1.51^\circ)$ ") indicates _____.
- possession
 - a reference
 - a contraction
6. The brackets in **paragraph 12, line 11** ("The climate in the region has a highly variable dry season for 0-3 months [9].") indicate _____.
- a clarification
 - a missing letter
 - a reference
7. The bullets in **paragraph 14, lines 2-4** ("In the middle of the site, a tower 15 m high was placed, and it contains: a) an automatic weather station, b) two pyranometers that measure the incoming and outgoing solar radiation, and c) two photosynthetic active radiation sensors that measure radiation between 400-700 nm.") indicate _____.
- an enumeration
 - a range of numbers
 - a formula
8. The abbreviation "i.e.," in **paragraph 15, line 5** ("To measure daily diameter growth and environmental factors the team is designing a basic data-logger (named Eco-logger) that will control two main tasks: a) collection of all data from remote sensors (i.e., dendrometers, weather station, and soil moisture station"...) indicates _____.
- a definition
 - a specification
 - a series of items



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Unit 1 - Lesson 2

Handout 4D - Pre-task 3

Let's practice...

Part 2:

Instructions: In groups, read the following excerpts taken from the technical article and identify the type of contextual clue that could help you guess the meaning of the underlined word.

Contextual Clue

1. "The project has already reached major milestones, such as the approval of the final design presented in the Critical Design Review, successful assembly of the manufactured structure and the components received from different CubeSat component providers, and successful performance during various environmental tests..." (**paragraph 1, lines 13-14**). _____

2. "Advances in the miniaturization of satellite technology, specifically the creation of the CubeSat standard, has allowed engineers and scientists to build and launch spacecraft at a lower cost and with a faster development time than older technologies. This new breed of nanosatellites, with a mass of only a few kilograms, is able to perform the same tasks as satellites in the range of hundreds of kilograms." (**paragraph 2, lines 3-11**) _____

3. "The Ecologger is a microcontroller-based device, which holds a repetitive software pattern to measure environmental variables and poll data from remote sensors at a configurable frequency." (**paragraph 16, lines 1-4**) _____



Handout 5 - Task

Instructions: In groups, read the following specific details from pages 1 to 8 of the technical article and identify if they are true or false. Remember to put into practice the reading strategies of skimming, scanning, and typographical or contextual clues.

	True	False
1. Project Irazú consists of using sensors to monitor carbon fixation in an experimental plot, and a CubeSat to transfer the scientific data to a research facility for analysis and publication.	☐	☐
2. The CubeSat Store and Forward System (CS&F) is the communications protocol used for Project Irazú.	☐	☐
3. One main objective of Project Irazú is to create capacities related to space technology in an emerging space nation.	☐	☐
4. Project Irazú consists of a total of six phases.	☐	☐
5. Project Irazú migrates from manual measurements of tree diameters to multiple, fully automated digital measurements taken virtually and in real-time.	☐	☐
6. A dendrometer is an electronic device used to monitor the daily growth (diameter) of trees.	☐	☐
7. A pyranometer is a device that measures incoming and outgoing voltage.	☐	☐
8. The CubeSat is divided into four subsystems: structure, electrical power system (EPS), communications (COMMS), and onboard computer (OBC).	☐	☐
9. Two solar panels and a battery system will be used to provide the CubeSat mission with power.	☐	☐
10. The NanoCom AX100 is the transceiver used as the CubeSat communications system.	☐	☐
11. An AVR32 microcontroller is not one of the main components of the onboard computer (OBC) architecture.	☐	☐
12. A vibration test and a vacuum cycle test will be performed as part of the testing stage.	☐	☐



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Unit 1 - Lesson 2

Handout 6 - Post-Task

Part 1

Instructions: Read Section 5 “Lessons Learned” from the reading. Share your opinion about Project Irazú with a partner. You can also leave a short comment about this project in the corresponding forum in Google Classroom. Consider the following aspects:

- The impact of this milestone on the field of Electrical Engineering.
- Its contribution to the country's goal of becoming carbon neutral.
- Its significance for other future technological projects.

Part 2

Instructions: Individually, go back to Section 4 “Assembly, Integration, and Testing” from the reading and create a list of key technical vocabulary related to Power Systems, Telecommunications, and Computing:



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Handout 7 - Post-Task

Part 3

Instructions: Review the following information about the correct use of the **present perfect**.



The Present Perfect

The present perfect is used to talk about...

1. something that **started in the past** and **continues in the present**.

Example: I **have studied** English for two weeks.
She **has worked** for the same company since 2010.

2. something that **happened in the past** but is **still important in the present**.

Example: I can't get in the house. I **'ve lost** my keys.

3. actions that **happened (or didn't happen)**, but **when it happened is not important (or not known)**.

Example: He **has read** that book before.

Let's practice...

Instructions: Unscramble the following sentences from the technical article. Use the present perfect tense and the correct word order.

1. project - already - milestones - The - reached - has - major

_____.

2. The - taken - spacecraft - necessary - team - has - the - precautions - the - for - components

_____.

3. designs - have - already - been - The - tested - risks - reduce - to

_____.

4. CubeSat - allowed - a - engineers - has - The - standard - to - build - spacecraft - at - to - cost - lower

_____.

5. The - space - Rican - has - into - been - deployed - satellite - Costa

_____.

6. have - stakeholders - of - The - worked - on - initiatives - different - the - creation

_____.

Present perfect structure

Form the present perfect with **have** or **has** and a **past participle**.

For regular verbs, the past participle form is the same as the simple past form:
(Examples: open → opened, study → studied)

For irregular verbs, use the correct past participle.
(Examples: go → gone, be → been, make → made)

	Affirmative	Negative	Question
I / You / We / They	have <u>worked</u> have <u>gone</u>	have <u>not</u> <u>worked</u> have <u>not</u> <u>gone</u>	Have you <u>worked</u> ? Have you <u>gone</u> ?
He / She / It	has <u>worked</u> has <u>gone</u>	has <u>not</u> <u>visited</u> has <u>not</u> <u>gone</u>	Has he <u>worked</u> ? Has he <u>gone</u> ?

Present perfect with time adverbials

You can use...	Example
since with a stated start time in the past.	I have lived here <u>since</u> March.
for to describe the period of time from its start until the present.	I have lived here <u>for</u> many years.
already or before in affirmative statements.	I have <u>already</u> read the safety manual. I have seen this video <u>before</u> .
yet or never in negative statements.	I haven't worked for a company <u>yet</u> . I have <u>never</u> written a technical article.
ever or before in questions.	Have you <u>ever</u> been to a power plant? Have you visited the site <u>before</u> ?

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Project Irazú: Advances of a Store & Forward CubeSat Mission for Environmental Monitoring in Costa Rica.

Marco Gómez Jenkins^{a,*}, Julio Calvo Alvarado^b, Ana Julieta Calvo^c, Adolfo Chaves Jiménez^{d,e}, Johan Carvajal Godínez^{f,g}, Alfredo Valverde Salazar^f, Julio Ramírez Molina^g, Luis Carlos Rosales^h, Esteban Martínezⁱ, Arys Carrasquilla Batista^j, Luis Diego Monge^k, Carlos Alvarado Briceño^l, Juan José Rojas^{m,p}, Marcos Hernándezⁿ

^a *Mechatronics Engineering, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101, marco.gomez@itcr.ac.cr*

^b *Rector, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101, jucalvo@itcr.ac.cr*

^c *School of Forest Engineering, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101, ajcalvo@itcr.ac.cr*

^d *School of Electronic Engineering, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101, adchavez@itcr.ac.cr*

^e *Faculty of Aerospace Engineering, Delft University of Technology, Delft, The Netherlands, 2629 HS, J.CarvajalGodinez@tudelft.nl*

^f *School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA, U.S.A, 30332, avalverde3@gatech.edu*

^g *Institute of Communication and Navigation, German Aerospace Centre, Oberpfaffenhofen-Wessling, Germany, 82234, Julio.Ramirez@dlr.de*

^h *School of Electronic Engineering, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101, lrosales@itcr.ac.cr*

ⁱ *School of Electronic Engineering, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101,*

^j *Mechatronics Engineering, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101, acarrasquilla@itcr.ac.cr*

^k *Central American Association of Aeronautics and Space, Curridabat, Costa Rica, 11801, luis.monge@acaec-ca.org*

^l *Central American Association of Aeronautics and Space, Curridabat, Costa Rica, 11801, carlos.alvarado@acaec-ca.org*

^m *Laboratory of Spacecraft Environment Interaction Engineering, Kyushu Institute of Technology, Kitakyushu, Japan, 804-8550, g595909h@mail.kyutech.jp*

ⁿ *Laboratory of Spacecraft Environment Interaction Engineering, Kyushu Institute of Technology, Kitakyushu, Japan, 804-8550, g550937h@mail.kyutech.jp*

^o *Space Systems Laboratory, School of Electronics Engineering, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101*

^p *School of Electromechanical Engineering, Costa Rican Institute of Technology, Cartago, Costa Rica, 30101, juan.rojas@itcr.ac.cr*

* Corresponding Author

Abstract

1

In 2007, the Government of Costa Rica announced to the world its ambitious goal of turning into the first carbon neutral country by 2021. Following the announcement, governmental institutions, universities, NGOs and private companies have worked arduously on the creation of different initiatives to reach that goal. One innovative project is Irazú, consisting of the design, construction, launch, and operation of the first Central American satellite. The project is not just intended to enable a baseline for training scientists, engineers, and managers in the necessary skills to execute an end-to-end space project. It also aims to demonstrate a CubeSat Store & Forward (CS&F) System that enables transmission of biomass and carbon dioxide fixation data from a remote fast growth tree plantation in the lowlands of Costa Rica to a research facility for its post-processing and analysis. The Irazú project is led jointly by the Central American Association for Aeronautics and Space (ACAEC) and the Costa Rican Institute of Technology (TEC). It also involves a variety of national and international stakeholders from government, academia, and industry. This paper is a continuation of previous reports on Irazú that were presented at the Workshop on Small Satellite Programs at the Service of Developing Countries over the last five International Astronautical Congresses. The project has already reached major milestones, such as the approval of the final design presented in the Critical Design Review (CDR), successful assembly of the manufactured structure and the components received from

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different CubeSat component providers, and successful performance during various environmental tests. The mission and satellite system architecture for a CS&F system were defined, which included the three primary components: the remote station, the spacecraft, and the ground segment. Experts from the National Aeronautics and Space Administration (NASA), Kyushu Institute of Technology (Kyutech) and Delft University of Technology (TU Delft) revised the design of Irazú. Advances in the Assembly, Integration & Testing (AI&T) phase are presented and discussed, which include the development of spacecraft components, testing of the communication link, assembly of the satellite and initial results of environmental testing. International cooperation is emphasized in this phase, because Costa Rican engineers carry out testing at the laboratories of the Kyushu Institute of Technology. Furthermore, advances in the satellite frequency coordination process and spacecraft registration for an emerging space nation are presented, as well as the lessons learned from the AI&T phase.

Keywords: CubeSat, Earth observation, offset carbon emissions, remote sensing.

Acronyms/Abbreviations

ACAE	Central American Association of Aeronautics and Space
AI&T	Assembly, Integration & Testing
CDR	Critical Design Review
COMMS	Communications
COPOUS	Committee on the Peaceful Uses of Outer Space
CRC	Cyclic Redundancy Check
CS&F	CubeSat Store & Forward System
CSP	CubeSat Space Protocol
EPS	Electrical Power System
FRR	Flight Readiness Review
IARU	International Radio Amateur Union
ITU	International Telecommunications Union
JAXA	Japan Aerospace Exploration Agency
JEM	Japanese Experimental Module
Kyutech	Kyushu Institute of Technology
LNA	Low Noise Amplifier
MCR	Mission Concept Review
MICITT	Ministry of Science, Technology, and Telecommunications
NASA	National Aeronautics and Space Administration
OBC	Onboard Computer
ORR	Operational Readiness Review
OST	Outer Space Treaty
PDR	Preliminary Design Review
RSSI	Relative Received Signal Strength
SETEC	Space Systems Laboratory
SM	Structural Model
SRR	Systems Requirements Review
SUTEL	Superintendence of Telecommunications
TEC	Costa Rican Institute of Technology
TU Delft	Delft University of Technology

designed and executed space missions. Advances in the miniaturization of satellite technology, specifically the creation of the CubeSat standard, has allowed engineers and scientists to build and launch spacecraft at a lower cost and with a faster development time than older technologies. This new breed of nanosatellites, with a mass of only a few kilograms, are able to perform the same tasks as satellites in the range of hundreds of kilograms. The reduction in development and launch cost has opened up access to space to new entities, which include universities and emerging space nations, and it has led to the movement called democratization of space.

One of the countries that has decided to enter this new movement is Costa Rica, which is developing Project Irazú. It consists of using ground sensors to monitor carbon fixation in an experimental plot and a 1U CubeSat to transfer the scientific data to a research institution for analysis and publication. The project is a joint effort between the Costa Rica Institute of Technology (TEC) and the Central American Association of Aeronautics and Space (ACAE). Project Irazú is a proof of concept, which plans to demonstrate how nanosatellite technology can be used to transmit data from remote locations to a central location for analysis. The communications protocol that is being developed is called the CubeSat Store and Forward (CS&F) system, which consists of uploading scientific data to the spacecraft, storing it in its internal memory, and transferring it to a ground station upon command. The team decided to monitor carbon fixation for this project to support Costa Rica's goal of becoming a carbon neutral entity by 2021 and to demonstrate an immediate benefit of space technology to a country that had not developed it previously.

Project Irazú has two main objectives: 1) to create capacities related to space technology in an emerging space nation, and 2) to monitor and to collect field data daily to estimate the growth in biomass as a function of environmental variables in a remote, tropical rainforest region [1].

The team has made considerable advances over the last few years (Table 1). The schedule is divided into seven phases, because the team is using a tailored

1. Introduction

At the start of the 21st century, the satellite community was experiencing a shift in the way they

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version of the National Aeronautics and Space Administration (NASA) project lifecycle. There are reviews for each of the first five phases of the project (Table 1). This is to ensure that the team is following the correct procedures and executing the project in a responsible fashion. Only after an external group of experts has approved the work is the team allowed to advance to the next phase. The experts carrying out this work on Project Irazú are from different international institutions including the NASA, Kyushu Institute of Technology (Kyutech), Delft University of Technology (TU Delft), and Ad Astra Rocket Company. Project Irazú is currently in Phase D, working on the assembly, integration, and testing (AI&T) of the systems, which will be the focus of this paper.

Table 1. Phases of Project Irazú and deliverables.

Phase	Time Period	Deliverable
Pre-Phase A: Mission Definition	Jan 2015- July 2015	Mission Concept Review (MCR)
Phase A: Requirements Definition	Aug 2015- Nov 2015	System Requirements Review (SRR)
Phase B: Preliminary Design	Nov 2015- Feb 2016	Preliminary Design Review (PDR)
Phase C: Final Design	March 2016- July 2016	Critical Design Review (CDR), CubeSat subsystems, ground station components, ground sensors
Phase D: Assembly, Integration and Testing	Aug 2016- March 2018	Flight Readiness Review (FRR), CubeSat flight model, mission control, ground segment, Operational Readiness Review (ORR).
Phase E: Mission Operations	April 2018- Sept 2018	CubeSat is operating in orbit and communicating with remote/ground stations.
Phase F: Mission Disposal	Oct 2018	Final mission report, lessons learned, scientific report.

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2. CubeSat Store and Forward System

The Store and Forward protocol is a technique used in telecommunications that consists of sending data to a node, storing it and transmitting it to another node after a given period [2]. It was created in the 1970's to manage networks that had low bandwidth connections and basic transmitters (these had very low memory, which led to frequent saturation). The Store and Forward protocol was useful for these networks,

because the transmitter stored the incoming data and waited until there were other "free" transmitters to forward the information and avoid saturation.

When the networks became more sophisticated, the technique became obsolete until the early 1990's, with the growth in popularity of small satellites, that were in the range of 100 – 500 kg. The design of Irazú shows that a 1 kg satellite can fulfill the same function as the satellites of the 90's, thanks to advances in microelectronics. This concept will be tested for the first time using a 1U CubeSat in 2018, with the operation of the Irazú satellite [3].

A CS&F system consists of at least three components: the remote station, the satellite, and the communication station (Figure 1). The remote station is an autonomous communication station that collects scientific data from sensors that are located in an area with difficult access and limited signal. Once the satellite is in the line of sight of this station, the data is transmitted and stored in its internal memory. The communication station then sends a signal to collect the scientific data and pre-analyze it. The simplest CS&F consists of a unit of each component but it could be developed with more remote stations, satellites and communication stations, which would result in a transmission system of real-time scientific data around the world using cost efficient spacecraft and ground stations.

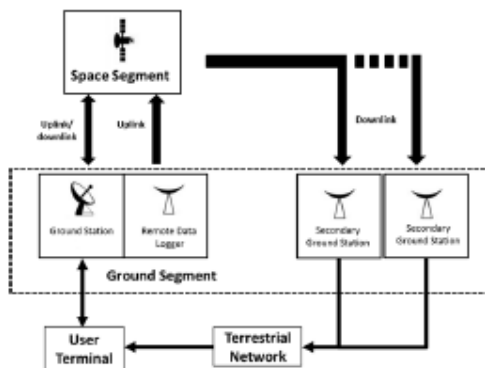


Fig. 1. Architecture of the CubeSat Store and Forward System.

3. Science

3.1 Scientific Mission.

The scientific mission is framed to respond to one of the most significant global threats: global climate change. Irazú will focus on how tree plantations fix atmospheric carbon on a daily basis and how the rate of carbon fixation is affected by changes in environmental variables. This contribution is relevant because, to the best of our knowledge, there have been no studies that

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have provided daily data to understand how planted trees grow and accumulate biomass. Daily measurements of tree diameters (growth) are unprecedented in forest ecology and climate change research, given that previous studies used only annual averages. The general objective of the science mission can be formulated as:

9 To monitor the carbon sequestration, which is an environmental service, of a forest plantation and to study the dynamics of biomass growth and its relationship with environmental variables on a daily basis.

10 To accomplish this objective, the scientific mission team is developing new technologies to improve efficiency, precision, frequency, and automation of data collection to measure tree growth. Hence, the innovation of Project Irazú is to migrate from manual measurements of tree diameter to multiple, fully automated digital measurements, which are taken virtually in real time and transmitted using a satellite link, a cellular network, or a radio frequency network.

3.2 Pilot Experimental Study

11 To understand how tree diameter growth varies and how precise the daily measurements need to be, a pilot study was established in March 2016 in a commercial *Gmelina arborea* (fast growing tree) forest plantation [3], which was 1.5 years old and located in the northern lowlands of Costa Rica. At this site, we also installed an automatic weather station and three plots with 40 trees per plot (Fig. 2). The diameter and height of all trees were measured manually every month.

After 10 months of measurements, the general results were: a) average monthly rainfall 280 mm, average temperature 26.6 °C, average relative humidity 93%, b) average growth rate of tree diameters, 3mm/day, equal to 11cm/year, and c) estimated annual accumulation of total biomass (areal + root) 39 Mg/Ha, total carbon 18 Mg/Ha, and equivalent CO₂ 79 Mg/Ha. All calculations were made using models that were recommended in the literature [4], [5], [6], [7], and [8]. These results demonstrated a remarkably high rate of diameter growth and equivalent fixation of CO₂.

3.3 Experimental Design and Data Collection

12 Once the pilot study concluded, we established the final experimental design in January 2017 on a property owned by TEC, located in the province of Alajuela, County San Carlos, in the North of Costa Rica. This experimental site was selected because of its secure perimeter and access to electrical power. The region's topography is relatively flat, with an average slope of 1.24° (±1.51°), an elevation of 35 m -110 m, mean annual temperature of 24-27°C, and an annual rainfall

of 1950-3000 mm. The climate in the region has a highly variable dry season for 0-3 months [9]. Three plots of 180 m² (12 m x 15 m) each were established at the selected site. This site will provide all the experimental data to be transmitted to the satellite during 2018. Therefore, these trees will be 1 - 1.5 years of age, and the estimated daily diameter growth rate will be of 0.3 mm (see section 3.2).

The monitoring of daily growth (diameter) will be carried out by placing electronic dendrometers (under final calibration) on five selected trees. The five electronic dendrometers will be synchronized with a data aggregator that stores the information. The daily average of tree diameter growth will be transmitted to the satellite.

In the middle of the site, a tower 15 m high was placed and it contains: a) an automatic weather station, b) two pyranometers that measure the incoming and outgoing solar radiation, and c) two photosynthetic active radiation sensors that measure radiation between 400 -700 nm. The information from all sensors in the tower, which include the dendrometers and soil moisture sensors, will be transmitted to a data aggregator every 30 min. Also, the tower will be used to install the antenna for the satellite data transmission system, solar panels, and data aggregators.

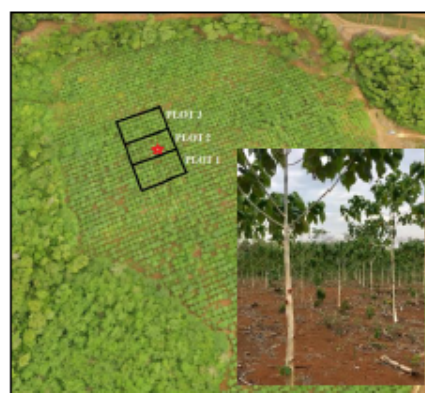


Fig. 2. Pilot experimental site for Project Irazú in Los Chiles de Alajuela, Costa Rica. Areal overview of plots and tree plantation.

3.4 Integration of Ground Instrument

To measure daily diameter growth and environmental factors, the team is designing a basic data-logger (named Eco-logger) that will control two main tasks: a) collection of all data from remote sensors (i.e., dendrometers, weather station, and soil moisture station) and b) packing of all collected information in a single data packet that is ready to be transmitted to the satellite relay.

16 The Ecologger is a microcontroller-based device, which holds a repetitive software pattern to measure environmental variables and poll data from remote sensors at a configurable frequency. Additionally, the Ecologger contains a precise time reference, which enables tracking measurements at the time (and therefore, events) when they occurred. It also offers an external storage system using an SD card that acts as data backup storage to retrieve information if communication with the satellite is lost and to verify the correct transmission of the experimental station. Additionally, it has a backup communication interface using a USB protocol, which can be used to connect to a different transmitter or to connect to ground-based communication technologies if required. On the communication interface, the Ecologger acts as a data aggregator, featuring an XBee master node, which can collect information from all the remote dendrometers (Fig. 3).

17 Similar to the dendrometer design (battery operated), the Ecologger will use a battery to support its life operation (including an energy-saving mode). For the initial prototype and test runs, one of the plantation's electrical outlets will be used. Future implementations will use a lithium battery that is dimensioned to support up to 10 days of continuous operation and connection to a solar panel.

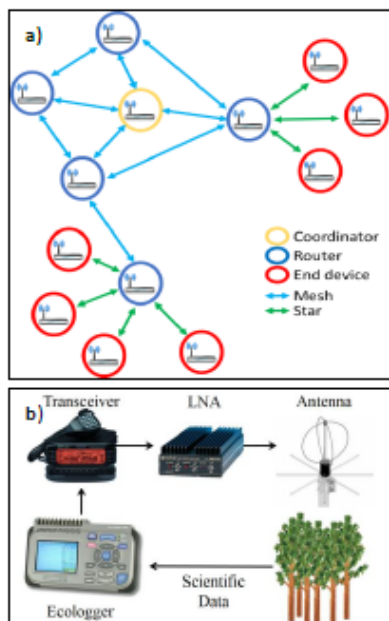


Fig. 3. a) Wireless transmission network and b) Block diagram of the remote ground station for Project Irazú.

3.5 Remote Communication Station

18 The objective of this station is to create an autonomous communication system that will collect the data from the ground sensors and transmit it to the spacecraft. The first element to consider is the Ecologger, which packages the data and sends it to the transceiver. This device creates a signal that passes through the low noise amplifier (LNA) and finally to the antenna for transmission to the spacecraft. An omnidirectional antenna was selected for this communication station, because a directional antenna must include rotor control. This feature is difficult to implement in an independent station given that the orbital elements of the spacecraft must be updated frequently during operations. The remote communications station design demonstrates a cost-efficient and simple, yet robust mechanism, for environmental monitoring.

4. Assembly, Integration, and Testing

19 The AI&T phase consists of building or procuring the different subsystems that were defined in the previous phase (Phase C: Final Design) and integrating them to create the final product, a 1U CubeSat system. This section will present the different subsystems that have been developed, along with a summary of the assembly and testing procedures that will be carried out at the end of this phase. Furthermore, an overview of the assembly and integration of the ground station is presented.

4.1 CubeSat Subsystems

20 The CubeSat is divided into four subsystems: the structure, electrical power system (EPS), communications (COMMS), and onboard computer (OBC). The following subsections present an overview of the activities that are related to each subsystem during Phase D of the project. Details about the design of each subsystem is found in [10].

4.1.1 Structure

21 The 1U CubeSat structure was designed by engineers at TEC and built by the precision manufacturing unit of the National Learning Institute (INA), a Costa Rican autonomous institution that specializes in technical education. This is one of the most critical components of the project, because it is a demonstration of the capabilities that are available in Costa Rica, that are not necessarily exploited with a space-focus.

22 The structure was designed considering the requirements that were specified for a 1U CubeSat in the Japanese Experimental Module (JEM) Payload Accommodation Handbook [11] published by the Japan Aerospace Exploration Agency (JAXA). It consists of four rails (one on each side of the cube), that allows the CubeSat to be inserted into a standard CubeSat launch

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mechanism. Two deployment switches are incorporated into opposite rails. This triggers a signal to the EPS once the satellite has been deployed into space. The other two rails include spring plungers that aid with the separation of the spacecraft once it is deployed. The material used for the structure was Aluminum Alloy 6061, which resulted in a final mass of 120 g.

Two models of this structure were manufactured: a structural model (SM) and a flight model. The SM was sent to Kyutech (Japan) for initial testing and verification of the requirements, and the flight model is in Costa Rica for assembly and integration (Fig. 4).

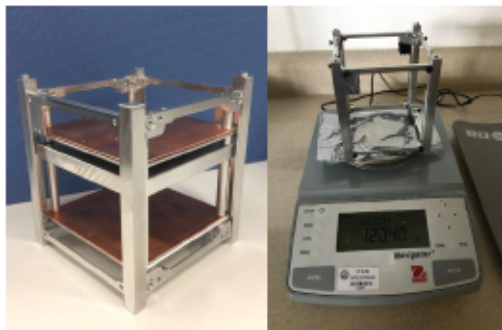


Fig. 4. Structural model of the 1U Irazú structure prepared for vibrational testing (left). Flight model of the structure being tested for mass requirements (right).

4.1.2 Electrical Power Systems

To provide the power needed for the CubeSat mission, the EPS consists of five solar panels and a battery system. These are designs that have already been tested in space by the provider to reduce the risks. The provider selected was GomSpace, with its "NanoPower P31u" as a power source, in combination with the "NanoPower P110" solar cells. The source of energy consists of two power buses with voltages of 3.3 V and 5 V, which are compatible with the requirements of all the other subsystems.

As an essential component of the CDR, it was proven that enough power would be generated with only five solar cells [10], even under worst-case scenario lighting conditions. The EPS system was tested and verified up to August 2017, and after verifying its working specifications compared to the CDR calculations, it is ready for integration in September 2017.

4.1.3 Communications

The CubeSat communications system consists primarily of a half-duplex, software configurable transceiver: the NanoCom AX100. It is responsible for sending the telemetry and receiving the commands for the uplink/downlink of the scientific data.

The telemetry data are obtained from the following subsystems: EPS for battery charge, the OBC for timestamp and gyroscope, and COMMS for the relative received signal strength (RSSI). In the main operation mode of the CubeSat, the scientific data for downlink will be obtained from the OBC and, for the uplink, data will be obtained from the Remote Ground Station, so the CS&F can be performed. Operators in the ground segment (mission control) can access the other operating modes.

The antenna coupled to the transceiver operates in the ultrahigh frequency (UHF), and it is circular polarized with an omnidirectional radiation pattern. The highest gain is 1.4 dBi (along the Z-axis of the CubeSat). The lowest gains are 0.6 to -0.3 dBi (along the X- and Y-axes) (Fig. 5).

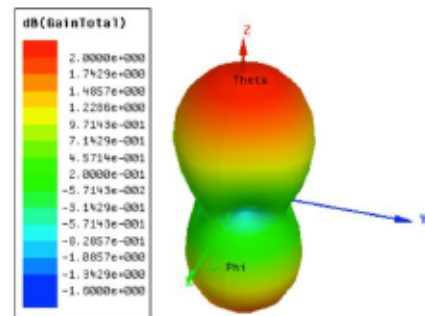


Fig. 5. Radiation pattern of UHF antenna: NanoCom Ant430 [GomSpace, 2017].

FLAG		60
AX.25 Header	INIT	0
	Source Calsign	82
		b0
		62
		60
		60
	a4	
	60	
	Calsign Destination	82
		b0
		62
60		
60		
a4		
61		
Control Field	3	
PID	f0	
AX.25 Data Field	CSP Header	94
		70
		6c
	CSP Packet	0
		51
		fa
CRC-32	67	
	49	
	c0	
FLAG		c0

Fig. 6. AX.25 data frame, in KISS mode, for the requested file upload command.

29 All scientific data sent to the ground stations is encoded into an AX.25 protocol by the transceiver. This data frame includes the AX.25 header, the data field, and a 16-bit cyclic redundancy check (CRC) for error detection. The software in the AX.25 header configures a call sign with SSID, for destination and source. In the AX.25 Data Field, an encoded header is added for the CubeSat Space Protocol (CSP), which contains the destination/ source node, ports, and priority, so the packets can be routed correctly in the communications architecture (Fig. 6).

30 In the developing process, a FTDI cable (USB-Serial Converter) was modified to have an external power supply, because the AX100 undergoes an external reset when it does not get enough current. The voltage of the power supply is set to 3.3V with a current limitation of 1A. This way, the transmission was achieved with the minimum power established in the "tx_pwr" parameter of the AX100, consuming approximately 0.3 A. The "tx_pwr" parameter goes from one to three. Initial tests demonstrated that it was possible to realize the transmission to maximum power with the EPS (NanoPower P31u).

31 4.1.4 Onboard Computer

The OBC is one of the core subsystems of the Irazú Satellite. It is in charge of receiving commands from both the ground station and the remote transmitter. Then, the computer decodes and executes these commands, together with other satellite subsystems like EPS and Communication. The OBC for the Irazú project is based on the GomSpace NanoMind A3200. This computer features a high performance microcontroller that is based on the AVR32 MCU architecture. It has 512 KB of built-in Flash memory, 32KB of FRAM for parameter configuration, Real Time clock and calendar capabilities, and on-board temperature sensors. For communication with other subsystems, the Irazú OBC makes use of the CSP over an I2C bus. The onboard computer was selected according to the requirements from the PDR/SRR. It also included the mapping of structural and functional requirements into a physical architecture (Fig. 7). The onboard software is split into a service layer (bootloader+operating system+libraries) and an application layer. The service layer handles all interfaces between software and hardware components. It also includes data interfaces to communicate with the radio transceiver and the electrical power unit.

32 The onboard software is implemented as a multi-task application intended to address the requirements specified above for each of the mission phases. Once the satellite passes the early operation period, the beginning of operations is done by changing the operational mode to the main mode, where the satellite will start to collect and relay data to the ground systems.

In this design, the use a synchronized main loop for all operations is proposed. The main advantage of this approach is that everything is dependent on one timer and all tasks will run synchronously, while the interrupts and priority handling is managed separately. The main loop starts with initiating the synchronization timer, which controls the end of this loop and the start of the next loop. Every synchronization period a command is sent to the slave subsystems, so they know that the OBC is alive and they should perform its core measurements at this command.

The watchdog timer will be preset every synchronization cycle. In case the OBC fails, the watchdog is not cleared from reaching the zero count, and the OBC will reset automatically. The functions for completing the proper satellite operation are meant to be implemented using the software development tools provided by the manufacturer. These functions include all the stated according to the requirements in the previous sections.

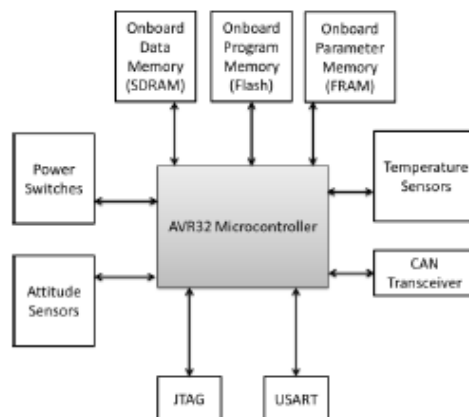


Fig. 7. Project Irazú onboard computer architecture

4.2 Assembly

35 The assembly of the CubeSat will take place in October 2017 in a clean room class 100,000 that is owned by MOOG Medical, a medical manufacturing company that is located in the Coyoil Free Zone, one of the project's sponsors. The assembly procedure is based on the CubeSat Integration Manual that was written by researchers at the California Polytechnic State University [12]. Currently, assembly manuals for the CubeSat are being developed at the TEC's Space Systems Laboratory (SETEC Lab). Activities that are related to the assembly include verifying the internal component distribution of the final designs, verification of final mass distribution, and an overall compliance to the requirements set by JAXA, the launch provider, and the CubeSat standard. The Irazú team has taken the necessary precautions when handling the spacecraft

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components, which include the use of safety gloves, an anti-static mat and grounding each of the engineers, who test the subsystems, to avoid electrostatic discharges. Fig. 8 displays the advances of the integration of the CubeSat components in the IU structure.

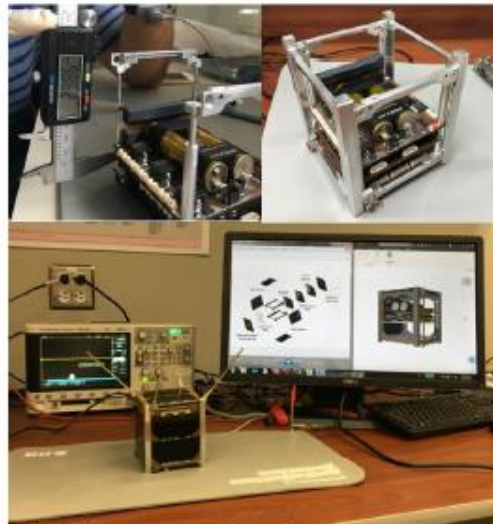


Fig. 8. Measurement of internal component separation of the spacecraft, integration of internal CubeSat components, and full CubeSat integration for Project Irazú.

4.3 Testing

The environmental tests to be performed on the Flight Model are the Vibration Test and the Thermal Vacuum Cycle test. The purpose of the Vibration Test is to demonstrate that the satellite can withstand the test levels of sinusoidal vibration, random vibration and quasi-static load (sine-burst) without structural failure, no malfunction of components (accidental turn-on or deployment) and no damage to electronic, mechanical or electromechanical components. The Thermal Vacuum Cycle Test demonstrates that the satellite was manufactured properly, that it can survive and properly operate in space and that it can withstand the thermal stress induced by temperature cycles. The two models of the satellite are tested under different test levels:

- Qualification Test level (QT) is set as the maximum predicted environment plus a margin. A dedicated model, which is called the SM, will be used for this test. The main objective is to detect design defects.
- Acceptance Test level (AT) is equal to the maximum predicted environment, and the FM

model shall be used for this test. This test is aimed to detect workmanship and material defects.

The environmental tests are carried out at the Center for Nanosatellite Testing (CeNT) of the Kyushu Institute of Technology, under the specifications of the JEM Payload Accommodation Handbook-Vol.8, and Structure Verification and Fracture Control Plan for JAXA Selected Small Satellite Released from J-SSOD [11].

4.3.1 SM Vibration Test

During the first week of July 2017, the SM of Irazú was tested at Kyutech. The SM was prepared by adding some aluminum, PCB, and brass plates to match the weight and center of mass of the actual components (Fig. 9).

A structural analysis using a finite element method simulation was made to evaluate the response of the modeled structure to the expected load, to determine the natural frequencies and set the test frequency range accordingly. From that preliminary simulation, we determined that Irazú satisfied the structural requirements for satellites released by Japan's Small Satellites Orbital Deployer (J-SSOD)

Before the actual test, a detailed test plan and a step-by-step SM assembly document were prepared. To perform the test, the Irazú SM was inserted into a Poly-Picosatellite Orbital Deployer (P-POD) with two dummy satellites. The structure was then attached to the vibration machine and monitored by accelerometers.

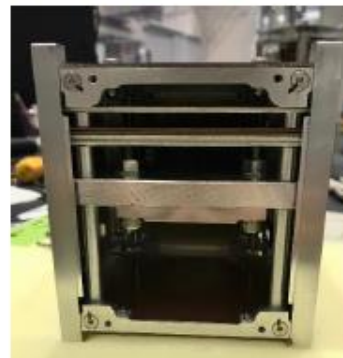


Fig. 9. Structural Model of the Irazú satellite.

The test is performed in all three axes, which consider several vibration input profiles as follows:

- Signature Check: The test consists of a frequency sweep from 5 Hz to 2000 Hz during 60 s to determine the natural frequencies of the satellite. It will be applied before and after every test profile to detect any displacement on the resonant frequency.

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- **Random Vibrations:** The test consists of random vibrations within a Power Spectral Density (PSD) profile for a range of frequencies from 20 to 2000 Hz. For Irazú, a combination of every possible launch vehicle was used (SpaceX Dragon, ESA ATV, Orbital Cygnus and JAXA HTV). A combined maximum envelope profile was calculated (Fig. 10). Over the maximum expected value, an additional margin of +3 dB/dec was added to the PSD. Under those conditions, the overall input was 6.8 grams. The test duration was set to 120 s.

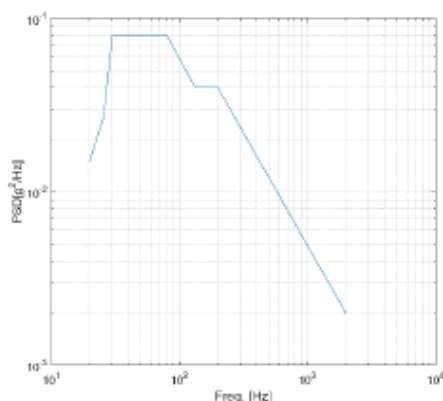


Fig. 10. Envelope of the random vibration profiles.

- **Sine Burst test:** The test used sinusoidal base waves to apply a quasi-static load into the satellite body at a specific frequency. The highest acceleration load of all possible launch vehicles was selected for the analysis (Orbital Cygnus: 18.1g). The applied load was $18.1g \times 1.25 = 22.6g$, at a frequency of 30 Hz with, at least, 20 waves of the maximum load applied to the body. The sequence of the test for each axis is: 1) Signature Check. 2) Random vibration. 3) Signature Check. 4) Sine Burst. 5) Signature Check.

As an example of the results, we provide the X-axis PSD profile of the before and after vibration test Signature Checks (Fig. 11) and the sine burst profile applied to the SM (Fig. 12).

4.3.1 Flight Model Vibration Test and Thermal Vacuum Cycle Test

The environmental testing for the FM is scheduled for November and December of 2017 in Kyutech, Japan. The flight model will be subjected to a Thermal Vacuum Cycle test and a Vibration test. For the thermal vacuum test, a vacuum chamber with a special cooling jacket is used to surround the satellite with liquid

nitrogen (LN2) at a temperature of -192°C . Thermal resistances are placed around the satellite to control the temperature and generate thermal cycles as if the satellite was orbiting the Earth. During the thermal cycles, the Irazú satellite will be powered using its battery, which will be recharged by an external energy source. There will be access ports to the chamber, which will allow monitoring the temperature of various critical components of the satellite during the test.

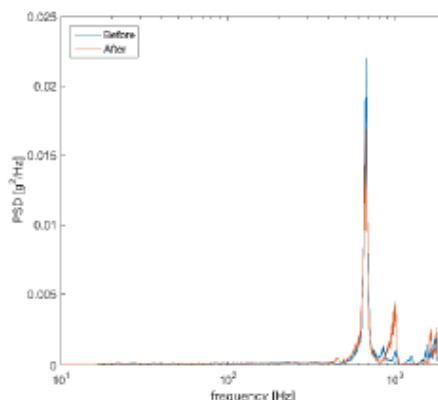


Fig. 11. Signature check of the SM.

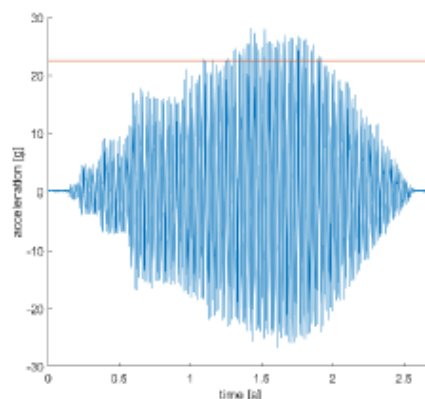


Fig. 12. Sine burst applied to the SM

RF transmission, the OBC receiver, and antenna deployment will also be tested during the Thermal Vacuum Cycle test. The Vibration test for the flight model will be performed following the same procedure for the SM, but it will be done at the AT level, which means that maximum expected environmental conditions will be employed without any margin. After every environmental test, a functional test is required to verify the proper operation of the satellite.

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4.4 Ground Stations

Except for the customized software modem, all ground station hardware is commercial off-the-shelf (COTS) amateur radio hardware. This hardware was selected to meet the requirements that were imposed by the uplink and downlink budgets.

The Remote Ground Station is formed by a Kenwood TM-D710G Radio (46.9 dBm), a Microset UHF power amplifier RU 2-45 (46.5 dBm) and an omnidirectional circular polarized UHF antenna (5.5 dBi). The computer that runs the CSP application is a Raspberry Pi 3 model b+, running in Raspbian (Debian) (Fig. 13).



Fig. 13. M2 Inc. EB-432 antenna and Kenwood TM-D710G used to run the ground station for Project Irazú.

Scientific data is collected from sensors wirelessly, using the radio frequency module: RFM69HCW (Fig. 14). After all data is obtained from the network of sensors and stored in the Raspberry, each data frame is encoded with the same AX.25 data frame used with the AX100 transceiver.

Both uplink and downlink are performed at a baud rate of 9600 bps. 1200 bps was originally intended to be used, but after testing between both radios, better performance was identified at 9600bps. This change was made with the intention of reducing risks in transmitting the scientific data by using a higher baud rate.

The CSP protocol implements interfaces and drivers, to transmit data over different protocols to conserve the CSP structure. A KISS interface is already carried out in the CSP GitHub, for serial communication.

The approach of the KISS interface is to send data to the CubeSat radio and/or OBC over a USB-Serial converter. In case the AX100 is in AX.25 mode, the AX.25 header is added by its microcontroller. Therefore, the AX.25 header is not included in either the KISS CSP interface or the Kenwood in KISS mode. To include the AX.25 Header and the correct CRC, a

“KENWOOD” interface was developed inside the CSP protocol that was based on the KISS interface.

The main problem faced with the link was the modulation incompatibility between radios. The AX100 uses G3RUH FSK modulation and the TM-D710G uses FM modulation with two-tone AFSK encoding that is generated by its built-in TNC.

Taking advantage of the “DATA” 6-pin mini-DIN connector in the TM-D710G, which includes an audio data IN/OUT pin and a PTT pin, a software TNC modem was implemented. In this way, the G3RUH FSK modulation can send and receive audios that contain the encoded data. In fact, plenty of software modems for amateur radios exist. The open source software called Direwolf was selected for this operation. With just a .configuration file, the encoding from a virtual serial port to the audio output of the Raspberry Pi can be done easily. The PTT can be controlled with a GPIO pin, and it is configurable with Direwolf.



Fig. 14. Raspberry Pi 3 and RFM69HCW module used to collect scientific data.

5. Lessons Learned

Irazú is the first satellite project developed in Costa Rica, and many lessons have been learned during its development. This section presents the most relevant lessons that we experienced during Phase D of the project.

5.1 Frequency Registration

The registration of the operating frequency of the satellite is necessary to launch the spacecraft into space. This is a long process, which takes a minimum of nine months. It consists of applying for an operating frequency with the International Telecommunications Union (ITU) and in parallel with the International Amateur Radio Union (IARU), because CubeSats operates in amateur radio frequency bands. The former process consists of using ITU's SpaceCap, which is software utilized to prepare the application. With this tool, the operating frequency and technical

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specifications of both the spacecraft and the ground systems are specified. For Irazú, the application was prepared with the help of the Ministry of Science, Technology and Telecommunications (MICITT), because the applications must be submitted by a governmental agency.

55 The application procedure with IARU is usually performed in parallel to avoid delays in the frequency registration process. It consists of specifying technical details of the communications equipment (similar to the ITU application) and a spacecraft operator, which must have an amateur radio license. Another option to this procedure is to obtain a scientific license from the government to operate the satellite, which is the course taken by the Irazú team. By working closely with MICITT and the Superintendent of Telecommunications (SUTEL), a license is currently being procured that will allow TEC to operate the satellite for the defined period that it will be in orbit. The team expects to have the operating frequency registered by December 2017.

5.2 Spacecraft Registration

56 Project Irazú represents Costa Rica and Central America's first experience in space use and exploration. Through the experience gained in this project, ACAE and TEC aim to develop in the region the human talent and capabilities to completely carry a space mission from conceptualization to design and execution. The capabilities needed to successfully carry on future missions include developing the legal and political mechanisms that constitute the international regulatory framework for space activities, in accordance with the Outer Space Treaty (OST).

57 As any other regulatory scheme, international space law establishes alongside obligations, a set of rights or freedoms derived from its core objectives. First, outer space is unrestricted for exploration and use by all nations for peaceful purposes. Secondly, its use should benefit all people. Third, it should be an instrument for international cooperation. In this sense, the right of Central America represented by Costa Rica to access and use outer space is granted by all international treaties that constitute international space law.

58 The five main space treaties conceived by the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) are listed as follows [13]:

- Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty or OST)
- Agreement on the Rescue of Astronauts the Return of Astronauts and the Return of Objects Launched into Outer Space (Rescue Agreement)

- Convention on International Liability for Damage Caused by Space Objects (Liability Convention)
- Convention on the Registration of Objects Launched into Outer Space (Registration Convention)
- Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement)

Among the international treaties relating to activities in outer space, Costa Rica has only adopted in its national jurisdiction the Registration Convention, approved by the Law 8832 of the Legislative Assembly of the Republic of Costa Rica on May 10, 2010 [14]. The registration process of the CubeSat is being conducted with the Ministry of Foreign Affairs of Costa Rica.

Space treaties establish a series of obligations for states looking to become space faring nations [15]. These ensure that all activities carried out in space have peaceful purposes, and that states remain liable for the activities of their citizens in space.

International registration of objects is an obligation placed upon states by the United Nations General Assembly. Each state must provide information regarding the function of the object, launching state or states, designation of the space object, information on the launch including territory and date, and orbital parameters such as nodal period, inclination, apogee and perigee.

5.3 Subsystem Manufacturer and JAXA Requirements

Safety reviews of any launch provider are processes in which many proof documents are requested. Some of the critical safety features that shall be examined by JAXA and are related to spacecraft subsystems are:

- Energizing inhibits (RBF pins and deployment switches).
- Battery protection circuits (overcharge, over discharge, overcurrent and external short circuit).
- Antenna deployment system.
- Electrochemical cell screening and matching for battery construction.
- Battery assembling and testing.

Most of these documents are considered as classified by spacecraft subsystem manufacturers and this implies that a negotiation should be carried out to ensure safety compliance. This can be solved by setting a non-disclosure agreement between some or all the involved parties. In the case of Irazú, this was the solution to this problem. We do strongly recommend negotiating these terms from the beginning with the subsystems' manufacturer to avoid unnecessarily affecting the schedule. Naturally, the manufacturer will like to

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protect its intellectual property, while the launch provider would like to know every detail possible about the components they are flying. It is important to understand the implications of the lack of access to information that the developing team will have.

5.4 Scientific Component

Our experience points out that in the planning and development of a CubeSat project, a scientific mission that is properly embedded within the context of society's needs and aspirations should be included, and that it must represent an outstanding challenge to the technical and scientific team. This will trigger innovation by generating new solutions to major problems. In our case, the selected scientific mission has garnered social attention. This has given the mission significant national and international projection, and a foundation to achieve financial, institutional and political support, all in an attempt to solve a relevant problem in an interdisciplinary fashion.

5.5 Risk Reduction

A mission in a developing country should be posed as a careful balance between risk minimization and technical challenges. The use of an international evaluating group subjecting the development to the NASA Systems Engineering Model has been fundamental in ensuring that the mission remains innovative and within the technical capabilities of the country, while bounding the risk levels. Evaluation of the PDR and CDR by the external team was a key source of feedback during the intermediate steps of the mission.

6. Conclusions

Project Irazú has reached various milestones in the last year, which include technical and scientific advances in the AI&T phase, which will lead to the launch of the CubeSat in March 2018. This innovative mission will contribute to the way we measure growth of tree diameters, and it will provide the foundation for future development of research in forest ecology, agriculture, and natural forest conservation and restoration to offset carbon emissions. This mission will also contribute to the country's goal of becoming carbon neutral in the near future.

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Maderas Cultivadas Company for allowing us to place the experimental site in their farm in Los Chiles to carry out the pilot study, and a special gratitude to Ing. Michael Garro for all the logistic help.

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Unit 1 - Lesson 2

Answer Key: Handout 1C - Warm-up

Part 3

Instructions: Read the main title of the reading and write a list of key vocabulary or expressions that you think will be found in the text.

Project Irazú: Advances of a Store & Forward CubeSat Mission for Environmental Monitoring in Costa Rica

Predicting Key Vocabulary

▪ Answers will vary.

-
-
-
-
-

Useful Language



Giving an opinion	Negotiation of meaning
▪ In my opinion, satellites are a key technological innovation. ▪ I would say that satellites can help us predict the weather. ▪ It seems to me that space projects can be successfully developed here. ▪ An example can/could be satellites for telecommunications.	▪ Did you say “a CubeSat mission”? ▪ Do you mean a satellite station? ▪ Could you repeat that again, please?



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Unit 1 - Lesson 2**Answer Key: Handout 2 - Pre-task 1****What is skimming?**

Looking rapidly through a text to determine its central idea (gist), for example to decide if a research paper is relevant to our own work.

Instructions: Open the reading file (Reading 1-2). In groups, preview the text of the complete article by skimming it and identify the gist. Then, answer the following questions and take notes as required.

What do you think the gist of the text is?

1. ☐ Costa Rica's goal of turning into a carbon neutral country.
2. ☐ A baseline for training engineers in skills to execute space projects.
3. ☒ Design, construction, launch, and operation of the first Costa Rican satellite.
4. ☐ The transmission of biomass and carbon dioxide data from remote lowlands.

Is the text formal or informal?

It is formal.

Do you think this text could be relevant to your field of study?

Answers will vary.



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Answer Key: Handout 3 - Pre-task 2

What is scanning?

Looking rapidly through a text to search for a specific piece of information (e.g., a name or a date) or to get an initial impression of whether a text belongs to a specific field or is suitable for a given purpose.

Instructions: In pairs, scan the text and images on pages 1-3. Then, match each item from column A with the correct answer from column B.

Column a

1. **1K** Date of publication of the article
2. **2E** Main author of the article
3. **3H** Institutions leading Project Irazú
4. **4C** Definition of a CubeSat
5. **5I** Steps of the CubeSat Store and Forward (CS&F) system
6. **6L** Institutions in charge of approving the project
7. **7A** Phase in which the article was written
8. **8J** Acronym used for Phase D
9. **9G** A deliverable of Phase F
10. **10D** Components of the CS&F system
11. **11B** Image showing the architecture of the CS&F system
12. **12F** Definition of a Store and Forward protocol

Column b

- a. In Phase D (August 2016 to March 2018)
- b. In Figure 1
- c. A new breed of nanosatellites
- d. The remote station, the satellite, and the communication station
- e. Marco Gómez
- f. A technique used in telecommunications created in the 1970s
- g. A final scientific report
- h. ACAE and TEC
- i. Uploading scientific data to a spacecraft, storing it in its internal memory, and transferring it to a ground station
- j. Assembly, Integration, and Testing (AI&T)
- k. In September 2017
- l. NASA, Kyutech, Delft University of Technology, and Ad Astra Rocket Company



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Answer Key: Handout 4C - Pre-task 3

Let's practice...

Part 1:

Instructions: In groups, read page 4 of the technical article and choose the correct answer for the following questions.

- The use of italics in **paragraph 9, lines 1-4** ("*To monitor the carbon sequestration, which is an environmental service, of a forest plantation and to study the dynamics of biomass growth and its relationship with environmental variables on a daily basis.*") indicates _____.
 d. a literary work
 e. a definition
 f. emphasis of key information
- The commas in **paragraph 10, line 3** ("... the scientific mission team is developing new technologies to improve efficiency, frequency, and automation of data collection to measure tree growth.") indicate _____.
 a. a definition
 b. a clarification
 c. a series of items
- The use of italics in **paragraph 11, line 4** ("To understand how tree diameter growth varies and how precise the daily measurement needs to be, a pilot study was established in March 2016 in a commercial *Gmelina arborea* (fast growing tree) forest plantation...") indicates _____.
 a. a literary work
 b. a text from another language
 c. emphasis of key information
- The capital letters used in CO₂ in **paragraph 11, line 20** ("These results demonstrated a remarkably high rate of diameter growth and equivalent fixation of CO₂.") indicate _____.
 a. a contraction
 b. possession
 c. a formula

5. The apostrophe in **paragraph 12, line 6** ("The region's topography is relatively flat, with an average slope of $1.24^\circ (\pm 1.51^\circ)$ ") indicates _____.
- a. possession
 - b. a reference
 - c. a contraction
6. The brackets in **paragraph 12, line 11** ("The climate in the region has a highly variable dry season for 0-3 months [9].") indicate _____.
- a. a clarification
 - b. a missing letter
 - c. a reference
7. The bullets in **paragraph 14, lines 2-4** ("In the middle of the site, a tower 15 m high was placed, and it contains: a) an automatic weather station, b) two pyranometers that measure the incoming and outgoing solar radiation, and c) two photosynthetic active radiation sensors that measure radiation between 400-700 nm.") indicate _____.
- a. an enumeration
 - b. a range of numbers
 - c. a formula
8. The abbreviation "i.e." in **paragraph 15, line 5** ("To measure daily diameter growth and environmental factors the team is designing a basic data-logger (named Eco-logger) that will control two main tasks: a) collection of all data from remote sensors (i.e., dendrometers, weather station, and soil moisture station"...) indicates _____.
- a. a definition
 - b. a specification
 - c. a series of items



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Answer Key: Handout 4D - Pre-task 3

Let's practice...

Part 2:

Instructions: In groups, read the following excerpts taken from the technical article and identify the type of contextual clue that could help you guess the meaning of the underlined word.

Contextual Clue

Example

1. "The project has already reached major milestones, such as the approval of the final design presented in the Critical Design Review, successful assembly of the manufactured structure and the components received from different CubeSat component providers, and successful performance during various environmental tests..." (**paragraph 1, lines 13-14**).

Synonym and Explanation

2. "Advances in the miniaturization of satellite technology, specifically the creation of the CubeSat standard, has allowed engineers and scientists to build and launch spacecraft at a lower cost and with a faster development time than older technologies. This new breed of nanosatellites, with a mass of only a few kilograms, are able to perform the same tasks as satellites in the range of hundreds of kilograms." (**paragraph 2, lines 3-11**)

Definition

3. "The Ecologger is a microcontroller-based device, which holds a repetitive software pattern to measure environmental variables and poll data from remote sensors at a configurable frequency." (**paragraph 16, lines 1-4**)



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Answer Key: Handout 5 - Task

Instructions: In groups, read the following specific details from pages 1 to 8 of the technical article and identify if they are true or false. Remember to put into practice the reading strategies of skimming, scanning, and typographical or contextual clues.

	True	False
1. Project Irazú consists of using sensors to monitor carbon fixation in an experimental plot, and a CubeSat to transfer the scientific data to a research facility for analysis and publication.	☒	☐
2. The CubeSat Store and Forward System (CS&F) is the communications protocol used for Project Irazú.	☒	☐
3. One main objective of Project Irazú is to create capacities related to space technology in an emerging space nation.	☒	☐
4. Project Irazú consists of a total of six phases.	☐	☒
5. Project Irazú migrates from manual measurements of tree diameters to multiple, fully automated digital measurements taken virtually and in real-time.	☒	☐
6. A dendrometer is an electronic device used to monitor the daily growth (diameter) of trees.	☒	☐
7. A pyranometer is a device that measures incoming and outgoing voltage.	☐	☒
8. The CubeSat is divided into four subsystems: structure, electrical power system (EPS), communications (COMMS), and onboard computer (OBC).	☒	☐
9. Two solar panels and a battery system will be used to provide the CubeSat mission with power.	☐	☒
10. The NanoCom AX100 is the transceiver used as the CubeSat communications system.	☒	☐
11. An AVR32 microcontroller is not one of the main components of the onboard computer (OBC) architecture.	☐	☒
12. A vibration test and a vacuum cycle test will be performed as part of the testing stage.	☒	☐



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Answer Key: Handout 7 - Post-Task

Part 3

Instructions: Review the following information about the correct use of the **present perfect**.



The Present Perfect

The present perfect is used to talk about...

1. something that **started in the past** and **continues in the present**.

Example: I **have studied** English for two weeks.
She **has worked** for the same company since 2010.

2. something that **happened in the past** but is **still important in the present**.

Example: I can't get in the house. I **'ve lost** my keys.

3. actions that **happened (or didn't happen)**, but **when it happened is not important (or not known)**.

Example: He **has read** that book before.

Let's practice...

Instructions: Unscramble the following sentences from the technical article. Use the present perfect tense and the correct word order.

1. project - already - milestones - The - reached - has - major

The project has already reached major milestones.

2. The - taken - spacecraft - necessary - team - has - the - precautions - the - for - components

The team has taken the necessary precautions for the spacecraft components.

3. designs - have - already - been - The - tested - risks - reduce - to

The designs have already been tested to reduce risks.

4. CubeSat - allowed - a - engineers - has - The - standard - to - build - spacecraft - at - to - cost - lower

The CubeSat standard has allowed engineers to build spacecraft at a lower cost.

5. The - space - Rican - has - into - been - deployed - satellite - Costa

The Costa Rican satellite has been deployed into space.

6. have - stakeholders - of - The - worked - on - initiatives - different - the - creation

The stakeholders have worked on the creation of different initiatives.



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Unit 1: Powering-up Reading Skills

Lesson 3: Identifying facts and opinions

Date: September 7, 2021

Unit Goal: By the end of the unit, the students will be able to successfully demonstrate understanding of technical readings for academic purposes by identifying main ideas, locating specific details, and making a critical judgement through the use of top-down and bottom-up strategies.

General Objective: By the end of the lesson, the students will be able to successfully make a critical judgement about technical texts related to Power Systems, Telecommunications, and Computing and Networking through the use of reading comprehension strategies such as identification of facts and opinions.

Specific Objectives: By the end of this lesson, the students will be able to...

1. effectively discriminate signal words related to facts and opinions by completing an online multiple-choice exercise individually;
2. appropriately identify facts as definitions, numbers, statistics, dates, measurements, or historical events by analyzing a series of technical statements in groups;
3. appropriately recognize key vocabulary related to opinions (e.g., adjectives, superlatives, comparatives, and words related to points of view, doubt, or possibility) by analyzing a series of technical statements in groups;
4. correctly distinguish whether a statement is a fact, an opinion, or a mix by analyzing a series of technical statements in groups;
5. effectively make a critical judgement about longer extracts from technical texts by classifying them as a fact, an opinion, or a mix and discussing their usefulness for an academic research paper in groups;

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6. successfully use the simple past and the present perfect tense to communicate in an academic or professional setting by completing a fill-in-the-gaps exercise individually; and
7. effectively differentiate the -ed endings of regular verbs in the simple past tense (/t/, /d/, or /ɪd/) by practicing their pronunciation.

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Making predictions T reviews the objective of the class and then shares a link to an online platform called Wordwall.net via the Zoom chat. T briefly explains the technical procedure for accessing the platform and gives instructions for the exercise. Ss access the online platform through this link: https://wordwall.net/play/21268/957/697. (Handout 1) Individually, Ss need to complete a group sorting activity by predicting signal words related to facts or opinions. Ss need to drag and drop the signal words into the corresponding category. T shares the screen for everyone to see the progress of the activity and the leaderboard. The platform automatically checks the Ss' answers. T leads a whole-class discussion by asking Ss why recognizing the difference between fact and opinion is relevant in their field. Once Ss share some ideas, T explains that distinguishing between fact and opinion is critical for electrical engineers as they need to read and communicate a lot of information (specifications, client needs, calculations, etc.). T also points out that engineers are expected to provide professional	S, L	Giving an opinion: - In my opinion, ... - It seems to me that... - For example, ... Vocabulary: <u>Signal words for facts:</u> Confirm Demonstrate Discover Evidence Know Prove Record Results Reveal Show Support True Verify <u>Signal words for opinions:</u> Agree Apparently Appear Bad Believe Best Better Disagree	Cognitive: - Classifying - Predicting - Inferencing Intrapersonal - Individual student work	20 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	recommendations (opinions) based on facts as part of their job. T also explains that feedback will be provided throughout the lesson and will also be posted on Google Classroom before the next session ("language pills").		Favorite Feel Good Guess Interpret Least Less Might More Most Possibly Potentially Probably Prefer Seem Should Suspect Think Worse Worst		
2	Pre-task 1: Identification of facts T asks Ss to open Handout 2A available in Google Classroom. To introduce the topic, T asks Ss to read the definition and examples of facts and opinions. T uses the whiteboard to show Ss the clue words in the examples for facts and opinions.	R, W, S, L	Giving an opinion - What do you think about this statement? What type of fact does it have? - In my opinion, ... - I'd definitely say that ... - I could be wrong, but ... - It seems to me that ... - How about you? - I (do not) agree with you.	Cognitive: - Classifying - Inferencing Linguistic: - Using context - Practicing Interpersonal: - Cooperating	20 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	Then, Ss are asked to identify different types of facts by using Handout 2B. Ss read a series of statements and classify them as definitions, numbers, statistics, dates, measurements, or historical events while interacting in groups. T moves across the breakout rooms to check Ss' understanding and interaction and to provide support if needed. Once Ss are finished, T checks the exercise as a whole group by asking Ss to share their answers orally. T provides the answer key through a PowerPoint slide as Ss share their answers.		Negotiation of meaning: - Did you say...? / Do you mean...? - Could you repeat that again, please? Vocabulary: Ampere Artificial intelligence Dates Definitions Dynamo Earth's core Electric current Generator Geothermal energy Gigawatt hour Gradient Grid Heat High-voltage lines Historical events Hydroelectric power plant Hydropower Kilowatt Measurements Numbers Statistics Strength		

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Telecommunications market Unit of measurement		
3	Pre-task 2: Identification of opinions Ss read a series of statements and highlight the word(s) acting as clues to identify the sentences as opinions. (Handout 3) T moves across the breakout rooms to check Ss' understanding and interaction and to provide support if needed. Once Ss are finished, T checks the exercise as a whole group by asking Ss to discuss their answers orally. T provides the answer key through a PowerPoint slide as Ss share their answers.	R, S, L	Giving an opinion - What do you think about this statement? What do you think the clue is? - In my opinion, ... - I'd definitely say that ... - I could be wrong, but ... - It seems to me that ... - How about you? - I (do not) agree with you. Negotiation of meaning: - Did you say...? / Do you mean...? - Could you repeat that again, please? Vocabulary: Appears Believes Electrons Energy consumption Good Less Likely Most	Cognitive: - Inferencing Linguistic: - Using context - Practicing Interpersonal: - Cooperating	20 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Might Network Positive/Negative Charge Probably Seem Should Solar panels Tidal power Turbine Wind energy Wind farm		
4	Pre-task 3: Identification of facts, opinions, and mixed statements T draws Ss' attention to a comparative table in Handout 4A and asks some Ss to read the information on it. This table provides further details and clues for Ss to differentiate between facts and opinions. Using Handout 4B, Ss analyze a set of technical statements and write F for fact or O for opinion depending on their purpose while interacting in groups. T moves across the breakout rooms to check Ss' understanding and interaction and to provide support if needed. Then, T checks the exercise as a whole class by asking Ss to share their answers	R, W, S, L	Giving an opinion - What do you think about this statement? What type of fact does it have? - In my opinion, ... - I'd definitely say that ... - I could be wrong, but ... - It seems to me that ... - How about you? - I (do not) agree with you. Vocabulary: Apparently Believe Blockchain technology CEO Chip technology Confirm	Cognitive: - Inferencing - Classifying Linguistic: - Using context - Practicing Interpersonal: - Cooperating	20 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
	orally. T provides the answer key through a PowerPoint slide as Ss share their answers. Finally, T explains that a piece of information can also mix facts and opinions. T asks one of the Ss to read a short paragraph (Handout 4C) to exemplify how facts and opinions can both be present in a text. T allows 3-5 minutes for Ss to analyze the text individually and then reviews the exercise as a whole group. T shares the answer key through a PowerPoint slide as Ss discuss their answers.		Demonstrate Discover Electrical vehicle Energy-efficient Fossil fuels 4G and 5G signals Global warming GPS Maintenance Most Nonrenewable energy Oil spills Programming error Project manager Reveal Scalable Should Smart-grid solutions Steadily growing Suspect Upgrade		
5	Task: In groups, Ss classify a series of passages as a fact, an opinion, or a mix. Ss are encouraged to use the clues and strategies learned in the pre-tasks. (Handout 5A) Ss also use a graphic organizer to take notes about the reason for their choice, their	R, W, S, L	Giving an opinion - What do you think passage # is? A fact, opinion, or mixed? - In my opinion, ... - I'd definitely say that ... - I could be wrong, but ... - It seems to me that ... - How about you?	Cognitive: - Inferencing - Classifying - Taking notes Linguistic: - Using context - Practicing	40 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	opinion about the passage, and whether or not the information would be suitable or useful to write a paper in the field of Electrical Engineering. (Handout 5B) T moves across the breakout rooms to check Ss' understanding and interaction and to provide support if needed. For the reporting stage, T asks Ss to share their answers as a whole group.		- I (do not) agree with you. Negotiation of meaning: - Did you say...? / Do you mean...? - Could you repeat that again, please? Vocabulary: Automation Barrels of oil Beam Bus speed Calculator Capacitor Connectivity Current Electrical engineer Electrical engineering Emission Energizing Equation Failure Frequency Impedance Knowledge-based Load Operational Overvoltage Patent Pollution	Affective: - Personalizing Interpersonal: - Cooperating	

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Robotics Run out Sand Semiconductor Silicon Solar energy Switching Tap settings Transmission line Transformer Voltage regulation		
6	Post-task: For the asynchronous session, Ss individually read the definition and the examples about the present perfect and the simple present before completing a fill-in-the-blanks exercise. Ss need to analyze the context and conjugate the verbs accordingly. (Handout 5) T reminds Ss to consult the material from the previous sessions in case they need additional support.	R, W	Grammar: - Simple past versus present perfect (regular and irregular verbs)	Cognitive: - Inferencing Linguistic - Practicing Intrapersonal: - Individual student work	30 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
7	Post-task: T recaps the pronunciation of the -ed endings in simple past regular verbs and asks Ss to classify a list of verbs by writing the corresponding -ed ending sound (/id/ /t/ /d/). Ss also practice the pronunciation of the words. (Handout 5)	W, S, L	Pronunciation: - Pronunciation of simple past tense (regular verbs) - /-ed/ endings	Cognitive: - Inferencing - Classifying Linguistic: - Practicing Intrapersonal: - Individual student work	30 min

Reminders:

- As a whole class, T reviews the exercises assigned as homework in the previous class and draws the learner's attention to the feedback posted on Google Classroom.
- T reminds Ss about the assessment tasks scheduled for next week.

Homework: Ss need to complete the post-tasks for the next class.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking
Ss:	The students	W:	Writing	L:	Listening

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms.

Link to Wordwall.net: <https://wordwall.net/play/21268/957/697>

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Unit 1- Lesson 3

Handout 1 - Warm-up

Instructions: Work individually. Sort the signal words below into the correct category. Decide whether they are related to facts or opinions.

best – believe – show – might – demonstrate –
evidence – confirm – seem – support – possibly

Fact	Opinion

Discussion:

Why is recognizing the difference between fact and opinion relevant for electrical engineers?

Useful Language:



Giving an opinion	Negotiation of meaning
▪ In my opinion, it is important to recognize the difference to know what to believe. ▪ It seems to me that knowing the difference is critical for electrical engineers because we need to read and communicate information all the time. ▪ As far as I know, it is necessary to understand the intention of the author.	▪ What do you mean by the intention of the author? ▪ Could you repeat that again, please? ▪ Could you please elaborate more on the importance of recognizing the difference between fact and opinion? ▪ Sure! What I mean is that engineers are expected to provide professional recommendations based on facts.



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Handout 2A - Pre-task 1

What is a fact?

- A fact is something **that is known or proved to be true**.
- Facts are always **objective and neutral**.
- Facts can always be **verified or proved** by concrete information, for example scientific research and data records.
- They generally use **statistics, numbers, dates, and measurements**.
- Authors often use facts **to support their opinions**.



Examples:

- The major hazards associated with electricity are electrical shock, fire, and arc flash.
- In 1939, Russell Ohl created the solar cell design that is used in many modern solar panels.
- The latest data shows that the market size of artificial intelligence was valued at \$27.23 billion in 2019 (Fortune Business Insights, 2020).
-

What is an opinion?

- An opinion is **a view or judgment about something, i.e., what someone thinks about something**.
- An opinion can be **a belief, a feeling, or speculation**.
- Opinions are not necessarily based on facts or knowledge.
- They are **personal interpretations** based on **an individual's knowledge and experience**.
- Opinions are **subjective**.
- Opinions can often include **adjectives, superlatives, comparatives, and words related to points of view, doubt, or possibility**.



Examples:

- I think Electrical Engineering is a challenging and satisfying profession.
- Peer-to-peer networks are more common in homes, while client/server networks are more likely to be used by businesses.
- Such details and insights should make room for further observations and speculations by students and teachers.



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Handout 2B - Pre-task 1

Instructions: Individually, read the following facts and indicate whether they correspond to *definitions, numbers, statistics, dates, measurements, or historical events*. Then, with your group, compare your answers and discuss those in which you have a different answer. Some statements can have more than one possible answer.

1. In 1831, Michael Faraday built the electric dynamo, a rudimentary electrical generator that produced a stable electric current and made electricity viable for use.

2. Geothermal energy is the heat produced deep in the Earth's core.

3. In Iceland, almost 90% of the country's people use geothermal heating resources.

4. In 1882, the world's first hydroelectric power plant began operating in the United States along the Fox River in Appleton, Wisconsin. _____
5. To produce a GWh (a gigawatt hour, or one million kilowatts of energy for one hour), a geothermal power plant uses the equivalent to 1,046 square kilometers (404 square miles) of land. _____
6. Costa Rica has been coasting on nothing but renewable power since the start of 2015, according to news from the Costa Rican Electricity Institute (ICE).

7. The ampere is the standard unit of measurement for the strength of an electric current.

8. The telecommunications market opening process enabled an increase in the number of operators, from 2 to more than 130. _____

9. The California ISO (Independent System Operator Corporation) is a non-profit public benefit corporation that manages the high-voltage lines that make up 80% of the California electric grid and oversees the market for electricity in the state.
- _____

10. In most parts of the world, the geothermal gradient is 25 °C per 1 kilometer of depth (1 °F per 77 feet of depth). _____

11. On average, hydropower comprises approximately 75 percent of Costa Rica's electricity generation, and geothermal, at about 12 percent, is the country's second-leading source of power according to the International Energy Agency.
- _____

12. Artificial Intelligence (AI) is a young discipline that aims to imitate the cognitive abilities of a human being. _____



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Unit 1- Lesson 3

Handout 3 - Pre-task 2

Instructions: In groups, read the following statements and highlight the clue words to identify the sentences as opinions.

1. A tidal-powered turbine, whose manufacturers claim that it is the most powerful in the world, has started to distribute electricity via the grid in Orkney.
2. Poor power quality also results in increased energy consumption which is not good for either homeowners or businesspeople.
3. Deserts are often very windy places and seem like natural sites to harvest wind energy.
4. For future work, the effect of this assumption should be investigated, and possible improvement of the engineering method should be proposed in case that the assumption is not satisfied.
5. Solar panels are becoming less expensive and widely adopted.
6. This new network operation is likely to bring added operational costs.
7. All electrons are negatively charged, so it might seem surprising that two like charges will attract.
8. Van Wageningen believes the wind farm will bring positive change to the Lake Turkana area.
9. Probably more information about each type of lamp should be extracted and provided for training to better handle cases where there are more sources of heat and other interferences.
10. Despite of its limitations, the study appears to have numerous strengths as well as advantages for computer network professionals.



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Handout 4A - Pre-task 3

FACT VERSUS OPINION	
FACT	OPINION
▪ Concrete piece of information ▪ Relies on denotative language ▪ Can be proved or verified with evidence ▪ Is not shaped or affected by a writer's personality, background, or training (objective) ▪ Does not change (invariable) ▪ Names and describes, but does not evaluate ▪ Uses statistics, numbers, dates, and measurements	▪ View or judgement about something ▪ Relies on connotative language ▪ Cannot be proved by evidence ▪ Is affected by a writer's personality, background, and training (subjective) ▪ May differ according to different people ▪ Often expresses comparisons (<i>more, better, most, least</i>) or is introduced by verbs and adverbs suggesting a point of view, doubt, or possibility (<i>think, believe, appears, seems, apparently, probably, potentially, possibly, etc.</i>)

Note: Not all the superlatives and comparatives in a sentence are used to give opinions. They can also be used to talk about facts. Carefully analyze each sentence to understand the author's purpose. Ask yourself this question: "Can this statement be proved or demonstrated to be true?"

Why is it important to distinguish between fact and opinion?**To evaluate texts:**

- To evaluate the reliability and usefulness of texts you encounter.

To develop critical thinking skills:

- To determine which statements are facts and which statements are opinions.

To identify bias:

- Bias is an opinion or an attitude we have for or against something.
- It usually results from our feelings rather than from rational thought.
- Facts can sometimes be influenced by opinions and biases, especially in the media and even in some academic and research fields.





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Handout 4B - Pre-task 3

Instructions: In groups, analyze the following statements and write **F** for fact or **O** for opinion next to each statement depending on its purpose.

1. The CEO believes that an effective team of engineers exhibits a sense of trust among members as well as between members and the project manager. _____
2. *Scientific American* is the most popular science and technology magazine in the world. _____
3. Many experts suspect that blockchain technology might not be as scalable as needed. _____
4. Our research confirms that executives expect smart-grid solutions to reduce the cost of grid maintenance and upgrades. _____
5. A team of researchers has demonstrated that they can charge an electrical vehicle in 10 minutes for a 200-to-300-mile (300-500 km) range. _____
6. The computer trouble was apparently caused by a programming error. _____
7. The company should have taken a major step forward in chip technology. _____
8. Researchers have discovered how to retrofit homes to be more energy-efficient. _____
9. This report reveals that the telecommunications sector has been steadily growing since 2010. _____
10. 4G and 5G signals might help warn pilots when their GPS is being spoofed. _____



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Unit 1- Lesson 3

Handout 4C - Pre-task 3

Mixed information

Sometimes, a piece of information mixes both objective—factual—and subjective information. The result is a mix of fact and opinion. Consider the following text:



Human Activities and the Environment

¹Unfortunately, human use of fossil fuels is one of the most significant developments of the past few centuries. ²Humans rely on fossil fuels, a nonrenewable energy resource, for more than 90 percent of their energy needs. ³This careless misuse of our planet's resources has resulted in pollution, global warming, and the destruction of fragile ecosystems. ⁴For example, oil pipelines carry more than one million barrels of oil each day across tundra regions. ⁵Transporting oil across such areas can only result in oil spills that poison the land for decades.

Instructions: In groups, determine if the information in the text is a fact (objective), an opinion (subjective), or a mix of fact and opinion. Read each sentence and then circle the correct word. Be ready to explain your choice.

<u>Sentence 1</u>	a. fact	b. opinion	c. mix
<u>Sentence 2</u>	a. fact	b. opinion	c. mix
<u>Sentence 3</u>	a. fact	b. opinion	c. mix
<u>Sentence 4</u>	a. fact	b. opinion	c. mix
<u>Sentence 5</u>	a. fact	b. opinion	c. mix
<u>The whole text</u>	a. fact	b. opinion	c. mix



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Handout 5A – Task

Instructions: In groups, evaluate the following passages and discuss whether they indicate a pure fact, a pure opinion, or a mix of fact and opinion.

1. An overvoltage is an increase in the RMS AC voltage greater than 110% at the power frequency for a duration longer than 1 min. They are usually the result of load switching (e.g., switching off a large load or energizing a capacitor bank). Overvoltages are generated because the system is either too weak for the desired voltage regulation or voltage controls are inadequate. Incorrect tap settings on transformers can also result in system overvoltages. _____
2. The United States generates the largest amount of geothermal energy of any other country. Every year, the U.S. generates at least 15 billion kilowatt-hours or the equivalent of burning about 25 million barrels of oil. Industrial geothermal technologies have been concentrated in the western U.S. In 2012, Nevada had 59 geothermal projects either operational or in development, followed by California with 31 projects, and Oregon with 16 projects. _____
3. Solar energy is likely to continue to exist so far into the future that we can think of it as being unending. Essentially, it is renewable, unlike fossil fuels which are running out as we use them. In addition, using solar energy does not cause air pollution or involve damaging the Earth's surface. It requires no difficult and expensive extraction procedures. Creating the solar cells themselves does require resources—converting sand into silicon still requires considerable energy—but this is paid back within three or four years of a solar cell's operation. _____

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

4. Edith Clarke was the first woman to be professionally employed as an electrical engineer and the first full-time female professor of electrical engineering in the United States. Unable to find work as an electrical engineer, Clarke worked for General Electric as a computer assistant after graduating from the Massachusetts Institute of Technology (MIT). It was there that Clarke filed her first patent on a "graphical calculator" (an early graphing calculator) in 1921. Clarke's device solved basic equations involving voltage, impedance, and current in power transmission lines ten times faster than other methods used at that time.

5. A new technology that ensures fast and reliable 5G connectivity between a base station and a receiver has been developed by electrical engineers at the University of California in San Diego. High-band 5G systems communicate data by sending one laser-like millimeter wave beam between a base station and a receiver, but the connection gets blocked if something or someone gets in the way of that beam's path. "Relying on a single beam creates a single point of failure," said Dinesh Bharadia, a professor of electrical and computer engineering at the UC San Diego Jacobs School of Engineering. Bharadia and his team split the one laser-like millimeter wave beam into multiple laser-like beams and have each beam take a different path from the base station to the receiver. The idea is to improve the chances that at least one beam reaches the receiver when an obstacle is in the way.

6. A study conducted by Forrester Consulting on the impacts of robotic process automation or RPA found that over 66 percent of employees believe that RPA is restructuring jobs, not removing them. RPA will relieve humans of their repetitive, boring work, allowing them to focus on work that robots and artificial intelligence can't do—the work that is knowledge-based, creative, and strategic.

7. Without electromagnetic compatibility (EMC) optimization, the technology trend toward more complex and faster designs is expected to lead to increased emission levels. Although EMC optimization techniques have partially filled the gap between IC customer requests and IC performance, new innovative techniques need to be investigated to compensate for the induced parasitic effects of technology scale-down. The required efficiency of these techniques should allow a reduction in unintended emissions of 40 dB. Despite these continuous efforts, there is a gap between IC customer requests and intrinsic IC performance. Not only do generic low-emission design guidelines need to be generalized and integrated into SOC design flows, but advanced design techniques should also be applied to respond to IC customer pressure for less conducted and radiated noise. The technology trend toward lower noise margins, more I/O structures, and higher bus speeds should lead to even higher susceptibility to RFI. Generic high-immunity design guidelines should be introduced in SOC design flows, as a response to IC customer pressure for higher immunity.

8. "When COVID hit last year, all of the auto orders dried up," said Phil Amsrud, senior principal analyst of automotive semiconductor research at market research firm IHS Markit in San Francisco. "But the consumer electronics industry saw the recovery and read the tea leaves faster than autos, so they began gobbling up capacity. When the market recovered and auto companies re-engaged the supply chains, it was too late and there was no more capacity." Chip orders from the auto sector now face a lead time of up to 30 weeks from only 12 weeks to 16 weeks before the pandemic, Amsrud said. The capacity conundrum is likely going to cost the auto industry millions, if not billions, of dollars as they battle for a place in line with an industry that has only a handful of major players — Taiwan Semiconductor Manufacturing Co., the world's largest contract chipmaker, operates roughly 50 percent of all chipmaking capacity globally.



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Handout 5B – Task

Instructions: In groups, take notes to explain how you know that each passage is a fact, an opinion, or a mix. Then, decide if the passage would provide useful information to write a research paper in the field of Electrical Engineering and discuss the reasons with your classmates.

Facts and Opinions

Passage 1

Passage 2

Passage 3

Passage 4**Passage 5****Passage 6****Passage 7****Passage 8**



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Handout 5 – Post-task

Instructions: Individually, review the following information about the correct use of the present perfect and complete the exercises.



Present Perfect vs. Simple Past

The **present perfect** can refer to events that began in the past, continue until now, and may continue in the future. The **simple past** expresses completed events.

For regular verbs, the past participle form is the same as the simple past form:

(**Examples:** watch → watched, investigate → investigated)

For irregular verbs, use the correct past participle.

(**Examples:** choose → chosen, grow → grown)

Part 1

Instructions: Use the simple past or the present perfect tense. In some sentences, either tense is possible, but the meaning is different.

Example: I (attended, not) haven't attended any meetings since I started working here.

1. Sharlotte (go) _____ to the power plant to do a site visit last Friday.
2. The electrical engineering consultant (arrive) _____ here three days ago.
3. The CEO (be) _____ here since May 22nd.
4. Try not to be absent from class again for the rest of the term. You (miss, already) _____ too many classes. You (miss) _____ two classes just last week.
5. So far this week, I (have) _____ two tests and a quiz.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

6. Daniel really needs to get in touch with you. Since this morning, he (call) _____ me four times trying to reach you. He (call) _____ at 9:10, 10:20, and 12:30.
7. I (know) _____ Francisco for ten years.
8. I (meet) _____ many people since the course started.
9. I (send) _____ her two emails yesterday.

Part 2

Instructions: Practice pronouncing the following verbs. Write the pronunciation of the -ed ending after each word (/t/, /d/, and /ɪd/). You may consult the material from the previous lessons to help you remember the rules.

Example: talked _____ /t/ _____

1. asked _____
2. filled _____
3. waited _____
4. helped _____
5. dried _____
6. believed _____
7. added _____
8. looked _____
9. saved _____



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Answer Key: Handout 1 – Warm-up

Instructions: Work individually. Sort the signal words below into the correct category. Decide whether they are related to facts or opinions.

best – believe – show – might – demonstrate –
evidence – confirm – seem – support – possibly

Fact	Opinion
Show Demonstrate Evidence Confirm support	Best Believe Might Seem Possibly

Discussion:

Why is recognizing the difference between fact and opinion relevant for electrical engineers?

Useful Language:

Giving an opinion	Negotiation of meaning
▪ In my opinion, it is important to recognize the difference to know what to believe. ▪ It seems to me that knowing the difference is critical for electrical engineers because we need to read and communicate information all the time. ▪ As far as I know, it is necessary to understand the intention of the author.	▪ What do you mean by the intention of the author? ▪ Could you repeat that again, please? ▪ Could you please elaborate more on the importance of recognizing the difference between fact and opinion? ▪ Sure! What I mean is that engineers are expected to provide professional recommendations based on facts.



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Answer Key: Handout 2A - Pre-task 1

What is a fact?

- A fact is something **that is known or proved to be true.**
- Facts are always **objective and neutral.**
- Facts can always be **verified or proved** by concrete information, for example scientific research and data records.
- They generally use **statistics, numbers, dates, and measurements.**
- Authors often use facts **to support their opinions.**



Examples:

- The major hazards associated with electricity are electrical shock, fire, and arc flash.
- In 1939, Russell Ohl created the solar cell design that is used in many modern solar panels.
- The latest data shows that the market size of artificial intelligence was valued at \$27.23 billion in 2019 (Fortune Business Insights, 2020).

What is an opinion?

- An opinion is **a view or judgment about something, i.e., what someone thinks about something.**
- An opinion can be **a belief, a feeling, or speculation.**
- Opinions are not necessarily based on facts or knowledge.
- They are **personal interpretations** based on **an individual's knowledge and experience.**
- Opinions are **subjective.**
- Opinions can often include **adjectives, superlatives, comparatives, and words related to points of view, doubt, or possibility.**



Examples:

- I think Electrical Engineering is a challenging and satisfying profession.
- Peer-to-peer networks are more common in homes, while client/server networks are more likely to be used by businesses.
- Such details and insights should make room for further observations and speculations by students and teachers.



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Answer Key: Handout 2B - Pre-task 1

Instructions: Individually, read the following facts and indicate whether they correspond to *definitions, numbers, statistics, dates, measurements, or historical events*. Then, with your group, compare your answers and discuss those in which you have a different answer. Some statements can have more than one possible answer.

1. In 1831, Michael Faraday built the electric dynamo, a rudimentary electrical generator that produced a stable electric current and made electricity viable for use. Date/
Historical event
2. Geothermal energy is the heat produced deep in the Earth's core. Definition
3. In Iceland, almost 90% of the country's people use geothermal heating resources.
Statistic
4. In 1882, the world's first hydroelectric power plant began operating in the United States along the Fox River in Appleton, Wisconsin. Date/Historical event
5. To produce a GWh (a gigawatt hour, or one million kilowatts of energy for one hour), a geothermal power plant uses the equivalent to 1,046 square kilometers (404 square miles) of land. Measurement/ Number
6. Costa Rica has been coasting on nothing but renewable power since the start of 2015, according to news from the Costa Rican Electricity Institute (ICE). Date
7. The ampere is the standard unit of measurement for the strength of an electric current.
Definition
8. The telecommunications market opening process enabled an increase in the number of operators, from 2 to more than 130. Number

9. The California ISO (Independent System Operator Corporation) is a non-profit public benefit corporation that manages the high-voltage lines that make up 80% of the California electric grid and oversees the market for electricity in the state.

Statistic/Definition

10. In most parts of the world, the geothermal gradient is 25 °C per 1 kilometer of depth (1 °F per 77 feet of depth). Measurement

11. On average, hydropower comprises approximately 75 percent of Costa Rica's electricity generation, and geothermal, at about 12 percent, is the country's second-leading source of power according to the International Energy Agency. Statistic

12. Artificial Intelligence (AI) is a young discipline that aims to imitate the cognitive abilities of a human being. Definition



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Answer Key: Handout 3 - Pre-task 2

Instructions: In groups, read the following statements and highlight the clue words to identify the sentences as opinions.

1. A tidal-powered turbine, whose manufacturers claim that it is the **most** powerful in the world, has started to distribute electricity via the grid in Orkney.
2. **Poor** power quality also results in increased energy consumption which is not **good** for either homeowners or businesspeople.
3. Deserts are often very windy places and **seem** like natural sites to harvest wind energy.
4. For future work, the effect of this assumption **should** be investigated, and possible improvement of the engineering method should be proposed in case that the assumption is not satisfied.
5. Solar panels are becoming **less** expensive and widely adopted.
6. This new network operation is **likely** to bring added operational costs.
7. All electrons are negatively charged, so it **might seem** surprising that two like charges will attract.
8. Van Wageningen **believes** the wind farm will bring positive change to the Lake Turkana area.
9. **Probably** more information about each type of lamp **should** be extracted and provided for training to **better** handle cases where there are more sources of heat and other interferences.
10. Despite of its limitations, the study **appears** to have numerous strengths as well as advantages for computer network professionals.



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Answer Key: Handout 4A - Pre-task 3

FACT VERSUS OPINION	
FACT	OPINION
▪ Concrete piece of information ▪ Relies on denotative language ▪ Can be proved or verified with evidence ▪ Is not shaped or affected by a writer's personality, background, or training (objective) ▪ Does not change (invariable) ▪ Names and describes, but does not evaluate ▪ Uses statistics, numbers, dates, and measurements	▪ View or judgement about something ▪ Relies on connotative language ▪ Cannot be proved by evidence ▪ Is affected by a writer's personality, background, and training (subjective) ▪ May differ according to different people ▪ Often expresses comparisons (<i>more, better, most, least</i>) or is introduced by verbs and adverbs suggesting a point of view, doubt, or possibility (<i>think, believe, appears, seems, apparently, probably, potentially, possibly, etc.</i>)

Note: Not all the superlatives and comparatives in a sentence are used to give opinions. They can also be used to talk about facts. Carefully analyze each sentence to understand the author's purpose. Ask yourself this question: "Can this statement be proved or demonstrated to be true?"

Why is it important to distinguish between fact and opinion?**To evaluate texts:**

- To evaluate the reliability and usefulness of texts you encounter.

To develop critical thinking skills:

- To determine which statements are facts and which statements are opinions.

To identify bias:

- Bias is an opinion or an attitude we have for or against something.
- It usually results from our feelings rather than from rational thought.
- Facts can sometimes be influenced by opinions and biases, especially in the media and even in some academic and research fields.





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Unit 1- Lesson 3**Answer Key: Handout 4B - Pre-task 3**

Instructions: In groups, analyze the following statements and write **F** for fact or **O** for opinion next to each statement depending on its purpose.

1. The CEO believes that an effective team of engineers exhibits a sense of trust among members as well as between members and the project manager. ___O___
2. *Scientific American* is the most popular science and technology magazine in the world. ___O___
3. Many experts suspect that blockchain technology might not be as scalable as needed. ___O___
4. Our research confirms that executives expect smart-grid solutions to reduce the cost of grid maintenance and upgrades. ___F___
5. A team of researchers has demonstrated that they can charge an electrical vehicle in 10 minutes for a 200-to-300-mile (300-500 km) range. ___F___
6. The computer trouble was apparently caused by a programming error. ___O___
7. The company should have taken a major step forward in chip technology. ___O___
8. Researchers have discovered how to retrofit homes to be more energy-efficient. ___F___
9. This report reveals that the telecommunications sector has been steadily growing since 2010. ___F___
10. 4G and 5G signals might help warn pilots when their GPS is being spoofed. ___O___



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Unit 1- Lesson 3

Answer Key: Handout 4C - Pre-task 3

Mixed information

Sometimes, a piece of information mixes both objective—factual—and subjective information. The result is a mix of fact and opinion. Consider the following text:



Human Activities and the Environment

¹Unfortunately, human use of fossil fuels is one of the most significant developments of the past few centuries. ²Humans rely on fossil fuels, a nonrenewable energy resource, for more than 90 percent of their energy needs. ³This careless misuse of our planet's resources has resulted in pollution, global warming, and the destruction of fragile ecosystems. ⁴For example, oil pipelines carry more than one million barrels of oil each day across tundra regions. ⁵Transporting oil across such areas can only result in oil spills that poison the land for decades.

Instructions: In groups, determine if the information in the text is a fact (objective), an opinion (subjective), or a mix of fact and opinion. Read each sentence and then circle the correct word. Be ready to explain your choice.

<u>Sentence 1</u>	c. fact	d. opinion	c. mix
<u>Sentence 2</u>	c. fact	d. opinion	c. mix
<u>Sentence 3</u>	c. fact	d. opinion	c. mix
<u>Sentence 4</u>	c. fact	d. opinion	c. mix
<u>Sentence 5</u>	c. fact	d. opinion	c. mix
<u>The whole text</u>	c. fact	d. opinion	c. mix



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Answer Key: Handout 5A - Task

Instructions: In groups, evaluate the following passages and discuss whether they indicate a pure fact, a pure opinion, or a mix of fact and opinion.

1. An overvoltage is an increase in the RMS AC voltage greater than 110% at the power frequency for a duration longer than 1 min. They are usually the result of load switching (e.g., switching off a large load or energizing a capacitor bank). Overvoltages are generated because the system is either too weak for the desired voltage regulation or voltage controls are inadequate. Incorrect tap settings on transformers can also result in system overvoltages. ___ **FACT** ___

2. The United States generates the largest amount of geothermal energy of any other country. Every year, the U.S. generates at least 15 billion kilowatt-hours or the equivalent of burning about 25 million barrels of oil. Industrial geothermal technologies have been concentrated in the western U.S. In 2012, Nevada had 59 geothermal projects either operational or in development, followed by California with 31 projects, and Oregon with 16 projects. ___ **FACT** ___

3. Solar energy is likely to continue to exist so far into the future that we can think of it as being unending. Essentially, it is renewable, unlike fossil fuels which are running out as we use them. In addition, using solar energy does not cause air pollution or involve damaging the Earth's surface. It requires no difficult and expensive extraction procedures. Creating the solar cells themselves does require resources—converting sand into silicon still requires considerable energy—but this is paid back within three or four years of a solar cell's operation. ___ **OPINION** ___

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

4. Edith Clarke was the first woman to be professionally employed as an electrical engineer and the first full-time female professor of electrical engineering in the United States. Unable to find work as an electrical engineer, Clarke worked for General Electric as a computer assistant after graduating from the Massachusetts Institute of Technology (MIT). It was there that Clarke filed her first patent on a "graphical calculator" (an early graphing calculator) in 1921. Clarke's device solved basic equations involving voltage, impedance, and current in power transmission lines ten times faster than other methods used at that time. _____ **FACT** _____
5. A new technology that ensures fast and reliable 5G connectivity between a base station and a receiver has been developed by electrical engineers at the University of California in San Diego. High-band 5G systems communicate data by sending one laser-like millimeter wave beam between a base station and a receiver, but the connection gets blocked if something or someone gets in the way of that beam's path. "Relying on a single beam creates a single point of failure," said Dinesh Bharadia, a professor of electrical and computer engineering at the UC San Diego Jacobs School of Engineering. Bharadia and his team split the one laser-like millimeter wave beam into multiple laser-like beams and have each beam take a different path from the base station to the receiver. The idea is to improve the chances that at least one beam reaches the receiver when an obstacle is in the way. _____ **MIXED** _____
6. A study conducted by Forrester Consulting on the impacts of robotic process automation or RPA found that over 66 percent of employees believe that RPA is restructuring jobs, not removing them. RPA will relieve humans of their repetitive, boring work, allowing them to focus on work that robots and artificial intelligence can't do—the work that is knowledge-based, creative, and strategic. _____ **MIXED** _____

7. Without electromagnetic compatibility (EMC) optimization, the technology trend toward more complex and faster designs is expected to lead to increased emission levels. Although EMC optimization techniques have partially filled the gap between IC customer requests and IC performance, new innovative techniques need to be investigated to compensate for the induced parasitic effects of technology scale-down. The required efficiency of these techniques should allow a reduction in unintended emissions of 40 dB. Despite these continuous efforts, there is a gap between IC customer requests and intrinsic IC performance. Not only do generic low-emission design guidelines need to be generalized and integrated into SOC design flows, but advanced design techniques should also be applied to respond to IC customer pressure for less conducted and radiated noise. The technology trend toward lower noise margins, more I/O structures, and higher bus speeds should lead to even higher susceptibility to RFI. Generic high-immunity design guidelines should be introduced in SOC design flows, as a response to IC customer pressure for higher immunity.

OPINION

8. "When COVID hit last year, all of the auto orders dried up," said Phil Amsrud, senior principal analyst of automotive semiconductor research at market research firm IHS Markit in San Francisco. "But the consumer electronics industry saw the recovery and read the tea leaves faster than autos, so they began gobbling up capacity. When the market recovered and auto companies re-engaged the supply chains, it was too late and there was no more capacity." Chip orders from the auto sector now face a lead time of up to 30 weeks from only 12 weeks to 16 weeks before the pandemic, Amsrud said. The capacity conundrum is likely going to cost the auto industry millions, if not billions, of dollars as they battle for a place in line with an industry that has only a handful of major players — Taiwan Semiconductor Manufacturing Co., the world's largest contract chipmaker, operates roughly 50 percent of all chipmaking capacity globally.

OPINION



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Unit 1- Lesson 3

Answer Key: Handout 5B – Task

Instructions: In groups, take notes to explain how you know that each passage is a fact, an opinion, or a mix. Then, decide if the passage would provide useful information to write a research paper in the field of Electrical Engineering and discuss the reasons with your classmates.

Facts and Opinions

Passage 1

Answers will vary.

Passage 2

Answers will vary.

Passage 3

Answers will vary.

Passage 4

Answers will vary.

Passage 5

Answers will vary.

Passage 6

Answers will vary.

Passage 7

Answers will vary.

Passage 8

Answers will vary.



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Unit 1- Lesson 3

Answer Key: Handout 5 - Post-task

Instructions: Individually, review the following information about the correct use of the present perfect and complete the exercises.



Present Perfect vs. Simple Past

The **present perfect** can refer to events that began in the past, continue until now, and may continue in the future. The **simple past** expresses completed events.

For regular verbs, the past participle form is the same as the simple past form:

(**Examples:** watch → watched, investigate → investigated)

For irregular verbs, use the correct past participle.

(**Examples:** choose → chosen, grow → grown)

Part 1

Instructions: Use the simple past or the present perfect tense. In some sentences, either tense is possible, but the meaning is different.

Example: I (attended, not) haven't attended any meetings since I started working here.

1. Sharlotte (go) went to the power plant to do a site visit last Friday.
2. The electrical engineering consultant (arrive) arrived here three days ago.
3. The CEO (be) has been here since May 22nd.
4. Try not to be absent from class again for the rest of the term. You (miss, already) have already missed too many classes. You (miss) missed two classes just last week.
5. So far this week, I (have) have had two tests and a quiz.

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6. Daniel really needs to get in touch with you. Since this morning, he (call) _____ **has** **called** _____ me four times trying to reach you. He (call) _____ **called** _____ at 9:10, 10:20, and 12:30.
7. I (know) _____ **have known** _____ Francisco for ten years.
8. I (meet) _____ **have met** _____ many people since the course started.
9. I (send) _____ **sent** _____ her two emails yesterday.

Part 2

Instructions: Practice pronouncing the following verbs. Write the pronunciation of the -ed ending after each word (/t/, /d/, and /ɪd/). You may consult the material from the previous lessons to help you remember the rules.

Example: talked _____ /t/ _____

1. asked _____ /t/ _____
2. filled _____ /d/ _____
3. waited _____ /ɪd/ _____
4. helped _____ /t/ _____
5. dried _____ /d/ _____
6. believed _____ /d/ _____
7. added _____ /ɪd/ _____
8. looked _____ /t/ _____
9. saved _____ /d/ _____



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Unit 1: Powering-up Reading Skills

Lesson 4: Assessment task for Unit 1

Date: September 14, 2021

Unit Goal: By the end of the unit, the students will be able to successfully demonstrate understanding of technical readings for academic purposes by identifying main ideas, locating specific details, and making a critical judgement through the use of top-down and bottom-up strategies.

General Objective: By the end of the lesson, the students will be able to successfully demonstrate understanding of technical texts about an environmental monitoring robot by identifying main ideas, locating specific details, and making a critical judgement through the use of reading comprehension strategies such as predicting and brainstorming, skimming and scanning, guessing meaning from typographical and contextual clues, and identifying facts and opinions.

Specific Objectives: By the end of this lesson, the students will be able to...

1. effectively brainstorm general ideas about the content of the technical texts as a whole group and make predictions based on images, titles, and keywords;
2. appropriately identify the gist of the reading and its level of formality by skimming a technical blog post individually and discussing their ideas in groups;
3. appropriately identify specific pieces of information within the text by scanning a technical blog post to complete a matching exercise in groups;
4. successfully demonstrate understanding of a technical blog post by using reading strategies such as typographical and contextual clues, main ideas and specific details, and facts and opinions to complete a multiple-choice exercise in groups;

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5. successfully demonstrate understanding of key sections of a technical article by using previously studied reading strategies (skimming and scanning, typographical and contextual clues, main ideas and specific details, and facts and opinions) to complete a multiple-choice reading test individually;
6. effectively give their opinions about the significance of the robotics project described in the technical texts by watching a complementary video to support their views and interacting with their classmates in an online forum; and
7. appropriately recognize the use of referents and expletives by analyzing sentences containing subject and object pronouns from the technical texts and by correctly rewriting sentences gathered from the students' oral interactions in previous classes.

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up Brainstorming and making predictions T reviews the objective of the class and introduces the topic by indicating the reasons for its selection (<i>the topic is related to the field of EE; it is motivating for Ss; and it will be used to practice reading strategies</i>). T asks Ss to brainstorm ideas and predict the content of the technical readings by showing images related to the main topic. (Handout 1A) T directs the Ss' attention towards the titles of the two readings and asks them to write a list of key vocabulary or expressions to be found in the texts based on their predictions. (Handout 1B) T asks Ss to share their opinions about technological innovations in the field of robotics and to give examples of projects developed in Costa Rica. (Handout 1B) T reviews the ideas as a whole group. Note: All the handouts are available in Google Classroom (access code 2yteyhw). T shares the link via the Zoom chat.	R, W, S, L	Predicting key vocabulary Based on the title, I think a key word is... ... is probably a key word in the text. I guess the text will refer to... Giving an opinion: Based on the pictures, I would say that... It seems to me that... An example can/could be... Vocabulary: ARCOS-Lab Assembly Automation Human-like Programmable machine Robot Robotics Rotary joints Servomotor Sloth Top / Bottom	Cognitive: - Predicting - Taking Notes Creative: - Brainstorming Intrapersonal: - Individual student work Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Tire Wire-traversing Types of robots: Articulated robots (robotic arms) Autonomous Mobile Robots Automated Guided Vehicles Humanoids Hybrids Main components: Cables Actuators Gears Battery / Solar panels Onboard computers Fields of application: Agriculture Banking Environment Healthcare Hospitality Manufacturing Smart cities Features: Efficient Expensive Intelligent State-of-the-art		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
2	Pre-task 1: Skimming T reviews the reading strategies studied in Unit 1 by providing brief definitions. (Handout 2A) Then, T models the use of skimming to identify the gist and of scanning to identify details. (Handout 2A) Individually, Ss preview the technical blog post ("SlothBot: The hyper energy efficient robot for environmental monitoring") by skimming it during 1-3 minutes to identify the gist. Ss also determine the level of formality of the text. (Handout 2B and 2C) Before checking the exercise, T provides Ss with useful language to give opinions and to negotiate meaning. Ss participate by reading some examples. T reviews the ideas provided by Ss in a whole-class discussion.	R, S, L	Giving an opinion - What do you think the central idea of the text is? - In my opinion, ... - I would say that... - It seems to me that... - An example can/could be... - How about you? - I (do not) agree with you. Negotiation of meaning: Did you say...? / Do you mean...? Could you repeat that again, please? Vocabulary: 3D printed parts Competitive price Energy-efficient Outdoor protection Shell Slow-moving	Linguistic: - Skimming Cognitive: - Discriminating Interpersonal: - Cooperating	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: Scanning In groups, Ss are required to search for specific information within the technical blog post to complete a matching exercise. (Handout 2D) T monitors the activity and reminds Ss of the useful language. At the end, Ss share their answers as a whole group.	R, S, L	Giving an opinion - In my opinion, ... - I would say that... - It seems to me that... - An example can/could be... - How about you? - I (do not) agree with you. Negotiation of meaning: Did you say...? / Do you mean...? Could you repeat that again, please? Vocabulary: Carbon fiber Carbon dioxide levels Chemical factors Motor switching off Researcher Sensing equipment Speed Supplier	Linguistic: - Scanning Interpersonal: - Cooperating	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
4	Pre-task 3: Multiple-choice exercise In groups, Ss complete a multiple-choice exercise based on the technical blog post by using the reading strategies previously studied in class (e.g., typographical clues, contextual clues, specific details, and facts and opinions). This exercise is a short practice to prepare Ss for the reading test. (Handout 2E) Once Ss are finished, T checks the exercise as a whole group.	R, S, L	Negotiation of meaning: Did you say...? / Do you mean...? Could you repeat that again, please? Vocabulary: Affordable Motors Off-the-shelf Quote Sensors Stress Waterproof Weight	Cognitive: - Discriminating Linguistic: - Practicing - Using context Interpersonal: - Cooperating	15 min
5	Task: Reading test T provides Ss with the reading test and the corresponding technical article via the Zoom chat and Google Classroom (Handout 3 and Reading "The SlothBot: A Novel Design for a Wire-Traversing Robot"). T reads the main purpose of the test and the instructions. T provides Ss with an additional 5-minute period to read the complete test and confirm that everything is clear.	R, L	Negotiation of meaning: Did you say...? / Do you mean...? Could you repeat that again, please? Vocabulary: Actuators / Actuation Battery charge Catalyst	Cognitive: - Discriminating Linguistic: - Skimming - Scanning - Practicing - Using context Intrapersonal: - Individual student work	60 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	Ss complete the multiple-choice test individually. The test assesses the following skills: ▪ skimming and scanning, ▪ recognizing the function of punctuation marks used as typographical clues, ▪ identifying the meaning of words and expressions by using contextual clues, ▪ classifying statements as true or false based on main ideas and specific details, and ▪ distinguishing if a statement is a fact, an opinion, or a mix. T monitors the activity, provides support as needed, and keeps track of time.		Constraint DC motors Energy-efficient Envision Hazardous Fail-safe / Fail-safeness Hinge I ² C IoT-enabled microcontroller LiPo (Lithium polymer) battery Maneuver Metrics Microchip Prototype Rim and tire Sensor data Slow-paced Torque Wire-traversing		
6	Post-task: Critical thinking Ss give their opinion about the robotics project described in the technical texts by interacting with their classmates in an online forum available in Google classroom. To do this, Ss also watch a complementary video ("Georgia Tech deploys SlothBot in Atlanta Botanical Garden") to support their views. (Handout 4)	R, W, S, L	Vocabulary: Key technical vocabulary and expressions studied in class to give opinions	Linguistic: - Practicing - Using context - Taking notes Creative: - Brainstorming Affective: - Personalizing	30 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
	T interacts with Ss as well in the forum and provides feedback as required.			Interpersonal: - Cooperating Intrapersonal: - Individual student work	
7-8	Post-task: Grammar: Referents and Expletives Ss recognize the use of referents and expletives by analyzing sentences containing subject and object pronouns from the technical texts and by correctly rewriting sentences gathered from the Ss' oral interactions in previous classes. (Handout 5)	R, W	Grammar: Referents and expletives. Note: Throughout the lesson, T pays attention to the following key details to provide Ss with suitable feedback after class, if required: - Verb tenses - /-s/ endings, /-ed/ endings - Pronunciation of key technical words	Cognitive: - Discriminating Linguistic: - Practicing - Using context - Scanning Affective: - Personalizing Intrapersonal: - Individual student work	30 min

Reminders:

- As a whole class, T reviews the exercises assigned as homework in the previous class and draws the learner's attention to the feedback posted on Google Classroom.

- Have a 10-minute break.

- T reminds Ss to complete the forms for assessing Unit 1 and each of the teachers. T shares the corresponding links to Google Forms via the Zoom Chat and Google Classroom.

Homework:

- Ss need to complete the post-tasks for homework.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking	EE:	Electrical Engineering
Ss:	The students	W:	Writing	L:	Listening		

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms, technical article and reading test corresponding to Unit 1

REFERENCES:

Georgia Tech. (2020, June 20). Georgia Tech deploys SlothBot in Atlanta Botanical Garden [Video]. YouTube.
<https://www.youtube.com/watch?v=foiRTJnc-vA>

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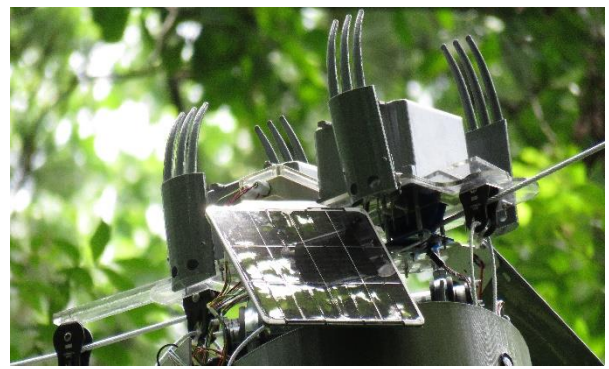
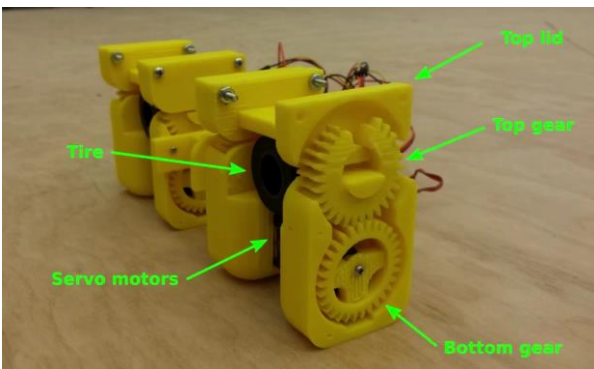
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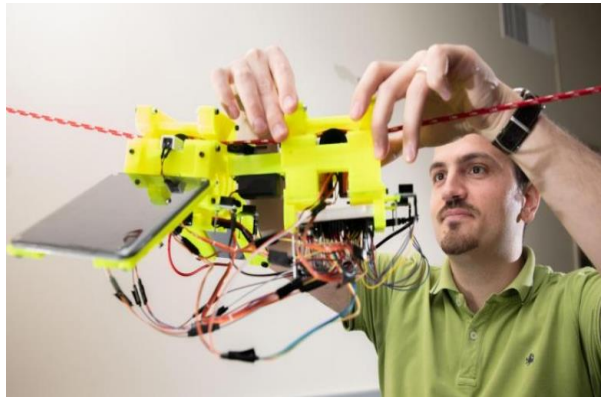
Unit 1 - Lesson 4

Handout 1A - Warm-up

Part 1

Instructions: Make predictions about the content of the technical reading based on the following pictures:





What do you think the reading is going to be about?



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Handout 1B - Warm-up

Part 2

Instructions: Based on the titles of the articles, write a list of key vocabulary or expressions that you think will be found in these texts.

SlothBot: The hyper energy efficient robot for environmental monitoring

The SlothBot: A Novel Design for a Wire-Traversing Robot

Main components	Fields of application	Features
▪ ▪ ▪ ▪	▪ ▪ ▪ ▪	▪ ▪ ▪ ▪

Part 3

Instructions: Think about the following questions and share your ideas with the rest of the class:

- What is your opinion about innovations in the field of robotics as a future electrical engineer?
- Have you heard about any projects in the field of robotics developed in Costa Rica? Could you provide an example?

Useful Language



Predicting key vocabulary	Giving an opinion
▪ Based on the title, I think a key word is.... ▪ ... is probably a key word in the text. ▪ I guess the text will refer to...	▪ I would say that... ▪ It seems to me that... ▪ An example can/could be...



Handout 2A - Pre-task 1

Reading strategies in a nutshell

Skimming and Scanning

Skimming means looking rapidly through a text to identify its central idea, while **scanning** means looking rapidly through a text to search for specific or relevant information.

Typographical Clues

Design elements that help the readers visually organize information and direct their attention to specific textual content. Some examples include **headings, images, styles and fonts, spacing, graphic elements, punctuation marks, abbreviations, and acronyms.**

Contextual Clues

Hints that help the readers understand a difficult word, e.g., **definitions, synonyms, antonyms, examples, explanations, etc.**

Authors also use patterns to organize the information, e.g., **listing, definition, comparison and contrast, cause and effect, process analysis, problem solution, purpose, and argument.** Remember to identify the key words associated with these patterns to better understand a text.

Main Ideas and Specific Details

The **main idea** is the central message or point of the paragraph that the author wants to communicate to the readers about the topic. The **specific details** are precise facts, examples, descriptions, or supporting ideas of something mentioned in the text.

Facts and Opinions

A **fact** is something that is known or proved to be true (e.g., statistics, numbers, dates, measurements, etc.). An **opinion** is a view or judgment about something (e.g., a belief, a feeling, or speculation), and it cannot be proved by evidence. A **mix** is a piece of information that combines facts and opinions.



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Handout 2B - Pre-task 1

Let's practice!

Instructions: Individually, preview the following article by skimming it and identify the central idea (gist).



SHARE THIS ARTICLE



SlothBot: The hyper energy efficient robot for environmental monitoring

Written by [Tess Roberts](#)

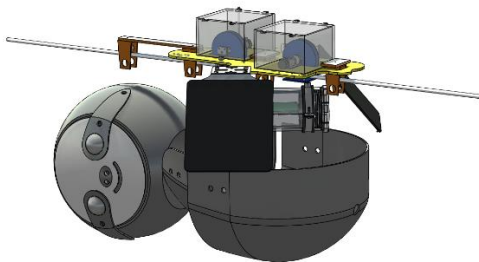
Organization	Georgia Institute of Technology
Industry	Robotics
Technology	3D printing (FDM)
Materials	PLA Pro

"The price offered by Hubs was also relatively affordable, and it was particularly useful to receive a quote instantly after changing a color or certain specification." - Gennaro Notomista, PhD student at Georgia Tech

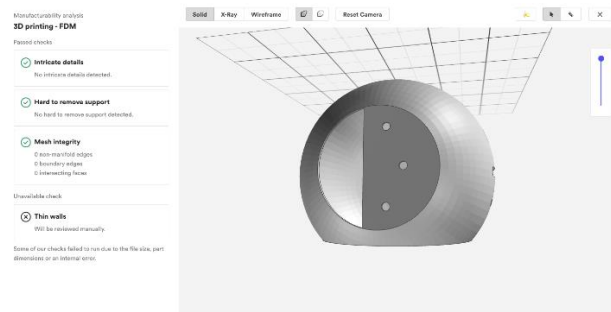
- 1 Currently deployed in the Atlanta Botanical Garden, the SlothBot can run (or climb) forever without ever needing to be charged through a power outlet. This extremely energy efficient robot monitors environmental factors such as temperature, weather, and carbon dioxide levels.
- 2 Inspiration for the robot came to Magnus Egerstedt, a robotics professor at Georgia Tech, after a visit made to Costa Rica, where he first encountered the notoriously lethargic animals creeping along overhead wires in their search for food.
- 3 How does the SlothBot have such a long battery life? Number one: it hangs on a cable and switches off all motors while stationary, which would be impossible for a drone. Secondly it traverses at a slow, sloth-like speed.
- 4 Programmed with control algorithms to only move when necessary, if the SlothBot is low on charge, it will automatically move until its light intensity and current sensors communicate that enough power is flowing into the battery via its solar panels.
- 5 The resulting behavior is very similar to a sloth, moving very slowly and only when absolutely necessary. "That was the reason we shaped the robot like a sloth: because we wanted to convey the message of slowness by design and energy efficiency," explains Gennaro Notomista, PhD student at Georgia Tech. Energy efficiency is essential in the environmental monitoring world where processes take place over very long periods of time.

Making a robot into a sloth

- 6 After first developing the control design, the first prototype was 3D printed in-house and consisted of a 5-cm robot which moved on one wire with one wheel. “The first tiny robot prototype was the implementation of the robotic algorithms, where we basically had a microcontroller with a solar panel and a very small lithium battery,” comments Gennaro, “We were trying to see, with the controllers we developed, if the robot was able to move in order to recharge.”
- 7 The second prototype design tested the mechanism to switch between cables in a fail-safe way. “The main problem was that if you want to switch wires, you can’t mount components on the top of the wires without disconnecting the electronics circuit inside,” adds Gennaro, “So the idea there was to balance the forces in such a way that could mount everything below.”
- 8 After 4 iterations to find the right weighting, and to remove unnecessary weight, Gennaro moved on to the last stage: designing the SlothBot shell.
- 9 “Because the SlothBot would be deployed outdoors, we wanted a material for the shell that was at least rain and UV resistant,” explains Gennaro. He settled on PLA Pro, manufactured using FDM 3D printing, which is strong enough to support larger parts, and takes very well to an additional protective rain and UV resistant coating for motors, gearing, actuators, batteries and sensing equipment.



Concept sketch of the SlothBot shell



SlothBot head shell uploaded to Hubs.

- 10 The Hubs platform offers automated DfM feedback to save time on determining manufacturability, but of course some features (such as thin walls in this case) need a second manual review.
- 11 “We were also considering using carbon fiber as it would have been stronger, but besides being much more expensive, we wanted a material we could color, which wasn’t possible with carbon fiber,” adds Gennaro, “Also introducing too much rigidity isn’t always a good thing because it means, when the robot hits something, stress is more easily transferred to the components inside the shell. We’d prefer the shell to break over damaging the components inside.”
- 12 Besides the outer shell, the SlothBot consists of a waterproof tube which houses all the electronics parts, except the off-the-shelf motors and sensors.

13



1. Rainproof environmental sensors, off-the-shelf
2. Waterproof ultrasonic sensors, off-the-shelf
3. FDM 3D printed shell in PLA Pro with UV & rain resistant coating
4. Waterproof tube housing all electronic parts, excl. motors & environmental sensors
5. Printed Circuit Board (PCB) designed in-house, manufactured externally
6. Motors, off-the-shelf

Getting large 3D printed parts at a competitive price

14

To produce the shell of the SlothBot, Gennaro outsourced all the parts needed to Hubs. “We were looking for companies that produced large 3D printed parts in different colors - a service a lot of manufacturers on the market didn’t provide,” explains Gennaro, “The price offered by Hubs was also relatively affordable, and it was particularly useful to receive a quote instantly after changing a color or certain specification.”

What’s next for SlothBot?

15

Deployed in the Atlanta Botanical Garden, the first SlothBot runs on a single wire and is used to entertain visitors, just as much as it’s used for environmental monitoring for conservation purposes.

16

Gennaro’s plan for the future is to use the SlothBot for agricultural monitoring, in particular to monitor pollination. For this to be possible, the SlothBot would need to be installed with a very low power satellite connection, so that it can be deployed in the mountains, or areas with no cellular connection (and maybe even interact with real-life sloths!). A camera would also need to be mounted on the head of the robot and paired with machine learning algorithms in order to recognize when a pollinator lands on a flower.

17

Gennaro Notomista is a robotics PhD student at Georgia Tech, whose research interests include constraints-driven control of robotic systems for long-duration autonomy. His goal is to develop control frameworks which allow robots to be deployed over long time horizons and be resilient to changing environmental conditions.

Adapted from:

Roberts, T. (n.d.). *SlothBot: The hyper energy efficient robot for environmental monitoring*. HUBS.
<https://www.hubs.com/blog/slothbot-energy-efficient-robot/>



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Unit 1 - Lesson 4**Handout 2C - Pre-task 1****Let's practice!**

Instructions: In groups, answer the following questions based on the reading and take notes as required.

What do you think the central idea of the text is?

1. ☐ The competitive price of 3D printed parts and materials used for the robot.
2. ☐ The design of a slow-moving robot that is used to study environmental factors.
3. ☐ The future plan of using an energy-efficient robot for agricultural monitoring.
4. ☐ The shell used for outdoor protection of the electrical components of the robot.

Is the text formal or informal?



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Handout 2D - Pre-task 2

Let's practice!

Instructions: In groups, scan the text and images of the reading. Then, match each item from column A with the correct answer from column B.

Column a

1. Supplier of 3D printed parts
2. Factors that contribute to energy efficiency
3. Components located outside the robot shell
4. Components required for future applications
5. Data to be collected and checked by the robot
6. Material used for designing the robot
7. Developer of the robot
8. Material not used for designing the robot
9. Location where the robot is operated
10. Researcher who provided the idea for the robot

Column b

- a. Speed and motor switching off
- b. Cameras
- c. Atlanta Botanical Garden
- d. Hubs
- e. Sensing equipment and motors
- f. Georgia Institute of Technology
- g. Carbon fiber
- h. PLA Pro
- i. Magnus Egerstedt
- j. Temperature and chemical factors (e.g., carbon dioxide)



Handout 2E - Pre-task 3

Let's practice!

Instructions: In groups, choose the correct answer for the following questions based on the reading.

- A. **TYPOGRAPHICAL CLUES.** Choose the best option to complete the following statement.
1. The apostrophe in **paragraph 11, line 5** ("We'd prefer the shell to break over damaging the components inside)") indicates _____.
 - a. possession
 - b. a reference
 - c. a contraction
- B. **CONTEXTUAL CLUES.** Read the following statement and choose the option that best fits the meaning of the underlined words. Use the contextual clues in the reading to guess the meaning.
2. "The price offered by Hubs was also relatively affordable, and it was particularly useful to receive a quote instantly after changing a color or certain specification." (**paragraph 14, line 4**)
 - a. reasonable
 - b. expensive
 - c. necessary
- C. **SPECIFIC DETAILS.** Read the following statement and choose if it is TRUE or FALSE.
3. Four new versions were required to define the right weight and to move to the last shell design stage.
 - a. True
 - b. False

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D. **FACT AND OPINION.** Read the following statements and choose if they are a FACT, an OPINION, or a MIX.

4. “Also introducing too much rigidity isn’t always a good thing because it means, when the robot hits something, stress is more easily transferred to the components inside the shell. We’d prefer the shell to break over damaging the components inside.” (**paragraph 11, lines 3-5**)

- c. Fact
- d. Opinion
- e. Mix

5. Besides the outer shell, the SlothBot consists of a waterproof tube which houses all the electronic parts, except the off-the-shelf motors and sensors” (**paragraph 12, lines 1-2**)

- c. Fact
- d. Opinion
- e. Mix



Handout 3 - Task

Students' Performance Test (Page 1)

This test is part of the assessment plan of ESP Dynamo: An Online English Course for Electrical Engineering Students. The main purpose of the test is to evaluate the students' ability to identify main ideas, locate specific details, and make a critical judgement about a given text through the use of reading comprehension strategies.

General Instructions:

- Make sure you are in a quiet, undisturbed location, and turn on your camera.
- The reading and the test are available as PDF files in Google Classroom (access code [2yteyhw](#)).
- Remember you can right-click the reading and select "Abrir enlace en una ventana nueva" or "Open link in new window" to have the reading and the test open on the same screen.
- If you have a question, use the "raise hand" tool or submit your question to the teachers via chat. The teachers will help you as soon as possible.
- The deadline for submitting your answers is May 14, 2021 at 7:00 pm. After that time, the teachers will indicate that the time has expired, and they will end the session. You will be notified when you have 10 minutes left.
- Once you finish, remember to click "Enviar" or "Submit".
- During the asynchronous session from 7:00 to 8:00 pm, remember to complete the additional assessment tasks indicated by the teachers.
- This session will be recorded as a backup of having performed the test.
- The reading test has six sections, and it is 25 points (25%).



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Students' Performance Test (Page 2)

I. General Information

Please complete the following personal information as required.

Full name: _____

Student's ID: _____

II. Reading Comprehension

Instructions:

1. Open the file "Unit 1-Lesson 4 - Reading."
2. Read the technical article "The SlothBot: A Novel Design for a Wire-Traversing Robot."
3. Individually, choose the correct answer for the following questions based on the reading. You can underline or highlight the correct answer on your .pdf file.

A. **SCANNING.** Scan **pages 1-3** of the technical article and choose the correct answer for each question. (5 points)

1. When was the article made available to readers through the Institute of Electrical and Electronics Engineers (IEEE)?
 - d. 1993
 - e. 2018
 - f. 2019
2. Which wire-traversing robot design has the lowest number of actuators and the lowest weight?
 - d. SlothBot
 - e. SkySweeper
 - f. LineScout



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Students' Performance Test (Page 3)

3. What is one of the key objectives driving the design and development of the SlothBot?
 - d. The locomotion principle
 - e. The reaction forces acting on the robot
 - f. The fail-safeness

4. Which figure shows the angles at which the gears of the front and rear SlothBot body can rotate?
 - d. Figure 3
 - e. Figure 4
 - f. Figure 5

- B. **TYPOGRAPHICAL CLUES.** Read **pages 1 to 3** of the technical article and choose the best option to complete each of the following statements. (4 points)

5. The brackets in **paragraph 2, lines 4-6** ("Due to their wire-traversing capability, these robots are suitable for applications in agricultural robotics [1], environmental monitoring [2] or maintenance in hazardous places, as in the case of power line inspection [3].") indicate _____.
 - a. changes made to a quoted passage
 - b. a series of items
 - c. bibliographical references

6. The parentheses in **paragraph 2, lines 10-14** ("Nevertheless, common features shared, to a certain extent, among many of the architectures are (i) simplicity of the system design and, consequently, of the motion control; (ii) reduced localization errors and navigation complexity; (iii) low energy requirements") indicate _____.
 - d. a range of numbers
 - e. a series of items
 - f. a definition



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Students' Performance Test (Page 4)

7. The hyphens in **paragraph 6, lines 1-4** ("Because of the long-term applications targeted by the SlothBot, in this letter we consider two aspects that have not been explicitly taken into account in the state-of-the-art designs, namely energy efficiency and fail-safeness.") indicate _____.
- compound words
 - brief interruptions
 - emphasis of key information
8. The colon in **paragraph 11, line 18** ("The fail-safeness of the SlothBot is guaranteed through the use of the two bodies connected by a hinge: this consists of a rotational joint, whose axis lies in the longitudinal plane of the robot, and it is actuated by a servo-motor.") introduces _____.
- a contraction
 - emphasis of key information
 - a clarification
- C. **CONTEXTUAL CLUES.** Read the following excerpts taken from **pages 1 to 4** of the technical article and choose the option that best fits the meaning of the underlined words. Use the context clues in the reading to guess the meaning. (4 points)
9. "Locomotion and wire-switching maneuvers are performed in a fail-safe fashion, inasmuch the robot is always firmly attached to the wires, even when switching between branching wires." (**paragraph 1, line 11**)
- except that
 - such as
 - as long as



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Students' Performance Test (Page 5)

10. "... these robots are suitable for applications in agricultural robotics [1], environmental monitoring [2] or maintenance in hazardous places, as in the case of power line inspection [3]. The latter has been the main catalyst for the development of wire-traversing robots..." (paragraph 2, line 6)
 - a. reaction
 - b. driver
 - c. change

11. "... we envision the deployment of the SlothBot for long-term environmental monitoring tasks, required, for example, in agricultural robotics applications." (paragraph 7, line 2)
 - d. implementation
 - e. disposal
 - f. movement

12. "Because of the fail-safeness constraint on the switching maneuver, the SlothBot does not have the ability of traversing crossings with more than 3 branching wires." (paragraph 18, line 1)
 - a. control
 - b. limitation
 - c. stress

- D. **MAIN IDEAS**. Read the following main ideas taken from **pages 1 and 2** and choose if they are TRUE or FALSE. (4 points)

13. The SlothBot is a slow-paced robot that performs tasks with less energy and that is able to move on a mesh of wires.
 - c. True
 - d. False



Students' Performance Test (Page 6)

14. The SlothBot is part of a complex generation of robots for inspection of power transmission lines.
- c. True
 - d. False
15. The SlothBot design is shaped by the ability to remain hung on a wire when switching wires and when experiencing a failure.
- c. True
 - d. False
16. The SlothBot is envisioned for short-term environmental monitoring applications, such as agricultural robotics.
- c. True
 - d. False
- E. **SPECIFIC DETAILS.** Read the following specific details taken from **pages 3 and 5** and choose if they are TRUE or FALSE. (4 points)
17. The use of two bodies connected by a rotational joint ensures a fail-safe SlothBot design.
- a. True
 - b. False
18. Equation 2 requires the results from Equation 1 to calculate the motor torque needed to carry a payload of a given mass.
- a. True
 - b. False



Students' Performance Test (Page 7)

19. The SlothBot uses a 7.4V 1000 mAh Lithium Polymer (LiPo) battery and three solar panels.

- a. True
- b. False

20. The I²C protocol is used by the IoT-enabled microcontroller, which is the main processing unit onboard the SlothBot, for connection to the sensors.

- a. True
- b. False

F. **FACT AND OPINION**. Read the following statements about SlothBot and choose if they are a FACT, an OPINION, or a MIX. (4 points)

21. "The servo motors used to rotate the spur gears are standard 9-gram servo motors with an operating voltage of 5V and a maximum torque of 0.16 Nm."

- a. Fact
- b. Opinion
- c. Mix

22. "The most exciting goal that SlothBot will demonstrate is the merge of robotics, technology, and conservation."

- a. Fact
- b. Opinion
- c. Mix

23. "It's really fascinating to think about robots becoming part of the environment."

- c. Fact
- d. Opinion
- e. Mix



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Unit 1 - Lesson 4**Students' Performance Test (Page 8)**

24. "As the SlothBot uses solar power to recharge its battery, we equipped it with a luminosity sensor and recorded sun light intensity together with battery voltage data which will be absolutely useful for identifying the dynamical model of the battery."
- c. Fact
 - d. Opinion
 - e. Mix
25. "The first step to really doing something about the climate threat is really understanding what is going on. My hope for the future is that there will be many SlothBots deployed under tree canopies in rainforests, doing things like measuring environmental factors."
- a. Fact
 - b. Opinion
 - c. Mix



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Unit 1 - Lesson 4

Handout 4 - Post-Task

Critical thinking

Instructions: Watch the video “Georgia Tech deploys SlothBot in Atlanta Botanical Garden” (<https://www.youtube.com/watch?v=foiRTJnc-vA>). Then, give your personal opinion about the following aspects:

- What do you think about the combination of robotics and environment achieved by SlothBot?
- Do you think that Costa Rica could be an inspiration to develop other projects in the field of robotics, environmental conservation, or any other industries?
- If you had the opportunity to create a robot, how would it be? What solutions would it provide?

Support your ideas with what you have learned in the lesson and share your opinion with your classmates by leaving your comments in the corresponding forum in Google Classroom.





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Handout 5 - Post-Task

Instructions: Review the following information about the correct use of the **referents and expletives**.



REFERENTS

A pronoun is a word used in place of a noun or noun phrase. Pronouns usually refer to something that was already mentioned in a previous sentence. They are very useful words because they avoid repeating nouns all the time.

It's important to understand which noun a pronoun refers to.

Subject pronouns usually refer back to subjects in sentences

Example: **Engineers** in the United States built a robot named SlothBot.
They designed this robot for environmental purposes.

Pepper is the world's first social humanoid.
It can recognize faces, dance, and use gestures.

Object pronouns usually refer back to objects in sentences:

Example: Wall-E knows **10,000** words and can use **them** for interaction.

The researcher was inspired by **Costa Rica**.
The researcher was inspired by **it**.

Remember that pronouns always match the nouns they refer to in number and gender. This is a list of pronouns that you need to know.

	Subject Pronouns	Object Pronouns
1st person	I	me
2nd person (sing/plural)	you	you
3rd person (male)	he	him
3rd person (female)	she	her
3rd person (neutral)	it	it
1st person (plural)	we	us
3rd person (plural)	they	them

“IT” AS AN EXPLETIVE

Expletives are words that have a grammatical function but do not have any meaning.

Sometimes, the pronoun “it” may work as an expletive in a sentence.

“It” has a referent when it refers to a noun that was already mentioned.

Example: The **lab report** was submitted yesterday. **It** included the test results.

In this case “it” refers back to the previous subject: *lab report*.

“It” is an expletive when used in impersonal sentences that require, for grammatical reasons, a subject at the beginning, but it does not refer to previous subjects.

Example: **It** is necessary to highlight the future importance of robotics.
It is essential to have a strong background in Mathematics and Science.
It seems difficult to believe, by 2050, 70 percent of today’s occupations will be replaced by automation.

In this case, “it” is an expletive because it does not refer back to anything.

Let’s practice...

Instructions: Read the following sentences taken from the technical articles and the video. Write **R** if the underlined pronoun has any referent or **E** if the pronoun functions as an expletive.

1. “We were also considering using carbon fiber as it would have been stronger.” _____

2. “For this to be possible, the SlothBot would need to be installed with a very low power satellite connection, so that it can be deployed in the mountains or areas with no cellular connection...” _____

3. I really think it is fascinating to think about robots as being part of an environment.

4. “In this sense, quadcopters, which are extensively used for agriculture robotics applications, are not suitable for long-term tasks because of the high power they require to remain operational.” _____

5. “The mechanical design has been conceived to be simple and compact, while at the same time allowing the robot to switch between branching wires and to remain safely attached to them even during the switching maneuvers.” _____

6. “Moreover, from Fig. 6, it is clear that the SlothBot cannot traverse crossings when the turning angle is smaller than 90°.” _____

Let's practice...

Instructions: Based on the information about referents and expletives, read the following sentences collected in the English class and identify what is missing. Then, correct the mistake by rewriting the sentence in the blank space.

1. Maybe is about solar panels.

2. Is going to be studied in the future.

3. Is important for electrical engineers to develop innovative projects.

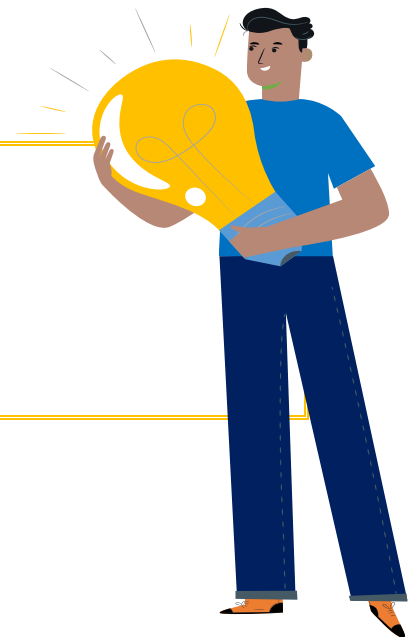
4. Yes, is because artificial intelligence is a current technological trend.

5. Additionally, allows the governments and institutions to make more investment on technological projects.

6. After this project, will be very common to find work teams developing new ideas.

Bonus tip:

Use a period at the end of a sentence in English, not a comma.



The SlothBot: A Novel Design for a Wire-Traversing Robot

Gennaro Notomista ¹, Yousef Emam ², and Magnus Egerstedt

Abstract—This letter presents the SlothBot, a wire-traversing robot envisioned for long-term environmental monitoring applications. The SlothBot is a solar-powered, slow-paced, energy-efficient robot—hence its name—capable of moving on a mesh of wires by switching between branching wires. Unlike ground mobile robots or aerial robots employed in environmental monitoring applications, the use of wire-traversing robots allows for longer-term deployment because of the significantly lower energy consumption. Wire traversing, coupled with the use of solar panels, facilitates the self-sustainability of the SlothBot. Locomotion and wire-switching maneuvers are performed in a fail-safe fashion, inasmuch the robot is always firmly attached to the wires, even when switching between branching wires. This is achieved by employing a two-body structure featuring an actuated decoupling mechanism. In this letter, we show the design and the motion control of the SlothBot, together with the results of long-term monitoring experiments.

Index Terms—Mechanism design, environment monitoring and management, energy and environment-aware automation.

I. INTRODUCTION

WIRE-TRAVERSING robots are able to move along cables, wires, and similar infrastructure. Due to their wire-traversing capability, these robots are suitable for applications in agricultural robotics [1], environmental monitoring [2] or maintenance in hazardous places, as in the case of power line inspection [3]. The latter has been the main catalyst for the development of wire-traversing robots, see e.g. [4]–[6]. The geometric and mechanical design of wire-traversing robots varies a lot among the existing mechanisms developed over the past 20 years, as discussed in [7]. Nevertheless, common features shared, to a certain extent, among many of the architectures are: (i) simplicity of the system design and, consequently, of the motion control; (ii) reduced localization errors and navigation complexity; (iii) low energy requirements. These characteristics

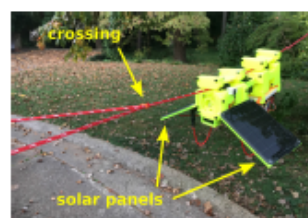


Fig. 1. The SlothBot is a lightweight, solar-powered, minimally-actuated, wire-traversing robot, capable of switching between branching wires and envisioned for long-term environmental monitoring applications.

have allowed wire-traversing robots to gain increasing interest in different applications domains.

The objective of this letter is to present the SlothBot (Fig. 1), a wire-traversing robot capable of moving on a mesh of wires, which is envisioned for long-term environmental monitoring tasks. Long-term environmental monitoring finds its application in agricultural robotics and, more in particular, in plantation growth and health state monitoring [1], where robots, generally quadcopters, are used to keep track of specific characteristics of plantations. The SlothBot—whose name stems from its energy efficiency and slow pace while traversing wires—is self-sustaining in that it is equipped with a pair of solar panels for autonomous charging. The mechanical design has been conceived to be simple and compact, while at the same time allowing the robot to switch between branching wires and to remain safely attached to them even during the switching maneuvers. In order to reduce the maintenance efforts and to minimize the risk of failures, robots targeting long-term applications should, in fact, be fail-safe and as simple as possible. We refer to *long-term* tasks as tasks that occur over extended periods of time and, in particular, which require multiple battery charges. In this sense, quadcopters, which are extensively used for agriculture robotics applications, are not suitable for long-term tasks because of the high power they require to remain operational [1].

A. Existing Wire-Traversing Robot Designs

Surveys of the state of the art of robots designed to traverse cables are presented in [7] and [8]. In [9] a robot consisting of multiple units allowing wire switching and obstacle avoidance is presented. More recent work on the development of wire-traversing robots can be found in [3], [10]–[12]. In [3], the presented robot has got folding capabilities that allow it to avoid

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The authors are with the Institute for Robotics and Intelligent Machines, Georgia Institute of Technology, Atlanta, GA 30308 USA (e-mail: g.notomista@gatech.edu; emamy@gatech.edu; magnus@gatech.edu).

This letter has supplementary downloadable material available at <http://ieeexplore.ieee.org>, provided by the authors. The attached video showcases the SlothBot, a novel design of a wire-traversing robot, performing various maneuvers of wire switching and moving on slack and inclined wires. This demonstrates the practicality of the presented design.

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TABLE I
COMPARISON BETWEEN THE SLOTHBOT AND EXISTING WIRE-TRAVERSING ROBOT DESIGNS

	Locomotion Principle	Wire-Switching Capability	Fail-safeness	Number of Actuators	Weight (kg)
LineScout [3]	Wheels	No	Yes	—	100
Caterpillar-like robot [11]	Wheels	No	Yes	—	—
SkySweeper [12]	Pulley Arms	No	Yes	3	0.466
Expliner [14]	Wheels	Yes	No	6	60
Modular robot [9]	Wheels	Yes	Yes	16	10
SlothBot	Wheels	Yes	Yes	7	1

obstacles. A modular robot that is able to slide on horizontal wires as well as climb on vertical ones is presented in [10]. In [11], the proposed robot uses a caterpillar-like locomotion strategy that allows it to climb up and move on ropes. In [12], the authors present a robot that is able to locomote using different methods, such as inchworm-like or brachiating motion patterns, which allow it to move fast and avoid occasional obstacles.

5 The obstacle avoidance feature has been subject of research because the designed robots have been mainly employed in power cables or suspension bridge maintenance. In these applications, since the robots have to adapt to existing infrastructures, the capability of avoiding obstacles along the wires constitutes an essential design requirement. Consequently, the resulting designs feature multiple robotic-arm-like attachments, each of which needs several motors to be fully actuated. The few existing robots capable of switching-wires also rely on similar multi-joint arm mechanisms that are large and complex. Furthermore, relatively little design effort has been put into designing energy efficient robotic platforms capable of staying out in the field for long-term missions. The maintenance operations of bridges and power cables mentioned above are, in fact, usually limited to a few hours. The robots shown in [13], for instance, only have up to 6 hours of autonomy.

6 Because of the long-term applications targeted by the SlothBot, in this letter we consider two aspects that have not been explicitly taken into account in the state-of-the-art designs, namely energy efficiency and fail-safeness. The definition of fail-safeness adopted in this letter is the ability of a wire-traversing robot to remain hung on the wire at any point in time given the undetectable failure of one of its actuators. Table I shows a comparison between the SlothBot and other existing wire-traversing robotic platforms. The metrics considered for the comparison are the wire-switching capabilities, the fail-safeness (as defined above), and the actuation complexity. The SlothBot possesses all the characteristics desirable for the long-term applications mentioned before, and has the minimum number of actuators among the platforms capable of wire-switching. How energy efficiency and fail-safeness shaped the design of the SlothBot will be the subject of Section II.

B. Specification-Driven Design

7 As discussed in the beginning of Section I, we envision the deployment of the SlothBot for long-term environmental monitoring tasks, required, for example, in agricultural robotics applications. In order to move in an agricultural field, the SlothBot has to be able to traverse a mesh of wires and, therefore, to

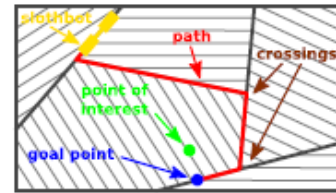


Fig. 2. Example of monitoring applications in agricultural robotics using a wire-traversing robot. Crosshatched areas represent different crops in a field. The robot (depicted in yellow) has to collect measurements at the point marked in green. It, therefore, traverses the wires (on the red path), overcoming crossings, until it reaches the blue point, closest to the green location.

overcome crossings. Fig. 2 represents an idealized agricultural field. The crosshatched areas represent different crops in the field, while the thick black lines show a mesh of wires that go across the field. The objective of the robot deployed in the field is that of monitoring phenomena that take place over long time scales, such as crop growth. For this task to be successfully completed, energy efficiency and fail safeness are required features, so that maintenance and risk of failure are minimized. Moreover, as mentioned before, in order to be able to move on the mesh of wires across the field, the robot has to traverse intersections of wires. For this to be possible, the robot has to have the capability of switching between different wire branches.

To summarize, the objectives that drove the design and development of the SlothBot are:

- energy efficiency
- wire-switching capability
- fail-safeness.

Among the existing wire-traversing robotic platforms, the ones that fulfill all the listed requirements exhibit complex designs that are, generally, less energy-efficient and not easy to control, requiring careful motion planning.

The remainder of the letter is organized as follows. Section II describes the mechanical design of the SlothBot and, in particular, the locomotion principle, the wire-switching mechanism, and the hardware architecture. Section III proposes a motion control strategy that is particularly suitable for controlling the SlothBot to move on the wires. Finally, Section IV reports the results of an environmental monitoring experiment.

II. MECHANICAL DESIGN

The SlothBot is composed of two bodies connected by an actuated hinge, as seen in Fig. 1. Each body, depicted in Fig. 3,

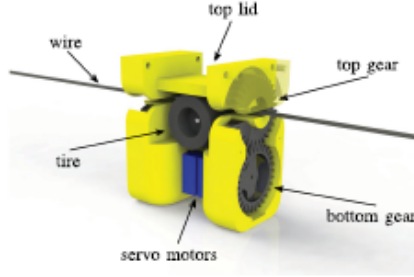


Fig. 3. One of the two bodies of the SlothBot, with the nomenclature used in the letter. Part of the top lid has been made transparent to be able to fully see the top gear.

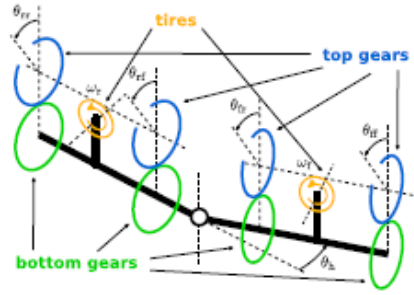


Fig. 4. Kinematic scheme of the SlothBot highlighting its degrees of freedom. θ_{fr} , θ_{tr} , θ_{br} , θ_{bt} are the angles of which the front and rear top gears of the front and rear body, respectively, can rotate. These degrees of freedom are actuated by 4 servo motors. θ_h is the relative angle between the two bodies of the SlothBot, and is also actuated by a servo motor. ω_f and ω_r are the speeds of the 2 DC motors that move the SlothBot.

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houses a driving motor connected to a rim on which a tire is mounted. The use of wheels for locomotion is simple, energy-efficient and makes the SlothBot safer when compared to brachiating robots. The switching maneuver is made possible through four pairs of spur gears. Each pair is stacked vertically with the top gear having a circumferential gap of 20° . The four gears with such a gap will be referred to as C-shaped gears throughout the letter. The bottom gear is driven by a servo-motor and allows orienting the C-shaped gear's gap to three different positions. These positions are top, left and right, which correspond to the robot going straight, turning right and turning left, respectively. This novel wire-switching mechanism minimizes the required actuation to only one servo-motor per gear pair, thus significantly increasing the simplicity and compactness of the design. The fail-safeness of the SlothBot is guaranteed through the use of the two bodies connected by a hinge: this consists of a rotational joint, whose axis lies in the longitudinal plane of the robot, and it is actuated by a servo-motor. The servo-motor ensures the alignment of the bodies with respect to the branches they are traversing. The switching maneuver itself will be explained in more detail in Section II-B. Fig. 4 depicts the scheme of the robot highlighting its degrees of freedom. Relative to existing designs that are capable of wire-switching, thanks to its

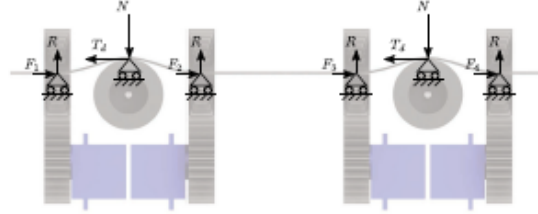


Fig. 5. Diagram of forces acting on the SlothBot. The small triangles represent hinge/cart supports. In the background the skeleton of the SlothBot is shown, highlighting the contact points between its bodies and the wire. T_d is the force generated by the motor torque τ . F_i , $i = 1, \dots, 4$, are the reaction forces due to friction. N and R are the force and the reaction due to the weight of robot and payload.

locomotion principle and wire-switching mechanism, the SlothBot is more energy-efficient as well as fail-safe.

A. Locomotion Principle

The wire that the SlothBot has to traverse is compressed between the tires and the top lids of both bodies. This lets the friction force remain high enough to allow the tires to move the robot. Fig. 5 depicts the forces involved in the dynamic equilibrium of the robot. The triangular supports represent hinges/carts capable of reacting with the forces drawn in the figure. The horizontal and vertical equilibrium equations reduce to:

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$$\sum_{i=1}^4 F_i = 2T_d, \quad 2N = 4R, \quad (1)$$

where T_d is the force generated by the motor used for locomotion, F_i , $i = 1, \dots, 4$ are the horizontal reaction forces exerted by the body due to friction, and N and R are the forces and the reactions of the constraints, respectively, due to the weight of the robot and of the payload. Starting from (1), we can calculate the motor torque required to carry a payload of a given mass. Let m be the mass of the payload the robot has to move around. Examples of payloads can be sensor modules or hard drives used to store collected measurements. The minimum value of motor torque τ provided by each motor that is required to move the robot along the wire is given by:

$$\tau = T_d r = 2F r = 2\mu R r = \frac{(m + M)g}{2} \mu r, \quad (2)$$

where r is the effective rolling radius of the tires [15], $F = \frac{T_d}{2}$ (from (1) assuming reaction forces equally distributed among the 4 support points), μ is the friction coefficient between the wires and the robot body, R the normal reaction force exerted by the supports (Fig. 5), M is the mass of the robot, and g is the acceleration due to gravity.

While moving on a mesh of wires, the SlothBot has to overcome wire crossings by switching to different wire branches. The switching maneuver is the subject of the next section.

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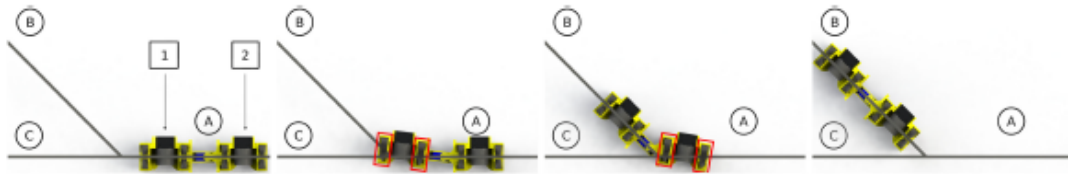


Fig. 6. Simulated wire-switching maneuver: the SlothBot switches from branch A to branch B. The top lids, that ensure that the wire is in contact with the tires, have been hidden to make the orientation of the top gears visible.

B. Fail-Safe Wire Switching

Switching between different wires is required in all applications where the robot is constrained to move on a mesh of wires. As discussed in the Introduction, there have been several solutions proposed to the wire-switching problem for wire-traversing robots. The mechanism we propose in this letter is robust against failures of the actuators and of the actuators' controller. More specifically, we designed the SlothBot in such a way that it firmly remains on the wire in case the actuators fail during the wire switch, or in case the motors are actuated at the wrong time. This is a key feature for robotic systems designed for long-term monitoring tasks. In fact, as the probability of failures increases with time, a way of at least mitigating unsafe consequences of these failures is required. The switching method presented in this section fulfills this requirement.

Fig. 6a to Fig. 6d show the sequence of actions performed by the SlothBot to switch to a different wire branch:

- Fig. 6a: Both bodies of the SlothBot are on the same wire, indicated by branch A, the servo motors keep all the gaps of the C-shaped gears straight up, holding the top lids on the wire while not allowing the wire to disengage. The objective is switching from branch A to branch B. 3
- Fig. 6b: Body 1 is at the junction between the wires, its C-shaped gears are both open allowing the branch C to disengage from it.
- Fig. 6c: Body 2 performs the same maneuver that Body 1 completed in Fig. 6b, disengaging from branch C and moving onto branch B.
- Fig. 6d: Both bodies are on the same wire, and the SlothBot successfully switches from branch A to branch B.

The described switching maneuver is made possible by the use of the C-shaped top gears, with a circumferential gap of 20° . In Fig. 7 the operation of these gears is shown in more detail. In order to be able to switch between branching wires, the parts of the robot that are above and below the wires, depicted in red and green, respectively, have to be disconnectable. In fact, referring to the sequence in Figs. 6a to 6d, the robot that has to switch from branch A to branch B, has to cross over branch C. Thus, at some point in time, opening a gap between the red and green parts is required. Nevertheless, in order to keep the robot hung to the wires at any point in time, parts above and below the wires have to remain connected.

In order to accomplish what has been described, an actuated decoupling mechanism is proposed. This consists of a train of two spur gears per side per body of the SlothBot. One gear is

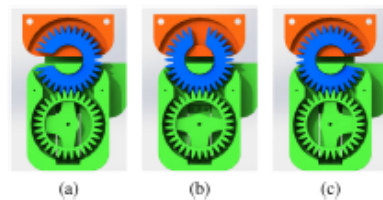


Fig. 7. The switching mechanism for the SlothBot. The red components of the robot always remain above the wires, while the green components are confined to stay below them. The C-shaped blue gear allows the red and green parts to be held together, while, at the same time, allowing the wires to disengage from the robot during wire-switching maneuvers.

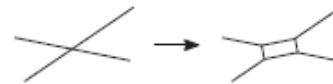


Fig. 8. Example of turning one 4-way crossing into a sequence of four 3-way crossings. This modification is required since the SlothBot is only able to traverse 3-way crossings.

mounted on the servo motor (green gears in Fig. 7); the other one (blue gears in Fig. 7) has a C-shape that allows the top lid to be held for any orientation of the gap (i. e. for any value of the angles θ_{fl} , θ_{fr} , θ_{tl} , θ_{tr} of Fig. 4). At the same time, the shape of this gear allows wire branches to disengage from the left (Fig. 7a) and from the right (Fig. 7c) of the robot. While the robot is driving straight on a wire, the C-shaped gears are oriented as in Fig. 7b.

Because of the fail-safeness constraint on the switching maneuver, the SlothBot does not have the ability of traversing crossings with more than 3 branching wires. However, this is not a substantial limitation, since any crossing can be turned into a sequence of 3-way crossings as shown in Fig. 8. Moreover, from Fig. 6 it is clear that the SlothBot cannot traverse crossings when the turning angle is smaller than 90° . However, this situation can always be avoided by performing a two-step maneuver in which two obtuse-angle crossings are overcome instead of one acute-angle crossing. Nevertheless, with the technique shown in Fig. 8, all the resulting crossing angles can be made strictly larger than 90° . Furthermore, the inability of the SlothBot to traverse crossings with more than 3 wire branches allows the synthesis of a motion control law that will be particularly suitable for navigating over meshes of wires, as will be explained further in Section III.

C. Hardware Architecture

19 A prototype of the SlothBot has been realized using rapid prototyping technologies. All the main components are 3D printed using standard PLA material. The printing time of an entire SlothBot is about 30 hours using a commercial 3D printer. Assembly time is 30 minutes since all the other components are off-the-shelf. The realized prototype of the SlothBot is 25.5 cm long, 11.2 cm high (13.5 cm with solar panels) and 6 cm wide (31.2 cm with solar panels). The 2 motors are Micro Metal Gear motors, operating at 6V, with 1000:1 reduction ratio, maximum speed of 32 rpm and maximum torque of 0.88 Nm, which allow the SlothBot to move at a maximum speed of 5 cm/s. The servo motors used to rotate the spur gears are standard 9-gram servo motors with an operating voltage of 5V and a maximum torque of 0.16 Nm. The servo motor used to actuate the hinge between the two bodies, required during the wire-switching maneuver, has a maximum torque of 1.52 Nm while operating at 5V. The robot is powered by a rechargeable 7.4V 1000 mAh LiPo battery. Two solar panels (visible in Fig. 1), mounted on the sides of the SlothBot, are used to recharge the battery when the light intensity is high enough. A maximum power point transfer (MPPT) solar charging circuit is used to regulate the charging current based on the solar cell characteristics. This way, the power efficiency, expressed as the ratio between the power that is transferred to the battery and the power received from the sun, is maximized at each time instant.

20 The main processing unit onboard the SlothBot is the ESP32, an IoT-enabled microcontroller. The microchip directly controls all the 5 servo motors, and, through a dedicated motor controller, the 2 DC motors that drive the tires.

21 The SlothBot is designed to carry sensors for environmental monitoring applications. In Section IV we show the results of a 1-day experiment during which the SlothBot measured its environment's temperature and luminosity. The ESP32 connects to the sensors using the I²C protocol, usually available on sensor data acquisition boards. Moreover, the microcontroller hosts a web server which handles requests of sensor data by a client running on a desktop computer responsible for storing the collected measurements, thus enabling remote environmental monitoring.

22 The next section is dedicated to the motion control of the SlothBot on a mesh of wires. Control laws will be introduced, which are suitable to control the robot to achieve environmental monitoring tasks.

III. MOTION PLANNING AND CONTROL

23 In this letter, we are interested in synthesizing a control law for the SlothBot that will allow it to move on the wires to monitor events and collect data in the environment. To this end, we assume, from now on, that the mesh of wires is planar and known a priori by the robot. Then, let $X \subset \mathbb{R}^2$ be a closed and convex polygon, representing the environment in which the robot is deployed. Provided that there is no slip between the driving tires of the robots and the wires, we can assume that, by acting on the torque τ of the two DC motors, we can control the speeds ω_l and ω_r (Fig. 4) to regulate the robot to a desired

velocity. The simplified robot model is then given by:

$$\dot{x} = u, \quad (3)$$

where $x \in X$ is the robot position and $u \in \mathbb{R}^2$ is the velocity control input. In the environment X there are wires, that are represented by line segments, on which the robot can move.

In this context, an environmental monitoring task for the SlothBot, consists of driving as close as possible to a location $p(t) \in X$, that moves in space over time, in order to collect measurements. Motion planning algorithms for wire-traversing robots typically use graph or road-map search [16] to find a path to a goal point on the graph. Given that the graph is known, once the route to the goal location on the graph is planned, the robot is driven by a lower level controller to the goal. However, in order to derive a continuous-time control law that will continuously drive the robot to the point on the wires closest to $p(t)$, we proceed as follows.

We define the task of getting to a point on the wires closest to a given location $p(t)$ as the following *constrained* optimization problem:

$$\min_{x \in X} \frac{1}{2} \|x - p(t)\|_2^2 \quad \text{s.t. } x \in \mathcal{G}, \quad (4)$$

where $\mathcal{G}$ denotes the mesh of wires, or, more precisely, the set of points in X that belong to the line segments defining the wires. In [17], a motion control algorithm, which allows to continuously map the velocities of an unconstrained robot onto the velocities of a robot constrained to move on wires, is formulated. With this in mind, we can then solve the *unconstrained* optimization problem

$$\min_{q \in X} \frac{1}{2} \|q - p(t)\|_2^2 \quad (5)$$

using the gradient flow method, obtaining:

$$\dot{q} = - \left(\frac{\partial}{\partial q} \frac{1}{2} \|q - p(t)\|_2^2 \right)^T = p(t) - q. \quad (6)$$

At this point, we can map $\dot{q}$ onto the wires obtaining $\dot{x}$. The expression of the mapping from the unconstrained velocity, $\dot{q}$, to the constrained one, $\dot{x}$, derived in [17] becomes significantly simpler when the robot moves on triangle meshes of wires. Since triangle meshes only contain 3-way crossings, they are extremely suitable for the design of the SlothBot. The resulting control law is given by the expression

$$u = \dot{x} = \dot{q}^{\tilde{M}(t)}, \quad (7)$$

where $\dot{q}^{\tilde{M}(t)}$ is the velocity $\dot{q}$ mapped onto the wires, which brings the robot to a point on the wires that is closest to $p(t)$. The mapping $\tilde{M}(t)$ is referred to as a *continuous-onto-wires* mapping, which depends on the geometry of the environment and the arrangement of the wires in it. We refer to [17] for the derivation and the details of (7).

Fig. 9 schematically depicts the monitoring scenario described Fig. 2 formulated in terms of the quantities introduced in this section. The robot, initially positioned at x_0 has to go and collect measurements at location denoted by $p(t)$. Since it is constrained to move on the wires (black lines), a continuous

1998

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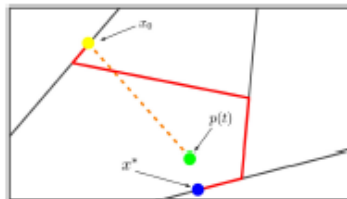


Fig. 9. Schematic representation of the monitoring scenario of Fig. 2. The robot, initially at x_0 , has to go and collect measurements at $p(t)$. Due to the wire constraints, the robot continuously moves to the location denoted by x^* , closest to $p(t)$, executing the controller (7) presented in [17].

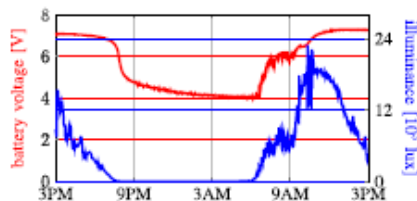


Fig. 10. Battery voltage and light intensity data collected by the SlothBot during a 24-hour experiment.

projection of the unconstrained path (orange dotted line) onto the wires is generated using (7), resulting in the constrained path (red solid line). Following this projected path, the robot arrives at location x^* , that is the point on the wires closest to $p(t)$.

IV. EXPERIMENTS

To show the effectiveness of SlothBot, we performed a long-term monitoring experiment during which we left the robot in the environment for 24 hours. Note that a battery life can keep the robot operational for about 12 hours, without any motors being activated. For this reason, according to the definition given in Section I, this classifies as a long-term experiment.

As the SlothBot uses solar power to recharge its battery, we equipped it with a luminosity sensor and recorded sun light intensity together with battery voltage data which will be useful for identifying the dynamical model of the battery. This model can be incorporated in the control framework to prevent the robot from completely discharging its battery, e.g. using the framework introduced in [18]. We report the collected battery voltage and light intensity data in Fig. 10.

V. CONCLUSION

In this letter we have presented the SlothBot, a novel design of a robot that is able to traverse a mesh of wires by switching between different branches. Compared to the state-of-the-art designs, both the locomotion and, in particular, the wire-switching maneuvers are executed using a simpler actuation mechanism, which, nevertheless, results in fail-safe executions. The

SlothBot, in fact, remains firmly hung on the wires even in case of failure of all its actuators.

The design choices that have been made are justified by the objective of creating a robotic platform that is energy efficient, that has the capability of switching wires, and that is fail-safe. We envision the use of the SlothBot for long-term environmental monitoring applications, found, for instance, in agricultural robotics. To this end, a way of planning and control the motion of the SlothBot on a mesh of wires is proposed, which allows the achievement of monitoring tasks. Finally, the results of a 1-day monitoring experiment in the field are reported.

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Adapted from:

Notomista, G., Emam, Y., & Egerstedt, M. (2019, April). The SlothBot: A novel design for a wire-traversing robot. *IEEE Robotics and Automation Letters*, Vol. 4 (2), 1993–1998. <https://doi.org/10.1109/LRA.2019.2899593>



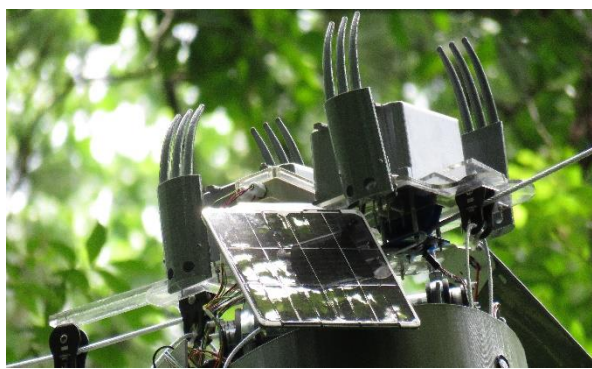
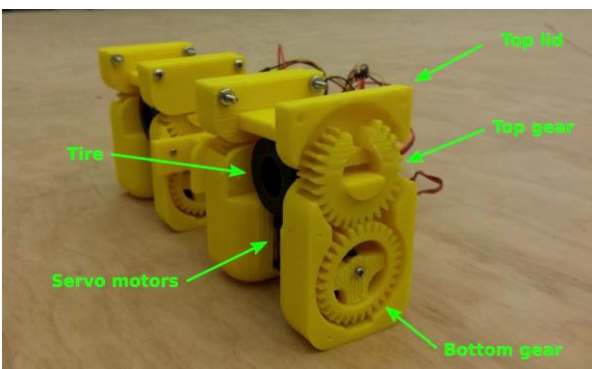
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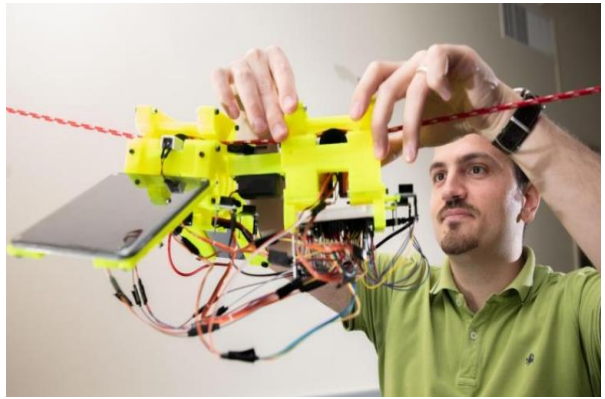
Unit 1 - Lesson 4

Answer Key: Handout 1A - Warm-up

Part 1

Instructions: Make predictions about the content of the technical reading based on the following pictures:





What do you think the reading is going to be about?

Answers will vary.



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Answer Key: Handout 1B - Warm-up

Part 2

Instructions: Based on the titles of the articles, write a list of key vocabulary or expressions that you think will be found in these texts.

SlothBot: The hyper energy efficient robot for environmental monitoring

The SlothBot: A Novel Design for a Wire-Traversing Robot

Main components	Fields of application	Features
- Answers will vary.		

Part 3

Instructions: Think about the following questions and share your ideas with the rest of the class:

- What is your opinion about innovations in the field of robotics as a future electrical engineer?
- Have you heard about any projects in the field of robotics developed in Costa Rica? Could you provide an example?

Useful Language



Predicting key vocabulary	Giving an opinion
- Based on the title, I think a key word is.... ... is probably a key word in the text. - I guess the text will refer to...	- I would say that... - It seems to me that... - An example can/could be...



Answer Key: Handout 2A - Pre-task 1

Reading strategies in a nutshell

Skimming and Scanning

Skimming means looking rapidly through a text to identify its central idea, while **scanning** means looking rapidly through a text to search for specific or relevant information.

Typographical Clues

Design elements that help the readers visually organize information and direct their attention to specific textual content. Some examples include **headings, images, styles and fonts, spacing, graphic elements, punctuation marks, abbreviations, and acronyms.**

Contextual Clues

Hints that help the readers understand a difficult word, e.g., **definitions, synonyms, antonyms, examples, explanations, etc.**

Authors also use patterns to organize the information, e.g., **listing, definition, comparison and contrast, cause and effect, process analysis, problem solution, purpose, and argument.** Remember to identify the key words associated with these patterns to better understand a text.

Main Ideas and Specific Details

The **main idea** is the central message or point of the paragraph that the author wants to communicate to the readers about the topic. The **specific details** are precise facts, examples, descriptions, or supporting ideas of something mentioned in the text.

Facts and Opinions

A **fact** is something that is known or proved to be true (e.g., statistics, numbers, dates, measurements, etc.). An **opinion** is a view or judgement about something (e.g., a belief, a feeling, or speculation), and it cannot be proved by evidence. A **mix** is a piece of information that combines facts and opinions.



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Answer Key: Handout 2B - Pre-task 1

Let's practice!

Instructions: Individually, preview the following article by skimming it and identify the central idea (gist).



SHARE THIS ARTICLE



SlothBot: The hyper energy efficient robot for environmental monitoring

Written by Tess Roberts

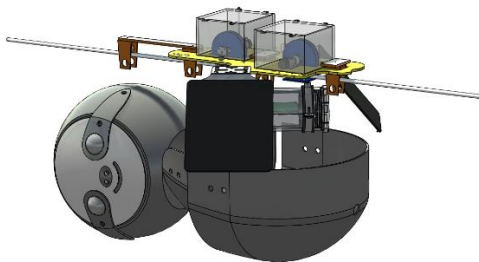
Organization	Georgia Institute of Technology
Industry	Robotics
Technology	3D printing (FDM)
Materials	PLA Pro

"The price offered by Hubs was also relatively affordable, and it was particularly useful to receive a quote instantly after changing a color or certain specification." - Gennaro Notomista, PhD student at Georgia Tech

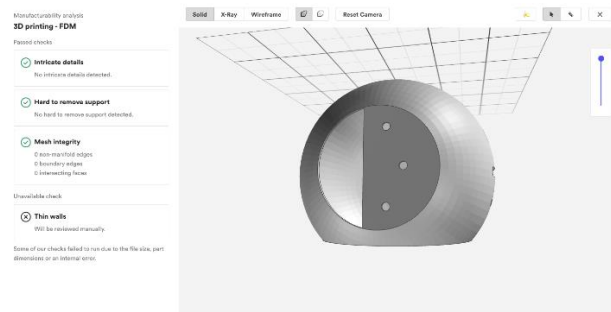
- 1 Currently deployed in the Atlanta Botanical Garden, the SlothBot can run (or climb) forever without ever needing to be charged through a power outlet. This extremely energy efficient robot monitors environmental factors such as temperature, weather, and carbon dioxide levels.
- 2 Inspiration for the robot came to Magnus Egerstedt, a robotics professor at Georgia Tech, after a visit made to Costa Rica, where he first encountered the notoriously lethargic animals creeping along overhead wires in their search for food.
- 3 How does the SlothBot have such a long battery life? Number one: it hangs on a cable and switches off all motors while stationary, which would be impossible for a drone. Secondly it traverses at a slow, sloth-like speed.
- 4 Programmed with control algorithms to only move when necessary, if the SlothBot is low on charge, it will automatically move until its light intensity and current sensors communicate that enough power is flowing into the battery via its solar panels.
- 5 The resulting behavior is very similar to a sloth, moving very slowly and only when absolutely necessary. "That was the reason we shaped the robot like a sloth: because we wanted to convey the message of slowness by design and energy efficiency," explains Gennaro Notomista, PhD student at Georgia Tech. Energy efficiency is essential in the environmental monitoring world where processes take place over very long periods of time.

Making a robot into a sloth

- 6 After first developing the control design, the first prototype was 3D printed in-house and consisted of a 5-cm robot which moved on one wire with one wheel. “The first tiny robot prototype was the implementation of the robotic algorithms, where we basically had a microcontroller with a solar panel and a very small lithium battery,” comments Gennaro, “We were trying to see, with the controllers we developed, if the robot was able to move in order to recharge.”
- 7 The second prototype design tested the mechanism to switch between cables in a fail-safe way. “The main problem was that if you want to switch wires, you can’t mount components on the top of the wires without disconnecting the electronics circuit inside,” adds Gennaro, “So the idea there was to balance the forces in such a way that could mount everything below.”
- 8 After 4 iterations to find the right weighting, and to remove unnecessary weight, Gennaro moved on to the last stage: designing the SlothBot shell.
- 9 “Because the SlothBot would be deployed outdoors, we wanted a material for the shell that was at least rain and UV resistant,” explains Gennaro. He settled on PLA Pro, manufactured using FDM 3D printing, which is strong enough to support larger parts, and takes very well to an additional protective rain and UV resistant coating for motors, gearing, actuators, batteries and sensing equipment.



Concept sketch of the SlothBot shell



SlothBot head shell uploaded to Hubs.

- 10 The Hubs platform offers automated DfM feedback to save time on determining manufacturability, but of course some features (such as thin walls in this case) need a second manual review.
- 11 “We were also considering using carbon fiber as it would have been stronger, but besides being much more expensive, we wanted a material we could color, which wasn’t possible with carbon fiber,” adds Gennaro, “Also introducing too much rigidity isn’t always a good thing because it means, when the robot hits something, stress is more easily transferred to the components inside the shell. We’d prefer the shell to break over damaging the components inside.”
- 12 Besides the outer shell, the SlothBot consists of a waterproof tube which houses all the electronics parts, except the off-the-shelf motors and sensors.

13



7. Rainproof environmental sensors, off-the-shelf
8. Waterproof ultrasonic sensors, off-the-shelf
9. FDM 3D printed shell in PLA Pro with UV & rain resistant coating
10. Waterproof tube housing all electronic parts, excl. motors & environmental sensors
11. Printed Circuit Board (PCB) designed in-house, manufactured externally
12. Motors, off-the-shelf

Getting large 3D printed parts at a competitive price

14

To produce the shell of the SlothBot, Gennaro outsourced all the parts needed to Hubs. “We were looking for companies that produced large 3D printed parts in different colors - a service a lot of manufacturers on the market didn’t provide,” explains Gennaro, “The price offered by Hubs was also relatively affordable, and it was particularly useful to receive a quote instantly after changing a color or certain specification.”

What’s next for SlothBot?

15

Deployed in the Atlanta Botanical Garden, the first SlothBot runs on a single wire and is used to entertain visitors, just as much as it’s used for environmental monitoring for conservation purposes.

16

Gennaro’s plan for the future is to use the SlothBot for agricultural monitoring, in particular to monitor pollination. For this to be possible, the SlothBot would need to be installed with a very low power satellite connection, so that it can be deployed in the mountains, or areas with no cellular connection (and maybe even interact with real-life sloths!). A camera would also need to be mounted on the head of the robot and paired with machine learning algorithms in order to recognize when a pollinator lands on a flower.

17

Gennaro Notomista is a robotics PhD student at Georgia Tech, whose research interests include constraints-driven control of robotic systems for long-duration autonomy. His goal is to develop control frameworks which allow robots to be deployed over long time horizons and be resilient to changing environmental conditions.

Adapted from:

<https://www.hubs.com/blog/slothbot-energy-efficient-robot/>



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Unit 1 - Lesson 4**Answer Key: Handout 2C - Pre-task 1****Let's practice!**

Instructions: In groups, answer the following questions based on the reading and take notes as required.

What do you think the central idea of the text is?

1. ☐ The competitive price of 3D printed parts and materials used for the robot.
2. ☐ The design of a slow-moving robot that is used to study environmental factors.
3. ☐ The future plan of using an energy-efficient robot for agricultural monitoring.
4. ☐ The shell used for outdoor protection of the electrical components of the robot.

Is the text formal or informal?



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Unit 1 - Lesson 4

Answer Key: Handout 2D - Pre-task 2

Let's practice!

Instructions: In groups, scan the text and images of the reading. Then, match each item from column A with the correct answer from column B.

Column a

1. Supplier of 3D printed parts
2. Factors that contribute to energy efficiency
3. Components located outside the robot shell
4. Components required for future applications
5. Data to be collected and checked by the robot
6. Material used for designing the robot
7. Developer of the robot
8. Material not used for designing the robot
9. Location where the robot is operated
10. Researcher who provided the idea for the robot

Column b

- a. Speed and motor switching off
- b. Cameras
- c. Atlanta Botanical Garden
- d. Hubs
- e. Sensing equipment and motors
- f. Georgia Institute of Technology
- g. Carbon fiber
- h. PLA Pro
- i. Magnus Egerstedt
- j. Temperature and chemical factors (e.g., carbon dioxide)

Answer Key:

1	D
2	A
3	E
4	B
5	J
6	H
7	F
8	G
9	C
10	I



Answer Key: Handout 2E - Pre-task 3

Let's practice!

Instructions: In groups, choose the correct answer for the following questions based on the reading.

- A. **TYPOGRAPHICAL CLUES**. Choose the best option to complete the following statement.
1. The apostrophe in **paragraph 11, line 5** ("We'd prefer the shell to break over damaging the components inside") indicates _____.
 - a. possession
 - b. a reference
 - c. a contraction
- B. **CONTEXTUAL CLUES**. Read the following statement and choose the option that best fits the meaning of the underlined words. Use the contextual clues in the reading to guess the meaning.
2. "The price offered by Hubs was also relatively affordable, and it was particularly useful to receive a quote instantly after changing a color or certain specification." (**paragraph 14, line 4**)
 - a. reasonable
 - b. expensive
 - c. necessary
- C. **SPECIFIC DETAILS**. Read the following statement and choose if it is TRUE or FALSE.
3. Four new versions were required to define the right weight and to move to the last shell design stage.
 - a. True
 - b. False

- D. **FACT AND OPINION**. Read the following statements and choose if they are a FACT, an OPINION, or a MIX.
4. “Also introducing too much rigidity isn’t always a good thing because it means, when the robot hits something, stress is more easily transferred to the components inside the shell. We’d prefer the shell to break over damaging the components inside.” (**paragraph 11, lines 3-5**)
- a. Fact
 - b. Opinion
 - c. Mix
5. Besides the outer shell, the SlothBot consists of a waterproof tube which houses all the electronic parts, except the off-the-shelf motors and sensors” (**paragraph 12, lines 1-2**)
- a. Fact
 - b. Opinion
 - c. Mix



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Unit 1 - Lesson 4

Answer Key: Handout 3 - Task

Students' Performance Test (Page 1)

This test is part of the assessment plan of ESP Dynamo: An Online English Course for Electrical Engineering Students. The main purpose of the test is to evaluate the students' ability to identify main ideas, locate specific details, and make a critical judgement about a given text through the use of reading comprehension strategies.

General Instructions:

- Make sure you are in a quiet, undisturbed location, and turn on your camera.
- The reading and the test are available as PDF files in Google Classroom (access code [2yteyhw](#)).
- Remember you can right-click the reading and select “Abrir enlace en una ventana nueva” or “Open link in new window” to have the reading and the test open on the same screen.
- If you have a question, use the “raise hand” tool or submit your question to the teachers via chat. The teachers will help you as soon as possible.
- The deadline for submitting your answers is May 14, 2021 at 7:00 pm. After that time, the teachers will indicate that the time has expired, and they will end the session. You will be notified when you have 10 minutes left.
- Once you finish, remember to click “Enviar” or “Submit”.
- During the asynchronous session from 7:00 to 8:00 pm, remember to complete the additional assessment tasks indicated by the teachers.
- This session will be recorded as a backup of having performed the test.
- The reading test has six sections, and it is 25 points (25%).



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Unit 1 - Lesson 4

Students' Performance Test (Page 2)

I. General Information

Please complete the following personal information as required.

Full name: _____

Student's ID: _____

II. Reading Comprehension

Instructions:

1. Open the file "Unit 1-Lesson 4 - Reading."
2. Read the technical article "The SlothBot: A Novel Design for a Wire-Traversing Robot."
3. Individually, choose the correct answer for the following questions based on the reading. .
You can underline or highlight the correct answer on your .pdf file.

A. **SCANNING.** Scan **pages 1-3** of the technical article and choose the correct answer for each question. (5 points)

1. When was the article made available to readers through the Institute of Electrical and Electronics Engineers (IEEE)?
 - a. 1993
 - b. 2018
 - c. 2019
2. Which wire-traversing robot design has the lowest number of actuators and the lowest weight?
 - a. SlothBot
 - b. SkySweeper
 - c. LineScout



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Unit 1 - Lesson 4

Students' Performance Test (Page 3)

3. What is one of the key objectives driving the design and development of the SlothBot?
 - a. The locomotion principle
 - b. The reaction forces acting on the robot
 - c. The fail-safeness

4. Which figure shows the angles at which the gears of the front and rear SlothBot body can rotate?
 - a. Figure 3
 - b. Figure 4
 - c. Figure 5

- B. **TYPOGRAPHICAL CLUES.** Read **pages 1 to 3** of the technical article and choose the best option to complete each of the following statements. (4 points)

5. The brackets in **paragraph 2, lines 4-6** ("Due to their wire-traversing capability, these robots are suitable for applications in agricultural robotics [1], environmental monitoring [2] or maintenance in hazardous places, as in the case of power line inspection [3].") indicate _____.
 - a. changes made to a quoted passage
 - b. a series of items
 - c. bibliographical references

6. The parentheses in **paragraph 2, lines 10-14** ("Nevertheless, common features shared, to a certain extent, among many of the architectures are (i) simplicity of the system design and, consequently, of the motion control; (ii) reduced localization errors and navigation complexity; (iii) low energy requirements") indicate _____.
 - a. a range of numbers
 - b. a series of items
 - c. a definition



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Students' Performance Test (Page 4)

7. The hyphens in **paragraph 6, lines 1-4** ("Because of the long-term applications targeted by the SlothBot, in this letter we consider two aspects that have not been explicitly taken into account in the state-of-the-art designs, namely energy efficiency and fail-safeness.") indicate _____.
 - a. compound words
 - b. brief interruptions
 - c. emphasis of key information

8. The colon in **paragraph 11, line 18** ("The fail-safeness of the SlothBot is guaranteed through the use of the two bodies connected by a hinge: this consists of a rotational joint, whose axis lies in the longitudinal plane of the robot, and it is actuated by a servo-motor.") introduces _____.
 - a. a contraction
 - b. emphasis of key information
 - c. a clarification

- C. **CONTEXTUAL CLUES.** Read the following excerpts taken from **pages 1 to 4** of the technical article and choose the option that best fits the meaning of the underlined words. Use the context clues in the reading to guess the meaning. (4 points)

9. "Locomotion and wire-switching maneuvers are performed in a fail-safe fashion, inasmuch the robot is always firmly attached to the wires, even when switching between branching wires." (**paragraph 1, line 11**)
 - a. except that
 - b. such as
 - c. as long as



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Students' Performance Test (Page 5)

10. "... these robots are suitable for applications in agricultural robotics [1], environmental monitoring [2] or maintenance in hazardous places, as in the case of power line inspection [3]. The latter has been the main catalyst for the development of wire-traversing robots..." (paragraph 2, line 6)
- a. reaction
 - b. driver
 - c. change
11. "... we envision the deployment of the SlothBot for long-term environmental monitoring tasks, required, for example, in agricultural robotics applications." (paragraph 7, line 2)
- a. implementation
 - b. disposal
 - c. movement
12. "Because of the fail-safeness constraint on the switching maneuver, the SlothBot does not have the ability of traversing crossings with more than 3 branching wires." (paragraph 18, line 1)
- a. control
 - b. limitation
 - c. stress
- D. **MAIN IDEAS.** Read the following main ideas taken from **pages 1 and 2** and choose if they are TRUE or FALSE. (4 points)
13. The SlothBot is a slow-paced robot that performs tasks with less energy and that is able to move on a mesh of wires.
- a. True
 - b. False



Students' Performance Test (Page 6)

14. The SlothBot is part of a complex generation of robots for inspection of power transmission lines.
- a. True
 - b. False
15. The SlothBot design is shaped by the ability to remain hung on a wire when switching wires and when experiencing a failure.
- a. True
 - b. False
16. The SlothBot is envisioned for short-term environmental monitoring applications, such as agricultural robotics.
- a. True
 - b. False
- E. **SPECIFIC DETAILS.** Read the following specific details taken from **pages 3 and 5** and choose if they are TRUE or FALSE. (4 points)
17. The use of two bodies connected by a rotational joint ensures a fail-safe SlothBot design.
- a. True
 - b. False
18. Equation 2 requires the results from Equation 1 to calculate the motor torque needed to carry a payload of a given mass.
- a. True
 - b. False



Students' Performance Test (Page 7)

19. The SlothBot uses a 7.4V 1000 mAh Lithium Polymer (LiPo) battery and three solar panels.

- a. True
- b. False

20. The I²C protocol is used by the IoT-enabled microcontroller, which is the main processing unit onboard the SlothBot, for connection to the sensors.

- a. True
- b. False

F. **FACT AND OPINION**. Read the following statements about SlothBot and choose if they are a FACT, an OPINION, or a MIX. (4 points)

21. "The servo motors used to rotate the spur gears are standard 9-gram servo motors with an operating voltage of 5V and a maximum torque of 0.16 Nm."

- a. Fact
- b. Opinion
- c. Mix

22. "The most exciting goal that SlothBot will demonstrate is the merge of robotics, technology, and conservation."

- a. Fact
- b. Opinion
- c. Mix

23. "It's really fascinating to think about robots becoming part of the environment."

- a. Fact
- b. Opinion
- c. Mix



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Unit 1 - Lesson 4**Students' Performance Test (Page 8)**

24. "As the SlothBot uses solar power to recharge its battery, we equipped it with a luminosity sensor and recorded sun light intensity together with battery voltage data which will be absolutely useful for identifying the dynamical model of the battery."
- a. Fact
 - b. Opinion
 - c. Mix
25. "The first step to really doing something about the climate threat is really understanding what is going on. My hope for the future is that there will be many SlothBots deployed under tree canopies in rainforests, doing things like measuring environmental factors."
- a. Fact
 - b. Opinion
 - c. Mix



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Unit 1 - Lesson 4

Answer Key: Handout 4 - Post-Task

Critical thinking

Instructions: Watch the video “Georgia Tech deploys SlothBot in Atlanta Botanical Garden” (<https://www.youtube.com/watch?v=foiRTJnc-vA>). Then, give your personal opinion about the following aspects:

- What do you think about the combination of robotics and environment achieved by SlothBot?
- Do you think that Costa Rica could be an inspiration to develop other projects in the field of robotics, environmental conservation, or any other industries?
- If you had the opportunity to create a robot, how would it be? What solutions would it provide?

Support your ideas with what you have learned in the lesson and share your opinion with your classmates by leaving your comments in the corresponding forum in Google Classroom.





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Answer Key: Handout 5 - Post-Task

Instructions: Review the following information about the correct use of the **referents and expletives**.



REFERENTS

A pronoun is a word used in place of a noun or noun phrase. Pronouns usually refer to something that was already mentioned in a previous sentence. They are very useful words because they avoid repeating nouns all the time.

It's important to understand which noun a pronoun refers to.

Subject pronouns usually refer back to subjects in sentences

Example: **Engineers** in the United States built a robot named SlothBot.
They designed this robot for environmental purposes.

Pepper is the world's first social humanoid.
It can recognize faces, dance, and use gestures.

Object pronouns usually refer back to objects in sentences:

Example: Wall-E knows **10,000** words and can use **them** for interaction.

The researcher was inspired by **Costa Rica**.
The researcher was inspired by **it**.

Remember that pronouns always match the nouns they refer to in number and gender. This is a list of pronouns that you need to know.

	Subject Pronouns	Object Pronouns
1st person	I	me
2nd person (sing/plural)	you	you
3rd person (male)	he	him
3rd person (female)	she	her
3rd person (neutral)	it	it
1st person (plural)	we	us
3rd person (plural)	they	them

“IT” AS AN EXPLETIVE

Expletives are words that have a grammatical function but do not have any meaning.

Sometimes, the pronoun “it” may work as an expletive in a sentence.

“It” has a referent when it refers to a noun that was already mentioned.

Example: The **lab report** was submitted yesterday. **It** included the test results.

In this case “it” refers back to the previous subject: *lab report*.

“It” is an expletive when used in impersonal sentences that require, for grammatical reasons, a subject at the beginning, but it does not refer to previous subjects.

Example: **It** is necessary to highlight the future importance of robotics.
It is essential to have a strong background in Mathematics and Science.
It seems difficult to believe, by 2050, 70 percent of today’s occupations will be replaced by automation.

In this case, “it” is an expletive because it does not refer back to anything.

Let’s practice...

Instructions: Read the following sentences taken from the technical articles and the video. Write **R** if the underlined pronoun has any referent or **E** if the pronoun functions as an expletive.

1. “We were also considering using carbon fiber as it would have been stronger.” R

2. “For this to be possible, the SlothBot would need to be installed with a very low power satellite connection, so that it can be deployed in the mountains or areas with no cellular connection...” R

3. I really think it is fascinating to think about robots as being part of an environment.
 E

4. “In this sense, quadcopters, which are extensively used for agriculture robotics applications, are not suitable for long-term tasks because of the high power they require to remain operational.” R

5. “The mechanical design has been conceived to be simple and compact, while at the same time allowing the robot to switch between branching wires and to remain safely attached to them even during the switching maneuvers.” R

6. “Moreover, from Fig. 6, it is clear that the SlothBot cannot traverse crossings when the turning angle is smaller than 90°.” E

Let's practice...

Instructions: Based on the information about referents and expletives, read the following sentences collected in the English class and identify what is missing. Then, correct the mistake by rewriting the sentence in the blank space.

1. Maybe is about solar panels.

Maybe **it** is about solar panels.

2. Is going to be studied in the future.

It is going to be studied in the future.

3. Is important for electrical engineers to develop innovative projects.

It is important for electrical engineers to develop innovative projects.

4. Yes, is because artificial intelligence is a current technological trend.

Yes, **it** is because artificial intelligence is a current technological trend.

5. Additionally, allows the governments and institutions to make more investment on technological projects.

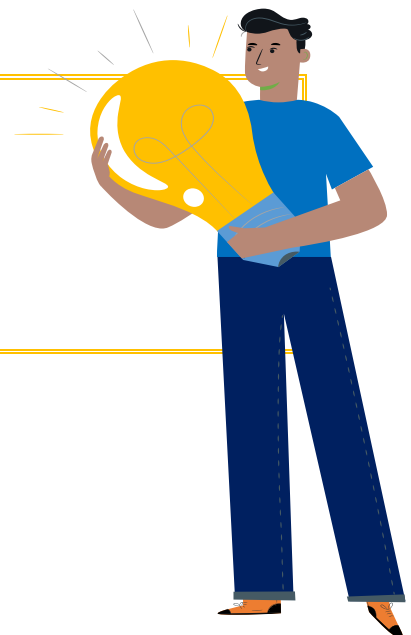
Additionally, **it** allows the governments and institutions to make more investment on technological projects.

6. After this project, will be very common to find work teams developing new ideas.

After this project, **it** will be very common to find work teams developing new ideas.

Bonus tip:

Use a period at the end of a sentence in English, not a comma.





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Unit 2: Empowering Communication at Work

Lesson 1: Conference
Date: September 21, 2021

Unit Goal: By the end of the unit, the students will be able to actively interact with prospective English-speaking professionals by role-playing work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting.

General Objective: By the end of the lesson, the students will be able to successfully role-play a small-talk conversation for networking with other participants at an international conference on Electrical Engineering by using appropriate starters, exchanging opinions, and sharing contact information before leaving the conversation.

Specific Objectives: By the end of this lesson, the students will be able to:

1. effectively brainstorm general ideas related to international conferences in the field of Electrical Engineering by predicting key words and concepts based on a series of pictures and discussion questions as a group;
2. correctly identify techniques to make small talk with other conference attendees by matching them with sample phrases while working in groups;
3. appropriately show understanding of the language used for starting a conversation at a conference, keeping it going, and leaving it by classifying a list of phrases commonly used for making small talk while working in groups;
4. effectively identify key recommendations for networking at a conference by watching the video "How to network at a conference when you don't know anyone" to complete a selective listening exercise individually;
5. successfully role-play a conversation between conference attendees by asking and answering questions about their motivation for attending the conference, their opinion about the conference topics, and their academic and professional experience, among others;

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6. correctly use the simple present tense by identifying the correct conjugation of a series of verbs used in affirmative and negative sentences; and
7. appropriately recognize the -s and -es ending sounds in the simple present tense after listening to the teacher by classifying a list of verbs into the correct category (/s/, /z/, and /ɪz/).

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up Brainstorming and making predictions T shares the link to Padlet for Ss to look at a series of pictures and brainstorm words/concepts related to conferences (Handout 1A). T briefly explains the technical procedure to use Padlet and assigns Ss to breakout rooms. T draws the Ss' attention to the useful language for them to give opinions and negotiate meaning. Ss participate by reading some examples. T checks the exercise by eliciting key ideas and concepts and writes some of them using the "Annotate" feature on Zoom. Then, T asks some questions to create a whole-class discussion and help Ss make connections with the topic of the lesson. (Handout 1B) Finally, T reviews the goal of the class and officially introduces the topic by referring to its relevance in the field of Electrical Engineering.	S, L	Giving an opinion: - In my opinion, one reason could be ... - I would say that attending conferences is important because ... - When attending a conference, I think you should ... - For me, to break the ice you should ... - For example, ... / For instance, ... - Here's an example. Negotiation of meaning: - What does ... mean? - What do you mean by ...?	Creative: - Brainstorming Cognitive: - Predicting Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			- Could you please define X for me? - Could you repeat that again, please? - Sure! What I mean is ... - That's right! - Well, that's not what I meant. Let me explain... Vocabulary: artificial intelligence attendees badge business card coffee break computing and networking conference electrical engineering electronics power systems robotics small talk speakers telecommunications venue		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
2	Pre-task 1: In groups, students match techniques for small talk at a conference in column A with the corresponding phrases in column B. (Handout 2) T monitors the activity and provides immediate corrective feedback when necessary. T also reminds Ss about the useful language. Ss compare their answers as a group after finishing. Finally, T directs Ss' attention toward the "Tip for Success" on page 4 - Handout 2, with further ideas about possible conversation topics with conference participants.	R, S, L, W	Useful language to make small talk: - I don't think we've met yet – I'm [name] from [company name]. - The CEO is a brilliant speaker, isn't she? - That was an interesting talk about ... - What technical topic/presentation has been the most relevant for you so far? - It was nice to talk to you. Do you have a business card? Giving an opinion: - In my opinion, ... - I would say that... - For me, ...	Cognitive: - Inferencing Linguistic: - Conversational patterns - Practicing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			- For example, ... / For instance, ... - Here's an example. Negotiation of meaning: - What does ... mean? - What do you mean by ...? - Could you please define X for me? - Could you repeat that again, please? - Sure! What I mean is ... - That's right! - Well, that's not what I meant. Let me explain...		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: T asks Ss to group a list of phrases used for networking at a conference depending on their purpose: starting a conversation, keeping the discussion moving, or leaving a conversation. T monitors the activity and provides immediate corrective feedback when necessary. Then, Ss share their answers as a group. Finally, T asks one of the Ss to read the “Culture Capsule” at the end of the handout so that they avoid sensitive topics when talking to people from different cultures.	R, S, L, W	Giving an opinion: - In my opinion, ... - I would say that... - For me, ... - For example, ... / For instance, ... - Here's an example. Negotiation of meaning: - What does ... mean? - What do you mean by ...? - Could you please define X for me? - Could you repeat that again, please? - Sure! What I mean is ... - That's right! - Well, that's not what I meant. Let me explain...	Cognitive: - Classifying - Inferencing Linguistic: - Conversational patterns - Practicing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
4	Pre-task 3: T provides Ss with Handout 4 and reads the instructions. Ss watch the video called “How to network at a conference when you don't know anyone” and check the boxes corresponding to the recommendations given in the video. Before playing the video, T focuses the listening by going over the options with the Ss and clarifying vocabulary as a whole class. Ss watch the video and identify the recommendations; then, they review the exercise with the T. T also generates a brief discussion by asking Ss which recommendations they found worthwhile and which other tips they would add to the list.	R, S, L, W	Giving an opinion: - In my opinion, ... - I would say that... - For me, ... - For example, ... / For instance, ... - Here's an example. Negotiation of meaning: - What does ... mean? - What do you mean by ...? - Could you please define X for me? - Could you repeat that again, please? - Sure! What I mean is ... - That's right! - Well, that's not what I meant. Let me explain...	Linguistic: - Selective listening Intrapersonal: - Individual student work	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
5	Task: T asks Ss to prepare and present a role-play conversation between conference attendees. (Handout 5) Ss need to consider specific aspects such as motivation for attending the conference, opinion about conference topics, academic/professional experience, and nationality, among others. Ss should also exchange information for future contact. Ss will rehearse the conversation to present it in front of the class. Before the activity, the T reminds Ss of some examples of useful language that they can use to facilitate the conversation and negotiate meaning. Ss are also encouraged to put into practice the vocabulary and recommendations that they have studied in the pre-tasks. The T monitors the activity, provides support as well corrective feedback as required. As part of the reporting stage, three pairs of Ss will give an effective and clear oral presentation of the role-play to the rest of the class.	R, S, L, W	Ss should recycle the following useful language and recommendations from the pre-tasks: - Key words brainstormed during the warm-up - Giving an opinion - Negotiation of meaning - Useful language to make small talk - Tip for success - Phrases for starting a conversation, keeping the discussion moving, or leaving a conversation - Culture capsule - Tips on how to network at a conference	Creative: - Brainstorming Affective: - Personalizing Linguistic: - Conversational patterns - Practicing Interpersonal: - Cooperating - Role-playing	40- 50 min. Plan and practice: 30 min + Presentation 20 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
6	Post-task: Grammar: Individually, Ss read some information about the correct use of the simple present tense to complete two exercises with the affirmative and negative conjugation. (Handout 6) Ss also review the explanation about the spelling rules and complete one exercise by writing the correct -s, -es, or -ies ending.	R, W	Grammar: - Simple present tense - /-s/ endings	Cognitive: - Classifying - Inducing Linguistic: - Practicing Intrapersonal: - Individual student work	40 min.
7	Post-task: Pronunciation: T uploads a recording of the material to Google Classroom and asks Ss to classify a list of simple present verbs (using the third person singular) into the correct category (/s/, /z/, or /ɪz/). (Handout 7)	R, W	Pronunciation: - Simple present tense - /-s/ endings	Cognitive: - Classifying - Inducing Linguistic: - Practicing Intrapersonal: - Individual student work	20 min.

Reminders:

- Have a 10-minute break.

- T reminds Ss to complete the forms for assessing Unit 1 and each of the teachers. T shares the corresponding links to Google Forms via the Zoom Chat and Google Classroom.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Homework:

Ask Ss to bring a draft of their resume which includes their academic background and professional experience.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking
Ss:	The students	W:	Writing	L:	Listening

COPIES AND MATERIALS:

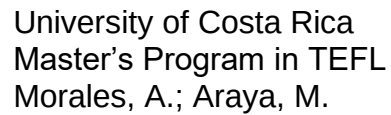
Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

Padlet: https://padlet.com/mariia_araya96/8vjr7ixz1jjcbq5s

YouTube: https://www.youtube.com/watch?v=9nBSQ7QR5fc&ab_channel=GoDaddy

REFERENCES:

GoDaddy. (2020, February 13). How to network at a conference when you don't know anyone [Video]. YouTube.
https://www.youtube.com/watch?v=9nBSQ7QR5fc&ab_channel=GoDaddy



Handout 1A - Warm-up

Instructions: Work in groups. Look at the [pictures](#) below and discuss what they all represent. Brainstorm some words or concepts related to the images and take notes to discuss with the rest of the class.

A close-up photograph showing a person's hand holding a lanyard with a badge. A handheld device is being used to scan the badge. The background is blurred, showing a crowd of people at an event.





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Unit 2 - Lesson 1

Handout 1B - Warm-up

Part 2

Instructions: Discuss the following questions with the rest of the class.

- Have you attended any conference on Electrical Engineering? If not, would you like to attend one in the near future?
- What are some reasons why electrical engineers attend conferences?
- How would you start a conversation at a conference during a coffee break? What strategies can help break the ice¹ when starting a conversation with a stranger?
- What do you understand by networking in the business context?



Useful Language:



Giving an opinion	Negotiation of meaning
▪ In my opinion, attending a conference has many benefits such as networking opportunities and industry support. ▪ I would say that attending conferences is an opportunity for us to get to know other people in our field. ▪ When attending a conference, I think you should connect with the speakers. ▪ For me, to break the ice, you should smile and quickly introduce yourself. ▪ For example, you can say "Hi, I'm Jose. Nice to meet you."	▪ What does [break the ice] mean? ▪ What do you mean by [networking]? ▪ Could you please define [networking] for me? ▪ Could you repeat that again, please? ▪ Sure! What I mean is that conferences give you the opportunity to share insight or advice with newcomers.

¹ **Break the ice:** to do or say something that makes people who do not know each other feel more comfortable.

Example: I tried to break the ice by talking to the people next to me about the weather.

Taken from [Cambridge Dictionary](#)



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Handout 2 - Pre-task 1

Instructions: Work in groups. Match the techniques 1–5 (column A) with the phrases a–e (column B) to make small talk with other attendees at a conference.

Column A

Column B

1. Introducing yourself	a. What technical topic/presentation has been the most relevant for you so far?
2. Asking an open question	b. That was an interesting talk about project management in Electrical Engineering.
3. Making a statement	c. It was nice to talk to you. Do you have a business card?
4. Using a tag question ²	d. The CEO is a brilliant speaker, isn't she?
5. Saying goodbye	e. I don't think we've met – I'm Jonathan Rodríguez from Intel Costa Rica.

² **Tag question:** use a tag question to confirm information you already think is true or to encourage someone to make small talk with you.

Tip for Success:

Before attending a conference, identify topics that are polite or suitable for making small talk with other participants or attendees, especially if they are from other cultures.

Consider the following options:

- The event itself
- The venue³
- Job experience and opportunities
- Current affairs, but NOT politics
- A specific technical topic or presentation
- A technical book or article you have recently read



³ **Venue:** the place where a public event or meeting happens.
Taken from [Cambridge Dictionary](#)



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Unit 2 - Lesson 1

Handout 3 - Pre-task 2

Instructions: Group the following list of phrases used for networking at a conference depending on their purpose: *starting a conversation*, *keeping the discussion moving*, or *leaving a conversation*. Then, write the number that corresponds to the phrase in the chart below. Some options may be used for two purposes.

1. I really liked hearing about your business idea.
2. It was great talking to you. Enjoy the rest of the event/conference!
3. What brings you to this conference?
4. Do you have any examples?
5. Where are you from?
6. What do you expect to learn from this conference?
7. How did you get started in the [Electrical Engineering] field?
8. That's an excellent idea.
9. You're right.
10. Hi, I'm [name] from [company name], and I am a/an [your position]. What do you do?
11. I [definitely/completely] agree with you.
12. It's been a pleasure meeting you. Can I get your business card?
13. I see what you mean, but I think ...
14. That sounds good.
15. I have to go now, but it was good talking to you.
16. What do you think of the speech/talk?
17. That's very interesting!
18. I really enjoyed our conversation. Do you mind if I follow up with you next week?
19. Are you working on a side project at the moment?
20. I see you are an expert in [field]. Would you like to connect on LinkedIn?

Starting a conversation	Keeping the discussion moving	Leaving a conversation



Culture Capsule:

Be careful about making small talk on topics like family, religion, or politics, or about making compliments about somebody's appearance. Depending on their cultural background, they might find the topics too aggressive or too personal in a business context.



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Unit 2 - Lesson 1

Handout 4 - Pre-task 3

Instructions: Individually, check the boxes that correspond to the recommendations given in the video "[How to network at a conference when you don't know anyone](#)." Then, check your answers with the class.

1. Make sure that your badge is filled out correctly.	☐
2. Focus on what you can offer to the people you meet by possibly connecting them to someone else.	☐
3. Do your research and prepare well ahead of time.	☐
4. Get to the conference session five minutes early.	☐
5. Bring business cards.	☐
6. Connect with attendees on social media (e.g., LinkedIn or Twitter).	☐
7. Show genuine interest by listening actively and making eye contact.	☐
8. Pay attention to pain points ⁴ or needs that you can eventually help out with.	☐
9. Ask open-ended questions.	☐

Instructions: In groups, discuss the following questions and share your ideas with the class.

1. What are the most important pieces of advice from the list?
2. What other tips would you add to the list?

⁴ **Pain point:** a problem, frustration, or troublesome issue, especially one experienced by consumers, customers, or employees. Example: We determined critical pain points for global electric engineers during the design of the project. Taken from Dictionary.com



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Unit 2 - Lesson 1

Handout 5 - Main Task

Instructions: Work in groups. Imagine you are attending an international conference on Electrical Engineering. It is the first coffee break, and you see a lot of people standing around and talking to each other. Role-play a networking⁵ conversation between conference attendees. Rehearse with your partner(s) and be ready to present in front of the class.

- **Follow these steps for making small talk:**

1. Introduce yourself and greet the other attendee.
2. Ask each other questions about motivation for attending the conference, opinion about the conference topics, academic/professional experience, and nationality, among others.
3. Show interest by making eye contact and listening attentively.
4. When appropriate, talk about something interesting or surprising about who you are or what you do.
5. Exchange your business cards or contact information (e.g., email address or social networks), and set up a future meeting, if applicable.



⁵ **Networking:** the activity of meeting people who might be useful to know, especially in your job.

Example: The conference is designed to encourage networking and to create unique business and educational opportunities for all attendees.

Taken from [Cambridge Dictionary](#)



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Unit 2 - Lesson 1

Handout 6A - Post-Task

Part 1

Instructions: Read the following information about the use of the simple present tense and complete the exercise.

Simple Present: Affirmative Statements

Subject	Verb	Complement
I You We They	work	every day.

Subject	Verb	Complement
He She It	works	every day.

Examples:	
1. Use the simple present to talk about habits or routines, schedules, and facts.	Habit or routine: I have English classes on Tuesdays. Schedule: Jennifer drives to work every day. Fact: Relevant industries in the field of Electrical Engineering include power systems, computing, and telecommunications.
2. Add -s to the verb for <i>he</i> , <i>she</i> , <i>it</i> , and singular subjects.	He attends only one conference per year. The event starts at 9:00 a.m. She works at a chip assembly plant.
3. Do not place the verb <i>to be</i> in front of another verb in the simple present.	✓ The speaker of the conference <u>comes</u> from England. ✗ The speaker of the conference <u>is come</u> from England.





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Handout 6B - Post-Task

Instructions: Highlight the correct form of the verb to complete each sentence.

1. Mr. Valverde's research interests **include** / **includes** monitoring of power systems, optimization methods, power system modeling and analysis, voltage stability, and voltage control of distribution networks.
2. Each individual project page **contain** / **contains** a components list, circuit diagram, code, working principle, and applications.
3. Our conference divisions **deliver** / **delivers** over 300 annual events across all industry sectors.
4. The Institute of Electrical and Electronics Engineers (IEEE) **publish** / **publishes** more than 1,200 conference proceedings every year.
5. During a conference, attendees **take** / **takes** notes about new ideas and **exchange** / **exchanges** business cards.

Simple Present Spelling Rules: -s and -es Endings

	Examples:
1. Add -s to most verbs in the third person singular.	close-closes put-puts stop-stops write-writes
2. Add -es to verbs ending in -sh , -ch , -s , -x , and -z .	watch-watches pass-passes
3. Change -y to -i and add -es to verbs ending in a consonant + y .	carry-carries copy-copies study-studies



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Handout 6C - Post-Task

Instructions: Write each verb with the correct -s, -es, or -ies ending.

1. stay _____	8. help _____
2. fish _____	9. miss _____
3. pass _____	10. fly _____
4. worry _____	11. fix _____
5. explore _____	12. watch _____
6. write _____	13. like _____
7. buy _____	14. pay _____

Simple Present: Negative Statements

Subject	Do Not/ Don't	Base Form of Verb
I You We They	do not don't	work.

Subject	Does Not/ Doesn't	Base Form of Verb
He She It	does not doesn't	work.

Remember...

In negative statements with *does not* or *doesn't*, do not add -s to the base form of the verb.

✓ She **doesn't study** Mechanical Engineering.

✗ She doesn't ~~studies~~ Mechanical Engineering.

Instructions: Highlight **doesn't** or **don't** to complete each sentence.

1. The silicon rods used in the experiment **doesn't** / **don't** weigh more than 10g.
2. An automated machine **doesn't** / **don't** have sensory feedback to reprogram the predetermined path.
3. Although small currents may aggravate damage and lead to breakdown if the voltage is raised to a high enough level, this usually **doesn't** / **don't** occur unless the weakness is significant.
4. It should be recognized that both power frequency voltage and direct voltage proof tests are empirical in nature and **doesn't** / **don't** necessarily check the adequacy of the design or the inherent breakdown voltage level of the insulation system.
5. Costa Rica is moving into distributed power generation using the most advanced international regulations available, namely IEEE 1547, to ensure that increased use of renewables-based distributed generation **doesn't** / **don't** lead to lower quality of service to customers.



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Handout 7A - Post-Task

Part 2

Instructions: Read the chart and complete the exercise.

Pronunciation: -s and -es Endings

In English, we pronounce the **-s** or **-es** endings at the end of 3rd person singular verbs in three different ways: **/s/**, **/z/**, and **/ɪz/**.

When you add an **-s** to words that end with unvoiced⁶ sounds /f/, /k/, /p/, and /t/, they have an **/s/** sound. When you add an **-s** to words that end in voiced⁷ sounds (all vowels, b, g, l, m, n, r, v, and z), they have a **/z/** sound. You add **-es** to all words that end in ch, sh, ss, x, and zz. The **-es** gives the word an extra syllable: **/ɪz/**.

Examples:	
/s/	stop- <u>s</u> tops put- <u>s</u> puts work- <u>s</u> works laugh- <u>s</u> laughs
/z/	rub- <u>s</u> rubs come- <u>s</u> comes read- <u>s</u> reads spin- <u>s</u> spins pay- <u>s</u> pays bag- <u>s</u> bags hear- <u>s</u> hears go- <u>s</u> goes feel- <u>s</u> feels improve- <u>s</u> improves
/ɪz/	guess- <u>es</u> guesses buzz- <u>es</u> buzzes wash- <u>es</u> washes watch- <u>es</u> watches relax- <u>es</u> relaxes



⁶ **Unvoiced:** a sound that occurs when there is no vibration in your throat and the sound comes from the mouth

⁷ **Voiced:** a sound that uses the vocal cords, and they produce a vibration in the throat when they are said



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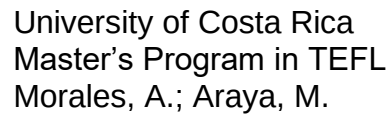
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Handout 7B - Post-Task

Instructions: Classify the following verbs according to the pronunciation of their third-person singular **-s** sound and write them in the correct column. Then, practice their pronunciation.

cuts – pauses – describes – lives – contains – helps – finishes – claims –
matches – sniffs – thinks – fixes – begs – embraces – graduates

<i>/s/</i>	<i>/z/</i>	<i>/ɪz/</i>



Answer Key: Handout 1A - Warm-up

Instructions: Work in groups. Look at the [pictures](#) below and discuss what they all represent. Brainstorm some words or concepts related to the images and take notes to discuss with the rest of the class.

A close-up photograph showing a person's hand holding a lanyard with a badge. The badge is being scanned by a handheld device held by another person. The background is blurred, showing a crowd of people at an event.





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Answer Key: Handout 1B - Warm-up

Part 2

Instructions: Discuss the following questions with the rest of the class.

- Have you attended any conference on Electrical Engineering? If not, would you like to attend one in the near future?
- What are some reasons why electrical engineers attend conferences?
- How would you start a conversation at a conference during a coffee break? What strategies can help break the ice⁸ when starting a conversation with a stranger?
- What do you understand by networking in the business context?

Answers may vary.



Useful Language:



Giving an opinion	Negotiation of meaning
▪ In my opinion, attending a conference has many benefits such as networking opportunities and industry support. ▪ I would say that attending conferences is an opportunity for us to get to know other people in our field. ▪ When attending a conference, I think you should connect with the speakers. ▪ For me, to break the ice, you should smile and quickly introduce yourself. ▪ For example, you can say "Hi, I'm Jose. Nice to meet you."	▪ What does [break the ice] mean? ▪ What do you mean by [networking]? ▪ Could you please define [networking] for me? ▪ Could you repeat that again, please? ▪ Sure! What I mean is that conferences give you the opportunity to share insight or advice with newcomers.

⁸ **Break the ice:** to do or say something that makes people who do not know each other feel more comfortable.

Example: I tried to break the ice by talking to the people next to me about the weather.

Taken from [Cambridge Dictionary](#)



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Answer Key: Handout 2 - Pre-task 1

Instructions: Work in groups. Match the techniques 1–5 (column A) with the phrases a–e (column B) to make small talk with other attendees at a conference.

Column A

Column B

1. Introducing yourself	e	a. What technical topic/presentation has been the most relevant for you so far?
2. Asking an open question	a	b. That was an interesting talk about project management in Electrical Engineering.
3. Making a statement	b	c. It was nice to talk to you. Do you have a business card?
4. Using a tag question ⁹	d	d. The CEO is a brilliant speaker, isn't she?
5. Saying goodbye	c	e. I don't think we've met – I'm Jonathan Rodríguez from Intel Costa Rica.

⁹ **Tag question:** use a tag question to confirm information you already think is true or to encourage someone to make small talk with you.

Tip for Success:

Before attending a conference, identify topics that are polite or suitable for making small talk with other participants or attendees, especially if they are from other cultures.

Consider the following options:

- The event itself
- The venue¹⁰
- Job experience and opportunities
- Current affairs, but NOT politics
- A specific technical topic or presentation
- A technical book or article you have recently read



¹⁰ **Venue:** the place where a public event or meeting happens.
Taken from [Cambridge Dictionary](#)



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Answer Key: Handout 3 - Pre-task 2

Instructions: Group the following list of phrases used for networking at a conference depending on their purpose: *starting a conversation*, *keeping the discussion moving*, or *leaving a conversation*. Then, write the number that corresponds to the phrase in the chart below. Some options may be used for two purposes.

1. I really liked hearing about your business idea.
2. It was great talking to you. Enjoy the rest of the event/conference!
3. What brings you to this conference?
4. Do you have any examples?
5. Where are you from?
6. What do you expect to learn from this conference?
7. How did you get started in the [Electrical Engineering] field?
8. That's an excellent idea.
9. You're right.
10. Hi, I'm [name] from [company name], and I am a/an [your position]. What do you do?
11. I [definitely/completely] agree with you.
12. It's been a pleasure meeting you. Can I get your business card?
13. I see what you mean, but I think ...
14. That sounds good.
15. I have to go now, but it was good talking to you.
16. What do you think of the speech/talk?
17. That's very interesting!
18. I really enjoyed our conversation. Do you mind if I follow up with you next week?
19. Are you working on a side project at the moment?
20. I see you are an expert in [field]. Would you like to connect on LinkedIn?

Starting a conversation	Keeping the discussion moving	Leaving a conversation
3-5-6-7-10-16-19	4-8-9-11-13-14-17-20	1-2-12-15-18



Culture Capsule:

Be careful about making small talk on topics like family, religion, or politics, or about making compliments about somebody's appearance. Depending on their cultural background, they might find the topics too aggressive or too personal in a business context.



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Answer Key: Handout 4 - Pre-task 3

Instructions: Individually, check the boxes that correspond to the recommendations given in the video "[How to network at a conference when you don't know anyone](#)." Then, check your answers with the class.

1. Make sure that your badge is filled out correctly.	☐
2. Focus on what you can offer to the people you meet by possibly connecting them to someone else.	☐
3. Do your research and prepare well ahead of time.	☐
4. Get to the conference session five minutes early.	☐
5. Bring business cards.	☐
6. Connect with attendees on social media (e.g., LinkedIn or Twitter).	☐
7. Show genuine interest by listening actively and making eye contact.	☐
8. Pay attention to pain points ¹¹ or needs that you can eventually help out with.	☐
9. Ask open-ended questions.	☐

Instructions: In groups, discuss the following questions and share your ideas with the class.

1. What are the most important pieces of advice from the list?
2. What other tips would you add to the list?

Answers may vary.

¹¹ **Pain point:** a problem, frustration, or troublesome issue, especially one experienced by consumers, customers, or employees. Example: We determined critical pain points for global electric engineers during the design of the project. Taken from Dictionary.com



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Handout 5 - Main Task

Instructions: Work in groups. Imagine you are attending an international conference on Electrical Engineering. It is the first coffee break, and you see a lot of people standing around and talking to each other. Role-play a networking¹² conversation between conference attendees. Rehearse with your partner(s) and be ready to present in front of the class.

- **Follow these steps for making small talk:**

1. Introduce yourself and greet the other attendee.
2. Ask each other questions about motivation for attending the conference, opinion about the conference topics, academic/professional experience, and nationality, among others.
3. Show interest by making eye contact and listening attentively.
4. When appropriate, talk about something interesting or surprising about who you are or what you do.
5. Exchange your business cards or contact information (e.g., email address or social networks), and set up a future meeting, if applicable.



¹² **Networking:** the activity of meeting people who might be useful to know, especially in your job.

Example: The conference is designed to encourage networking and to create unique business and educational opportunities for all attendees.

Taken from [Cambridge Dictionary](#)



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Handout 6A - Post-Task

Part 1

Instructions: Read the following information about the use of the simple present tense and complete the exercise.

Simple Present: Affirmative Statements

Subject	Verb	Complement
I You We They	work	every day.

Subject	Verb	Complement
He She It	works	every day.

Examples:	
1. Use the simple present to talk about habits or routines, schedules, and facts.	Habit or routine: I have English classes on Tuesdays. Schedule: Jennifer drives to work every day. Fact: Relevant industries in the field of Electrical Engineering include power systems, computing, and telecommunications.
2. Add -s to the verb for <i>he</i> , <i>she</i> , <i>it</i> , and singular subjects.	He attends only one conference per year. The event starts at 9:00 a.m. She works at a chip assembly plant.
3. Do not place the verb <i>to be</i> in front of another verb in the simple present.	✓ The speaker of the conference <u>comes</u> from England. ✗ The speaker of the conference <u>is come</u> from England.





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Answer Key: Handout 6B - Post-Task

Instructions: Highlight the correct form of the verb to complete each sentence.

1. Mr. Valverde's research interests **include** / **includes** monitoring of power systems, optimization methods, power system modeling and analysis, voltage stability, and voltage control of distribution networks.
2. Each individual project page **contain** / **contains** a components list, circuit diagram, code, working principle, and applications.
3. Our conference divisions **deliver** / **delivers** over 300 annual events across all industry sectors.
4. The Institute of Electrical and Electronics Engineers (IEEE) **publish** / **publishes** more than 1,200 conference proceedings every year.
5. During a conference, attendees **take** / **takes** notes about new ideas and **exchange** / **exchanges** business cards.

Simple Present Spelling Rules: -s and -es Endings

	Examples:
4. Add -s to most verbs in the third person singular.	close-closes put-puts stop-stops write-writes
5. Add -es to verbs ending in -sh , -ch , -s , -x , and -z .	watch-watches pass-passes
6. Change -y to -i and add -es to verbs ending in a consonant + y .	carry-carries copy-copies study-studies



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Answer Key: Handout 6C - Post-Task

Instructions: Write each verb with the correct -s, -es, or -ies ending.

1. stay <u>stays</u>	8. help <u>helps</u>
2. fish <u>fishes</u>	9. miss <u>misses</u>
3. pass <u>passes</u>	10. fly <u>flies</u>
4. worry <u>worries</u>	11. fix <u>fixes</u>
5. explore <u>explores</u>	12. watch <u>watches</u>
6. write <u>writes</u>	13. like <u>likes</u>
7. buy <u>buys</u>	14. pay <u>pays</u>

Simple Present: Negative Statements

Subject	Do Not/ Don't	Base Form of Verb
I You We They	do not don't	work.

Subject	Does Not/ Doesn't	Base Form of Verb
He She It	does not doesn't	work.

Remember...

In negative statements with *does not* or *doesn't*, do not add -s to the base form of the verb.

✓ She **doesn't study** Mechanical Engineering.

✗ She doesn't ~~studie~~s Mechanical Engineering.

Instructions: Highlight **doesn't** or **don't** to complete each sentence.

1. The silicon rods used in the experiment **doesn't** / **don't** weigh more than 10g.
2. An automated machine **doesn't** / **don't** have sensory feedback to reprogram the predetermined path.
3. Although small currents may aggravate damage and lead to breakdown if the voltage is raised to a high enough level, this usually **doesn't** / **don't** occur unless the weakness is significant.
4. It should be recognized that both power frequency voltage and direct voltage proof tests are empirical in nature and **doesn't** / **don't** necessarily check the adequacy of the design or the inherent breakdown voltage level of the insulation system.
5. Costa Rica is moving into distributed power generation using the most advanced international regulations available, namely IEEE 1547, to ensure that increased use of renewables-based distributed generation **doesn't** / **don't** lead to lower quality of service to customers.



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Handout 7A - Post-Task

Part 2

Instructions: Read the chart and complete the exercise.

Pronunciation: -s and -es Endings

In English, we pronounce the **-s** or **-es** endings at the end of 3rd person singular verbs in three different ways: **/s/**, **/z/**, and **/ɪz/**.

When you add an **-s** to words that end with unvoiced¹³ sounds /f/, /k/, /p/, and /t/, they have an **/s/** sound. When you add an **-s** to words that end in voiced¹⁴ sounds (all vowels, b, g, l, m, n, r, v, and z), they have a **/z/** sound. You add **-es** to all words that end in ch, sh, ss, x, and zz. The **-es** gives the word an extra syllable: **/ɪz/**.

Examples:	
/s/	stop- <u>s</u> tops put- <u>s</u> puts work- <u>s</u> works laugh- <u>s</u> laughs
/z/	rub- <u>s</u> rubs come- <u>s</u> comes pay- <u>s</u> pays read- <u>s</u> reads spin- <u>s</u> spins go- <u>s</u> goes bag- <u>s</u> bags hear- <u>s</u> hears feel- <u>s</u> feels improve- <u>s</u> improves
/ɪz/	guess- <u>es</u> guesses buzz- <u>es</u> buzzes wash- <u>es</u> washes watch- <u>es</u> watches relax- <u>es</u> relaxes



¹³ **Unvoiced:** a sound that occurs when there is no vibration in your throat and the sound comes from the mouth

¹⁴ **Voiced:** a sound that uses the vocal cords, and they produce a vibration in the throat when they are said



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Answer Key: Handout 7B - Post-Task

Instructions: Classify the following verbs according to the pronunciation of their third-person singular **-s** sound and write them in the correct column. Then, practice their pronunciation.

cuts – pauses – describes – lives – contains – helps – finishes – claims –
matches – sniffs – thinks – fixes – begs – embraces – graduates

<i>/s/</i>	<i>/z/</i>	<i>/ɪz/</i>
cuts	describes	pauses
helps	lives	finishes
sniffs	contains	matches
thinks	claims	fixes
graduates	begs	embraces



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Unit 2: Empowering Communication at Work

Lesson 2: Job Interview
Date: September 28, 2021

Unit Goal: By the end of the unit, the students will be able to actively interact with prospective English-speaking professionals by role-playing work-related scenarios such as a job interview, a conference, and a telephone call to set up a meeting.

General Objective: By the end of the lesson, the students will be able to successfully role-play a job interview at a company that requires electrical engineers by discussing their own academic or work experience, skills and achievements, and professional goals based on their résumé.

Specific Objectives: By the end of this lesson, the students will be able to:

1. effectively brainstorm ideas and predict relevant vocabulary and expressions related to job interviews, job interview questions, and soft and hard skills that may be required of an electrical engineer by interacting as a whole group;
2. properly describe reasons for applying or not applying to specific positions advertised for electrical engineers by using relevant collocations with *have* while interacting in groups;
3. appropriately show understanding of the key sections of a résumé (i.e., header, summary, education, work experience, and skills) by completing an online template individually with their personal information;
4. correctly identify key recommendations for a job interview by watching the video “How to prepare for a job interview” to complete a selective listening exercise in groups;
5. appropriately show understanding of questions commonly asked during a job interview by classifying them into categories according to their purpose (i.e., general profile, experience, motivation, and availability) while working in groups;

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6. successfully role-play a job interview between an employer and an applicant by asking and answering questions about their academic and professional qualifications, skills or achievements, and future professional goals;
7. effectively show understanding of the previously studied vocabulary on skills, the collocations with *have*, and the modal *would* by completing a simulated employee referral form for a classmate or a friend; and
8. correctly recognize the use of the modal *would* by individually unscrambling sentences related to job interviews and practicing their correct pronunciation with a silent /l/.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Brainstorming ideas and making predictions T reviews the goal of the class and activates schemata by asking Ss to brainstorm ideas and predict vocabulary and expressions related to job interviews, job interview questions, and soft and hard skills that may be required of an electrical engineer. (Handout 1) T explains the difference between hard skills (technical knowledge or training) and soft skills (personal attributes).	R, S, L	Information collected in a job interview: - Personal information - Education / Work experience - Skills / Goals / Motivation Hard skills: - Language skills - IT skills - HTML/JavaScript/Python - Scientific expertise - Mathematical analysis - Project management Soft skills: - Creativity - Good communication skills - Logical thinking - Practical ideas - Problem-solving ability - Strong attention to detail Attributes: Committed, confident, detail-oriented, dynamic, hard workers, honest, innovator, leader, motivated, open-minded, organized, passionate, team-player, etc.	Cognitive: - Predicting Creative: - Brainstorming Interpersonal: - Cooperating	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
2	Pre-task 1: In groups, Ss read job ads for electrical engineers and discuss why they would or would not apply for the specific positions by using collocations (or word partners) with have. T models a sample conversation before the activity. (Handout 2) As a whole class, T also reviews useful language to describe other qualifications, to give an opinion, to negotiate meaning, and to show interest during a conversation. T monitors the activity and provides support as required.	R, S, L	Collocations with have for qualifications: I have experience... - doing sth. - with (sth.) - in (a field) I have... - training in (a field) - the ability to (do sth.) - knowledge of (a skill, a field) Other ways to describe qualifications: I am... - good at (sth. / doing sth.) - interested in (sth. / doing sth.) - able to (do sth.) - certified in (a field) I can (do sth.) I have... - a degree in (a field) - a certificate in (a field)	Linguistic: - Conversationa - I patterns - Practicing Affective: - Personalizing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Giving an opinion: - In my opinion, ... - I would say that... - Here's an example... - I would / wouldn't like to... Negotiating meaning: - Could you repeat that again, please? - Could you please elaborate more on...? - Sure! What I mean is... - That's right - Let me explain... Showing interest: - I see. / I understand. - Definitely! - Really? - That's interesting.		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: T provides Ss with the definition of a résumé and a CV and explains their key sections. (Handout 3) Individually, Ss go to VisualCV (https://www.visualcv.com/), log in, choose a free CV template, and complete the key sections with their personal information. T gives the instructions, monitors the activity, and provides support and useful language as necessary.	R, S, L, W	Key résumé sections: - Header - Summary or profile - Work experience - Education - Skills	Cognitive: - Note taking Creative: - Brainstorming Intrapersonal: - Individual student work	20 min
4	Pre-task 3: T reads Handout 4 with the whole group for Ss to become acquainted with the exercise beforehand (a series of recommendations to be identified based on a video). Ss watch and listen to the video “How to prepare for a job interview” (https://www.youtube.com/watch?v=enD8mK9Zvwo). Ss recognize the recommendations mentioned in the video and then exchange the information in groups. T provides support and checks the answers with the whole group.	R, S, L	Giving an opinion: - In my opinion, ... - I would say that... - Here's an example... - I would / wouldn't like to... Recommendations for a job interview (samples): - Arrive on time - Smile and make eye-contact - Give a firm handshake - Have an active sitting position - Use the STAR method - Ask follow-up questions	Linguistic: - Selective listening Interpersonal: - Cooperating	10 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
5	Pre-task 4: Ss read a list of questions commonly asked during job interviews. In groups, Ss classify the questions depending on their purpose (i.e., general profile, experience, motivation, and availability). (Handout 5)	R, S, L	Job interview questions (samples): How would you describe yourself? What can you tell me about your background? Why would you like to work for this company? Would you be able to start next week?	Cognitive: - Classifying Interpersonal: - Cooperating	10 min
6	Task: In pairs, Ss role-play a conversation between an employer and an applicant as if they were in a job interview. Ss practice the conversation and then switch roles. (Handout 6) T reminds Ss to use a formal and polite tone and the useful language studied in class. T monitors the activity and provides support as required. T asks 2-3 pairs of volunteers to role-play their job interview in front of the class.	R, S, L	Vocabulary and expressions studied during the pre-tasks, including: - Expressions for describing qualifications, giving an opinion, negotiating meaning, and showing interest - Collocations with have - Questions and statements with would	Linguistic: - Conversationa - I patterns - Practicing Affective: - Personalizing Interpersonal: - Cooperating - Role-playing	40 min Plan and practice 20 min + Present 20 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
7	Post-task: Individually, Ss complete a simulated employee referral form for a classmate. Ss explain why this person would qualify for a job position. To review grammar and vocabulary, Ss should include a sentence with would, a collocation with have, and three attributes or skills in their descriptions. (Handout 7)	R, W	Grammar and vocabulary: Modal auxiliaries: would Collocations with have Vocabulary on skills	Linguistic: - Practicing Affective: - Personalizing Intrapersonal: - Individual student work	30 min.
8	Post-task: Individually, Ss recognize the use of the modal would by unscrambling sentences related to job interviews and by practicing the correct pronunciation with a silent //l/. (Handout 8)	R, S, W	Grammar and vocabulary: Modal auxiliaries: would Pronunciation: Would (silent //l/)	Linguistic: - Practicing Intrapersonal: - Individual student work	30 min.

Reminders:

- Have a 10-minute break.

Homework:

- T reminds Ss to complete the forms for assessing Unit 1 and each of the teachers. T shares the corresponding links to Google Forms via the Zoom Chat and Google Classroom.

- Ask Ss to check the language pills (feedback posted in Google Classroom) and the post-task answer keys.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking
Ss:	The students	W:	Writing	L:	Listening

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

REFERENCES:

Universiteit Utrecht. (2017, September 19). *How to prepare for a job interview* [Video]. YouTube.
<https://www.youtube.com/watch?v=enD8mK9Zvwo>



University of Costa Rica
Master's Program in TEFL
Morales, A.; Araya, M.

Unit 2 - Lesson 2

Handout 1 - Warm-up

Instructions: Individually, brainstorm ideas about the following categories related to job interviews. Then, share your ideas with the whole group:

Job Interviews

Information collected by employers in a job interview

-
-
-
-

Companies where you would like to work in the future

-
-
-
-



Questions that may be asked in a job interview

-
-
-
-

Skills required of an electrical engineer

Hard skills:
Technical knowledge or training
■ ■ ■ ■

Soft skills:
Personal attributes about how you work and relate to others
■ ■ ■ ■





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Unit 2 - Lesson 2

Handout 2 - Pre-task 1

Instructions: Work in groups. Read the following job ads and discuss why you **would** or **would not** apply for the specific positions. Use the collocations with **have** in the box below. Once you finish, practice the conversation by using other expressions from the useful language section.

Collocations with *have*

Definition: Collocations are two or more words that usually go together.

- I **have experience** (doing something)
- I **have experience** with (equipment, a process)
- I **have experience** in (a field)
- I **have training** in (a field)
- I **have the ability** to (do something)
- I **have knowledge** of (a skill, a field)

Example:

Student A: Where **would** you like to work?

Student B: I **would** like to work for [name of the company]

Student A: Why **would** you like to apply for that job?

Student B: I **would** like to apply for this job because I **have training in** English. /

I **wouldn't** apply for this job because I don't **have experience** supervising Electrical technicians.

How about you? Where **would** you like to work?

Useful Language

Other ways to describe qualifications, skills, and interests		
▪ I am good <u>at</u> (something / doing something) ▪ I am interested <u>in</u> (something / doing something) ▪ I am able <u>to</u> (do something) ▪ I can (do something) ▪ I have a degree / certificate <u>in</u> (a field) ▪ I am certified <u>in</u> (a field)		
Giving an opinion	Negotiating meaning	
▪ In my opinion, hard skills are as important as soft skills. ▪ I would say that <u>I'm good at</u> solving mathematical problems. ▪ Here's an example. ▪ I would like to [start immediately / apply for this job] because <u>[I have experience with</u> microprocessors].	▪ What do you mean by [soft skills]? ▪ Could you repeat that again, please? ▪ Could you please elaborate more on your academic experience? ▪ Sure! What I mean is that <u>I also had training in</u> Electrical and Computer Engineering at the Purdue University. ▪ That's right!	
Showing interest during a conversation		
▪ Alright! ▪ Definitely!	▪ I see. ▪ I understand.	▪ Really? ▪ That's interesting.

Job Ad 1:

WE ARE HIRING!

JUNIOR POWER SYSTEMS ENGINEER

JOB QUALIFICATIONS

- Candidate must possess at least Bachelor of Science in Electrical Engineering, Professional License (Passed Board/Bar/Professional License Exam) in Electrical Engineering or equivalent.
- Required language(s): English
- Required Skill(s): Autocad, driving, technical report writing
- Preferably Less than 1 year experience specialized in Electrical Engineering or equivalent

JOB RESPONSIBILITIES

- Create technical reports
- Conduct power system analysis such as load flow analysis, short circuit analysis, protective device coordination, arc flash risk assessment, and alike.
- Conduct other electrical tests related to Electrical System Analysis.
- Supervise Electrical technicians
- Conduct data gathering and verifications at the site.



INTERESTED APPLICANTS PLEASE SEND YOUR RESUME TO
tess.sandagon@exquisengineering.com



Job Ad 2:

JOIN OUR TALENT NETWORK!

WE ARE LOOKING FOR GREAT MINDS LIKE YOURS!

WHEN:
APRIL
5TH 2018

TIME:
8:30AM - 12MD

WHERE:
INTEL AUDITORIUM

What better place to build your future than with the team creating it. Would you like to become an Intel Student Worker? If you are a Bachelor, Licenciatura or Master student pursuing a degree in **Electric, Electronic or Computer Engineer** and have **50%** of career completed, we are glad to invite you to apply for an assessment center activity.

REQUIREMENTS:

- Being an active student.
- Programming skills (perl and/or python) .
- Completed digital electronics and analog circuits courses.
- Intermediate English proficiency (written and spoken).

HOW CAN I APPLY?

Send your CV to Lar.swi.program@intel.com in order to assess your qualifications for this opportunity. A Human Resources Representative will contact you in order to inform you about the next steps.

Job Ad 3:**TESHAN Engineering Ltd.**

We are an ISO certified company in the Telecommunications industry.

We invite smart young candidates to join our team.

TELECOMMUNICATIONS
ENGINEER

**Technical Officer – Telecommunications**

The applicant should be a young energetic candidate with a smart and pleasant personality

Role:

- Conducting technical site surveys and report generating
- Supervising and monitoring the installation process
- Coordinating with client engineering personnel and other relevant parties
- Quality inspections and troubleshooting

Job Qualifications and Requirements:

- Diploma in Telecommunications or Electronics sciences
- Excellent communication skills
- Fair knowledge in MS Excel and MS Word
- An analytical mind

**WE ARE
HIRING**

Attractive remuneration package is provided along with a life insurance policy. Please apply if you meet the above requirements by sending us your CV within 7 workdays with a recent photograph to hr@teshan.com



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Unit 2 - Lesson 2

Handout 3 - Pre-task 2

Instructions: Read the following information about résumés and CVs.

What is a résumé or a CV?

Your résumé or CV is the most important document in your job application.

A résumé is a one- to two-page document presenting key facts about your education, work experience, and relevant skills. A CV (Curriculum Vitae) is a longer document that provides more details about your experience, publications, and other accomplishments.

Employers use this information to decide how suitable you are for a position, so you should include or emphasize certain details depending on the position you would like to apply for.

Start by asking yourself this question: “What do I want the employer to think of me after reading my résumé or CV?”



What are the key sections of a résumé?

Let's practice!

Instructions: Read the following information about how to complete the key sections of a résumé or CV: header, summary, education, work experience (if any), and skills. Then, individually, go to <https://www.visualcv.com>, log in with your email, choose a free CV template, and complete the key sections with your personal information.

Full Name Your headline or current title City, State/Province Phone number email@ucr.ac.cr	Header: Include your name, title, and basic contact details.
Summary A brief summary of your skills and experience here.	Summary or profile: Summarize who you are, what you have to offer, and what your goals are.
Work experience Your most recent position here Start date - End date Most recent company here Your most impressive achievements here.	Work experience: Include any relevant work position or internship.
Education Your most recent degree or certification Start date - End date School name Your most impressive academic achievements here.	Education: Refer only to your university and high school. You can include your Grade Point Average (GPA), thesis, or any specialized course completed.
Skills Your most impressive skills here Description of this skill set	Skills: Mention 3-5 hard or soft skills.
Text section Your skills, certifications, interests, and more.	Text section: List any additional information.
Created with VisualCV Upgrade to remove this banner Add section ▼	



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Unit 2 - Lesson 2

Handout 4 - Pre-task 3

Instructions: Work in groups. Check the boxes that correspond to the recommendations given in the video “How to prepare for a job interview” (<https://www.youtube.com/watch?v=enD8mK9Zvwo>).

1. Smile and make eye contact.	☐
2. Wear formal clothes.	☐
3. Give a firm handshake to greet the interviewers.	☐
4. Have an active sitting position.	☐
5. Keep your stress at a minimum level.	☐
6. Demonstrate your skills by using the STAR method. ¹	☐
7. Have a good conversation dynamic.	☐
8. Give short and powerful answers.	☐
9. Ask follow-up questions.	☐
10. Bring business cards.	☐
11. Practice with a friend beforehand.	☐
12. Connect with the interviewers on LinkedIn.	☐

Instructions: Discuss the following questions and share your ideas with the class:

- Which is the most important recommendation for you? Why?
- What other recommendations would you add to the list?

¹ **STAR Method:** A structured manner of responding to interview questions by discussing the specific **Situation** (a challenge or problem you faced), **Task** (your role and responsibilities), **Action** (your behavior or skills to solve the problem), and **Result** (the outcome or what you accomplished).



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Unit 2 - Lesson 2

Handout 5 - Pre-Task 4

Instructions: The following questions are commonly used during job interviews. In groups, classify them depending on their purpose by choosing the correct letter for each question based on the following categories:

Category	G	E	M	A
To ask about the applicant's...	General profile	Experience	Motivation	Availability

1. How would you describe yourself?	G	E	M	A
2. What can you tell me about your professional background?	G	E	M	A
3. Why would you like to work for this company?	G	E	M	A
4. How long have you studied Electrical Engineering?	G	E	M	A
5. Where do you see yourself in 5 years?	G	E	M	A
6. When would you be able to start working with us?	G	E	M	A
7. What skills in your résumé are relevant for this position?	G	E	M	A
8. Would you be able to start next week?	G	E	M	A



University of Costa Rica
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Unit 2 - Lesson 2

Handout 6 - Main Task

Instructions: In pairs, role-play a conversation as if you were in a job interview. Practice the conversation and then exchange roles. Be ready to present your conversation in front of the class. Remember the recommendations from the video and review the useful expressions studied in class.

Student A: Employer or manager

- You are a very formal manager looking for a new electrical engineer to work at [name of the company].
- First, welcome the job applicant and introduce yourself. Then, ask questions about his/her personal data, experience, skills, and goals.
- At the end, you can ask the job applicant about his/her availability.

Student B: Job applicant

- You are looking for a position as an electrical engineer.
- You really want to get the job and give a good impression in the job interview.
- First, greet the interviewer and introduce yourself. Then, answer the questions with your own ideas. Tell the interviewer about your profile, experience, skills, and goals.
- You can use your résumé as a reference.

Example:

A: Good afternoon. Welcome to _____.! My name is _____ and I'm in charge of the job interview. Nice to meet you.

B: Nice to meet you, too. My name is _____. It's a pleasure to be here.

A: Let's start with the questions. First, tell me about....



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Unit 2 - Lesson 2

Handout 7 - Post-Task

Instructions: Individually, make a referral of a classmate or a friend for a job position. First, complete the following Employee Referral Form¹. Then, explain why this person **would** qualify or be eligible. In your description, include at least one sentence with **would**, one collocation with **have**, and five skills.

EMPLOYEE REFERRAL FORM	
Employee Information	
Your name:	
Email:	
Referral Information	
Name of the candidate:	
Email:	
Potential position: What positions are suitable for this person?	
Relationship: How do you know this person?	
Work history: How long have you studied or worked with this person?	
Rating: How would you rate this person?	★★★★★
Skills: What skills make him/her a good candidate?	
Additional notes: Explain why your referral is eligible for the role.	
SUBMIT	

¹ **Employee Referral Form:** A strategy used by companies and organizations to find talented people by asking current employees to recommend potential candidates for a job.



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Unit 2 - Lesson 2

Handout 8 - Post-Task

Instructions: Review the following information about the correct use and pronunciation of the modal **would**.



Modal Auxiliaries: Would

Would is a modal verb or modal auxiliary that “helps” other verbs to express a meaning.

It does not have a meaning by itself. This means that it always requires a main verb.

Other examples of modal auxiliaries are the following: *can, could, will, would, should, may, might, must, ought, and shall*.

Would is often used for the following functions:

- To offer something

Example: **Would** you like to work for our company?

- To express desire, opinion, hope or wish

Example: I **would** like to work for that company.
I **would not** apply for that job.

- To state a polite request

Example: **Would** you repeat that again, please?

How to pronounce *would* correctly?

Like in the case of *should* and *could*, the letter // is silent in **would**. This means that you do not pronounce the // sound. Thus, the correct pronunciation is /wʊd/.

Let's practice...

Instructions: Unscramble the following answers and questions related to job interviews. Use the correct word order based on the previous information about the modal **would**. Once you finish, read the sentences aloud to put into practice the correct pronunciation of the modal **would**.

1. would - I - like - participate - in - Norway - student - program - to - a - exchange

_____.

2. Would - you - Master's - pursue - a - graduation - after - degree - to - like

_____?

3. wouldn't - apply - job - a - this - network - for - Francis - as - engineer

_____.

4. Why - you - like - work - for - to - would - the - Hydropower - department

_____?

5. I - my - would - improve - skills - with - English - to - like - job - future - a - for

_____.

6. Would - skill - consider - teamwork - a - you - key - STEM - professionals - for - soft

_____?

***Optional:** Record a WhatsApp audio and send it directly to your teachers so that we can confirm if the modal **would** is pronounced correctly in the sentences.



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Unit 2 - Lesson 2

Answer Key: Handout 1 - Warm-up

Instructions: Individually, brainstorm ideas about the following categories related to job interviews. Then, share your ideas with the whole group:

Job Interviews

Information collected by employers in a job interview

-
- Answers will vary.
-
-

Companies where you would like to work in the future

-
-
-
-



Questions that may be asked in a job interview

-
-
-
-

Skills required of an electrical engineer

Hard skills:
Technical knowledge or training
■ ■ ■ ■

Soft skills:
Personal attributes about how you work and relate to others
■ ■ ■ ■





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Unit 2 - Lesson 2

Answer Key: Handout 2 - Pre-task 1

Instructions: Work in groups. Read the following job ads and discuss why you **would** or **would not** apply for the specific positions. Use the collocations with **have** in the box below. Once you finish, practice the conversation by using other expressions from the useful language section.

Collocations with *have*

Definition: Collocations are two or more words that usually go together.

- I **have experience** (doing something)
- I **have experience** with (equipment, a process)
- I **have experience** in (a field)
- I **have training** in (a field)
- I **have the ability** to (do something)
- I **have knowledge** of (a skill, a field)

Example:

Student A: Where **would** you like to work?

Student B: I **would** like to work for [name of the company]

Student A: Why **would** you like to apply for that job?

Student B: I **would** like to apply for this job because I **have training in** English. /

I **wouldn't** apply for this job because I don't **have experience** supervising Electrical technicians.

How about you? Where **would** you like to work?

Useful Language

Other ways to describe qualifications, skills, and interests		
▪ I am good <u>at</u> (something / doing something) ▪ I am interested <u>in</u> (something / doing something) ▪ I am able <u>to</u> (do something) ▪ I can (do something) ▪ I have a degree / certificate <u>in</u> (a field) ▪ I am certified <u>in</u> (a field)		
Giving an opinion	Negotiating meaning	
▪ In my opinion, hard skills are as important as soft skills. ▪ I would say that <u>I'm good at</u> solving mathematical problems. ▪ Here's an example. ▪ I would like to [start immediately / apply for this job] because <u>[I have experience with</u> microprocessors].	▪ What do you mean by [soft skills]? ▪ Could you repeat that again, please? ▪ Could you please elaborate more on your academic experience? ▪ Sure! What I mean is that <u>I also had training in</u> Electrical and Computer Engineering at the Purdue University. ▪ That's right!	
Showing interest during a conversation		
▪ Alright! ▪ Definitely!	▪ I see. ▪ I understand.	▪ Really? ▪ That's interesting.

Job Ad 1:

WE ARE HIRING!

JUNIOR POWER SYSTEMS ENGINEER

JOB QUALIFICATIONS

- Candidate must possess at least Bachelor of Science in Electrical Engineering, Professional License (Passed Board/Bar/Professional License Exam) in Electrical Engineering or equivalent.
- Required language(s): English
- Required Skill(s): Autocad, driving, technical report writing
- Preferably Less than 1 year experience specialized in Electrical Engineering or equivalent

JOB RESPONSIBILITIES

- Create technical reports
- Conduct power system analysis such as load flow analysis, short circuit analysis, protective device coordination, arc flash risk assessment, and alike.
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- Supervise Electrical technicians
- Conduct data gathering and verifications at the site.



INTERESTED APPLICANTS PLEASE SEND YOUR RESUME TO
tess.sandagon@exquisengineering.com



Job Ad 2:

JOIN OUR TALENT NETWORK!

WE ARE LOOKING FOR GREAT MINDS LIKE YOURS!

WHEN:
APRIL
5TH 2018

TIME:
8:30AM - 12MD

WHERE:
INTEL AUDITORIUM

What better place to build your future than with the team creating it. Would you like to become an Intel Student Worker? If you are a Bachelor, Licenciatura or Master student pursuing a degree in **Electric, Electronic or Computer Engineer** and have **50%** of career completed, we are glad to invite you to apply for an assessment center activity.

REQUIREMENTS:

- Being an active student.
- Programming skills (perl and/or python) .
- Completed digital electronics and analog circuits courses.
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Send your CV to Lar.swi.program@intel.com in order to assess your qualifications for this opportunity. A Human Resources Representative will contact you in order to inform you about the next steps.

Job Ad 3:**TESHAN Engineering Ltd.**

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TELECOMMUNICATIONS
ENGINEER

**Technical Officer – Telecommunications**

The applicant should be a young energetic candidate with a smart and pleasant personality

Role:

- Conducting technical site surveys and report generating
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- Coordinating with client engineering personnel and other relevant parties
- Quality inspections and troubleshooting

Job Qualifications and Requirements:

- Diploma in Telecommunications or Electronics sciences
- Excellent communication skills
- Fair knowledge in MS Excel and MS Word
- An analytical mind

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Attractive remuneration package is provided along with a life insurance policy. Please apply if you meet the above requirements by sending us your CV within 7 workdays with a recent photograph to hr@teshan.com



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Unit 2 - Lesson 2

Answer Key: Handout 3 - Pre-task 2

Instructions: Read the following information about résumés and CVs.

What is a résumé or a CV?

Your résumé or CV is the most important document in your job application.

A résumé is a one- to two-page document presenting key facts about your education, work experience, and relevant skills. A CV (Curriculum Vitae) is a longer document that provides more details about your experience, publications, and other accomplishments.

Employers use this information to decide how suitable you are for a position, so you should include or emphasize certain details depending on the position you would like to apply for.

Start by asking yourself this question: “*What do I want the employer to think of me after reading my résumé or CV?*”

What are the key sections of a résumé?

Let's practice!

Instructions: Read the following information about how to complete the key sections of a résumé or CV: header, summary, education, work experience (if any), and skills. Then, individually, go to <https://www.visualcv.com>, log in with your email, choose a free CV template, and complete the key sections with your personal information.

Full Name Your headline or current title City, State/Province Phone number email@ucr.ac.cr	Header: Include your name, title, and basic contact details.
Summary A brief summary of your skills and experience here.	Summary or profile: Summarize who you are, what you have to offer, and what your goals are.
Work experience Your most recent position here Start date - End date Most recent company here Your most impressive achievements here.	Work experience: Include any relevant work position or internship.
Education Your most recent degree or certification Start date - End date School name Your most impressive academic achievements here.	Education: Refer only to your university and high school. You can include your Grade Point Average (GPA), thesis, or any specialized course completed.
Skills Your most impressive skills here Description of this skill set	Skills: Mention 3-5 hard or soft skills.
Text section Your skills, certifications, interests, and more.	Text section: List any additional information.
Created with VisualCV Upgrade to remove this banner Add section ▼	



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Unit 2 - Lesson 2

Answer Key: Handout 4 - Pre-task 3

Instructions: Work in groups. Check the boxes that correspond to the recommendations given in the video “How to prepare for a job interview” (<https://www.youtube.com/watch?v=enD8mK9Zvw0>).

1. Smile and make eye contact.	☒
2. Wear formal clothes.	☐
3. Give a firm handshake to greet the interviewers.	☒
4. Have an active sitting position.	☒
5. Keep your stress at a minimum level.	☐
6. Demonstrate your skills by using the STAR method. ¹	☒
7. Have a good conversation dynamic.	☒
8. Give short and powerful answers.	☒
9. Ask follow-up questions.	☒
10. Bring business cards.	☐
11. Practice with a friend beforehand.	☒
12. Connect with the interviewers on LinkedIn.	☐

Instructions: Discuss the following questions and share your ideas with the class:

- Which is the most important recommendation for you? Why?
- What other recommendations would you add to the list? **Answers will vary.**

¹ **STAR Method:** A structured manner of responding to interview questions by discussing the specific **S**ituation (a challenge or problem you faced), **T**ask (your role and responsibilities), **A**ction (your behavior or skills to solve the problem), and **R**esult (the outcome or what you accomplished).



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Unit 2 - Lesson 2

Answer Key: Handout 5 - Pre-Task 4

Instructions: The following questions are commonly used during job interviews. In groups, classify them depending on their purpose by choosing the correct letter for each question based on the following categories:

Category	G	E	M	A
To ask about the applicant's...	General profile	Experience	Motivation	Availability

1. How would you describe yourself?	G	E	M	A
2. What can you tell me about your professional background?	G	E	M	A
3. Why would you like to work for this company?	G	E	M	A
4. How long have you studied Electrical Engineering?	G	E	M	A
5. Where do you see yourself in 5 years?	G	E	M	A
6. When would you be able to start working with us?	G	E	M	A
7. What skills in your résumé are relevant for this position?	G	E	M	A
8. Would you be able to start next week?	G	E	M	A



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Unit 2 - Lesson 2

Answer Key: Handout 6 - Main Task

Instructions: In pairs, role-play a conversation as if you were in a job interview. Practice the conversation and then exchange roles. Be ready to present your conversation in front of the class. Remember the recommendations from the video and review the useful expressions studied in class.

Student A: Employer or manager

- You are a very formal manager looking for a new electrical engineer to work at [name of the company].
- First, welcome the job applicant and introduce yourself. Then, ask questions about his/her personal data, experience, skills, and goals.
- At the end, you can ask the job applicant about his/her availability.

Student B: Job applicant

- You are looking for a position as an electrical engineer.
- You really want to get the job and give a good impression in the job interview.
- First, greet the interviewer and introduce yourself. Then, answer the questions with your own ideas. Tell the interviewer about your profile, experience, skills, and goals.
- You can use your résumé as a reference.

Example:

A: Good afternoon. Welcome to _____! My name is _____ and I'm in charge of the job interview. Nice to meet you.

B: Nice to meet you, too. My name is _____. It's a pleasure to be here.

A: Let's start with the questions. First, tell me about....



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Unit 2 - Lesson 2

Answer Key: Handout 7 - Post-Task

Instructions: Individually, make a referral of a classmate or a friend for a job position. First, complete the following Employee Referral Form¹. Then, explain why this person **would** qualify or be eligible. In your description, include at least one sentence with **would**, one collocation with **have**, and five skills.

EMPLOYEE REFERRAL FORM	
Employee Information	
Your name:	
Email:	
Referral Information	
Name of the candidate:	
Email:	
Potential position: What positions are suitable for this person?	
Relationship: How do you know this person?	
Work history: How long have you studied or worked with this person?	
Rating: How would you rate this person?	★★★★★
Skills: What skills make him/her a good candidate?	
Additional notes: Explain why your referral is eligible for the role.	
SUBMIT	

¹ **Employee Referral Form:** A strategy used by companies and organizations to find talented people by asking current employees to recommend potential candidates for a job.



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Unit 2 - Lesson 2

Answer Key: Handout 8 - Post-Task

Instructions: Review the following information about the correct use and pronunciation of the modal **would**.



Modal Auxiliaries: Would

Would is a modal verb or modal auxiliary that “helps” other verbs to express a meaning.

It does not have a meaning by itself. This means that it always requires a main verb.

Other examples of modal auxiliaries are the following: *can, could, will, would, should, may, might, must, ought, and shall*.

Would is often used for the following functions:

- To offer something

Example: **Would** you like to work for our company?

- To express desire, opinion, hope or wish

Example: I **would** like to work for that company.
I **would not** apply for that job.

- To state a polite request

Example: **Would** you repeat that again, please?

How to pronounce *would* correctly?

Like in the case of *should* and *could*, the letter // is silent in **would**. This means that you do not pronounce the // sound. Thus, the correct pronunciation is /wʊd/.

Let's practice...

Instructions: Unscramble the following answers and questions related to job interviews. Use the correct word order based on the previous information about the modal **would**. Once you finish, read the sentences aloud to put into practice the correct pronunciation of the modal **would**.

1. would - I - like - participate - in - Norway - student - program - to - a - exchange

I would like to participate in a student exchange program in Norway.

2. Would - you - Master's - pursue - a - graduation - after - degree - to - like

Would you like to pursue a Master's degree after graduation?

3. wouldn't - apply - job - a - this - network - for - Francis - as - engineer

Francis wouldn't apply for this job as a network engineer.

4. Why - you - like - work - for - to - would - the - Hydropower - department

Why would you like to work for the Hydropower department?

5. I - my - would - improve - skills - with - English - to - like - job - future - a - for

I would like to improve my English skills for a future job.

6. Would - skill - consider - teamwork - a - you - key - STEM - professionals - for - soft

Would you consider teamwork a key soft skill for STEM professionals?

***Optional:** Record a WhatsApp audio and send it directly to your teachers so that we can confirm if the modal **would** is pronounced correctly in the sentences.



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Morales, A.; Araya, M.

Unit 2: Empowering Communication at Work

Lesson 3: Telephone call

Date: October 5, 2021

Unit Goal: By the end of the unit, the students will be able to actively interact with prospective English-speaking professionals by role-playing work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting.

General Objective: By the end of the lesson, the students will be able to appropriately make a telephone call to coordinate a technical site visit by using proper openings and closings, scheduling the date (e.g., suggesting and agreeing on the date), and making and responding to suggestions politely (safety measures).

Specific Objectives: By the end of this lesson, the students will be able to:

1. effectively brainstorm general ideas about making telephone calls, coordinating or scheduling technical site visits, and wearing Personal Protective Equipment (PPE) during a technical visit at a work site by predicting key vocabulary based on a series of pictures and questions discussed in groups;
2. correctly identify common expressions used to schedule a site visit over the phone by classifying them according to their purpose (i.e., suggesting and agreeing on a date, rejecting the meeting, accepting or confirming the date, and making and responding to suggestions) while interacting in groups;
3. appropriately show understanding of basic Personal Protective Equipment (PPE) required during a site visit by matching the pictures to their corresponding names in an online memory game while working in groups;
4. accurately identify relevant precautions to avoid electrical hazards before and during a technical site visit by generating a list of instructions using the imperative mood while interacting in groups;

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

5. successfully role-play a telephone conversation between an electrical engineer and an international consultant to coordinate a technical site visit by using proper openings and closings, suggesting and agreeing on the date, and making and responding to suggestions politely;
6. appropriately identify the modal auxiliaries (*would*, *could*, *should*, and *may*) by completing a fill-in-the-blanks exercise; and
7. correctly use the imperative mood by writing a list of directions for making a good impression in work-related settings and for finding a job.

Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Brainstorming ideas and making predictions Part 1 T presents a series of pictures on a PowerPoint slide and leads a whole-class discussion to elicit related ideas and vocabulary. T asks questions related to activities performed by electrical engineers, facilities, and protective equipment. (Handout 1A) Part 2 T shares a link to Jamboard via the Zoom chat. (Handout 1B) T briefly explains the technical procedure for accessing and using the platform to ensure the activity is done smoothly. T assigns one board to each group before sending Ss into breakout rooms. Then, T asks each group to brainstorm two to three possible answers for questions related to technical site visits. T asks for volunteers to model the UL to facilitate their interaction while brainstorming ideas in groups. Ss return to the main room after finishing, and T quickly goes over the answers. Then, T reviews	S, L, W	Giving an opinion: - As far as I know... - It seems to me that... - I'd definitely say that ... - For example, ... / For instance, ... - I agree/disagree with you. Negotiation of meaning: - Would you mind repeating that? - What does ... mean? - What do you mean by ...? - Sure! What I mean is ... Turn-taking: - Who would like to start? - I'd like to start / I'll go first. - Would you like to add anything?	Creative: - Brainstorming Cognitive: - Predicting Interpersonal: - Cooperating	25 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	the objective of the class and makes the connection between the warm-up and the topic of the lesson: making telephone calls to coordinate site visits. Finally, T explains that this lesson will be useful to further develop the Ss' soft skills for professional purposes. Also, making suggestions or agreeing on a time is key for electrical engineers who need to work with foreign English-speaking coworkers, managers, and clients, among others.		- I'm sorry to interrupt but... (I've got something to say) Activities performed by electrical engineers: - Discussing a technical project - Making a telephone call to coordinate a technical visit - Scheduling a technical site visit Facilities: - Chip assembly plant - Head office - Power plant - Telecommunications facility Protective equipment: - Dielectric boots - Gloves - Hard hat / helmet - Personal Protective Equipment (PPE) - Safety glasses / goggles - Safety vest		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
2	Pre-task 1: T shares the link to Wordwall via the Zoom chat. In groups, Ss classify common expressions used to schedule a site visit according to their purpose (<i>suggesting and agreeing on a date, rejecting the meeting, accepting or confirming the date, and making and responding to suggestions</i>). (Handout 2) T monitors the activity and provides immediate corrective feedback when necessary. T also reminds Ss about the useful language. T reviews the exercise as a whole group by sharing the screen and asking Ss to provide their answers. Finally, T asks Ss to read some additional useful phrases to introduce themselves and finish the telephone call.	R, S, L	Giving an opinion: - As far as I know... - It seems to me that... - I'd definitely say that ... - For example, ... / For instance, ... - I agree/disagree with you. Suggesting and agreeing on a date: Actually, Thursday morning would be better for me. Are you available/free on Monday? Could we meet on Friday at 2 p.m.? Could we schedule the site visit for Wednesday?	Cognitive: - Inferencing - Classifying Linguistic: - Conversational patterns Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Wednesday looks good, but I'm busy at nine. How about 11 o'clock instead? Would Monday suit you? Rejecting the meeting: I'm afraid I won't be able to meet next week. I'm sorry, but I've got another site visit next Friday. Accepting or confirming the date: I would be able to meet on Wednesday at 8 a.m. Monday would be perfect. OK, we'll see each other next Thursday at 11 a.m.		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Sounds good. Let's do it on Tuesday at 2 p.m. Wednesday suits me. Making and responding to suggestions: I suggest that you bring... I'd recommend following... You should wear.... Certainly. Thank you! Of course. Thank you for your help! That's a good idea! Introducing yourself: - Hello, this is [first and last name]. I am calling from [company name], and I would like to speak with [Mr.		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Collins]. - Hello, my name is [first and last name]. I'm with [company name]. May I speak to [Ms. Smith]? I'm calling to coordinate her visit to our chip assembly plant next week. Finishing the call: - If you have any questions, please contact me. - I appreciate that you're taking the time to talk to me. - I look forward to meeting you soon. - Looking forward to seeing you next week.		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: T shares the link to Educaplay and briefly explains how the platform works. In groups, Ss match pictures of Personal Protective Equipment (PPE) for electrical engineers with their corresponding names by playing a memory game. (Handout 3) T monitors the activity and provides support when necessary. T also reminds Ss about the UL. Then, T shows the pictures in a PowerPoint slide and reviews the exercise as a group.	R, S, L	Turn-taking: - Who would like to start? - I'd like to start / I'll go first. Personal Protective Equipment (PPE): - Arc flash protective clothing - Harness - Hearing protection - Insulated footwear - Lab coat - Rubber sleeves - Safety glasses - Safety gloves - Safety helmet - Safety vest	Cognitive: - Classifying - Inferencing Linguistic: - Using context Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
4	Pre-task 3: To challenge Ss and take advantage of their background knowledge, T asks them to write a list of electrical hazards and a list of instructions or safety precautions to limit these hazards during a site visit. Ss first need to read a short explanation about the use of imperatives in English to become familiar with this verb structure. (Handout 4) T encourages team collaboration to complete this task and gives support with any unknown words. reminds Ss that they can use an online dictionary to look up any unknown words. Ss share their answers as a group after finishing.	R, S, L, W	Giving an opinion: - As far as I know... - It seems to me that... - I'd definitely say that ... - For example, ... / For instance, ... - I agree/disagree with you. Negotiation of meaning: - Would you mind repeating that? - What does ... mean? - What do you mean by ...? - Sure! What I mean is ... Turn-taking: - Who would like to start? - I'd like to start / I'll go first. - Would you like to add anything?	Creative: - Brainstorming Affective: - Personalizing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			- I'm sorry to interrupt but... (I've got something to say) Hazards: - Contact with power lines - Lack of ground fault protection - Missing or discontinuous path to ground - Inappropriate use of equipment - Incorrect use of extension or flexible cords Safety precautions: - Don't use faulty equipment. - Don't operate electrical equipment while standing in water. - Wear the required PPE at all times. - Use non-conductive wood or fiberglass ladders.		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
5	Task: Ss prepare and present a role-play conversation between an electrical engineer and a consultant. (Handout 5) Ss plan their conversation according to the role cards and the recommended steps included in the handout. They rehearse the conversation and exchange roles to present it in front of the class. Ss are also encouraged to put into practice the vocabulary and recommendations that they have studied in the pre-tasks. T monitors the activity and provides support or corrective feedback as required. As part of the reporting stage, two or three pairs of Ss give an effective and clear oral presentation of the role-play to the rest of the class (5 min. each pair).	R, S, L	Ss should recycle vocabulary and expressions previously studied, including: - Key words brainstormed in the warm-up - Expressions for giving an opinion, negotiating meaning, and turn-taking. - Phrases to schedule a site visit over the phone (openings and closings, suggesting and agreeing on the date, and making and responding to suggestions politely) - Personal Protective Equipment (PPE) - Imperatives to give instructions about safety precautions before and during a technical visit	Linguistic: - Conversational patterns - Practicing Affective: - Personalizing Interpersonal: - Cooperating - Role-playing	35 min. Planning: 20 min. + Reporting: 15 min.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
6-7	Post-task: Grammar: Individually, Ss review an explanation about modal auxiliaries (<i>would, could, should, and may</i>) and their pronunciation. Then, they complete a fill-in-the-blanks exercise (dialogue) by writing the correct modal auxiliary. (Handout 6A) Ss read an explanation about the correct use of imperatives in English and then write a list of imperative sentences for people who want to make a good impression in work-related settings and find a job. (Handout 6B)	R, W	Grammar and pronunciation: - Imperatives - Modal auxiliaries: <i>would, could, should, and may</i> - Silent // in modals	Creative: - Brainstorming Linguistic: - Practicing Affective: - Personalizing Intrapersonal: - Individual student work	1 hr.

Reminders:

- Have a 10-minute break.

Homework:

- Ask Ss to complete the post-task for homework.

ABBREVIATIONS:

T: The teacher
Ss: The students

R: Reading
W: Writing

S: Speaking
L: Listening

UL: Useful Language

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

Jamboard: <https://jamboard.google.com/d/1r0vMhhGMERlHkUbxUkYuzg5AlJWrxl03djt3vaURpw8/edit?usp=sharing>

Wordwall: <https://wordwall.net/play/22719/270/830>

Educaplay: https://es.educaplay.com/recursos-educativos/10453567-memory_game.html

REFERENCES:

N/A



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Unit 2 - Lesson 3

Handout 1A - Warm-up

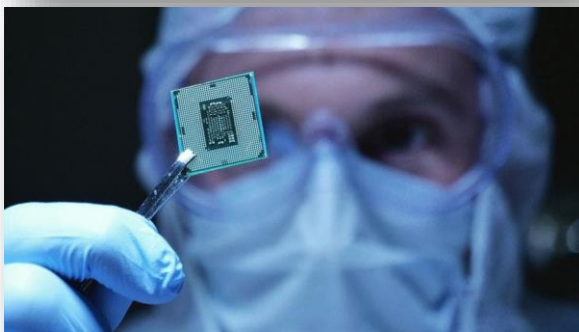
Part 1

Instructions: Individually, analyze the following pictures and brainstorm ideas about them based on the questions below. Then, share your ideas with the class.

What is happening in the pictures?



- What are these electrical engineers doing or talking about?
- Where do you think they are?
- What are they wearing?





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Unit 2 - Lesson 3

Handout 1B - Warm-up

Part 2

Instructions: Work in groups. Go to [Jamboard.com](https://jamboard.com) and brainstorm two or three possible answers for each of the questions below. Then, discuss your answers with the class.

What are some reasons why electrical engineers may coordinate site visits?

-
-
-

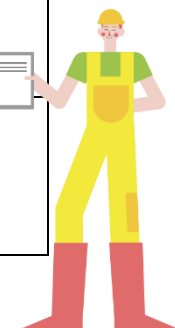
What aspects need to be considered when scheduling a site visit over the phone?

-
-
-

Useful Language:



Giving an opinion	▪ As far as I know, we coordinate site visits to have consultants conduct inspections. ▪ It seems to me that site visits allow senior executives and consultants to build a better understanding of a site's potential. ▪ I'd definitely say that you need to consider the date and time. ▪ For example, you should suggest a date and see if they are available. ▪ I agree/disagree with you.
Negotiation of meaning	▪ Would you mind repeating that? ▪ What does [PPE] mean? ▪ What do you mean by [safety vest]? ▪ Sure! What I mean is that you must wear a safety vest.
Turn-taking	▪ Who would like to start? ▪ I'd like to start / I'll go first. ▪ Would you like to add anything? ▪ I'm sorry to interrupt but [I've got something to say].





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Handout 2 - Pre-task 1

Instructions: Work in groups. These are common expressions used to schedule the date of an appointment or a site visit. Go to Wordwall.net and match the sample phrases to their purpose during a telephone call. Then, write the phrases in their corresponding chart below.

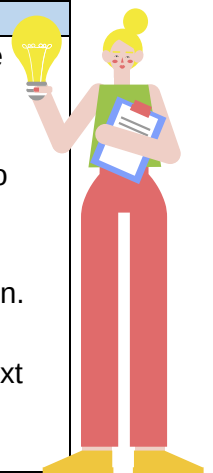
Scheduling a Site Visit over the Phone

a) Monday would be perfect.	k) Wednesday suits me.
b) I suggest that you bring...	l) Sounds good. Let's do it on Tuesday at 2 p.m.
c) Are you available/free on Monday?	m) I would be able to meet on Wednesday at 8 a.m.
d) Would Monday suit you?	n) You should wear....
e) Could we schedule the site visit for Wednesday?	o) Of course. Thank you for your help!
f) Certainly. Thank you!	p) I'm sorry, but I've got another site visit next Friday.
g) I'm afraid I won't be able to meet next week.	q) Wednesday looks good, but I'm busy at nine. How about 11 o'clock instead?
h) OK, we'll see each other next Thursday at 11 a.m.	r) Actually, Thursday morning would be better for me.
i) Could we meet on Friday at 2 p.m.?	s) That's a good idea!
j) I'd recommend following...	

1. Suggesting and agreeing on a date

2. Rejecting the meeting**3. Accepting or confirming the date****4. Making and responding to suggestions****Useful Phrases:**

Introducing yourself	Finishing the call
- Hello, this is [first and last name]. I am calling from [company name], and I would like to speak with [Mr. Collins]. - Hello, my name is [first and last name]. I'm with [company name]. May I speak to [Ms. Smith]? I'm calling to coordinate her visit to our chip assembly plant next week.	- If you have any questions, please contact me. - I appreciate you taking the time to talk to me. - I look forward to meeting you soon. - Looking forward to seeing you next week.





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Handout 3 - Pre-task 2

Instructions: Work in groups and take turns. Go to [Educaplay.com](https://www.educaplay.com) and play the memory game on Personal Protective Equipment (PPE)¹⁵ required for technical visits. Start the game by flipping a card and then find another card with a description that matches the image. If you cannot find a pair, the cards will be flipped back with the face down.

1 	2 Lab coat	3 	4 Insulated footwear	5 Arc flash protective clothing	6 Safety glasses
7 	8 	9 Rubber sleeves	10 	11 	12 Harness
13 	14 	15 Hearing protection	16 Safety vest	17 	18 
		19 Safety gloves	20 Safety helmet		

educaplay

¹⁵ Personal Protective Equipment or PPE is specialized clothing or equipment worn or used by a worker for protection against health and safety hazards at a work site.



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Handout 4 - Pre-task 3

Read the following information and complete the exercise.

Imperatives

Imperatives are used to give commands and orders. They use the simple form of the verb to address the subject “you” which is not explicitly stated.

For example:

Wear protective clothing.

Do not wear loose-fitting clothing.

Instructions: Work in groups. Write a list of unsafe environmental conditions (hazards) and a list of instructions or safety precautions to limit these hazards during a site visit by using imperatives.

Electrical Hazards

Electrical Safety Precautions (Dos and Don'ts)



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Handout 5 - Main Task

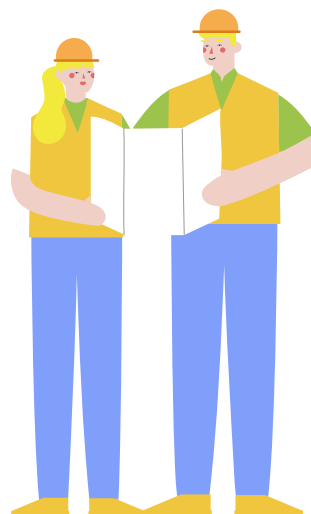
Instructions: In pairs, carefully read the following descriptions and role-play a conversation between an electrical engineer and an international consultant. Practice the conversation and then exchange the roles. Feel free to customize it according to your area of specialization and interests.

Electrical Engineer:

You work at a Costa Rican company or institution, and you have been asked to coordinate a site visit with an English-speaking engineering consultant. You will need to meet with the consultant at a power plant, telecommunications facility, or a chip assembly plant to explain the entire process and the projects you and your company are currently working on. The consultant needs to ensure that satisfactory standards and good practices are implemented at the workplace. To arrange this meeting, you will need to make a call to agree on a time that suits you both.

Follow these steps during the telephone call:

- Call the engineering consultant.
- Identify yourself and your company.
- State the reason for the call.
- Propose a date and a time.
- Offer at least two different options to arrange the meeting.
- Make suggestions about the safety equipment and measures required during this technical visit.
- Summarize the details of the meetings for confirmation.
- Use a closing phrase with a future focus to finish the call.

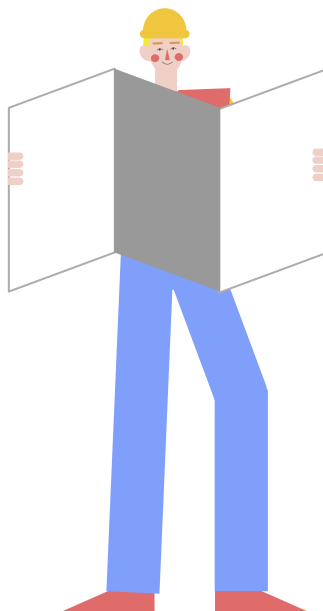


Electrical Engineering Consultant:

You work for an international firm that would like to sponsor a Costa Rican electric company in 2022. You have been asked to visit a project site soon to ensure regulatory compliance with international codes and standards. An electrical engineer who works for that company will call you to schedule the technical visit.

Follow these steps during the telephone call:

- Answer the phone politely and listen to the electrical engineer who will call you.
- The electrical engineer will first propose two dates, but you will not be able to attend due to other meetings scheduled on the same date and time. Be ready to negotiate this with the engineer and, if appropriate, talk about your availability.
- Agree on the meeting date and time and confirm the details before ending the phone call.
- Use an appropriate closing phrase to finish the call.





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Handout 6A- Post-Task

Instructions: Review the following information about the correct use of the modals **may**, **could**, **would**, and **should**.

Modal Auxiliaries: May, Could, and Would

May, **could**, and **would** are often used to ask questions or make requests in a polite way. The questions ask for someone's help, cooperation, permission, or agreement. They are always followed by the simple form of a verb. Use *please* at the end of the sentence or after the subject in formal situations.

Examples:

Modal	Subject	Base Form of the Verb	Complement
May ¹⁶	I	speak	to the HR manager?
Could	you	give	me some advice, please?
Would		come	to our class and talk about your work on robotics, please?

Note: **May** is NOT used when "you" is the subject of a polite question.

Examples:

May you meet me at 2:00 p.m. today? → ❌

Could you meet me at 2:00 p.m. today? → ✅

When you agree to a request, you can give a short answer such as "of course" or "certainly" instead of "yes."

¹⁶ 'May' is very polite. Use it with people you do not know well in very formal situations. For example, when you want to speak to a specific person, ask to speak to him or her with a polite question starting with 'may.'





Modal Auxiliary: Should

Should is a modal auxiliary verb used to express obligation and duty through advice or recommendations. English speakers use this modal when they think something is a good (or a bad) idea.

Examples: 

Affirmative	You should schedule the technical visit in advance so that the consultant can plan accordingly.
Negative	You should not try to repair energized equipment.
Question	What safety measures should be followed if an electrical accident takes place?

How to pronounce *would, could, and should* correctly?

The // sound in **could**, **would**, and **should** is silent. This means that you do not pronounce the // sound. The correct pronunciation is as follows:

Could – /kʊd/

Would – /wʊd/

Should – /ʃʊd/

Let's practice...

Instructions: Complete the following telephone conversation with the modals **may**, **could**, **would** and **should**.

Nick: Hello.

Susana: Hello, _____ I speak to Nick Lawrence, please?

Nick: Yeah, Nick speaking.

Susana: Mr. Lawrence, this is Susana Lopez from National Grid Corporation.

Nick: Oh! Hi, Ms. Lopez, thank you for your call. How are you?

Susana: I'm doing great, thank you for asking! I'm calling to coordinate your visit to our site.
_____ we schedule it for next week?

Nick: Let me just check my calendar. What day exactly?

Susana: _____ Monday be convenient for you, at 10 a.m.?

Nick: Monday looks good, but I'm busy at ten. How about 11 o'clock instead?

Susana: Sounds good. OK, Mr. Lawrence, that's Monday at eleven o'clock.

Nick: Wonderful! _____ you please send me an email confirmation with the details?

Susana: Of course! You _____ only bring your safety helmet and glasses. We can provide you with the rest of the protective equipment onsite. I look forward to seeing you!

Nick: Same here. Thanks again for calling. Goodbye!



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Handout 6B - Post-Task

Instructions: Review the following information about the correct use of the imperative mood.

Imperative Mood

Imperative sentences are used to give commands and directions. The difference between a command and a request lies in the speaker's tone of voice and the use of "please."

"Please" can come at the beginning or end of a request:

- *Open the door, **please**.*
- ***Please** open the door.*

The simple form of a verb is used in imperative sentences. The understood subject of the sentence is you (meaning the person the speaker is talking to): *(You) come this way.*

Negative form:

Don't + the simple form of a verb.

Let's practice...

Instructions: Write imperative sentences about the following topics and share your answers with the class next week. Give three pieces of advice to people who want to:

Make a good first impression
▪ ▪ ▪

Find a job
▪ ▪ ▪



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Answer Key: Handout 1A - Warm-up

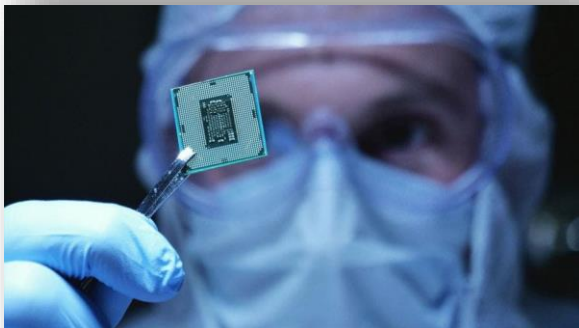
Part 1

Instructions: Individually, analyze the following pictures and brainstorm ideas about them based on the questions below. Then, share your ideas with the class.

What is happening in the pictures?



- What are these electrical engineers doing or talking about? Discussing a technical project, making a telephone call to coordinate a technical visit, scheduling a technical site visit, etc.
- Where do you think they are? Chip assembly plant, head office, power plant, or telecommunications facility.
- What are they wearing? Personal Protective Equipment (PPE): Dielectric boots, gloves, hard hat/helmet, safety glasses/goggles, safety vest, etc.





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Answer Key: Handout 1B - Warm-up

Part 2

Instructions: Work in groups. Go to [Jamboard.com](https://jamboard.com) and brainstorm two or three possible answers for each of the questions below. Then, discuss your answers with the class.

What are some reasons why electrical engineers may coordinate site visits?

- Answers may vary.
-
-

What aspects need to be considered when scheduling a site visit over the phone?

- Answers may vary.
-
-

Useful Language:



Giving an opinion	▪ As far as I know, we coordinate site visits to have consultants conduct inspections. ▪ It seems to me that site visits allow senior executives and consultants to build a better understanding of a site's potential. ▪ I'd definitely say that you need to consider the date and time. ▪ For example, you should suggest a date and see if they are available. ▪ I agree/disagree with you.
Negotiation of meaning	▪ Would you mind repeating that? ▪ What does [PPE] mean? ▪ What do you mean by [safety vest]? ▪ Sure! What I mean is that you must wear a safety vest.
Turn-taking	▪ Who would like to start? ▪ I'd like to start / I'll go first. ▪ Would you like to add anything? ▪ I'm sorry to interrupt but [I've got something to say].





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Unit 2 - Lesson 3

Answer Key: Handout 2 - Pre-task 1

Instructions: Work in groups. These are common expressions used to schedule the date of an appointment or a site visit. Go to Wordwall.net and match the sample phrases to their purpose during a telephone call. Then, write the phrases in their corresponding chart below.

Scheduling a Site Visit over the Phone

a) Monday would be perfect.	k) Wednesday suits me.
b) I suggest that you bring...	l) Sounds good. Let's do it on Tuesday at 2 p.m.
c) Are you available/free on Monday?	m) I would be able to meet on Wednesday at 8 a.m.
d) Would Monday suit you?	n) You should wear....
e) Could we schedule the site visit for Wednesday?	o) Of course. Thank you for your help!
f) Certainly. Thank you!	p) I'm sorry, but I've got another site visit next Friday.
g) I'm afraid I won't be able to meet next week.	q) Wednesday looks good, but I'm busy at nine. How about 11 o'clock instead?
h) OK, we'll see each other next Thursday at 11 a.m.	r) Actually, Thursday morning would be better for me.
i) Could we meet on Friday at 2 p.m.?	s) That's a good idea!
j) I'd recommend following...	

1. Suggesting and agreeing on a date

- Actually, Thursday morning would be better for me.
- Are you available/free on Monday?
- Could we meet on Friday at 2 p.m.?
- Could we schedule the site visit for Wednesday?
- Wednesday looks good, but I'm busy at nine. How about 11 o'clock instead?
- Would Monday suit you?

2. Rejecting the meeting

- I'm afraid I won't be able to meet next week.
- I'm sorry, but I've got another site visit next Friday.

3. Accepting or confirming the date

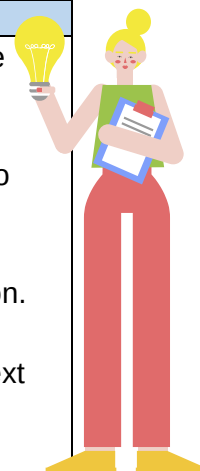
- I would be able to meet on Wednesday at 8 a.m.
- Monday would be perfect.
- OK, we'll see each other next Thursday at 11 a.m.
- Sounds good. Let's do it on Tuesday at 2 p.m.
- Wednesday suits me.

4. Making and responding to suggestions

- I suggest that you bring...
- I'd recommend following...
- You should wear...
- Certainly. Thank you!
- Of course. Thank you for your help!
- That's a good idea!

Useful Phrases:

Introducing yourself	Finishing the call
• Hello, this is [first and last name]. I am calling from [company name], and I would like to speak with [Mr. Collins]. • Hello, my name is [first and last name]. I'm with [company name]. May I speak to [Ms. Smith]? I'm calling to coordinate her visit to our chip assembly plant next week.	• If you have any questions, please contact me. • I appreciate you taking the time to talk to me. • I look forward to meeting you soon. • Looking forward to seeing you next week.



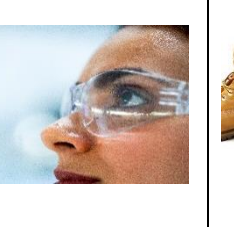


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Unit 2 – Lesson 3

Answer Key: Handout 3 - Pre-task 2

Instructions: Work in groups and take turns. Go to [Educaplay.com](https://www.educaplay.com) and play the memory game on Personal Protective Equipment (PPE)¹⁷ required for technical visits. Start the game by flipping a card and then find another card with a description that matches the image. If you cannot find a pair, the cards will be flipped back with the face down.

				
Safety gloves	Lab coat	Arc flash protective clothing	Safety helmet	Hearing protection
				
Safety vest	Harness	Rubber sleeves	Safety glasses	Dielectric footwear

¹⁷ Personal Protective Equipment or PPE is specialized clothing or equipment worn or used by a worker for protection against health and safety hazards at a work site.



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Unit 2 - Lesson 3

Answer Key: Handout 4 - Pre-task 3

Read the following information and complete the exercise.

Imperatives

Imperatives are used to give commands and orders. They use the simple form of the verb to address the subject “you” which is not explicitly stated.

For example:

***Wear** protective clothing.*

***Do not wear** loose-fitting clothing.*

Instructions: Work in groups. Write a list of unsafe environmental conditions (hazards) and a list of instructions or safety precautions to limit these hazards during a site visit by using imperatives.

Answers may vary.

Electrical Hazards
Example: - Inappropriate use of equipment.

Electrical Safety Precautions (Dos and Don'ts)
Example: - Don't use faulty equipment.



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Unit 2 - Lesson 3

Answer Key: Handout 5 - Main Task

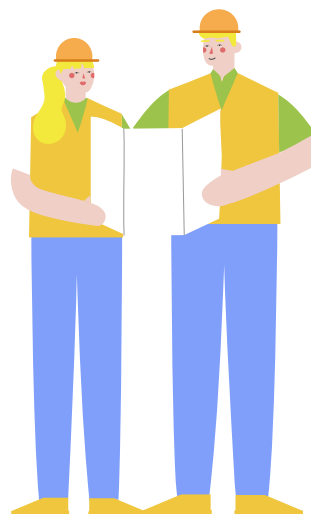
Instructions: In pairs, carefully read the following descriptions and role-play a conversation between an electrical engineer and an international consultant. Practice the conversation and then exchange the roles. Feel free to customize it according to your area of specialization and interests.

Electrical Engineer:

You work at a Costa Rican company or institution, and you have been asked to coordinate a site visit with an English-speaking engineering consultant. You will need to meet with the consultant at a power plant, telecommunications facility, or a chip assembly plant to explain the entire process and the projects you and your company are currently working on. The consultant needs to ensure that satisfactory standards and good practices are implemented at the workplace. To arrange this meeting, you will need to make a call to agree on a time that suits you both.

Follow these steps during the telephone call:

- Call the engineering consultant.
- Identify yourself and your company.
- State the reason for the call.
- Propose a date and a time.
- Offer at least two different options to arrange the meeting.
- Make suggestions about the safety equipment and measures required during this technical visit.
- Summarize the details of the meetings for confirmation.
- Use a closing phrase with a future focus to finish the call.

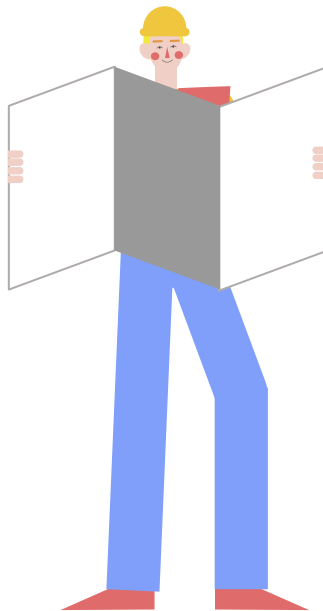


Electrical Engineering Consultant:

You work for an international firm that would like to sponsor a Costa Rican electric company in 2022. You have been asked to visit a project site soon to ensure regulatory compliance with international codes and standards. An electrical engineer who works for that company will call you to schedule the technical visit.

Follow these steps during the telephone call:

- Answer the phone politely and listen to the electrical engineer who will call you.
- The electrical engineer will first propose two dates, but you will not be able to attend due to other meetings scheduled on the same date and time. Be ready to negotiate this with the engineer and, if appropriate, talk about your availability.
- Agree on the meeting date and time and confirm the details before ending the phone call.
- Use an appropriate closing phrase to finish the call.





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Answer Key: Handout 6A- Post-Task

Instructions: Review the following information about the correct use of the modals **may**, **could**, **would**, and **should**.

Modal Auxiliaries: May, Could, and Would

May, **could**, and **would** are often used to ask questions or make requests in a polite way. The questions ask for someone's help, cooperation, permission, or agreement. They are always followed by the simple form of a verb. Use *please* at the end of the sentence or after the subject in formal situations.

Examples:

Modal	Subject	Base Form of the Verb	Complement
May ¹⁸	I	speak	to the HR manager?
Could	you	give	me some advice, please?
Would		come	to our class and talk about your work on robotics, please?

Note: **May** is NOT used when "you" is the subject of a polite question.

Examples:

May you meet me at 2:00 p.m. today? → ❌

Could you meet me at 2:00 p.m. today? → ✅

When you agree to a request, you can give a short answer such as "of course" or "certainly" instead of "yes."



¹⁸ 'May' is very polite. Use it with people you do not know well in very formal situations. For example, when you want to speak to a specific person, ask to speak to him or her with a polite question starting with 'may.'



Modal Auxiliary: Should

Should is a modal auxiliary verb used to express obligation and duty through advice or recommendations. English speakers use this modal when they think something is a good (or a bad) idea.

Examples: 

Affirmative	You should schedule the technical visit in advance so that the consultant can plan accordingly.
Negative	You should not try to repair energized equipment.
Question	What safety measures should be followed if an electrical accident takes place?

How to pronounce *would, could, and should* correctly?

The // sound in **could**, **would**, and **should** is silent. This means that you do not pronounce the // sound. The correct pronunciation is as follows:

Could – /kʊd/

Would – /wʊd/

Should – /ʃʊd/

Let's practice...

Instructions: Complete the following telephone conversation with the modals **may**, **could**, **would** and **should**.

Nick: Hello.

Susana: Hello, ____ **may** ____ I speak to Nick Lawrence, please?

Nick: Yeah, Nick speaking.

Susana: Mr. Lawrence, this is Susana Lopez from National Grid Corporation.

Nick: Oh! Hi, Ms. Lopez, thank you for your call. How are you?

Susana: I'm doing great, thank you for asking! I'm calling to coordinate your visit to our site.
____ **Could** ____ we schedule it for next week?

Nick: Let me just check my calendar. What day exactly?

Susana: ____ **Would** ____ Monday be convenient for you, at 10 a.m.?

Nick: Monday looks good, but I'm busy at ten. How about 11 o'clock instead?

Susana: Sounds good. OK, Mr. Lawrence, that's Monday at eleven o'clock.

Nick: Wonderful! ____ **Could** ____ you please send me an email confirmation with the details?

Susana: Of course! You ____ **should** ____ only bring your safety helmet and glasses. We can provide you with the rest of the protective equipment onsite. I look forward to seeing you!

Nick: Same here. Thanks again for calling. Goodbye!



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Answer Key: Handout 6B - Post-Task

Instructions: Review the following information about the correct use of the imperative mood.

Imperative Mood

Imperative sentences are used to give commands and directions. The difference between a command and a request lies in the speaker's tone of voice and the use of "please."

"Please" can come at the beginning or end of a request:

- *Open the door, **please**.*
- ***Please** open the door.*

The simple form of a verb is used in imperative sentences. The understood subject of the sentence is you (meaning the person the speaker is talking to): *(You) come this way.*

Negative form:

Don't + the simple form of a verb.

Let's practice...

Instructions: Write imperative sentences about the following topics and share your answers with the class next week. Give three pieces of advice to people who want to:

Make a good first impression
▪ Answers may vary. ▪ ▪

Find a job
▪ Answers may vary. ▪ ▪



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Unit 2: Empowering Communication at Work

Lesson 4: Assessment task for Unit 2

Date: October 19, 2021

Unit Goal: By the end of the unit, the students will be able to actively interact with prospective English-speaking professionals by role-playing work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting.

General Objective: By the end of the lesson, the students will be able to successfully role-play a small-talk conversation for networking at a conference on Electrical Engineering, a job interview at a company that requires electrical engineers, or a telephone call to coordinate a technical site visit by producing chunks of language of different lengths, fluent speech, correct grammatical structures, appropriate pronunciation, and an adequate repertoire of vocabulary.

Specific Objectives: By the end of this lesson, the students will be able to:

1. effectively brainstorm relevant vocabulary and expressions that may be required of an electrical engineer for work-related scenarios (i.e., a conference, a job interview, and a telephone call to schedule a site visit) while playing a game in groups;
2. appropriately show understanding of the language used for starting a conversation at a conference, keeping it going, and leaving it by arranging the parts of a small-talk interaction in a logical sequence and practicing the conversation while working in groups;
3. properly describe reasons for applying to a specific position advertised for electrical engineers by completing an application for employment individually with their personal information (i.e., general profile, academic and professional experience, skills, motivation, and availability) and discussing their ideas in groups;
4. appropriately show understanding of common expressions used to schedule a site visit over the phone by filling in the gaps of a conversation between an electrical engineer and a consultant while interacting in groups;

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

- 5.1 successfully role-play a conversation between conference attendees by asking and answering questions about their motivation for attending the conference, their opinion about the conference topics, and their academic and professional experience, among others; or
- 5.2 successfully role-play a job interview between an employer and an applicant by asking and answering questions about their academic and professional qualifications, skills or achievements, and future professional goals; or
- 5.3 successfully role-play a telephone conversation between an electrical engineer and an international consultant to coordinate a site visit by using proper openings and closings, suggesting and agreeing on the date, and politely making and responding to suggestions on personal protective equipment; and
6. demonstrate understanding of the use of the modals *must* and *should* by individually writing correct sentences related to conferences, job interviews, or telephone calls and practicing their correct pronunciation.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Brainstorming ideas and making predictions T reviews the goal of the class and activates schemata by asking Ss to brainstorm vocabulary and expressions for work-related scenarios (conferences, job interviews, and telephone calls). For this, T shares the link to an Excel file (Handout 1A). T gives instructions for the activity and sets a timer for the game (10 minutes). Ss brainstorm ideas for each category. Whoever has the most expressions in the set amount of time wins. Then, T and Ss review the ideas as a whole group and directs attention towards additional useful language. (Handout 1B)	R, S, L	Giving an opinion: - I would say that... - It seems to me that... - As far as I know... - I would / wouldn't like to... Negotiating meaning: - What do you mean by...? - Could you repeat that again, please? - Could you please elaborate more on...? - Sure! What I mean is... Showing interest: - I see. - Sounds good. - Really? - That is a good idea. Starting a small-talk conversation / Introducing yourself: - Hi! Allow me to introduce myself. I'm [name] from [company/country]. - Nice to meet you.	Cognitive: - Predicting Creative: - Brainstorming Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Keeping the conversation going: - What do you think about the conference? - How long have you studied Electrical Engineering? Leaving the conversation: - I really enjoyed our conversation. - Would you like to connect on LinkedIn? Asking job interview questions: - How would you describe yourself? - What can you tell me about your background? - Why would you like to work for this company? - Would you be able to start next week? - Who would I work with? Describing qualifications: I have... - experience with (sth) - training in (a field) - the ability to (do sth.) - a degree/certificate (in sth)		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			I am... - interested in (sth. / doing sth.) - able to (do sth.) - certified in (a field) Skills: - IT skills (JavaScript / Python) - Project management - Problem-solving ability - Strong attention to detail Scheduling a site visit: - Could we meet on [date]? - I'm sorry. I have another meeting. - Let's do it on [date] at [time]? Giving safety instructions: - Wear protective equipment - Don't use faulty equipment		
2	Pre-task 1: In groups, Ss arrange a list of expressions in a logical sequence (i.e., starting a conversation, keeping it going, and leaving it) to complete a small-talk dialogue between two conference attendees. Then, Ss practice the conversation and exchange roles. (Handout 2) T monitors the activity and provides support as required.	R, S, L	Making small talk: Starting a conversation: - Allow me to introduce myself. - I'm [name] from [company/country]. - Do you mind if I call you [nickname]? - No need to be so formal.	Linguistic: - Conversationa - l patterns - Practicing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
	T provides a culture note on the use of names and titles for business situations.		Keeping the conversation going: - What do you expect to learn from the conference? - How about you? - Wow! That's amazing. - I completely agree with you. Leaving the conversation: - It was a pleasure meeting you. - Would you like to connect on LinkedIn? - Enjoy the rest of the conference. Key vocabulary: - First / Middle / Last name - Generator - Intelligent transportation - Smart cities - Topic of interest - Turbine		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: Individually, Ss read a job ad for electrical engineers and complete an application for employment with their personal information. Then, Ss discuss their ideas in groups and the reasons why they would apply for the specific position. (Handout 3) T monitors the activity and provides support and useful language as required. T also provides a culture note on common terms used in English-speaking countries for academic degrees.	R, S, L, W	Asking job interview questions: - Are you currently employed? - How long have you studied/worked there? - When would you be able to start? - Why would you like to work for this company? Describing qualifications: - I have experience with (sth) - I would be able to... - I would like to apply for this job because... Key vocabulary: - Application for employment - High school diploma - Bachelor's degree - Graduate's degree - Master's degree	Linguistic: - Practicing Affective: - Personalizing Interpersonal: - Cooperating Intrapersonal: - Individual student work	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
4	Pre-task 3: In groups, Ss complete a telephone conversation between an engineer and a consultant to schedule a technical site visit. For this activity, Ss fill in the gaps of the conversation with the correct option from a bank of expressions. Then, Ss practice the conversation and exchange roles. (Handout 4)	R, S, L	Starting a telephone conversation: - May I speak to [name]? - Hi! [name] speaking Scheduling a site visit: - I'm calling to coordinate your visit. - Could we schedule it for [date]? - Would it be convenient for you? Giving safety instructions: - Please bring protective equipment. Closing the conversation: - If you have any additional questions, please contact me. - I look forward to seeing you. Key vocabulary: - Infrastructure - Itinerary - Power generation and transmission	Linguistic: - Conversationa I patterns - Practicing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
5 - 7	Task: T reads the instructions (Handout 5) and the role-play cue cards for the speaking test (Handouts 6A-6C). Then, by using the application Wheel of Names (https://wheelofnames.com/), Ss are assigned a topic corresponding to the work scenarios previously studied (conference, job interview, or telephone call to schedule a technical visit). Ss are sent into the breakout rooms, and T gives them five minutes for planning and organizing ideas before the role-play. Then, Ss return to the main room to role-play the conversation for the topic assigned. Each pair has a maximum of five minutes to perform the role-play. T uses the speaking assessment rubric to grade each student's performance. (Handout 7) Ss are reminded to use a formal and polite tone and the useful language studied in class. T monitors the activity and provides support as necessary.	R, S, L	Vocabulary and expressions studied during the pre-tasks, including expressions for: - Making small talk at a conference - Asking and answering questions at an interview - Making a telephone call to schedule a site visit Key words for conferences: experience, motivation, expectation, goals, opinion, topic, agree/disagree, agenda, participants, speaker, research, event, venue, talk, networking, business cards, social media Key words for job interviews: résumé, profile, academic/professional experience, soft and hard skills, motivation, goals, availability, training, ability, knowledge, qualifications, position, degree, major, certificate.	Linguistic: - Conversationa - l patterns - Practicing Affective: - Personalizing Interpersonal: - Cooperating - Role-playing	50 min Plan and practice 5 min + Present 45 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Key words for telephone calls: agenda, site visit, inspection, hazard, safety measure, personal protective equipment, availability, inconvenience, head offices, chip assembly plant, power plant, telecommunications facility.		
8	Post-task: Individually, Ss review the use of the modal <i>must</i> and <i>should</i> by analyzing examples and writing sentences related to conferences, job interviews, and telephone calls. Ss practice the correct pronunciation of the sentences. (Handout 8)	R, S, W	Grammar and vocabulary: Modal auxiliaries: should and must Pronunciation: Should (silent /l/)	Linguistic: - Practicing Intrapersonal: - Individual student work	1 hr

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Reminders:

- Have a 10-minute break.
- All the handouts are available in Google Classroom (access code 2yteyhw).

Homework:

- Ask Ss to check the language pills (feedback posted in Google Classroom) and the post-task answer keys.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking
Ss:	The students	W:	Writing	L:	Listening

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

REFERENCES:

N/A.



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Unit 2 - Lesson 4

Handout 1A - Warm-up: What are they saying?

Instructions: Individually, go to the shared Excel file. Brainstorm vocabulary and expressions about the following categories: conferences, job interviews, and telephone calls to coordinate a technical site visit.

Students that brainstorm the most words and expressions in the set amount of time (10 minutes) win the game. Then, share your ideas with the whole group.

Conferences

Expressions to introduce yourself	Expressions to make small talk with other attendees
▪	▪
▪	▪
▪	▪

Job Interviews

Questions that may be asked in a job interview	Expressions to describe qualifications, skills, interests, and availability
▪	▪
▪	▪
▪	▪

Expressions to show interest during a conversation

▪
▪
▪

Telephone Calls to Schedule a Site Visit

Expressions to suggest, decline, or accept a date for a site visit	Instructions or safety precautions for a site visit
▪ ▪ ▪	▪ ▪ ▪

Extra Bonus

Expressions to finish a conversation, an interview, or a call
▪ ▪ ▪



Handout 1B - Review

Useful language:



Giving an opinion	▪ <u>I would say that</u> the conference is showing cutting-edge projects in our field. ▪ <u>It seems to me that</u> the technical visit was a great success. ▪ <u>As far as I know</u>, you should wear dielectric boots at the site.
Negotiating meaning	▪ <u>What do you mean by</u> “Licenciatura”? ▪ <u>Could you repeat that again, please?</u> ▪ <u>Could you please elaborate more on</u> your academic background? ▪ <u>Sure! What I mean is</u> a graduate program in Costa Rica.
Showing interest	▪ Alright! ▪ Definitely! ▪ I see. ▪ I understand. ▪ Really? ▪ Sounds good. ▪ That’s a good idea. ▪ That’s interesting.

Conferences: Steps and techniques for making small talk

Start the conversation ▪ Introduce yourself ▪ Ask a tag question	▪ Hi! Allow me to introduce myself. I’m Elon Musk from Tesla Inc. ▪ Great event, isn’t it?
Keep the conversation going ▪ Ask an open question ▪ Make a statement	▪ What do you think about the conference? ▪ In my opinion, the speaker’s recommendations about how to promote Smart Cities were fascinating.
Leave the conversation ▪ Share business cards ▪ Connect on social media	▪ I really enjoyed our conversation. Would you like to connect on LinkedIn?

Conferences: Topics that are polite or suitable for different cultures

▪ The event itself ▪ The venue ▪ Job experience and opportunities	▪ Current affairs ▪ A specific technical topic or presentation ▪ A technical book or article



Job Interviews: Expressions with *have* and *would*:

- I have experience <u>with</u> electromechanical equipment. - I have the ability <u>to</u> solve analytical problems. - I have a degree/certificate <u>in</u> English.	- Why would you like to apply for this job? - I would like to apply for this job because it is an opportunity to learn about control systems.

Job interviews: Common topics

General profile	- How would you describe yourself? - I would say that I am a creative engineer with positive attitude.
Experience	- What can you tell me about your academic background? - I have studied Electrical Engineering for five years.
Motivation	- Why would you like to work for this telecommunications company? - I would like to grow professionally and demonstrate my skills.
Availability	- Would you be able to start as soon as possible? - This is a great opportunity, so I would like to start immediately.
*Additional inquiries	- Who would I work with? - What training is there for the job?

Hard skills and soft skills

IT skills: HTML/JavaScript/Python English proficiency Project management	Communication skills Logical thinking Problem-solving ability

Telephone call: Scheduling a site visit

Suggest and agree on a date	- Could we meet on Monday afternoon? - Friday at 2:00 p.m. would be better for me.
Decline a meeting	- I'm afraid I won't be able to meet on Saturday. - I'm sorry, but I've got another meeting next Monday.
Confirm a date	- Sounds good. Let's do it on Tuesday. - OK. We'll see each other next week.
Give instructions for a site visit	- Wear a harness for electrical works at heights. - Do not use faulty equipment.



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Handout 2 - Pre-task 1

Instructions: Work in groups. Arrange the following small talk in a logical sequence (i.e., starting a conversation, keeping it going, and leaving it). Write the number in the corresponding box. Once you finish, practice the conversation with a classmate and exchange roles.

- And please call me Frank. No need to be so formal.	☐
- I'd like to learn more about new technologies for turbines and generators. Renewable energy and power engineering are my topics of interest. How about you?	☐
- Wow! That's amazing. The speakers are absolutely brilliant. Don't you think so?	☐
- Nice to meet you too. I'm Franklin Murat from Andritz Group in Austria. Do you mind if I call you Jen?	☐
- I completely agree with you. In my opinion, the talks have been very interesting for our field.	☐
- Not at all. Please do.	☐
- That sounds great. In my case, I'm here to learn about smart cities and intelligent transportation systems.	☐
- It really is. By the way, allow me to introduce myself. I'm Jennifer Segovia from the University of Costa Rica. Nice to meet you.	☐
- All right, Frank. And what do you expect to learn from this conference on electrical engineering?	☐
- Sure! This is my business card. It was a pleasure meeting you. Enjoy the rest of the conference.	☐
- Good morning. Beautiful day, isn't it?	☐
- You're right! Sorry, the next event is about to start, and I have to go now. It was nice talking with you. Would you like to connect on LinkedIn?	☐

Culture note:

In English-speaking countries, the order for names is first name (also known as *given name*), middle name, and then last name (*surname* or *family name*).

In the U.S., people usually call each other by their first names. In business situations, you often introduce a person using their full name and title, but then you can use their first name only.





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Unit 2 - Lesson 4

Handout 3 - Pre-task 2

Instructions: Individually, read the following job ad and complete the application for employment with your personal information. Then, discuss in groups the reasons why you **would** apply for that position.

International company expanding its operations in power, telecommunications, and networking is looking for a great mind like yours!

JUNIOR ELECTRICAL ENGINEER

If you are a student pursuing a degree in Electrical Engineering and have 80% of your degree program completed, we are glad to invite you to apply for an assistant position in our company.

The candidate will work in-house or be assigned to assist project management teams in Costa Rica and Germany as part of a cooperation agreement.



Requirements:

- Being an active student
- Intermediate English proficiency level
- A dynamic, self-motivated individual with teamwork skills
- Ability to learn new technologies quickly

How to apply?

- Submit an application form in order to assess your qualifications for this professional opportunity.
- A Human Resources representative will contact you to inform you about the next steps.



Application for Employment

PERSONAL INFORMATION

Name

first	middle	last

cell phone / e-mail

/ /
When would you be able to start? (date)

EMPLOYMENT

Are you currently employed?

☐

Yes

☐

No

If so, where do you work?

How long have you worked there?

EDUCATION

	Name	Main field	Did you graduate?
University			
High School			

SKILLS

What skills or experience do you **have** that may contribute to your ability to perform this job?

▪ ▪ ▪

GOALS

Why **would** you like to work for this company? Briefly state your goals or motivation.

SUBMIT

Culture note: Academic degrees

Typically, graduate degrees include Master's, Doctoral (Ph.D.), and other specialized degrees like M.D. (Doctor of Medicine). *Licenciatura* can be described as an *undergraduate post-Bachelor's degree*.



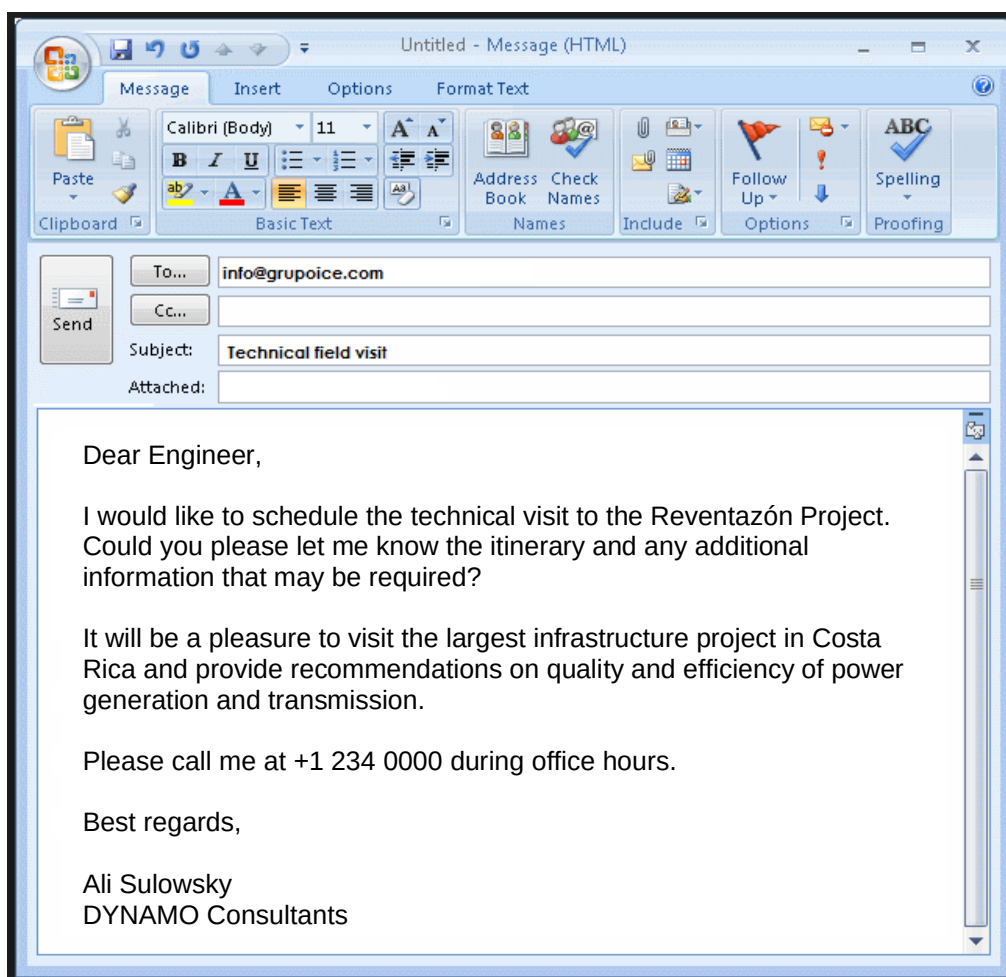


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Handout 4 - Pre-task 3

Instructions: Work in groups. Read the following email sent by a consultant regarding a technical site visit. Then, complete the telephone conversation to schedule the visit. Write the number of the correct expression from the box in the blank space. You will not use all of the expressions. Once you finish, practice the conversation with a classmate and exchange roles.



ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Engineer: Hello. May I speak to Mr. Ali Sulowski?

Consultant: Yeah, Ali speaking.

Engineer: Hi, Ali. _____

Consultant: Oh! Joan. Thanks for your call. How are you doing?

Engineer: Pretty good, thanks. _____
Could we schedule it for next week?

Consultant: Give me one second to check my agenda. What day exactly?

Engineer: _____

Consultant: Oh, I am afraid I won't be able to meet on that date.
_____ How about September 15th?

Engineer: I'm sorry. _____
Does that work for you?

Consultant: That sounds great. Could you please let me know if I have to bring anything?

Engineer: Sure. The site is not under construction anymore, but you still need personal protective equipment as we will inspect electrical equipment and machines in the powerhouse. _____

Consultant: What about safety glasses and hearing protection?

Engineer: _____ I will also send you an email with the latest report and a confirmation for the visit.

Consultant: That's perfect. Thanks a lot for your help.

Engineer: You're welcome. _____
I'll be happy to help you.

Consultant: I really appreciate it. I look forward to seeing you!

Engineer: Me too. See you soon in our meeting. Bye!

1. This is Ali from Dynamo Consultants.	7. It looks good, but I'm busy at nine.
2. Please bring your dielectric boots, a safety vest, and a helmet.	8. This is Joan Vargas from the Costa Rican Electricity Institute.
3. If you have any additional questions, please contact me.	9. Please do not touch the exposed cables at the site.
4. We have a holiday on that date here, but we could meet one day after.	10. I'm traveling to Canada for another technical inspection project.
5. September 5 th . Would it be convenient for you?	11. I'm calling to coordinate your visit to our site.
6. Well, we can provide you with the rest of protective equipment onsite.	12. Are you available on September 15 th ?



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Unit 2 - Lesson 4

Handout 5 - Main Task

Students' Performance Test

This test is part of the assessment plan of ESP Dynamo: An Online English Course for Electrical Engineering Students. The main purpose of the test is to evaluate the students' ability to role-play work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting by producing chunks of language of different lengths, fluent speech, correct grammatical structures, appropriate pronunciation, and an adequate repertoire of vocabulary.

General Instructions:

8. Turn on your camera and audio settings.
9. Each group of students will be assigned a role-play situation at random.
10. Each group has maximum of five minutes to perform the role-play. The teachers will give the students five minutes for planning and organizing ideas before the role-play.
11. Remember to find a balance when interacting by giving your peer opportunities for participating. A student should not monopolize the conversation.
12. If you have a question, use the "raise hand" tool or submit your question to the teachers via chat. The teachers will help you as soon as possible.
13. This session will be recorded as a backup of having performed the test.
14. The speaking test is 25 points (25%). A minimum passing grade of 7 is required.



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Unit 2 - Lesson 4

Handout 6A - Main Task

Students' Performance Test – Situation 1

Instructions: Work in groups. Imagine you are attending an international conference on Electrical Engineering. It is the first coffee break and you see a lot of people talking to each other. Role-play a conversation between conference attendees. Rehearse with your partner(s) and be ready to present in front of the class.

Key words: *experience, motivation, expectation, goals, opinion, topic, agree/disagree, agenda, participants, speaker, research, event, venue, talk, networking, business cards, social media.*

Follow these steps for making small talk:

Student A and B: Conference attendees

6. Greet the other attendee and introduce yourself.
7. Ask each other questions about motivation for attending the conference, opinion about the conference topics, academic/professional experience, and nationality, among others.
8. Show interest during the conversation, make eye contact, and listen carefully.
9. When appropriate, talk about something interesting or surprising about who you are or what you do.
10. Exchange your business cards or contact information (e.g., email address or social networks), and set up a future meeting for developing a future technical project for your country, if applicable.



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Unit 2 - Lesson 4

Handout 6B - Main Task

Students' Performance Test – Situation 2

Instructions: Work in groups. Imagine you are at a job interview. Role-play a conversation between the employer and the job applicant. Rehearse with your partner(s) and be ready to present in front of the class.

Key words: *résumé, profile, academic/professional experience, soft and hard skills, motivation, goals, availability, training, ability, knowledge, qualifications, position, degree, major, certificate.*

Follow these steps for the job interview:

Student A: Employer

6. You are a very formal manager looking for a new electrical engineer to work at [name of the company].
7. Welcome the job applicant and introduce yourself.
8. Provide a brief description of the company and the position. Then, ask questions about the applicant's personal information, experience, skills, and goals. Answer any questions the applicant may have.
9. Show interest during the conversation, make eye contact, and listen carefully.
10. Ask the job applicant about his/her availability and provide information about any future steps of the application and hiring process, if applicable.

Student B: Job Applicant

6. You are a looking for a position as an electrical engineer. You really want to get a job and give a good impression during the interview.
7. Greet the interviewer and introduce yourself.
8. Answer the questions with your own ideas. Tell the interviewer about your profile, experience, skills, and goals. Ask the interviewer a question about the job.
9. Show interest during the conversation, make eye contact, and listen carefully.
10. Tell the interviewer about your availability and provide your résumé or any additional information. Ask the interviewer about any future steps of the application and hiring process, if applicable.



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Handout 6C - Main Task

Students' Performance Test – Situation 3

Instructions: Work in groups. Imagine you are making a telephone call to coordinate a technical site visit. Role-play a conversation between an engineer and an English-speaking consultant. Rehearse with your partner(s) and be ready to present in front of the class.

Key words and expressions: *agenda, site visit, inspection, hazard, safety measure, personal protective equipment, availability, inconvenience, head offices, chip assembly plant, power plant, telecommunications facility.*

Follow these steps for the telephone call:

Student A: Electrical engineer

6. You are an electrical engineer working at [name of the company]. You need to call an engineering consultant to coordinate a site visit.
7. Introduce yourself, identify the company you work for, and state the reason for the call.
8. Propose a date and a time (offer at least two different options to arrange the meeting), and make suggestions about the safety equipment and measures required for the visit.
9. Show interest during the conversation, make eye contact, and listen carefully.
10. Summarize the details of the meeting for confirmation and use a closing phrase with a future focus to finish the call.

Student B: Engineering consultant

6. You are a consultant from [name of the company]. You will receive a call to schedule a site visit to ensure regulatory compliance with international standards.
7. Greet the engineer, introduce yourself, and identify the company you work for.
8. Propose a date and a time (negotiate at least two different options to arrange the meeting) and ask for suggestions about the safety equipment and measures required for the visit.
9. Show interest during the conversation, make eye contact, and listen carefully.
10. Confirm the details of the meeting and use a closing phrase with a future focus to finish the call.



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Unit 2 - Lesson 4

Handout 7 - Main Task

Speaking Assessment Rubric

Student's Name: _____ Role-Play Situation: _____

Score	Content
1	- Ability to ask and answer questions about personal details. Simple communication totally dependent on repetition, rephrasing and repair. - Poor development of information and knowledge of the topic.
2	- Ability to ask and answer questions and respond to simple statements, mainly on familiar topics or areas of immediate need. - Little information and knowledge of the topic.
3	- Ability to maintain a simple conversation on topics that are familiar or of personal interest, and to provide a brief description or narration. - Fair development of information and knowledge of the topic.
4	- Ability to develop relevant ideas and viewpoints on most general and specialized topics, and to give a detailed description or narration. - Sufficient information and knowledge of the topic.
5	Ability to develop a wide range of ideas and viewpoints on complex topics, even integrating subthemes.
Score	Fluency
1	- Very short, isolated, pre-packaged utterances. - Long pauses to search for expressions or to repair communication. - Hesitant and incomplete statements.
2	- Short utterances. - Some pauses, false starts and reformulation. - Flow of speech disrupted by several gaps.
3	- Fair stretches of language. - Occasional use of pauses for planning followed by recovery, especially in longer stretches of free production.
4	- Long stretches of language with few hesitations. - Few pauses for searching for expressions. - Continuous flow of speech.
5	- Fluent and spontaneous speech, almost effortless. - Smooth flow of speech with no hesitations.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Score	Grammar
1	- Limited control of a few simple grammatical structures and sentence patterns. - Very inaccurate communication. Meaning disrupted by too many errors and structural problems.
2	- Use of some simple grammatical structures and sentence patterns. - Inaccurate communication. Meaning disrupted by some errors and structural problems.
3	- Reasonable repertoire of patterns related to predictable situations. - Accurate communication with a few errors and structural problems.
4	- Relatively high grammar accuracy. Use of some complex sentence forms. - Very accurate communication with minor structural problems that do not affect meaning. Self-correction.
5	- High degree of grammar accuracy. Use of complex sentence forms. - Errors are rare and difficult to spot. Self-correction.
Score	Pronunciation
1	Poor pronunciation. Too many errors.
2	Several pronunciation and intonation problems. Meaning is often unclear.
3	Some pronunciation and intonation problems. Meaning is understood but with problems.
4	Minor pronunciation errors but immediately continued.
5	Few errors. Clear and correct pronunciation.
Score	Vocabulary
1	- Very basic repertoire of words and simple phrases related to personal details and particular concrete situations. - Meaning disrupted by too many errors.
2	- Basic groups of words and memorized phrases to communicate limited information on simple everyday situations. - Many vocabulary errors. Meaning is often unclear.
3	- Sufficient vocabulary to get by. Some hesitation and circumlocutions. - Some vocabulary errors, but the meaning is clear.
4	- Sufficient vocabulary to give descriptions and express viewpoints on most general and specialized topics. - Lack of errors. The meaning is clear.
5	- Good command of a broad range of vocabulary to express on a wide range of general, academic, and professional topics. - Lack of errors. The meaning is clear.
Total:	Comments:

Score obtained: _____

Percentage: _____

Final grade: _____



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Handout 8 - Post-Task

Modal Auxiliaries: Must



Must is a modal verb or modal auxiliary that “helps” other verbs to express a meaning.

It does not have a meaning by itself. This means that it always requires a main verb.

Must is often used for the following functions:

- Possibility or probability

Example: *The consultant did not arrive on time for the technical visit. He **must** have missed the flight to Costa Rica.*

*The engineer graduated with honors. He **must** be an excellent student.*

- Advice or strong obligation

Example: *You **must** wear personal protective equipment when working with high-voltage machines in the factory.*

*Engineers **must** submit their CVs to be considered in the recruitment process.*

- Prohibition

Example: *Electricians **must not** climb poles supporting power lines as this can cause an electric shock.*

*Employers **must not** discriminate against applicants during job interviews.*

Modal Auxiliaries: Should

Should is a modal auxiliary commonly used to express advice or to offer an opinion.

Example: *Applicants **should** demonstrate their qualifications by means of a good conversation dynamic with the interviewer.*

*I think that you **should** wear your badge during the conference to attend the different talks.*

Remember that, like in the case of *would* and *could*, the letter // is silent in **should**. This means that you do not pronounce the // sound. The correct pronunciation is /ʃʊd/.

Job requirements: Must versus Should

Note that **must** is generally stronger than **should** and means that a requirement is essential rather than desirable.

Example: *Engineers **must** be proficient in English and IT skills to get a job at an international company.*

*Engineers **should** be trained in different programming languages to assist the team in more challenging tasks.*

Let's Practice

Instructions: Work individually. Based on the work-related scenarios studied in Unit 2 (i.e., conference, interview, and telephone call to schedule a technical visit), write one or two sentences with either **must** or **should** for each of the following functions as appropriate:

1.	Probability
2.	Strong obligation
3.	Prohibition
4.	Advice
5.	Opinion



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Answer Key: Handout 1A - Warm-up: What are they saying?

Instructions: Individually, go to the shared Excel file. Brainstorm vocabulary and expressions about the following categories: conferences, job interviews, and telephone calls to coordinate a technical site visit.

Students that brainstorm the most words and expressions in the set amount of time (10 minutes) win the game. Then, share your ideas with the whole group.

Conferences

Expressions to introduce yourself	Expressions to make small talk with other attendees
▪ ▪ Answers will vary. ▪	▪ ▪ ▪

Job Interviews

Questions that may be asked in a job interview	Expressions to describe qualifications, skills, interests, and availability
▪ ▪ ▪	▪ ▪ ▪

Expressions to show interest during a conversation

▪ ▪ ▪

Telephone Calls to Schedule a Site Visit

Expressions to suggest, decline, or accept a date for a site visit	Instructions or safety precautions for a site visit
▪ ▪ ▪	▪ ▪ ▪

Extra Bonus

Expressions to finish a conversation, an interview, or a call
▪ ▪ ▪



Answer Key: Handout 1B - Review

Useful language:



Giving an opinion	▪ <u>I would say that</u> the conference is showing cutting-edge projects in our field. ▪ <u>It seems to me that</u> the technical visit was a great success. ▪ <u>As far as I know</u>, you should wear dielectric boots at the site.
Negotiating meaning	▪ <u>What do you mean by</u> “Licenciatura”? ▪ <u>Could you repeat that again, please?</u> ▪ <u>Could you please elaborate more on</u> your academic background? ▪ <u>Sure! What I mean is</u> a graduate program in Costa Rica.
Showing interest	▪ Alright! ▪ Definitely! ▪ I see. ▪ I understand. ▪ Really? ▪ Sounds good. ▪ That’s a good idea. ▪ That’s interesting.

Conferences: Steps and techniques for making small talk

Start the conversation ▪ Introduce yourself ▪ Ask a tag question	▪ Hi! Allow me to introduce myself. I’m Elon Musk from Tesla Inc. ▪ Great event, isn’t it?
Keep the conversation going ▪ Ask an open question ▪ Make a statement	▪ What do you think about the conference? ▪ In my opinion, the speaker’s recommendations about how to promote Smart Cities were fascinating.
Leave the conversation ▪ Share business cards ▪ Connect on social media	▪ I really enjoyed our conversation. Would you like to connect on LinkedIn?

Conferences: Topics that are polite or suitable for different cultures

▪ The event itself ▪ The venue ▪ Job experience and opportunities	▪ Current affairs ▪ A specific technical topic or presentation ▪ A technical book or article



Job Interviews: Expressions with *have* and *would*:

- I have experience <u>with</u> electromechanical equipment. - I have the ability <u>to</u> solve analytical problems. - I have a degree/certificate <u>in</u> English.	- Why would you like to apply for this job? - I would like to apply for this job because it is an opportunity to learn about control systems.

Job interviews: Common topics

General profile	- How would you describe yourself? - I would say that I am a creative engineer with positive attitude.
Experience	- What can you tell me about your academic background? - I have studied Electrical Engineering for five years.
Motivation	- Why would you like to work for this telecommunications company? - I would like to grow professionally and demonstrate my skills.
Availability	- Would you be able to start as soon as possible? - This is a great opportunity, so I would like to start immediately.
*Additional inquiries	- Who would I work with? - What training is there for the job?

Hard skills and soft skills

IT skills: HTML/JavaScript/Python English proficiency Project management	Communication skills Logical thinking Problem-solving ability

Telephone call: Scheduling a site visit

Suggest and agree on a date	- Could we meet on Monday afternoon? - Friday at 2:00 p.m. would be better for me.
Decline a meeting	- I'm afraid I won't be able to meet on Saturday. - I'm sorry, but I've got another meeting next Monday.
Confirm a date	- Sounds good. Let's do it on Tuesday. - OK. We'll see each other next week.
Give instructions for a site visit	- Wear a harness for electrical works at heights. - Do not use faulty equipment.



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Answer Key: Handout 2 - Pre-task 1

Instructions: Work in groups. Arrange the following small talk in a logical sequence (i.e., starting a conversation, keeping it going, and leaving it). Write the number in the corresponding box. Once you finish, practice the conversation with a classmate and exchange roles.

- And please call me Frank. No need to be so formal.	☐ 5
- I'd like to learn more about new technologies for turbines and generators. Renewable energy and power engineering are my topics of interest. How about you?	☐ 7
- Wow! That's amazing. The speakers are absolutely brilliant. Don't you think so?	☐ 9
- Nice to meet you too. I'm Franklin Murat from Andritz Group in Austria. Do you mind if I call you Jen?	☐ 3
- I completely agree with you. In my opinion, the talks have been very interesting for our field.	☐ 10
- Not at all. Please do.	☐ 4
- That sounds great. In my case, I'm here to learn about smart cities and intelligent transportation systems.	☐ 8
- It really is. By the way, allow me to introduce myself. I'm Jennifer Segovia from the University of Costa Rica. Nice to meet you.	☐ 2
- All right, Frank. And what do you expect to learn from this conference on electrical engineering?	☐ 6
- Sure! This is my business card. It was a pleasure meeting you. Enjoy the rest of the conference.	☐ 12
- Good morning. Beautiful day, isn't it?	☐ 1
- You're right! Sorry, the next event is about to start, and I have to go now. It was nice talking with you. Would you like to connect on LinkedIn?	☐ 11

Culture note:

In English-speaking countries, the order for names is first name (also known as *given name*), middle name, and then last name (*surname* or *family name*).

In the U.S., people usually call each other by their first names. In business situations, you often introduce a person using their full name and title, but then you can use their first name only.





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Answer Key: Handout 3 - Pre-task 2

Instructions: Individually, read the following job ad and complete the application for employment with your personal information. Then, discuss in groups the reasons why you **would** apply for that position.

International company expanding its operations in power, telecommunications, and networking is looking for a great mind like yours!

JUNIOR ELECTRICAL ENGINEER

If you are a student pursuing a degree in Electrical Engineering and have 80% of your degree program completed, we are glad to invite you to apply for an assistant position in our company.

The candidate will work in-house or be assigned to assist project management teams in Costa Rica and Germany as part of a cooperation agreement.



Requirements:

- Being an active student
- Intermediate English proficiency level
- A dynamic, self-motivated individual with teamwork skills
- Ability to learn new technologies quickly

How to apply?

- Submit an application form in order to assess your qualifications for this professional opportunity.
- A Human Resources representative will contact you to inform you about the next steps.

Application for Employment

PERSONAL INFORMATION

Name

first	middle	last

	/ /
cell phone / e-mail	When would you be able to start? (date)

EMPLOYMENT

Are you currently employed?

☐

Yes

☐

No

If so, where do you work?

How long have you worked there?

EDUCATION

	Name	Main field	Did you graduate?
University			
High School			

SKILLS

What skills or experience do you **have** that may contribute to your ability to perform this job?

-
- Answers will vary.
-

GOALS

Why **would** you like to work for this company? Briefly state your goals or motivation.

- Answers will vary.

SUBMIT

Culture note: Academic degrees

Typically, graduate degrees include Master's, Doctoral (Ph.D.), and other specialized degrees like M.D. (Doctor of Medicine). *Licenciatura* can be described as an *undergraduate post-Bachelor's degree*.



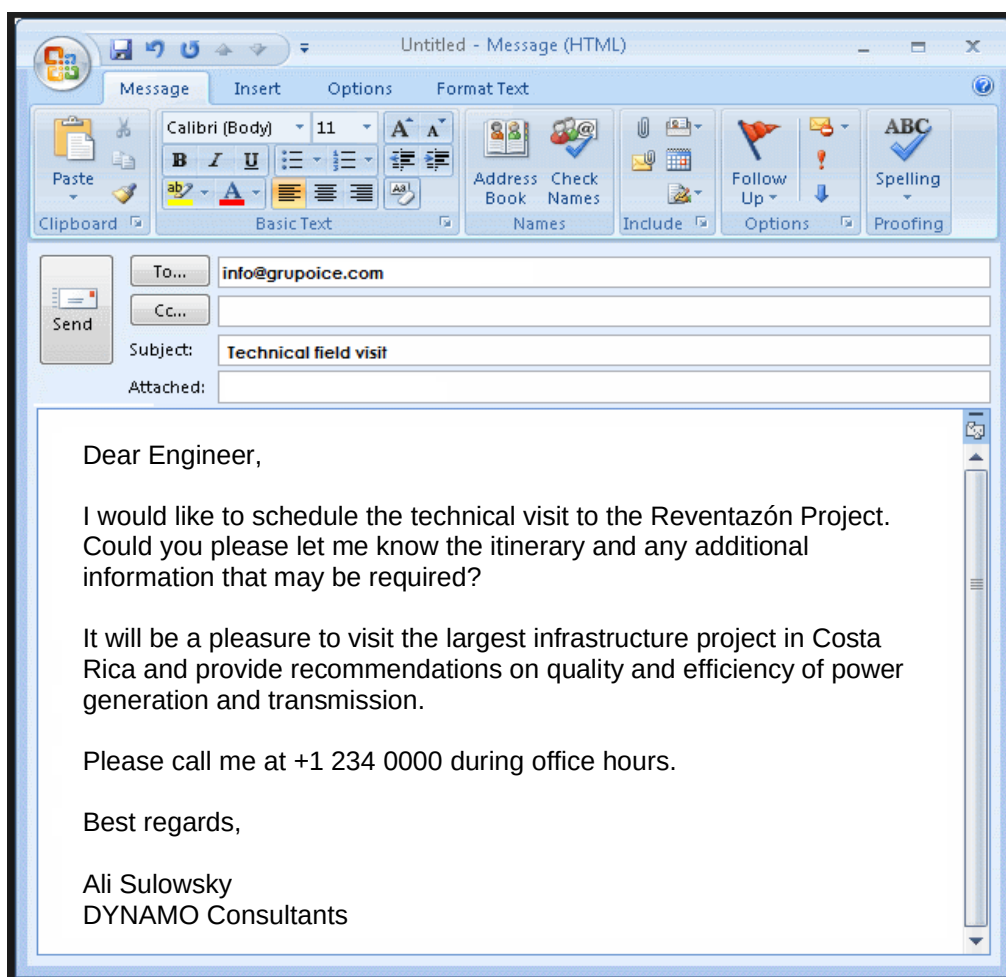


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Answer Key: Handout 4 - Pre-task 3

Instructions: Work in groups. Read the following email sent by a consultant regarding a technical site visit. Then, complete the telephone conversation to schedule the visit. Write the number of the correct expression from the box in the blank space. You will not use all of the expressions. Once you finish, practice the conversation with a classmate and exchange roles.



ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

- Engineer:** Hello. May I speak to Mr. Ali Sulowski?
- Consultant:** Yeah, Ali speaking.
- Engineer:** Hi, Ali. This is Joan Vargas from the Costa Rican Electricity Institute (8).
- Consultant:** Oh! Joan. Thanks for your call. How are you doing?
- Engineer:** Pretty good, thanks. I'm calling to coordinate your visit to our site (11). Could we schedule it for next week?
- Consultant:** Give me one second to check my agenda. What day exactly?
- Engineer:** September 5th. Would it be convenient for you (5)?
- Consultant:** Oh, I am afraid I won't be able to meet on that date. I'm traveling to Canada for another technical inspection project (10). How about September 15th?
- Engineer:** I'm sorry. We have a holiday on that date here, but we could meet one day after (4). Does that work for you?
- Consultant:** That sounds great. Could you please let me know if I have to bring anything?
- Engineer:** Sure. The site is not under construction anymore, but you still need personal protective equipment as we will inspect electrical equipment and machines in the powerhouse. Please bring your dielectric boots, a safety vest, and a helmet (2).
- Consultant:** What about safety glasses and hearing protection?
- Engineer:** Well, we can provide you with the rest of protective equipment onsite (6). I will also send you an email with the latest report and a confirmation for the visit.
- Consultant:** That's perfect. Thanks a lot for your help.
- Engineer:** You're welcome. If you have any additional questions, please contact me (3). I'll be happy to help you.
- Consultant:** I really appreciate it. I look forward to seeing you!
- Engineer:** Me too. See you soon in our meeting. Bye!

1. This is Ali from Dynamo Consultants.	7. It looks good, but I'm busy at nine.
2. Please bring your dielectric boots, a safety vest, and a helmet.	8. This is Joan Vargas from the Costa Rican Electricity Institute.
3. If you have any additional questions, please contact me.	9. Please do not touch the exposed cables at the site.
4. We have a holiday on that date here, but we could meet one day after.	10. I'm traveling to Canada for another technical inspection project.
5. September 5 th . Would it be convenient for you?	11. I'm calling to coordinate your visit to our site.
6. Well, we can provide you with the rest of protective equipment onsite.	12. Are you available on September 15 th ?



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Unit 2 - Lesson 4

Answer Key: Handout 5 - Main Task

Students' Performance Test

This test is part of the assessment plan of ESP Dynamo: An Online English Course for Electrical Engineering Students. The main purpose of the test is to evaluate the students' ability to role-play work-related scenarios such as a conference, a job interview, and a telephone call to set up a meeting by producing chunks of language of different lengths, fluent speech, correct grammatical structures, appropriate pronunciation, and an adequate repertoire of vocabulary.

General Instructions:

1. Turn on your camera and audio settings.
2. Each group of students will be assigned a role-play situation at random.
3. Each group has maximum of five minutes to perform the role-play. The teachers will give the students five extra minutes for planning and organizing ideas before the role-play.
4. Remember to find a balance when interacting by giving your peer opportunities for participating. A student should not monopolize the conversation.
5. If you have a question, use the "raise hand" tool or submit your question to the teachers via chat. The teachers will help you as soon as possible.
6. This session will be recorded for back-up purposes.
7. The speaking test is 25 points (25%). A minimum passing grade of 7 is required.



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Unit 2 - Lesson 4

Answer Key: Handout 6A - Main Task

Students' Performance Test – Situation 1

Instructions: Work in groups. Imagine you are attending an international conference on Electrical Engineering. It is the first coffee break and you see a lot of people talking to each other. Role-play a conversation between conference attendees. Rehearse with your partner(s) and be ready to present in front of the class.

Key words: *experience, motivation, expectation, goals, opinion, topic, agree/disagree, agenda, participants, speaker, research, event, venue, talk, networking, business cards, social media.*

Follow these steps for making small talk:

Student A and B: Conference attendees

1. Greet the other attendee and introduce yourself.
2. Ask each other questions about motivation for attending the conference, opinion about the conference topics, academic/professional experience, and nationality, among others.
3. Show interest during the conversation, make eye contact, and listen carefully.
4. When appropriate, talk about something interesting or surprising about who you are or what you do.
5. Exchange your business cards or contact information (e.g., email address or social networks), and set up a future meeting for developing a future technical project for your country, if applicable.



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Answer Key: Handout 6B - Main Task

Students' Performance Test – Situation 2

Instructions: Work in groups. Imagine you are at a job interview. Role-play a conversation between the employer and the job applicant. Rehearse with your partner(s) and be ready to present in front of the class.

Key words: *résumé, profile, academic/professional experience, soft and hard skills, motivation, goals, availability, training, ability, knowledge, qualifications, position, degree, major, certificate.*

Follow these steps for the job interview:

Student A: Employer

1. You are a very formal manager looking for a new electrical engineer to work at [name of the company].
2. Welcome the job applicant and introduce yourself.
3. Provide a brief description of the company and the position. Then, ask questions about the applicant's personal information, experience, skills, and goals. Answer any questions the applicant may have.
4. Show interest during the conversation, make eye contact, and listen carefully.
5. Ask the job applicant about his/her availability and provide information about any future steps of the application and hiring process, if applicable.

Student B: Job Applicant

1. You are looking for a position as an electrical engineer. You really want to get a job and give a good impression during the interview.
2. Greet the interviewer and introduce yourself.
3. Answer the questions with your own ideas. Tell the interviewer about your profile, experience, skills, and goals. Ask the interviewer a question about the job.
4. Show interest during the conversation, make eye contact, and listen carefully.
5. Tell the interviewer about your availability and provide your résumé or any additional information. Ask the interviewer about any future steps of the application and hiring process, if applicable.



Answer Key: Handout 6C - Main Task

Students' Performance Test – Situation 3

Instructions: Work in groups. Imagine you are making a telephone call to coordinate a technical site visit. Role-play a conversation between an engineer and an English-speaking consultant. Rehearse with your partner(s) and be ready to present in front of the class.

Key words and expressions: *agenda, site visit, inspection, hazard, safety measure, personal protective equipment, availability, inconvenience, head offices, chip assembly plant, power plant, telecommunications facility.*

Follow these steps for the telephone call:

Student A: Electrical engineer

1. You are an electrical engineer working at [name of the company]. You need to call an engineering consultant to coordinate a site visit.
2. Introduce yourself, identify the company you work for, and state the reason for the call.
3. Propose a date and a time (offer at least two different options to arrange the meeting), and make suggestions about the safety equipment and measures required for the visit.
4. Show interest during the conversation, make eye contact, and listen carefully.
5. Summarize the details of the meeting for confirmation and use a closing phrase with a future focus to finish the call.

Student B: Engineering consultant

1. You are a consultant from [name of the company]. You will receive a call to schedule a site visit to ensure regulatory compliance with international standards.
2. Greet the engineer, introduce yourself, and identify the company you work for.
3. Propose a date and a time (negotiate at least two different options to arrange the meeting) and ask for suggestions about the safety equipment and measures required for the visit.
4. Show interest during the conversation, make eye contact, and listen carefully.
5. Confirm the details of the meeting and use a closing phrase with a future focus to finish the call.



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Unit 2 - Lesson 4

Answer Key: Handout 7 - Main Task

Speaking Assessment Rubric

Student's Name: _____ Role-Play Situation: _____

Score	Content
1	- Ability to ask and answer questions about personal details. Simple communication totally dependent on repetition, rephrasing and repair. - Poor development of information and knowledge of the topic.
2	- Ability to ask and answer questions and respond to simple statements, mainly on familiar topics or areas of immediate need. - Little information and knowledge of the topic.
3	- Ability to maintain a simple conversation on topics that are familiar or of personal interest, and to provide a brief description or narration. - Fair development of information and knowledge of the topic.
4	- Ability to develop relevant ideas and viewpoints on most general and specialized topics, and to give a detailed description or narration. - Sufficient information and knowledge of the topic.
5	Ability to develop a wide range of ideas and viewpoints on complex topics, even integrating subthemes.
Score	Fluency
1	- Very short, isolated, pre-packaged utterances. - Long pauses to search for expressions or to repair communication. - Hesitant and incomplete statements.
2	- Short utterances. - Some pauses, false starts and reformulation. - Flow of speech disrupted by several gaps.
3	- Fair stretches of language. - Occasional use of pauses for planning followed by recovery, especially in longer stretches of free production.
4	- Long stretches of language with few hesitations. - Few pauses for searching for expressions. - Continuous flow of speech.
5	- Fluent and spontaneous speech, almost effortless. - Smooth flow of speech with no hesitations.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Score	Grammar
1	- Limited control of a few simple grammatical structures and sentence patterns. - Very inaccurate communication. Meaning disrupted by too many errors and structural problems.
2	- Use of some simple grammatical structures and sentence patterns. - Inaccurate communication. Meaning disrupted by some errors and structural problems.
3	- Reasonable repertoire of patterns related to predictable situations. - Accurate communication with a few errors and structural problems.
4	- Relatively high degree of grammar accuracy. Use of some complex sentence forms. - Very accurate communication with minor structural problems that do not affect meaning. Self-correction.
5	- High degree of grammar accuracy. Use of complex sentence forms. - Errors are rare and difficult to spot. Self-correction.
Score	Pronunciation
1	Poor pronunciation. Too many errors.
2	Several pronunciation and intonation problems. Meaning is often unclear.
3	Some pronunciation and intonation problems. Meaning is understood but with problems.
4	Minor pronunciation errors but immediately continued.
5	Few errors. Clear and correct pronunciation.
Score	Vocabulary
1	- Very basic repertoire of words and simple phrases related to personal details and particular concrete situations. - Meaning disrupted by too many errors.
2	- Basic groups of words and memorized phrases to communicate limited information on simple everyday situations. - Many vocabulary errors. Meaning is often unclear.
3	- Sufficient vocabulary to get by. Some hesitation and circum-locutions. - Some vocabulary errors, but the meaning is clear.
4	- Sufficient vocabulary to give descriptions and express viewpoints on most general and specialized topics. - Lack of errors. The meaning is clear.
5	- Good command of a broad range of vocabulary to express on a wide range of general, academic, and professional topics. - Lack of errors. The meaning is clear.
Total:	Comments:

Score obtained: _____

Percentage: _____

Final grade: _____



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Unit 2 - Lesson 4

Answer Key: Handout 8 - Post-Task

Modal Auxiliaries: Must



Must is a modal verb or modal auxiliary that “helps” other verbs to express a meaning.

It does not have a meaning by itself. This means that it always requires a main verb.

Must is often used for the following functions:

- Possibility or probability

Example: *The consultant did not arrive on time for the technical visit. He **must** have missed the flight to Costa Rica.*

*The engineer graduated with honors. He **must** be an excellent student.*

- Advice or strong obligation

Example: *You **must** wear personal protective equipment when working with high-voltage machines in the factory.*

*Engineers **must** submit their CVs to be considered in the recruitment process.*

- Prohibition

Example: *Electricians **must not** climb poles supporting power lines as this can cause an electric shock.*

*Employers **must not** discriminate against applicants during job interviews.*

Modal Auxiliaries: Should

Should is a modal auxiliary commonly used to express advice or to offer an opinion.

Example: *Applicants **should** demonstrate their qualifications by means of a good conversation dynamic with the interviewer.*

*I think that you **should** wear your badge during the conference to attend the different talks.*

Remember that, like in the case of *would* and *could*, the letter // is silent in **should**. This means that you do not pronounce the // sound. The correct pronunciation is /ʃʊd/.

Job requirements: Must versus Should

Note that **must** is generally stronger than **should** and means that a requirement is essential rather than desirable.

Example: *Engineers **must** be proficient in English and IT skills to get a job at an international company.*

*Engineers **should** be trained in different programming languages to assist the team in more challenging tasks.*

Let's Practice

Instructions: Work individually. Based on the work-related scenarios studied in Unit 2 (i.e., conference, interview, and telephone call to schedule a technical visit), write one or two sentences with either **must** or **should** for each of the following functions as appropriate:

1. Answers will vary. Ss are expected to use <i>must</i> .	Probability
2. Answers will vary. Ss are expected to use <i>must</i> .	Strong obligation
3. Answers will vary. Ss are expected to use <i>must</i> .	Prohibition
4. Answers will vary. Ss are expected to use <i>should</i> .	Advice
5. Answers will vary. Ss are expected to use <i>should</i> .	Opinion



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Unit 3: Engineering the Future

Lesson 1: Writing an email

Date: October 26, 2021

Unit Goal: By the end of the unit, the students will be able to effectively describe orally and in writing their interest in participating in an international trade fair, an innovative product or system in the field of Electrical Engineering, and a business idea for a solution to a problem.

General Objective: By the end of the lesson, the students will be able to properly write an email to express their interest in participating in an international trade fair or exchange program by analyzing illustrative texts and by following the basic stages of the writing process (planning, drafting, editing, and final drafting).

Specific Objectives: By the end of this lesson, the students will be able to...

1. effectively brainstorm ideas about the type of text, purpose, audience, content, and tone of an email by answering questions based on an illustrative text while interacting as a group;
2. properly identify the key sections of an email by analyzing an illustrative sample email while working in groups;
3. successfully select relevant information for an email application to an international trade fair by individually creating a mind map based on an illustrative sample email and previous notes about the organization and preliminary writing plans;
4. appropriately write a draft email application individually by using the information selected in the preliminary plan;
5. efficiently assess a draft email application by using a self-evaluation form and answering peer-review questions to revise an email application draft;

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

6. successfully write the final version of an application email to show interest in participating in an international trade fair by following the basic stages of the writing process (planning, drafting, editing, and final drafting);
7. appropriately reflect on the writing process by discussing their experience with the different stages of the lesson, the part of the lesson they enjoyed the most, the most difficult part, and what they can do to improve;
8. effectively show understanding of transition words used in email writing by completing a fill-in-the-blanks exercise; and
9. properly apply the basic stages of the writing process by writing a new application email for an exchange program (Master's degree).

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Brainstorming ideas T reviews the goal of the class and activates schemata by asking Ss to individually read an illustrative sample email and discuss the following questions as a group. (Handout 1) - Who do you think Ms. Russ is? The trade fair organizer. - What is Jeffrey Lopez's purpose for writing this email? Showing interest in participating in an international trade fair. - Do you know what an international trade fair is? Can you explain? A large event in which different companies in a particular industry show and sell their products or services.	R, S, L	Giving an opinion: - As far as I know... - It seems to me that... - I'd definitely say that ... - For example, ... / For instance, ... - I agree/disagree with you.	Cognitive: - Predicting Creative: - Brainstorming Interpersonal: - Cooperating	15 min
2	Pre-task 1: Studying the features of the genre T asks Ss to read and analyze the illustrative text individually. Then, Ss will work in pairs to identify the name of the different sections of the application email based on the options provided in the vocabulary bank. (Handout 2) T monitors the activity and provides support as required.	W, R, S, L	Giving an opinion: - As far as I know... - It seems to me that... - I'd definitely say that ... - For example, ... / For instance, ... - I agree/disagree with you.	Cognitive: - Inferencing Intrapersonal: - Individual student work Interpersonal: - Cooperating	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	T checks the exercise as a group by sharing the screen and writing the names of the different parts of the email next to the numbers based on the Ss' voluntary participation.		Negotiation of meaning: ▪ Would you mind repeating that? ▪ What does [launching] mean? ▪ What do you mean by [rivaled]? ▪ Sure! What I mean is ... Turn-taking: ▪ Who would like to start? ▪ I'd like to start / I'll go first. ▪ Would you like to add anything? ▪ I'm sorry to interrupt but... [I've got something to say] Parts of an email: - subject line - salutation - email body - complimentary close - signature block		

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: Planning the text Ss prepare a preliminary plan by creating a mind map and making notes about how they can organize key information in their email. (Handout 3) T shares the link to Google Docs and goes over a few tips included in the presentation. Then, T quickly explains how to use the platform to create their mind maps. The T points out that ideas for the email body can be selected based on the following recommendations: ▪ State the reason for writing (purpose). ▪ Write two or three key points related to the company's background, the writer's expertise, and the product features. ▪ Indicate which document(s) are attached. ▪ Show appreciation and willingness to provide additional information. T monitors the activity and provides support as required. Finally, T asks two Ss to share their preliminary plan with the rest of the class. T	W, S, L	Other ways to describe product attributes: advanced alternative automated cleantech compatible computerized cost-saving cutting-edge efficient eco-friendly fifth-generation full-scale futuristic hi-tech hybrid innovative interactive latest low-cost modern newest promising reliable revolutionary safe sophisticated speedy stand-alone sustainable	Affective: - Personalizing Cognitive - Concept mapping - Diagramming Creative: - Brainstorming Intrapersonal: - Individual student work	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	answers any arising questions while reviewing the exercise.		technical technological trustworthy up-to-date user-friendly wearable Wireless		
4	Pre-task 3: Drafting the text T asks Ss to write a draft application email individually based on the information selected and organized in the preliminary plan (mind map). (Handout 4) Ss are required to mention the name of their product/service and what makes it unique by using adjectives to describe its attributes. Ss are also required to use transition words and formulaic expressions for email writing. T also reminds Ss about the illustrative sample which may also serve as a model. Ss ask questions by using the “raise hand” tool or submitting their question to the T via chat. T provides support as required and indicates when the time is up to move on with the next activity.	W, S, L	Transition words: ▪ Sequence (firstly, secondly, thirdly). ▪ Talking generally (in general, usually, on the whole). ▪ Contrast (however, nevertheless, on the other hand). ▪ Adding another point (in addition/additionally, moreover, furthermore). ▪ Examples (for example, for instance, e.g.). ▪ Rephrasing (in other words, that is to say, to put it differently). ▪ Result/consequence (as a result, therefore, for this reason).	Affective: - Personalizing Intrapersonal: - Individual student work	15 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Formulaic expressions commonly used for emails: Salutations - Dear Mr./Ms. [last name], - Dear [department name] Team, Introducing yourself - My name is ... - This is [your first and last name] from [company name]. Reason for writing - I am writing with regard to ... - I am writing to let you know that ... - I am interested in [verb+ing → e.g., participating/receiving/finding out]		

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Attachments - Please find attached the [proposal/specifications/data sheet] - I am sending you the [proposal/specifications/data sheet] as an attachment. - I have attached the [proposal/specifications/data sheet] as a pdf document/file. Requests - I would really appreciate your help. - I would be grateful if you could reply to this email as soon as possible. Final comments - Please feel free to contact [me/us] if you have any [further/additional] questions. - If you have any other questions, please let me know. - [I/We] look forward to hearing from you soon.		

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			- I'm looking forward to your reply. Close - Regards - Kind/Best regards		
5	Pre-task 4: Editing (reflecting and revising) Ss reflect on the writing process (by using a self-evaluation rubric where they need to check the boxes that best describe their experience. (Handout 5) Then, Ss exchange their draft emails with a partner and provide feedback on their classmate's draft by answering peer-review questions orally. Based on the results, Ss will edit (revise) the draft email and make any necessary changes. The T provides feedback and guidance during the process. T indicates when the time is up and moves on to the main task.	R, W, S, L	Giving an opinion: ▪ As far as I know... ▪ It seems to me that... ▪ I'd definitely say that ... ▪ For example, ... / For instance, ... ▪ I agree/disagree with you. Negotiation of meaning: ▪ Would you mind repeating that? ▪ What does [launching] mean? ▪ What do you mean by [rivalled]? ▪ Sure! What I mean is ...	Affective: - Personalizing - Self-evaluating Intrapersonal: - Individual student work Interpersonal: - Cooperative	20 min

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Turn-taking: - Who would like to start? - I'd like to start / I'll go first. - Would you like to add anything? - I'm sorry to interrupt but... [I've got something to say]		
6	Task: Writing the final version Individually, Ss write the final draft of the application email for the international trade fair based on the feedback obtained in the pre-tasks. T monitors the activity and provides support as required. As part of the reporting stage, three to five Ss present their email orally. T provides feedback as necessary.	W, R, L, S	Ss should recycle the following, useful expressions, vocabulary, and grammar structures from the pre-tasks: - Giving an opinion - Other ways to describe product attributes - Transition words - Formulaic expressions commonly used for emails	Affective: - Personalizing Intrapersonal: - Individual student work	30 min
7-8	Post-task 1: Ss discuss their personal writing experience by answering the following questions: How do you feel about the writing process? / What was your experience like?	R, W, S, L	Vocabulary: Transition words	Affective: - Personalizing - Self-evaluating - Reflecting Intrapersonal: - Individual student work	20 min

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
	- What was the part of the lesson that you enjoyed the most? - What was the most difficult part of the lesson? - What are some aspects that you still need to improve regarding email writing? Then, Ss read an email sample and complete a fill-in-the-blanks exercise with appropriate transition words by using the vocabulary studied in Pre-Task 3. (Handout 7)				
9	Post-task 2: Ss write an email to apply for a Master's degree in Electrical Engineering at a top international university. They need to put into practice the different stages of the writing cycle (planning, drafting, editing, and final drafting). Then, Ss turn in the assignment before the next session via Google Classroom. (Handout 8)	W	Vocabulary: - Transition words - Common expressions for email writing - Adjectives to describe technical experience and projects	Affective: - Personalizing Intrapersonal: - Individual student work	40 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Reminders:

- Have a 10-minute break.
- All the handouts are available in Google Classroom (access code 2yteyhw).

Homework:

- Ask Ss to check the language pills (feedback posted in Google Classroom) and the post-task answer keys.

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms.

Link to Google Docs: https://docs.google.com/presentation/d/1g-qP_yKW-8VxFgEdGweB5FLr_9BahgDukYisFOpZB1M/edit?usp=sharing

REFERENCES:

Harmer, J. (2004). *How to teach writing*. UK: Longman.

O'Malley, J. M., & Valdez Pierce, L. (1996). *Authentic assessment for English learners*. Addison Wesley Publishing Company.



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Unit 3 - Lesson 1

Handout 1 - Warm-up

Instructions: Individually, read the following text. Then, discuss the questions on the next page as a whole group.

Exhibitor Registration for ITF on Electrical Engineering 2021 – Application

Dear Ms. Russ,

My name is Jeffrey Lopez from ABC Technology Costa Rica. I am writing to express my interest in participating as an exhibitor at the 2021 International Trade Fair (ITF) on Electrical Engineering.

Firstly, our company has been in the market for over ten years, and we are currently in the process of launching a new product. Based on the features demanded by larger markets, we have created innovative, user-friendly products that are now available to small and medium-sized companies.

Additionally, our expertise in the Electrical Engineering field has provided us with solutions that meet the needs of today's clients by increasing their productivity and customer satisfaction and reducing operating costs.

Finally, this is a relatively new product that still has to be rivaled. Therefore, I believe that this international fair can give our product the publicity that it requires. Please see the attached proposal for more details.

If you need any further information, do not hesitate to contact me. You can email me or call me on the number below.

I look forward to hearing from you soon.

Kind regards,

Jeffrey Lopez
Electrical Engineer
ABC Technology Costa Rica
T. (+506) 8495-6871
jeffrey.lopez@abctechnology.com



Discussion:

- Who do you think Ms. Russ is?
- What is Jeffrey Lopez's purpose for writing this email?
- Do you know what an international trade fair is? Can you explain?

Useful Language

Giving an opinion	Negotiation of meaning	Turn-taking
▪ <u>As far as I know</u>, Ms. Russ is the engineering manager. ▪ <u>It seems to me that</u> he is writing to (schedule a meeting / sell a new product). ▪ <u>I would say that</u> an international trade fair is an event where can people buy and sell products and services. ▪ <u>For example</u>, you can create an innovative product and sell it at a trade fair. ▪ <u>I agree/disagree with you</u>.	▪ <u>Would you mind repeating that?</u> ▪ <u>What does [launching] mean?</u> ▪ <u>What do you mean by [rivalled]?</u> ▪ <u>Sure! What I mean is that</u> no other product has proven to be a worthy rival of my newest product.	▪ Would you like to add anything? ▪ I'm sorry to interrupt but... [I've got something to say]



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Unit 3 - Lesson 1

Handout 2 – Pre-task 1

Instructions: Individually, read and analyze the email below. Then, in pairs, identify the correct name for each part of the email.

complimentary close - salutation - signature block - subject line - email body

1 → **Exhibitor Registration for ITF on Electrical Engineering 2021 – Application**

2 → Dear Ms. Russ,

3 → My name is Jeffrey Lopez from ABC Technology Costa Rica. I am writing to express my interest in participating as an exhibitor at the 2021 International Trade Fair (ITF) on Electrical Engineering.

Firstly, our company has been in the market for over ten years, and we are currently in the process of launching a new product. Based on the features demanded by larger markets, we have created innovative, user-friendly products that are now available to small and medium-sized companies.

Additionally, our expertise in the Electrical Engineering field has provided us with solutions that meet the needs of today's clients by increasing their productivity and customer satisfaction and reducing operating costs.

Finally, this is a relatively new product that still has to be rivaled. Therefore, I believe that this international fair can give our product the publicity that it requires. Please see the attached proposal for more details.

If you need any further information, do not hesitate to contact me. You can email me or call me on the number below.

I look forward to hearing from you soon.

4 → Kind regards,

5 → Jeffrey Lopez
Electrical Engineer
ABC Technology Costa Rica
T. (+506) 8495-6871
jeffrey.lopez@abctechnology.com

 **ABC TECHNOLOGY**
ELECTRICAL SOLUTIONS

1) _____
2) _____
3) _____

4) _____
5) _____



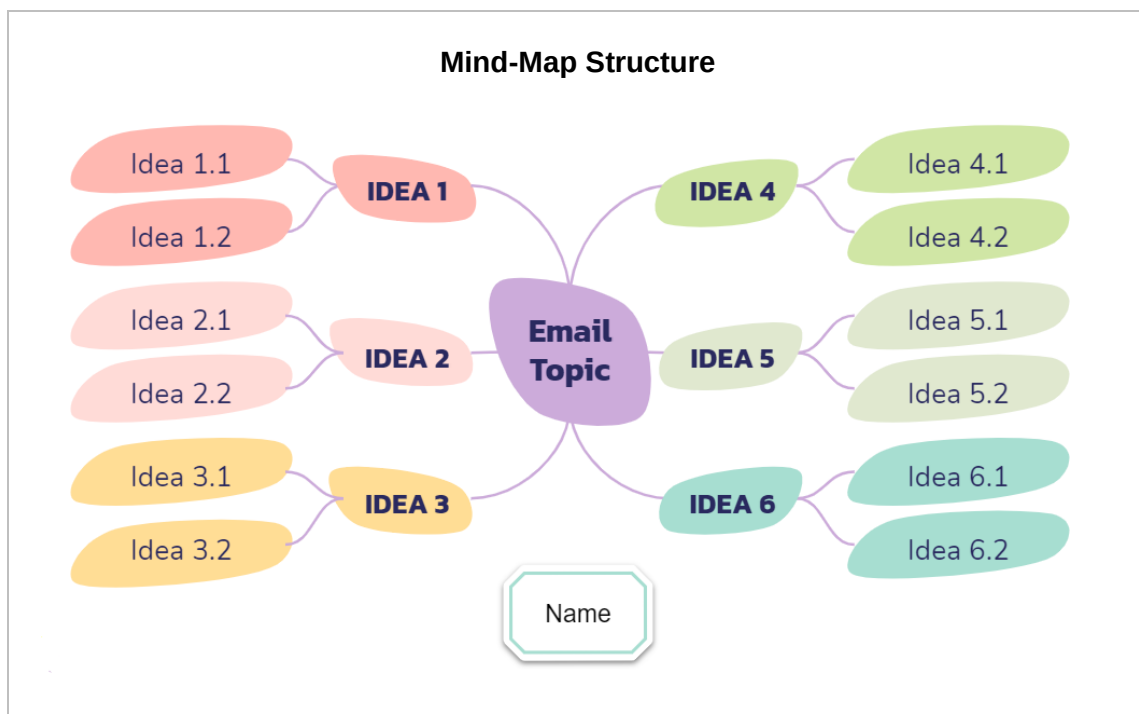
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Handout 3 – Pre-task 2: Planning

Instructions:

1. Go to Google Docs by clicking [here](#).
2. Read the first slides for tips to help you with the planning stage.
3. Then, create a mind map as a preliminary plan for an email application to an international trade fair organized by the IEEE. Add your name to your slide and customize your map as necessary.
4. Be ready to share your writing plan with the rest of the class.



Tips for Success



1. Good writers plan what they are going to write. Consider the purpose, the audience, and the content (facts, ideas, or arguments).
2. The ideas for the email body can be selected based on the following recommendations:
 - State the reason for writing (purpose).
 - Write two or three key points related to the company's background, the writer's expertise, and the product features.
 - Indicate the documents that are attached.
 - Show appreciation and willingness to provide additional information.
3. The scope of your proposal may be an existing field of interest, a subset of that field, or a new technology in the Electrical Engineering field.

Useful Language:



Other ways to describe product attributes		
advanced alternative automated cleantech compatible computerized cost-saving cutting-edge efficient eco-friendly fifth-generation full-scale	futuristic hi-tech hybrid innovative interactive latest low-cost modern newest promising reliable revolutionary	safe sophisticated speedy stand-alone sustainable technical technological trustworthy up-to-date user-friendly wearable wireless



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Handout 4 – Pre-task 3: Drafting

Instructions: Individually, write a draft email to participate as an exhibitor at an international trade fair by using the preliminary plan (mind map) previously created in class. Mention the name of your product/service and what makes it unique according to the preliminary plan.

Remember that this is **not** the final version, and mistakes are part of learning.

Useful Language:



The draft is the stage at which the writers begin to compile all the details into cohesive, flowing thoughts. Remember to use transition words!

Sequence	Firstly, ...	Secondly, ...	Thirdly, ...
Talking generally	In general, ...	Usually, ...	On the whole, ...
Contrast	However, ...	Nevertheless, ...	On the other hand, ...
Adding another point	In addition, .../ additionally, ...	Moreover, ...	Furthermore, ...
Examples	For example, ...	For instance, ...	e.g.,
Rephrasing	In other words, ...	That is to say, ...	To put it differently, ...
Result/consequence	As a result, ...	Therefore, ...	For this reason, ...

Connecting with the reader	
▪ Salutations - Dear Mr./Ms. [last name], - Dear [department name] Team, ▪ Introducing yourself - My name is ... - This is [your first and last name] from [company name]. ▪ Reason for writing - I am writing with regard to ... - I am writing to let you know that ... - I am interested in [verb+ing → e.g., participating/receiving/finding out] ... ▪ Attachments - Please find attached the [proposal/specifications/data sheet] - I am sending you the [proposal/specifications/data sheet] as an attachment. - I have attached the [proposal/specifications/data sheet] as a pdf document/file.	▪ Requests - I would really appreciate your help. - I would be grateful if you could reply to this email as soon as possible. ▪ Final comments - Please feel free to contact [me/us] if you have any [further/additional] questions. - If you have any other questions, please let me know. - [I/We] look forward to hearing from you soon. - I'm looking forward to your reply. ▪ Close - Regards - Kind/Best regards

Draft:



Lined area for writing the draft.





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Handout 5A – Pre-task 4: Editing

Instructions: Individually, complete the following self-evaluation chart to reflect on your writing process. Check the box that best describes your writing experience.

Purpose and Organization	Yes	No
1. I stated my purpose clearly.	☐	☐
2. I organized my thoughts.	☐	☐
3. The text included an introduction, a body, and a conclusion.	☐	☐
4. I used appropriate language such as adjectives for describing my product, transition words for linking different ideas, and common expressions for writing emails in order to make my point.	☐	☐

Word and Sentence Use	Yes	No
1. I used new vocabulary.	☐	☐
2. I wrote complete sentences (i.e., subject + verb + complement).	☐	☐
3. I used correct subject-verb agreement (i.e., a subject and its verb must be both singular or both plural).	☐	☐
4. I used the verb tenses correctly.	☐	☐

Spelling, Punctuation, and Format	Yes	No
1. I spelled the words correctly.	☐	☐
2. I used capital letters to start sentences.	☐	☐
3. I used punctuation marks correctly.	☐	☐
4. I used an appropriate format for email writing (i.e., subject line, salutation, body, complimentary close, signature block).	☐	☐

Adapted from: O'Malley, J. M., & Valdez Pierce, L. (1996). *Authentic assessment for English learners*. Addison Wesley Publishing Company.



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Handout 5B – Pre-task 4: Editing

Instructions: Work in pairs. Exchange your draft with a partner and use the following peer-evaluation form as a reference to provide oral feedback. Based on the results, edit (revise) your draft email as necessary.

Peer-evaluation form:



- My immediate reactions to this piece of writing are _____.
- I find the content _____.
- I like the part on _____.
- The part on _____ could be further developed/elaborated.
- You tend to _____.
- I'm not sure about _____.
- The specific language errors that I have noticed are _____.
- The best part of this email is _____.

Adapted from: Harmer, J. (2004). *How to teach writing*. UK: Longman.



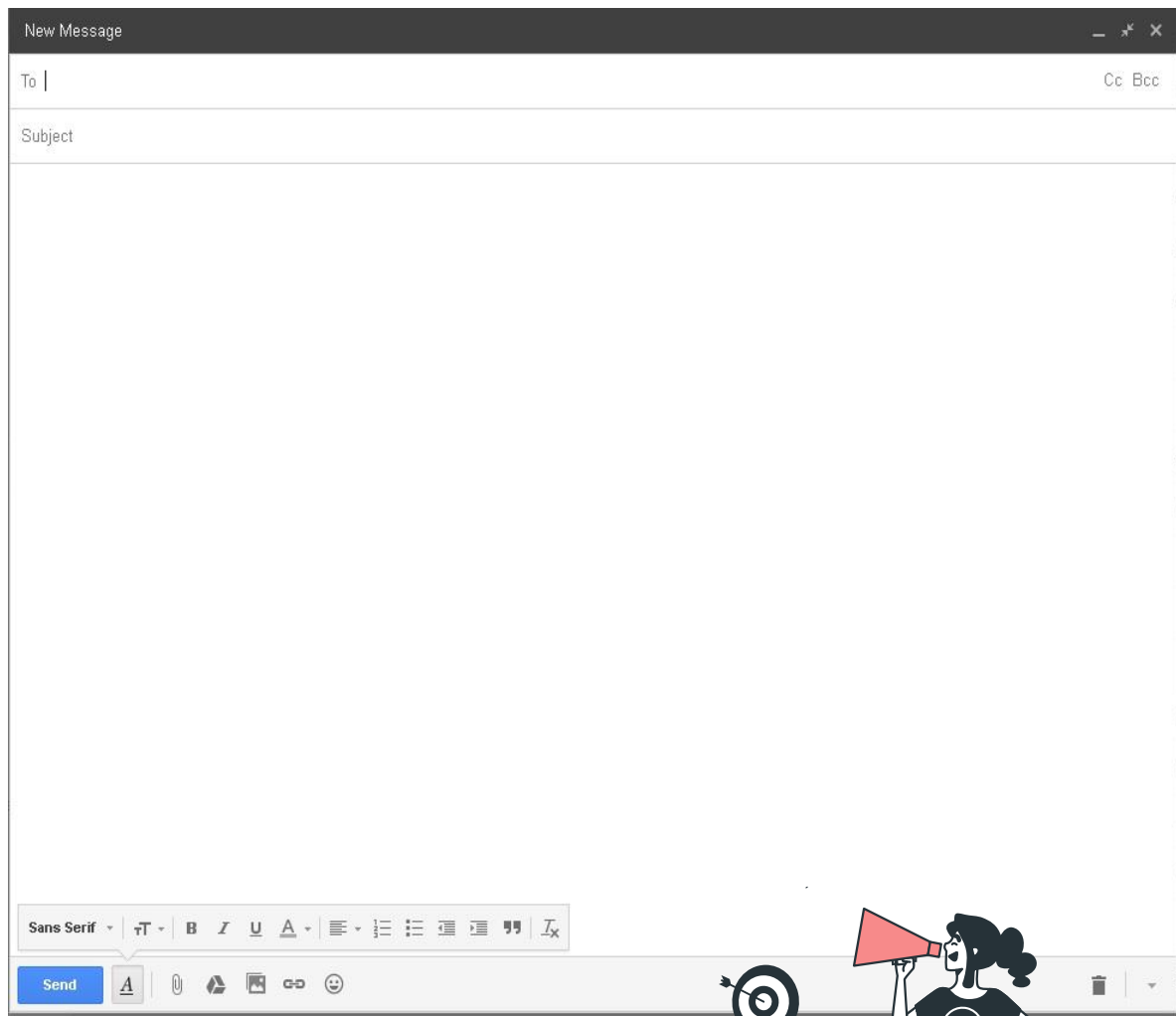


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Handout 6 -Task: Final Version

Instructions: Work individually. Once you have edited your draft and made the necessary changes, write the final version of your application email to participate at an International Trade Fair on Electrical Engineering. Be ready to read your email in front of the class.





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Unit 3 - Lesson 1

Handout 7 - Post-Task 1

Part 1

Instructions: Answer the following questions:

- How do you feel about the writing process? What was your experience like?
- What was the part of the lesson that you enjoyed the most?
- What was the most difficult part of the lesson?
- What are some aspects that you still need to improve regarding email writing? What can you do to improve?

Part 2

Instructions: Read the email below and fill in the blanks with the appropriate transition word. See Handout 4 – Pre-task 3.

Dear Mr. Schneider,

This is Brenda Castro from Robotics and Innovation, Costa Rica. I am writing about the invitation that we received for the 2021 EcoEnergy Expo to express our interest in participating.

_____,¹ this is the biggest technology trade fair in Europe, and it is very important to our work. Last time we attended your trade show, we learned a lot and made many new contacts that have been key for the development of our company.

_____,² we would like to take advantage of the trade fair to continue to cultivate our image and look for business partners.

_____,³ we are focused on robotics, as that is our main area of interest.

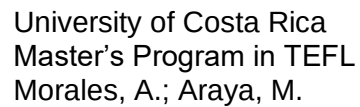
_____,⁴ products such as robot hands and robots for hospitals are particularly interesting for us. _____,⁵ we are attaching a detailed report on our exhibits for your consideration.

Thanks again for this opportunity. I would be glad to discuss the report further if you are interested.

Best regards,

Brenda Castro
Electrical Engineer
Robotics & Innovation Center
T. (+506) 8414-6133
brenda.castro@roboticsandinnovationcenter.com





Handout 8 - Post-Task 2

Consider the following aspects when writing the email application:

- Write an appropriate subject line
- Introduce yourself
- Briefly describe your academic and professional experience and any projects you have carried out
- Provide two to three arguments as to why you should be admitted and how you would benefit from this opportunity

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



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Unit 3 - Lesson 1

Answer Key: Handout 1 - Warm-up

Instructions: Individually, read the following text. Then, discuss the questions on the next page as a whole group.

Exhibitor Registration for ITF on Electrical Engineering 2021 – Application

Dear Ms. Russ,

My name is Jeffrey Lopez from ABC Technology Costa Rica. I am writing to express my interest in participating as an exhibitor at the 2021 International Trade Fair (ITF) on Electrical Engineering.

Firstly, our company has been in the market for over ten years, and we are currently in the process of launching a new product. Based on the features demanded by larger markets, we have created innovative, user-friendly products that are now available to small and medium-sized companies.

Additionally, our expertise in the Electrical Engineering field has provided us with solutions that meet the needs of today's clients by increasing their productivity and customer satisfaction and reducing operating costs.

Finally, this is a relatively new product that still has to be rivaled. Therefore, I believe that this international fair can give our product the publicity that it requires. Please see the attached proposal for more details.

If you need any further information, do not hesitate to contact me. You can email me or call me on the number below.

I look forward to hearing from you soon.

Kind regards,

Jeffrey Lopez
Electrical Engineer
ABC Technology Costa Rica
T. (+506) 8495-6871
jeffrey.lopez@abctechnology.com



ABC TECHNOLOGY
ELECTRICAL SOLUTIONS

Discussion:

- Who do you think Ms. Russ is? The trade fair organizer.
- What is Jeffrey Lopez's purpose for writing this email? Showing interest in participating in an international trade fair.
- Do you know what an international trade fair is? Can you explain? A large event in which different companies in a particular industry show and sell their products or services.

Useful Language

Giving an opinion	Negotiation of meaning	Turn-taking
▪ <u>As far as I know</u>, Ms. Russ is the engineering manager. ▪ <u>It seems to me that</u> he is writing to (schedule a meeting / sell a new product). ▪ <u>I would say that</u> an international trade fair is an event where can people buy and sell products and services. ▪ <u>For example</u>, you can create an innovative product and sell it at a trade fair. ▪ <u>I agree/disagree with you.</u>	▪ <u>Would you mind repeating that?</u> ▪ <u>What does [launching] mean?</u> ▪ <u>What do you mean by [rivalled]?</u> ▪ <u>Sure! What I mean is that</u> no other product has proven to be a worthy rival of my newest product.	▪ Would you like to add anything? ▪ I'm sorry to interrupt but... [I've got something to say]



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Answer Key: Handout 2 – Pre-task 1

Instructions: Individually, read and analyze the email below. Then, in pairs, identify the correct name for each part of the email.

complimentary close - salutation - signature block - subject line - email body

1 → **Exhibitor Registration for ITF on Electrical Engineering 2021 – Application**

2 → Dear Ms. Russ,

3 → My name is Jeffrey Lopez from ABC Technology Costa Rica. I am writing to express my interest in participating as an exhibitor at the 2021 International Trade Fair (ITF) on Electrical Engineering.

Firstly, our company has been in the market for over ten years, and we are currently in the process of launching a new product. Based on the features demanded by larger markets, we have created innovative, user-friendly products that are now available to small and medium-sized companies.

Additionally, our expertise in the Electrical Engineering field has provided us with solutions that meet the needs of today's clients by increasing their productivity and customer satisfaction and reducing operating costs.

Finally, this is a relatively new product that still has to be rivaled. Therefore, I believe that this international fair can give our product the publicity that it requires. Please see the attached proposal for more details.

If you need any further information, do not hesitate to contact me. You can email me or call me on the number below.

I look forward to hearing from you soon.

4 → Kind regards,

5 → Jeffrey Lopez
Electrical Engineer
ABC Technology Costa Rica
T. (+506) 8495-6871
jeffrey.lopez@abctechnology.com

 **ABC TECHNOLOGY**
ELECTRICAL SOLUTIONS

1) Subject line

2) Salutation

3) Email body

4) Complimentary close

5) Signature block



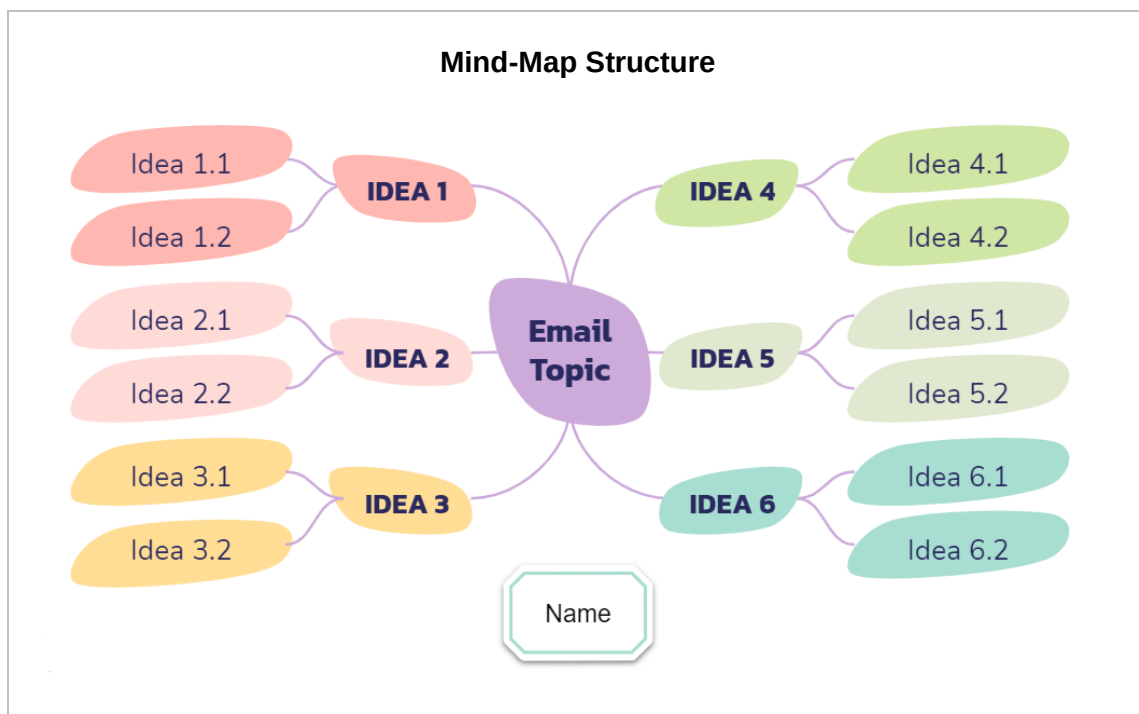
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Unit 3 - Lesson 1

Answer Key: Handout 3 – Pre-task 2: Planning

Instructions:

1. Go to Google Docs by clicking [here](#).
2. Read the first slides for tips to help you with the planning stage.
3. Then, create a mind map as a preliminary plan for an email application to an international trade fair organized by the IEEE. Add your name to your slide and customize your map as necessary.
4. Be ready to share your writing plan with the rest of the class.



Tips for Success



1. Good writers plan what they are going to write. Consider the purpose, the audience, and the content (facts, ideas, or arguments).
2. The ideas for the email body can be selected based on the following recommendations:
 - State the reason for writing (purpose).
 - Write two or three key points related to the company's background, the writer's expertise, and the product features.
 - Indicate the documents that are attached.
 - Show appreciation and willingness to provide additional information.
3. The scope of your proposal may be an existing field of interest, a subset of that field, or a new technology in the Electrical Engineering field.

Useful Language:



Other ways to describe product attributes		
advanced alternative automated cleantech compatible computerized cost-saving cutting-edge efficient eco-friendly fifth-generation full-scale	futuristic hi-tech hybrid innovative interactive latest low-cost modern newest promising reliable revolutionary	safe sophisticated speedy stand-alone sustainable technical technological trustworthy up-to-date user-friendly wearable wireless



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Unit 3 - Lesson 1

Answer Key: Handout 4 – Pre-task 3: Drafting

Instructions: Individually, write a draft email to participate as an exhibitor at an international trade fair by using the preliminary plan (mind map) previously created in class. Mention the name of your product/service and what makes it unique according to the preliminary plan.

Remember that this is **not** the final version, and mistakes are part of learning.

Useful Language:

The draft is the stage at which the writers begin to compile all the details into cohesive, flowing thoughts. Remember to use transition words!

Sequence	Firstly, ...	Secondly, ...	Thirdly, ...
Talking generally	In general, ...	Usually, ...	On the whole, ...
Contrast	However, ...	Nevertheless, ...	On the other hand, ...
Adding another point	In addition, .../ additionally, ...	Moreover, ...	Furthermore, ...
Examples	For example, ...	For instance, ...	e.g.,
Rephrasing	In other words, ...	That is to say, ...	To put it differently, ...
Result/consequence	As a result, ...	Therefore, ...	For this reason, ...

Connecting with the reader	
▪ Salutations - Dear Mr./Ms. [last name], - Dear [department name] Team, ▪ Introducing yourself - My name is ... - This is [your first and last name] from [company name]. ▪ Reason for writing - I am writing with regard to ... - I am writing to let you know that ... - I am interested in [verb+ing → e.g., participating/receiving/finding out] ... ▪ Attachments - Please find attached the [proposal/specifications/data sheet] - I am sending you the [proposal/specifications/data sheet] as an attachment. - I have attached the [proposal/specifications/data sheet] as a pdf document/file.	▪ Requests - I would really appreciate your help. - I would be grateful if you could reply to this email as soon as possible. ▪ Final comments - Please feel free to contact [me/us] if you have any [further/additional] questions. - If you have any other questions, please let me know. - [I/We] look forward to hearing from you soon. - I'm looking forward to your reply. ▪ Close - Regards - Kind/Best regards

[illegible]



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Answer Key: Handout 5A – Pre-task 4: Editing

Instructions: Individually, complete the following self-evaluation chart to reflect on your writing process. Check the box that best describes your writing experience.

Purpose and Organization	Yes	No
1. I stated my purpose clearly.	☐	☐
2. I organized my thoughts.	☐	☐
3. The text included an introduction, a body, and a conclusion.	☐	☐
4. I used appropriate language such as adjectives for describing my product, transition words for linking different ideas, and common expressions for writing emails in order to make my point.	☐	☐

Word and Sentence Use	Yes	No
1. I used new vocabulary.	☐	☐
2. I wrote complete sentences (i.e., subject + verb + complement).	☐	☐
3. I used correct subject-verb agreement (i.e., a subject and its verb must be both singular or both plural).	☐	☐
4. I used the verb tenses correctly.	☐	☐

Spelling, Punctuation, and Format	Yes	No
1. I spelled the words correctly.	☐	☐
2. I used capital letters to start sentences.	☐	☐
3. I used punctuation marks correctly.	☐	☐
4. I used an appropriate format for email writing (i.e., subject line, salutation, body, complimentary close, signature block).	☐	☐

Adapted from: O'Malley, J. M., & Valdez Pierce, L. (1996). *Authentic assessment for English learners*. Addison Wesley Publishing Company.



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Answer Key: Handout 5B – Pre-task 4: Editing

Instructions: Work in pairs. Exchange your draft with a partner and use the following peer-evaluation form as a reference to provide oral feedback. Based on the results, edit (revise) your draft email as necessary.

Peer-evaluation form:



- My immediate reactions to this piece of writing are _____.
- I find the content _____.
- I like the part on _____.
- The part on _____ could be further developed/elaborated.
- You tend to _____.
- I'm not sure about _____.
- The specific language errors that I have noticed are _____.
- The best part of this email is _____.

Adapted from: Harmer, J. (2004). *How to teach writing*. UK: Longman.



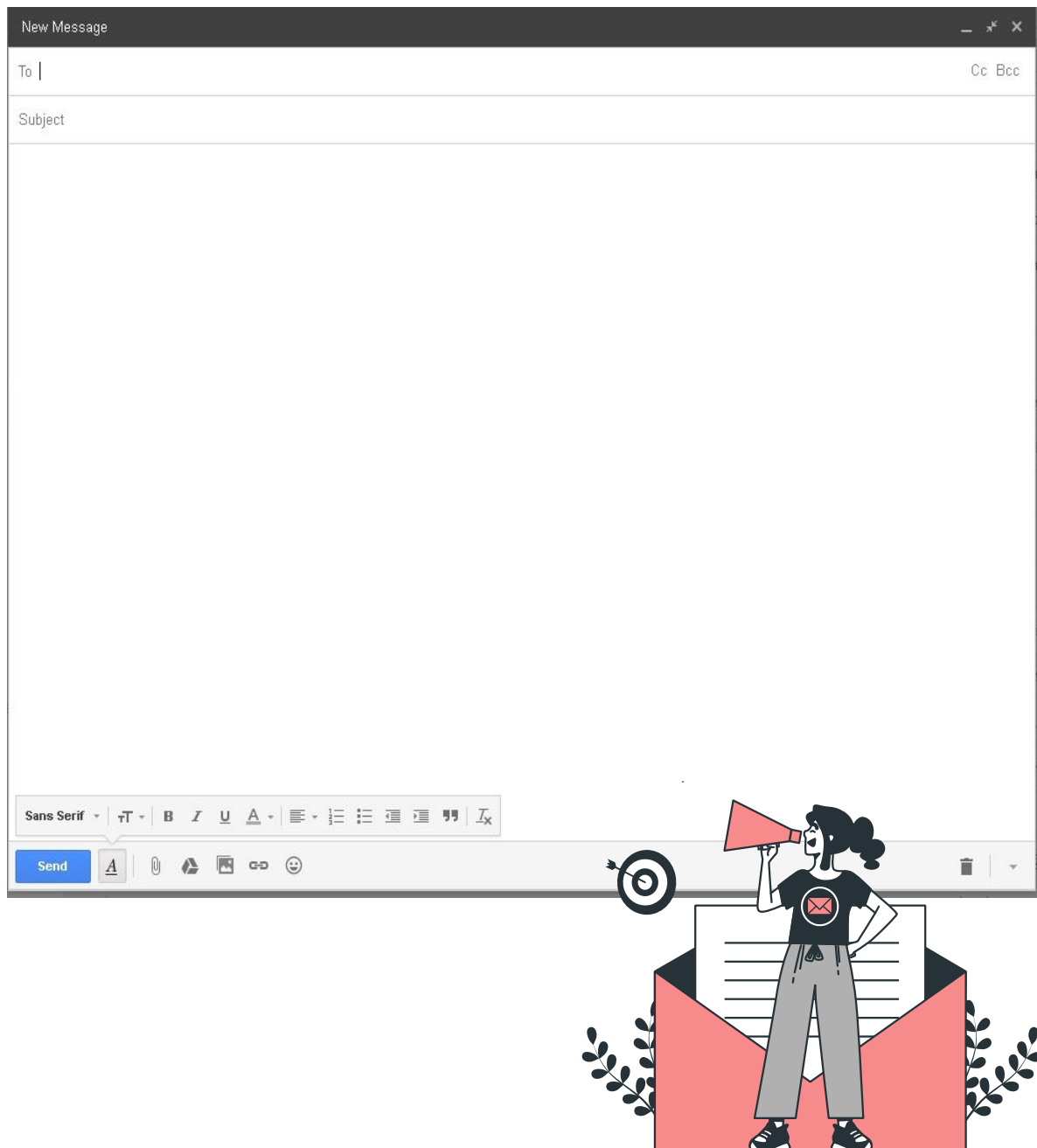


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Unit 3 - Lesson 1

Answer Key: Handout 6 -Task: Final Version

Instructions: Work individually. Once you have edited your draft and made the necessary changes, write the final version of your application email to participate at an International Trade Fair on Electrical Engineering. Be ready to read your email in front of the class.





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Unit 3 - Lesson 1

Answer Key: Handout 7 – Post-Task 1

Part 1

Instructions: Answer the following questions:

- How do you feel about the writing process? What was your experience like?
- What was the part of the lesson that you enjoyed the most?
- What was the most difficult part of the lesson?
- What are some aspects that you still need to improve regarding email writing?
What can you do to improve?

Answers may vary.

Part 2

Instructions: Read the email below and fill in the blanks with the appropriate transition word. See Handout 4 – Pre-task 3.

Dear Mr. Schneider,

This is Brenda Castro from Robotics and Innovation, Costa Rica. I am writing about the invitation that we received for the 2021 EcoEnergy Expo to express our interest in participating.

First, this is the biggest technology trade fair in Europe, and it is very important to our work. Last time we attended your trade show, we learned a lot and made many new contacts that have been key for the development of our company. Therefore, we would like to take advantage of the trade fair to continue to cultivate our image and look for business partners.

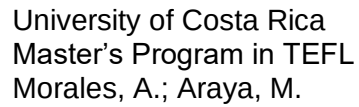
Second, we are focused on robotics, as that is our main area of interest. For example, products such as robot hands and robots for hospitals are particularly interesting for us. For this reason, we are attaching a detailed report on our exhibits for your consideration.

Thanks again for this opportunity. I would be glad to discuss the report further if you are interested.

Best regards,

Brenda Castro
Electrical Engineer
Robotics & Innovation Center
T. (+506) 8414-6133
brenda.castro@roboticsandinnovationcenter.com





Answer Key: Handout 8 - Post-Task 2

Consider the following aspects when writing the email application:

- Write an appropriate subject line
- Introduce yourself
- Briefly describe your academic and professional experience and any projects you have carried out
- Provide two to three arguments as to why you should be admitted and how you would benefit from this opportunity

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Unit 3: Engineering the Future

Lesson 2: Description of a product or system

Date: November 2, 2021

Unit Goal: By the end of the unit, the students will be able to effectively describe orally and in writing their interest in participating in an international trade fair, an innovative product or system in the field of Electrical Engineering, and a business idea for a solution to a problem.

General Objective: By the end of the lesson, the students will be able to successfully describe a hydroelectric, wind, or geothermal power generation, transmission, and distribution process orally in a meeting by identifying the main technical components of the system, explaining the steps required for its operation, and using a mind map as a guide for the presentation while working in groups.

Specific Objectives: By the end of this lesson, the students will be able to:

1. effectively brainstorm general ideas about power generation processes with renewable resources and make predictions based on images, titles, and key words;
2. appropriately show understanding of the technical components of a hydropower generation, transmission, and distribution process by matching the names and definitions to their corresponding pictures while working in groups.
3. correctly identify the location of the technical components of a hydropower generation, transmission, and distribution process by filling in the gaps of a diagram with the corresponding names while working in groups.
4. properly explain a hydropower generation, transmission, and distribution process by arranging a list of general steps in a logical sequence and practicing the sequence orally in groups;

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

5. successfully describe a wind or geothermal power generation, transmission, and distribution process orally in a meeting by identifying the main technical components of the system, explaining the steps required for its operation in a logical sequence, and using a mind map as a guide for the presentation while working in groups; and
6. correctly recognize the use of the passive voice individually by rewriting sentences related to power generation, transmission, and distribution processes.

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Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Brainstorming ideas and making predictions T reviews the goal of the class and activates schemata by asking Ss to brainstorm ideas and predict the main topic of the class. For this, T shows images about power generation and renewable resources. Ss also answer questions about the difference between renewable and nonrenewable resources, sustainable energy as an influential trend for electrical engineering, examples of power plants in Costa Rica, and ideas to describe a power generation process. T reviews the ideas as a whole group and directs attention towards useful language for the class. Finally, T explains why describing is a key skill when referring to technical products, systems, or processes. (Handout 1)	S, L	Giving an opinion: - I would say that... - It seems to me that... - As far as I know, ... Negotiating meaning: - What do you mean by...? - Could you repeat that again, please? - Could you please elaborate more on...? - Sure! What I mean is... Showing interest: - I see. - Sounds good. - Really? - That is a good idea.	Cognitive: - Predicting Creative: - Brainstorming Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
2	Pre-task 1: In groups, Ss match the name and definition of the technical components of a hydropower generation, transmission, and distribution process with the corresponding pictures. (Handout 2) T monitors the activity and provides support as required.	R, S, L	Key vocabulary: - Dam - Generator - Grid - Headrace tunnel - Intake - Overhead power line - Penstock - Powerhouse - Reservoir - Rotor - Shaft - Stator - Substation - Tailrace channel - Transmission tower - Transformer - Turbine - Utility pole Key verbs: - Attach - Carry - Consist of - Convert - Convey - Direct - Distribute - Generate - House - Increase - Reduce - Release - Support - Transmit	Linguistic: - Practicing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: In groups, Ss analyze visual diagrams about the hydroelectric power generation, transmission, and distribution process and identify the location of the technical components by filling in the gaps of the diagrams with the correct names from the bank of vocabulary. (Handouts 3A and 3B) T monitors the activity and provides support and useful language as required.	S, L	Key vocabulary (hydro): - Dam - Generator - Grid - Headrace tunnel - Intake - Overhead power line - Penstock - Powerhouse - Reservoir - Substation - Tailrace channel - Transmission tower - Transformer - Turbine - Utility pole	Linguistic: - Practicing Interpersonal: - Cooperating	15 min
4	Pre-task 3: In groups, Ss arrange the steps to explain a hydropower generation, transmission, and distribution process in a logical sequence. Then, Ss practice the sequence orally and exchange roles. (Handout 4) T also provides a fun fact about the largest hydroelectric power plant in Costa Rica and useful time expressions to describe a process.	R, S, L	Key vocabulary: - Technical components and verbs studied in pre-tasks 1 and 2. Time expressions to describe a process: - First, ... Second, ... Third, ... - First of all, ... - Then, ... - Next, ... - After that, ... - Finally, ...	Linguistic: - Conversationa l patterns - Practicing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
5	Task: T reads the instructions (Handout 5) for the main task activity and provide useful language related to signposting for meetings. Ss choose a topic corresponding to a renewable resource (geothermal or wind power) to describe a power generation, transmission, and distribution process orally as if they were in a meeting. Then, Ss are sent into the breakout rooms. In groups, Ss complete the exercises that function as input for their presentation by identifying the technical components in a visual diagram and arranging the steps of the process in a logical sequence. Ss also create a mind map as a guide for planning the presentation. Ss use Handouts 6A, 6B, 6C, and 6D for wind power or Handouts 7A, 7B, 7C, and 7D for geothermal power. After that, Ss return to the main room to present the description of the topic assigned. Ss are reminded to use visual aids and useful language to guide the audience during the presentation.	R, S, L	Signposting for presentations in meetings: Starting a presentation: - Hello/Good [evening], everyone. - Thank you very much for [inviting me here today]. Stating the purpose: - Our purpose/objective/aim today is [to describe clean energy]. - I am here today to [describe power generation]. Giving the structure: - This presentation is divided into [number] parts. - First of all, I'd like to look at [the main components]. - Then, I'll be talking about [how the system works]. - Finally, I'll be looking at... Handling questions: - At the end of the presentation, I'll be happy to answer any questions. - Please let me know if you have any questions that I can help you with.	Linguistic: - Conversationa - l patterns - Practicing Affective: - Personalizing Interpersonal: - Cooperating	50 min Plan and practice 30 min + Present 20 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Using visual aids: - As you can see [here], [there is a generator]. - [On the right/left], we can see [the generator]. - This diagram shows [the process]. - Let's have a look at [the process]. Using transitions: - So, let me start by explaining [the background]. - Now, let's move on to/turn to [the next topic]. - Now, I'd like to go on to [the next topic]. Concluding: - Let me end by saying that [clean energy is important]. - I'd like to finish by emphasizing that [clean energy is important]. - Thank you for your attention/time		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Key vocabulary (wind): - AC - Blades - Cables - Gear box - Generator - Nacelle - Sensors - Shaft - Tower - Turbine rotor Key vocabulary (geothermal): - Condenser - Cooling tower - Generator - Geothermal fluid - Powerhouse - Production well - Reinjection well - Separator - Steam - Turbine Key verbs: - Blow - Carry - Connect - Cool - Drill - Drop - Flow - Measure - Pump - Rotate - Spin - Transfer		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
8	Post-task: Individually, Ss recognize the use of the passive voice by rewriting sentences related to power generation, transmission, and distribution processes. (Handout 8)	R, S, L, W	Grammar and vocabulary: Passive voice Note: Throughout the lesson, T pays attention to the following key details to provide Ss with suitable feedback after class, if required: - Verb tenses - /-s/ endings, /-ed/ endings - Pronunciation of key technical words	Linguistic: - Practicing Intrapersonal: - Individual student work	1 hr

Reminders:

- Have a 10-minute break.
- All the handouts are available in Google Classroom (access code 2yteyhw).

Homework:

- Ask Ss to check the language pills (feedback posted in Google Classroom) and the post-task answer keys.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking
Ss:	The students	W:	Writing	L:	Listening

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

REFERENCES:

Grupo ICE. (n.d.). *Somos autodidactas*. Dirección de Comunicación.

Grupo ICE. (n.d.). *Recorrido energía eléctrica*. Dirección de Comunicación.

Grupo ICE. (2015). *Costa Rica: Matrix eléctrica. Un modelo sostenible, único en el mundo*. Dirección de Comunicación e Identidad Corporativa - ICE. Costa Rica.



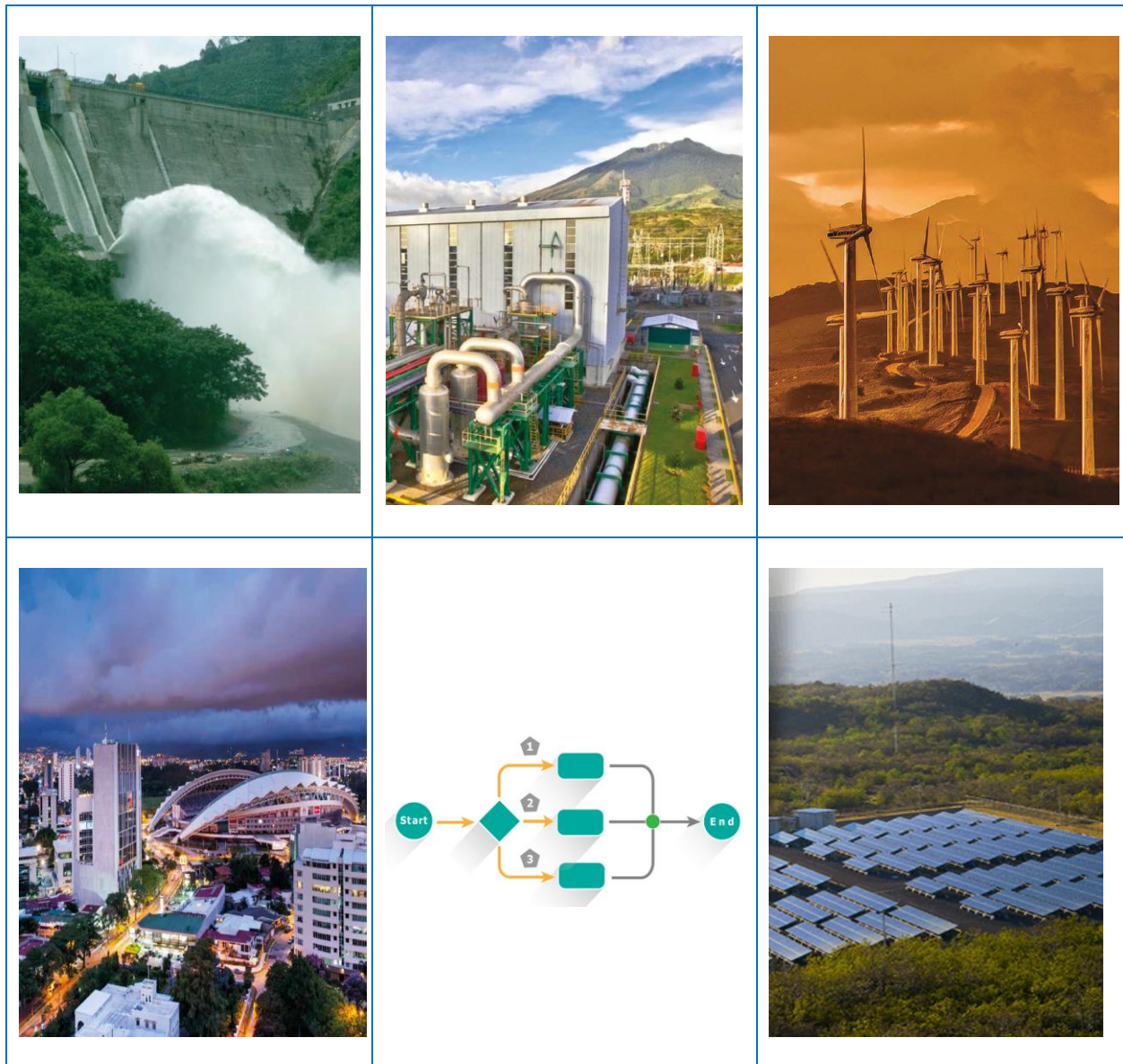
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Unit 3 - Lesson 2

Handout 1 - Warm-up

Part 1

Instructions: Make predictions about the topic of the class based on the following pictures:



What do you think today's class is going to be about?

Part 2

Instructions: Think about the following questions and share your ideas with the rest of the class:

Sustainable Energy: An Influential Trend for Electrical Engineering in 2021

- What is the difference between **renewable** and **nonrenewable** sources of energy? Give an example of each.
- Do you think that sustainable energy systems have become **an influential trend** for Electrical Engineering? Why?
- What are some examples of **power plants** here in Costa Rica? Have you ever been to one? Tell us about your experience.
- If you had to describe how electricity is produced in a power plant, what aspects would you include in the description?

Useful Language



Giving an opinion	▪ <u>I would say that</u> there are many cutting-edge projects in the field. ▪ <u>It seems to me that</u> clean energy is a trend and a key topic for today's class. ▪ <u>As far as I know</u>, if the supply does not meet the demand, the power system can fail and cause blackouts.		
Negotiating meaning	▪ <u>What do you mean by</u> "AC"? ▪ <u>Could you repeat that again, please?</u> ▪ <u>Could you please elaborate more on</u> this topic? ▪ <u>Sure! What I mean is</u> that we don't need three-phase AC in our homes. Single-phase is enough.		
Showing interest	▪ Alright! ▪ Definitely! ▪ I see.	▪ I understand. ▪ Really? ▪ Sounds good.	▪ That's a good idea. ▪ That's interesting.

Describing is an essential skill that helps people understand more about the specific characteristics and details of a person, place, or thing. For example, to describe **a product** (e.g., a motherboard, a drone, a cable, etc.) or **a system or process** (e.g., a technical procedure), you can refer to its main components and then explain the steps required for its operation.



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Unit 3 - Lesson 2

Handout 2 - Pre-task 1

Instructions: In groups, match each technical definition with the corresponding picture by writing the letter in the correct box.

1. ☐ **Dam:** A barrier that prevents the flow of a river to form a **reservoir**.
2. ☐ **Intake:** An entrance that directs water from the reservoir towards the headrace tunnel and prevents the passage of foreign matter.
3. ☐ **Headrace tunnel:** A large underground work that conveys water from the reservoir to the penstock.
4. ☐ **Penstock:** A steel structure that carries water from the tunnel to the powerhouse at high pressure.
5. ☐ **Powerhouse:** A structure that houses the turbo generator units to produce electricity.
6. ☐ **Substation:** A facility that converts electricity generated by the powerhouse for transmission and distribution to the **grid**.
7. ☐ **Turbine:** A rotary machine that converts the kinetic energy of a fluid into mechanical energy. It is attached to a generator by a long **shaft**.
8. ☐ **Generator:** A machine that converts mechanical energy into electric power. It consists of a large spinning **rotor** and a stationary **stator**.
9. ☐ **Tailrace channel:** A structure that releases water back into a river.
10. ☐ **Transformer:** A machine that increases (steps up) or reduces (steps down) voltage.
11. ☐ **Overhead power line:** A cable that transmits and distributes electrical power and that can be supported by **transmission towers** or **poles**.
12. ☐ **Utility pole:** A column that supports distribution lines and other related equipment such as transformers and street lights.

a.



b.



c.



d.



e.



f.



g.



h.



i.



j.



k.



l.





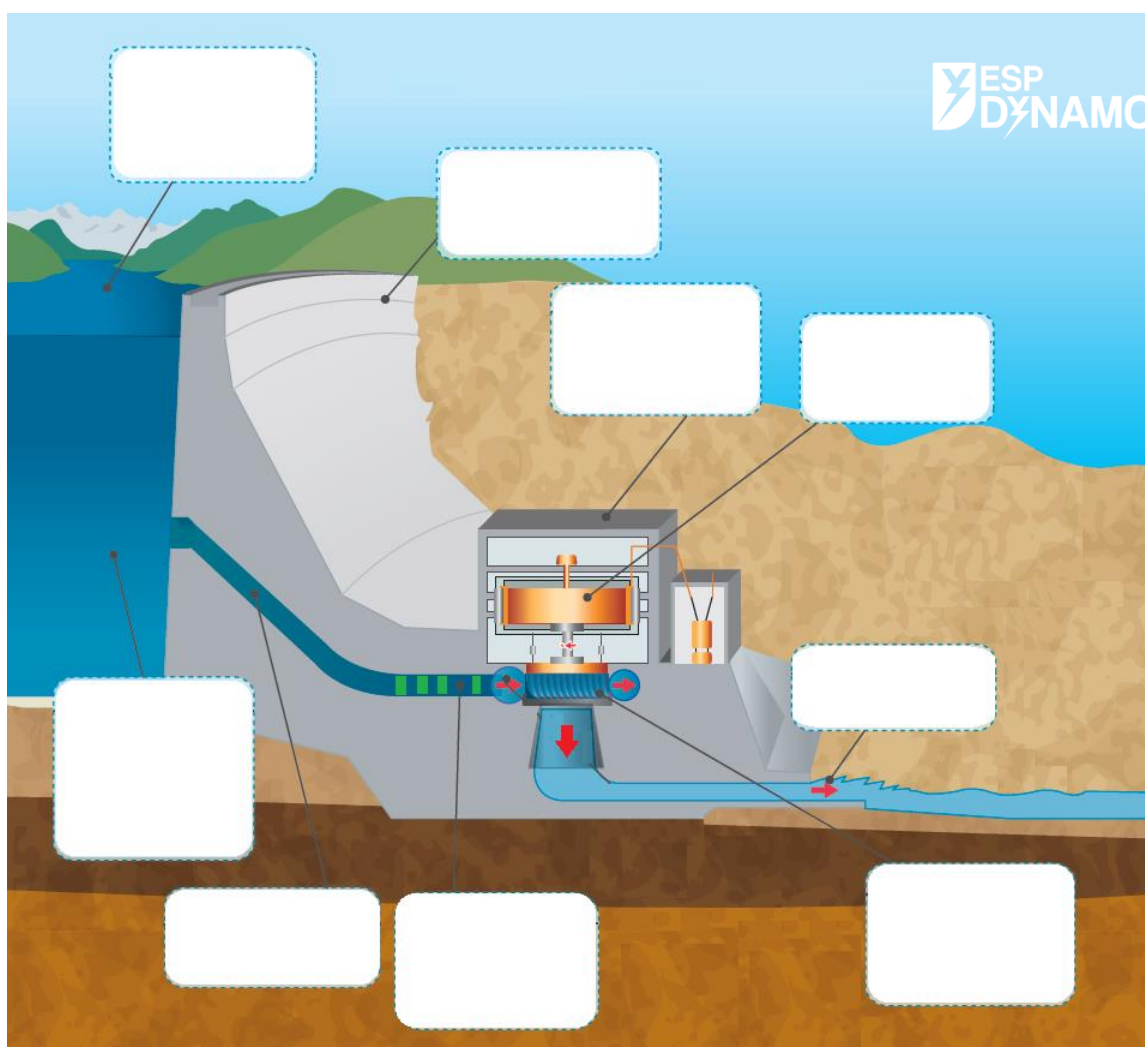
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Unit 3 - Lesson 2

Handout 3A - Pre-task 2

Part 1

Instructions: Work in groups. Analyze the following diagram about the hydroelectric power **generation** process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



1. penstock	2. powerhouse	3. headrace tunnel	4. reservoir	5. power line	6. intake
7. dam	8. grid	9. tailrace channel	10. pole	11. generator	12. turbine

Adapted from:

Grupo ICE. (n.d.). *Somos autodidactas*. Dirección de Comunicación.
Grupo ICE. (n.d.). *Recorrido energía eléctrica*. Dirección de Comunicación.



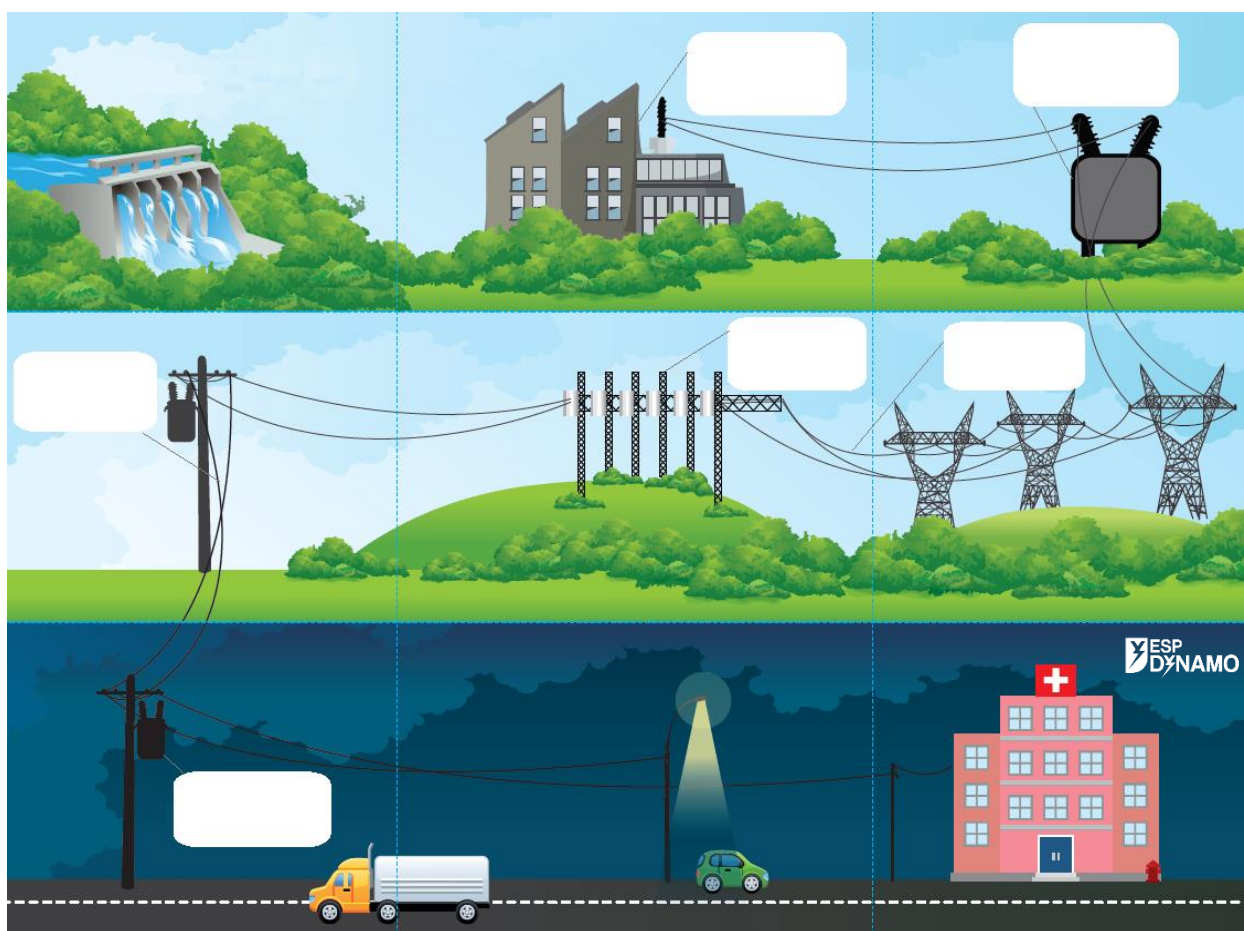
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Unit 3 - Lesson 2

Handout 3B - Pre-task 2

Part 2

Instructions: Work in groups. Analyze the following diagram about the hydroelectric power **transmission** and **distribution** process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



1. step-down transformer	2. powerhouse	3. towers and poles	4. distribution lines
5. transmission lines	6. substation	7. step-up transformer	8. street light



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Unit 3 - Lesson 2

Handout 4 - Pre-task 3

Instructions: Work in groups. Arrange the following steps in a logical sequence to explain the hydroelectric power generation, transmission, and distribution process by writing the number in the corresponding box. Once you finish, practice the sequence orally with a classmate and exchange roles. Use the time expressions at the bottom.

a. Electricity <u>is produced</u> by the generators connected to the turbines.	☐
b. Once the reservoir <u>is filled</u> , water <u>enters</u> through an intake and <u>is directed</u> towards the headrace tunnel.	☐
c. A dam <u>is built</u> to slow down the flow of a river and to create a reservoir.	☐
d. Electricity <u>travels</u> along transmission lines to another substation where step-down transformers take the voltage back to a lower level for local distribution.	☐
e. The headrace tunnel <u>conveys</u> water to a steel penstock, where water <u>flows</u> downhill at high pressure until it gets to the powerhouse.	☐
f. Turbines inside the powerhouse <u>spin</u> by the force of falling water.	☐
g. Electric power <u>is carried</u> from the powerhouse to a substation where transformers <u>step up</u> the voltage for efficient long-distance transmission.	☐
h. Electricity <u>is provided</u> to commercial and residential customers.	☐

Interesting fact:

The Reventazón Hydroelectric Power Plant is the largest infrastructure project in Costa Rica, with a power capacity of 305.5 MW.

It supplies clean energy for 525,000 Costa Rican families.

The dam is 130 m tall, and the reservoir area is 7 km².



Useful Language



Time expressions to describe a process

▪ First, Second, Third, ...	▪ Next, ...
▪ First of all, ...	▪ After that, ...
▪ Then, ...	▪ Finally, ...



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Unit 3 - Lesson 2

Handout 5 - Main Task

Instructions: Work in groups. Imagine that you are attending a meeting with a company interested in clean and sustainable electrical projects in Costa Rica. Choose a renewable resource (geothermal or wind), complete the exercises and then describe the power generation process orally. Rehearse with your partner(s) and be ready to present in front of the class.

Tips for a Successful Presentation:

- Decide which member of your group will present each idea.
- Greet the audience and include a brief introduction, a body (description of the components and the process), and a conclusion.
- Use visual aids.
- Take advantage of the following useful language to guide the audience during the presentation.



Useful Language



Starting	▪ Hello/Good [evening], everyone. ▪ Thank you very much for [inviting me here today].
Stating the purpose	▪ Our purpose/objective/aim today is [to describe clean energy]. ▪ I am here today to [describe power generation].
Giving the structure	▪ This presentation is divided into [number] parts. ▪ First of all, I'd like to look at [the main components]. ▪ Then, I'll be talking about [how the system works]. ▪ Finally, I'll be looking at...
Handling questions	▪ At the end of the presentation, I'll be happy to answer any questions. ▪ Please let me know if you have any questions that I can help you with.
Using visual aids	▪ As you can see [here], [there is a generator]. ▪ [On the right/left], we can see [the generator]. ▪ This diagram shows [the process]. ▪ Let's have a look at [the process].
Using transitions	▪ So, let me start by explaining [the background]. ▪ Now, let's move on to/turn to [the next topic]. ▪ Now, I'd like to go on to [the next topic].
Concluding	▪ Let me end by saying that [clean energy is important]. ▪ I'd like to finish by emphasizing that [clean energy is important]. ▪ Thank you for your attention/time.



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Unit 3 - Lesson 2

Handout 6A - Main Task

Situation 1 - Wind Power

Instructions: Work in groups. Analyze the following diagram about the wind power **generation** process. Then, complete the blank spaces with the correct technical component from the box.



- | |
|---|
| a. Gear box: A set of gears located between the turbine rotor and the generator to increase rotation speed |
| b. Nacelle: A housing that protects the mechanical and electrical elements |
| c. Shaft: A structure that connects the turbine with the generator |
| d. Tower: A structure that supports the nacelle and the turbine rotor |
| e. Blades: The main components that constitute and drive the turbine rotor |
| f. Generator: A machine that converts mechanical energy into electric power. |
| g. Cables: Conductors that convey electrical power from the tower to the power station |
| h. Sensors: A set of devices to measure wind speed and weather conditions |



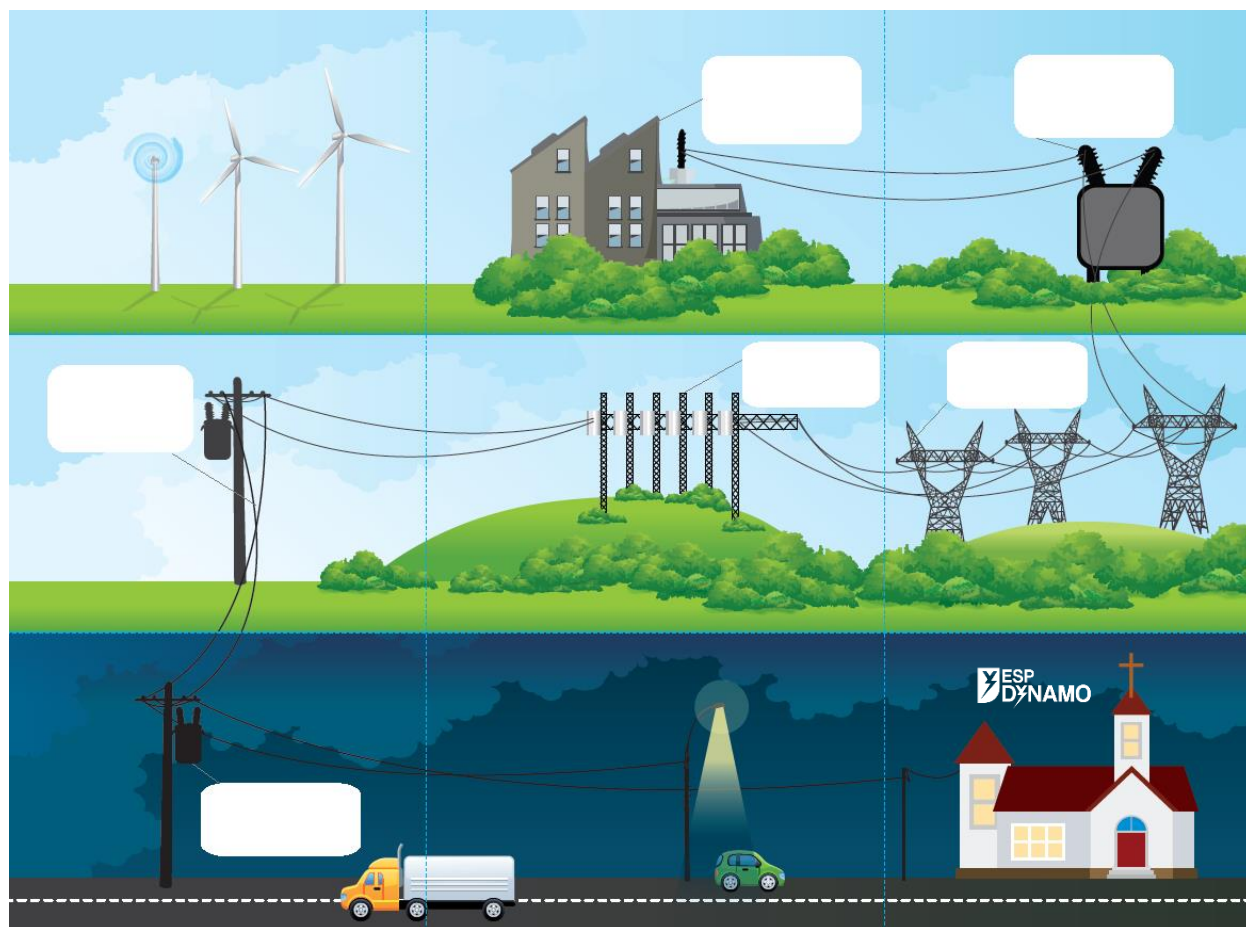
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Handout 6B - Main Task

Situation 1 - Wind Power

Instructions: Work in groups. Analyze the following diagram about the wind power **transmission** and **distribution** process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



1. step-down transformer	2. powerhouse	3. towers and poles	4. distribution lines
5. transmission lines	6. substation	7. step-up transformer	8. wind turbines



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Handout 6C - Main Task

Situation 1 - Wind Power

Instructions: Work in groups. Arrange the following steps in a logical sequence to explain the wind power generation, transmission, and distribution process by writing the number in the corresponding box. Once you finish, practice the sequence orally with a classmate and exchange roles. Use the time expressions at the bottom.

a. Electricity is distributed to consumers through the local network.	☐
b. Electric power flows down the tower shaft so that it can be transferred from the wind farm to a substation.	☐
c. Generators convert mechanical energy into AC electricity.	☐
d. Electricity is carried along transmission lines to another substation where step-down transformers reduce voltage for local distribution.	☐
e. The gearbox increases the rotation speed transmitted to the generator.	☐
f. In the substation, transformers step up the voltage for efficient long-distance transmission.	☐
g. The wind blows and rotates the blades of the wind turbine. The higher the turbine, the more electricity it generates.	☐



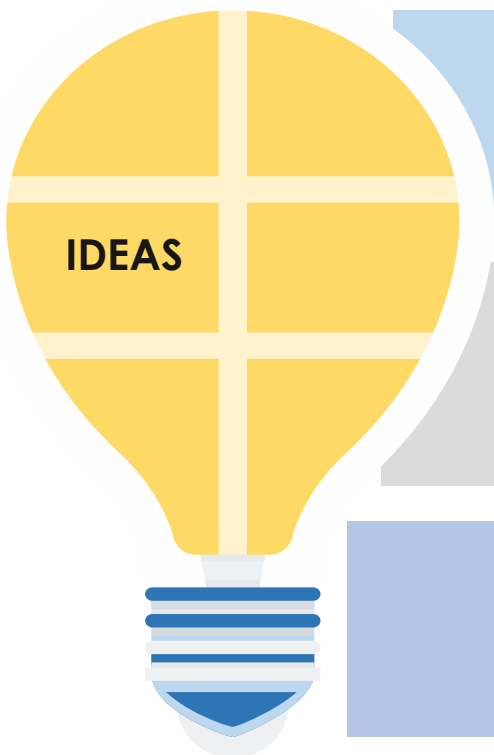
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Handout 6D - Main Task

Situation 1 - Wind Power

Instructions: Work in groups. After reviewing the components and the steps of the wind power generation process, create a mind map as a guide for your presentation. Think about any details and useful language you may add to describe the process and customize your map as necessary.



Introduction:

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Development:

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Conclusion:

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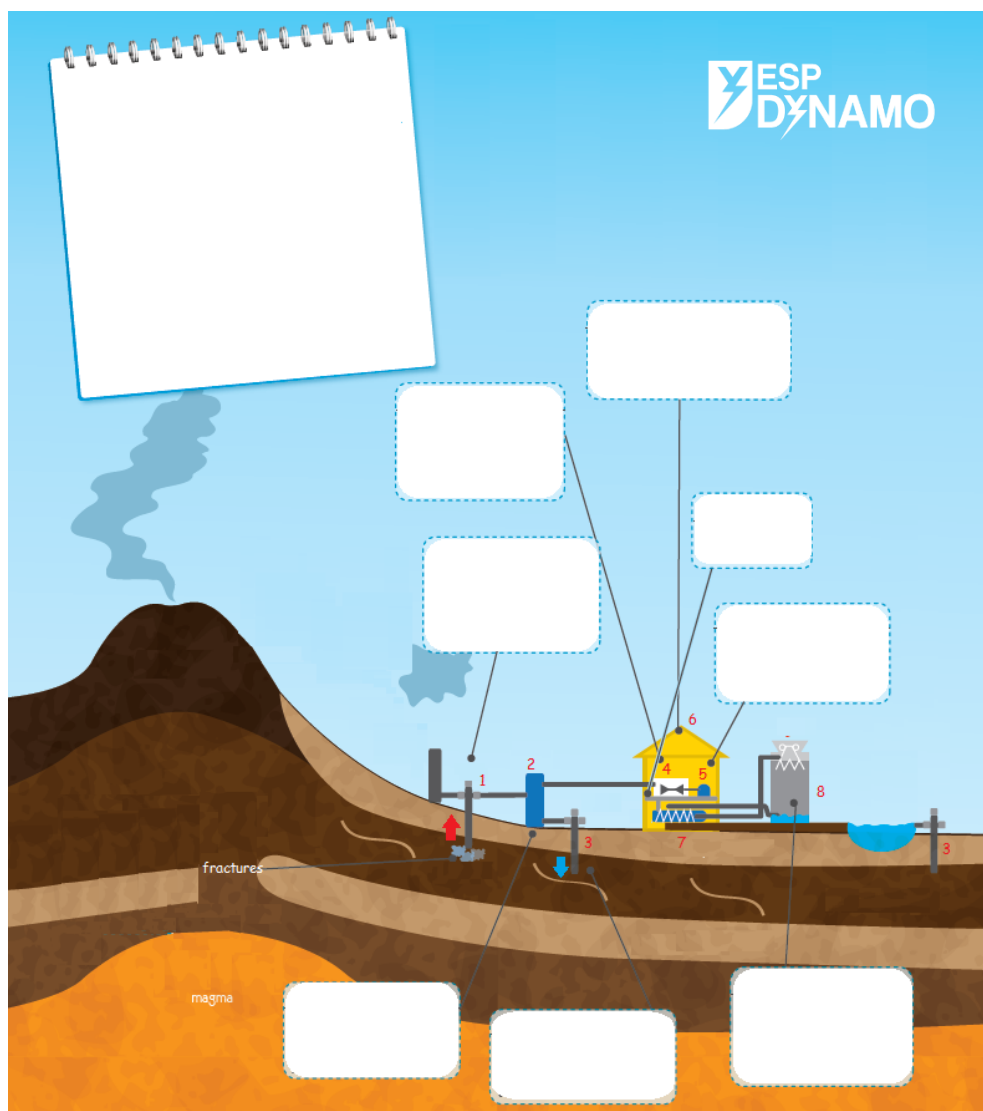
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Unit 3 - Lesson 2

Handout 7A - Main Task

Situation 2 - Geothermal Power

Instructions: Work in groups. Analyze the following diagram about the geothermal power **generation** process. Then, complete the blank spaces with the correct technical component from the box.



- | |
|---|
| a. Separator: A system that separates water from steam after extraction |
| b. Powerhouse: A building that houses the turbines and the generators |
| c. Cooling tower: A structure that keeps water from the condenser at low temperatures |
| d. Production well: A drilled hole that allows the upward extraction of geothermal fluid from the rock fractures |
| e. Condenser: A heat exchanger that transforms steam into liquid state |
| f. Generator: A machine that converts mechanical energy into electric power |
| g. Turbine: A rotary machine that converts the kinetic energy of steam into mechanical energy |
| h. Reinjection wells: Drilled holes that return geothermal fluids back into the earth |



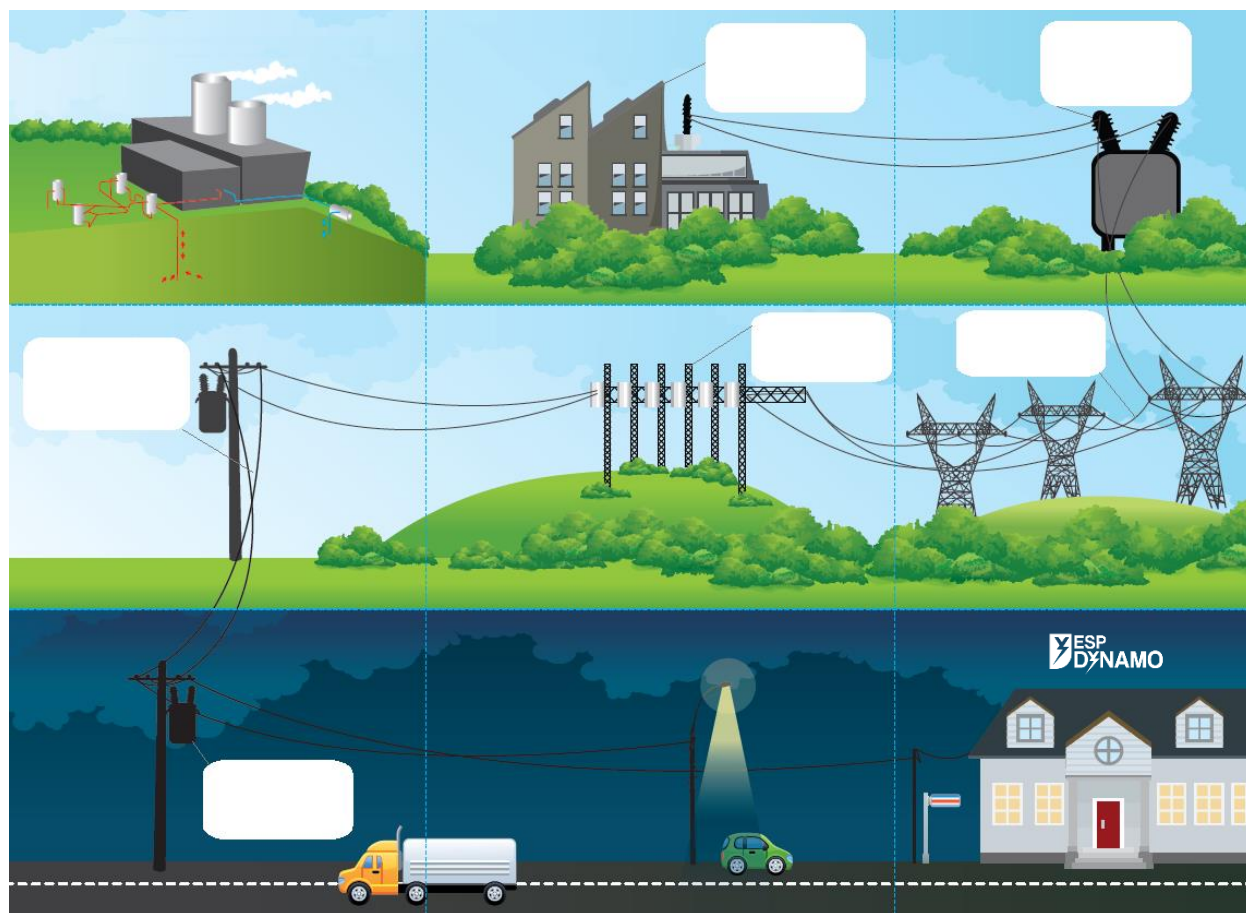
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Handout 7B - Main Task

Situation 2 - Geothermal Power

Instructions: Work in groups. Analyze the following diagram about the geothermal power **transmission** and **distribution** process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



1. step-down transformer	2. powerhouse	3. towers and poles	4. distribution lines
5. transmission lines	6. substation	7. step-up transformer	8. production well



Handout 7C - Main Task

Situation 2 - Geothermal Power

Instructions: Work in groups. Arrange the following steps in a logical sequence to explain the geothermal power generation, transmission, and distribution process by writing the number in the corresponding box. Once you finish, practice the sequence orally with a classmate and exchange roles. Use the time expressions at the bottom.

a. Steam spins a turbine connected to a generator to produces electricity.	☐
b. Geothermal fluid, a mixture of water and steam at high temperature, is pumped from underground to the surface through a production well under pressure.	☐
c. A condenser converts steam back into water for maximum efficiency.	☐
d. Electricity is increased by step-up transformers for transmission and then reduced by step-down transformers for distribution to consumers.	☐
e. A steam-water separator is used to ensure that only clean steam enters the turbine.	☐
f. The cooling tower cools off the water from the condenser, so that it can be pumped back through reinjection wells to begin the process again.	☐
g. When hot water reaches the surface, the pressure is dropped, causing the water to turn into steam.	☐



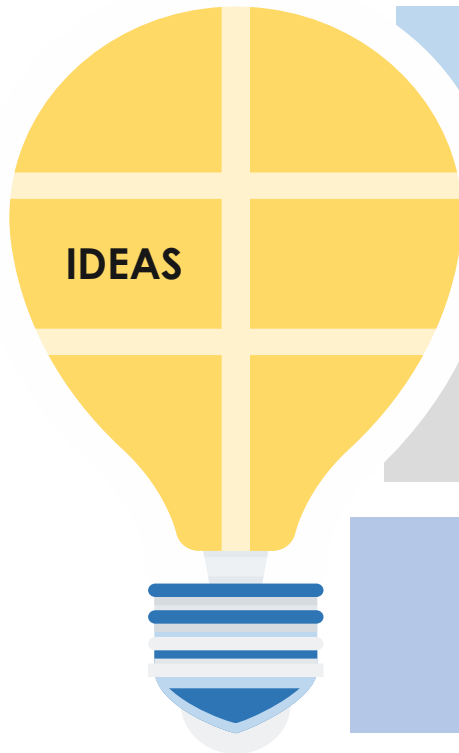
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Handout 7D - Main Task

Situation 2 - Geothermal Power

Instructions: Work in groups. After reviewing the components and the steps of the geothermal power generation process, create a mind map as a guide for your presentation. Think about any details and useful language you may add to describe the process and customize your map as necessary.



Introduction:

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-

Development:

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-

Conclusion:

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-



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Handout 8 - Post-Task

The Passive Voice

Read the following sentences. What do they have in common?

- The turbines are attached to the generators by means of a shaft.
- Water was directed towards the tunnel.
- Electricity is provided to commercial and residential customers.

All of them use a form of the verb **to be + a past participle**. In English, this verb structure is called **the passive voice**.

To describe a product or a process, you can use the simple present tense, for example:

- The step-up transformer increases the voltage for long-distance transmission.
- The wind moves the blades to produce electric power.

However, it is also common to use the passive voice. This is because, when talking about a process, mentioning who performs an action is often not important or relevant.

- The dam is filled with water.
- The generators are stored in the powerhouse.

To specify who or what performs an action, use “by” with the passive.

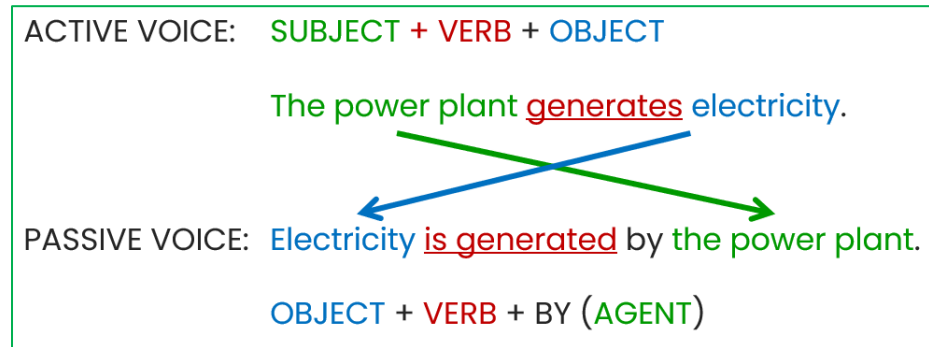
- A meeting was held **by the electrical engineering team** to identify trends in the field.
- Overhead power lines are supported **by transmission towers**.

Remember that verbs that do not take an object (e.g., travel) cannot be used in the passive voice.

- Electricity ~~is travelled~~ through the power lines.

How do you write sentences in the passive voice?

It is necessary to make some changes in the order of elements as follows:



Remember:

The passive voice uses a form of the verb **TO BE + a past participle**



Let's Practice

Instructions: Work individually. Rewrite the following sentences in the passive voice.

1. The penstock conveys pressurized water to the powerhouse.
2. The gearbox increases the rotation speed transmitted to the generator.
3. International journals recognized Costa Rica's efforts on renewable power generation.
4. The presentation included the latest hydropower process flow chart.
5. Solar panels capture sunlight to produce electricity.
6. The cooling tank lowers water temperature for reinjection into the earth.



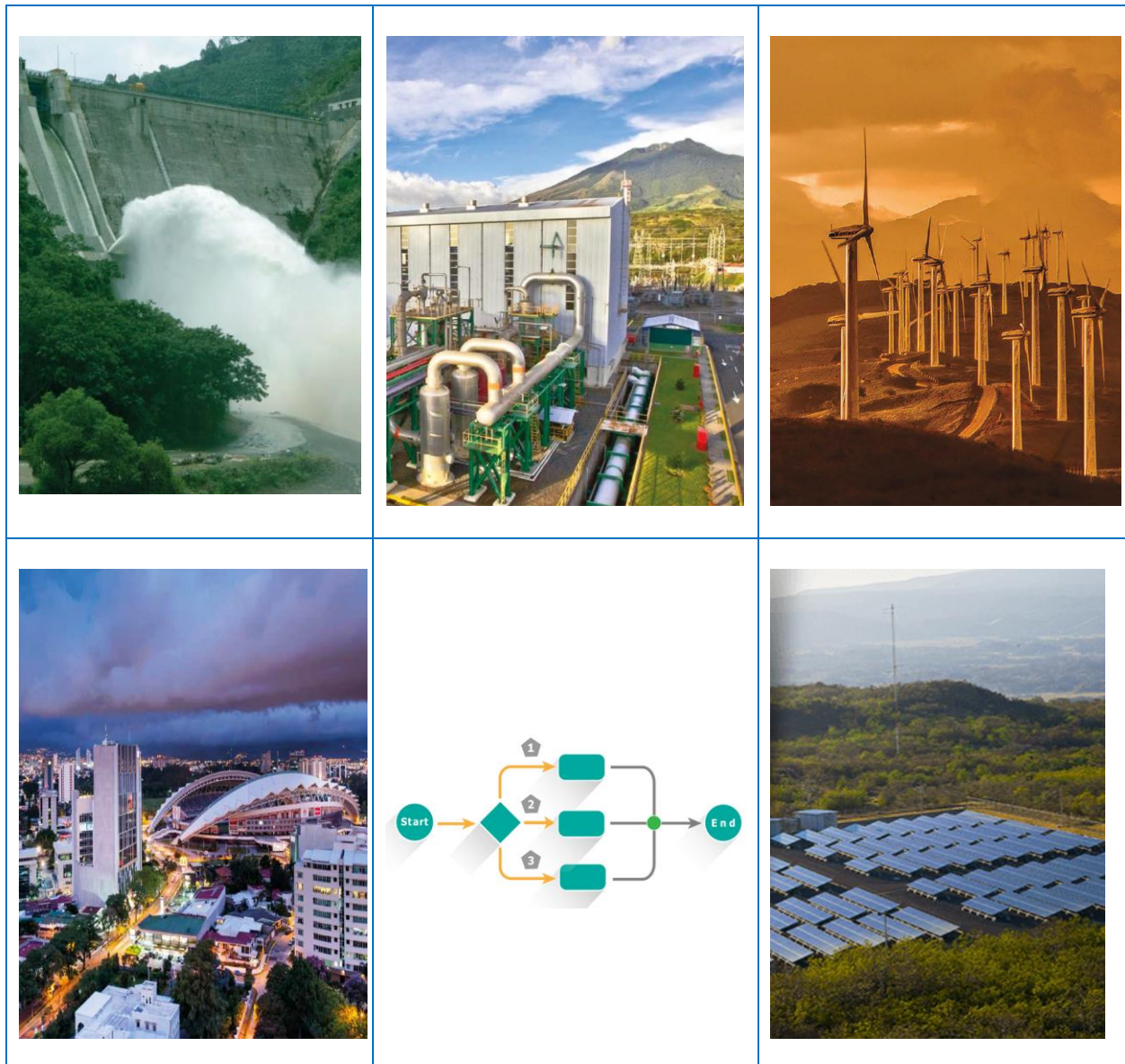
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Unit 3 - Lesson 2

Answer Key: Handout 1 - Warm-up

Part 1

Instructions: Make predictions about the topic of the class based on the following pictures:



What do you think today's class is going to be about?

Part 2

Instructions: Think about the following questions and share your ideas with the rest of the class:

Sustainable Energy: An Influential Trend for Electrical Engineering in 2021

- What is the difference between **renewable** and **nonrenewable** sources of energy? Give an example of each. RE includes water, wind, solar, and geothermal sources. NRE have a limited supply and include fossil fuels.
- Do you think that sustainable energy systems have become **an influential trend** for Electrical Engineering? Why?
- What are some examples of **power plants** here in Costa Rica? Have you ever been to one? Tell us about your experience. Reventazón, Pirrís, Pailas, Miravalles, etc.
- If you had to describe how electricity is produced in a power plant, what aspects would you include in the description?

Useful Language



Giving an opinion	▪ <u>I would say that</u> there are many cutting-edge projects in the field. ▪ <u>It seems to me that</u> clean energy is a trend and a key topic for today's class. ▪ <u>As far as I know</u>, if the supply does not meet the demand, the power system can fail and cause blackouts.		
Negotiating meaning	▪ <u>What do you mean by</u> "AC"? ▪ <u>Could you repeat that again, please?</u> ▪ <u>Could you please elaborate more on</u> this topic? ▪ <u>Sure! What I mean is</u> that we don't need three-phase AC in our homes. Single-phase is enough.		
Showing interest	▪ Alright! ▪ Definitely! ▪ I see.	▪ I understand. ▪ Really? ▪ Sounds good.	▪ That's a good idea. ▪ That's interesting.

Describing is an essential skill that helps people understand more about the specific characteristics and details of a person, place, or thing. For example, to describe **a product** (e.g., a motherboard, a drone, a cable, etc.) or **a system or process** (e.g., a technical procedure), you can refer to its main components and then explain the steps required for its operation.



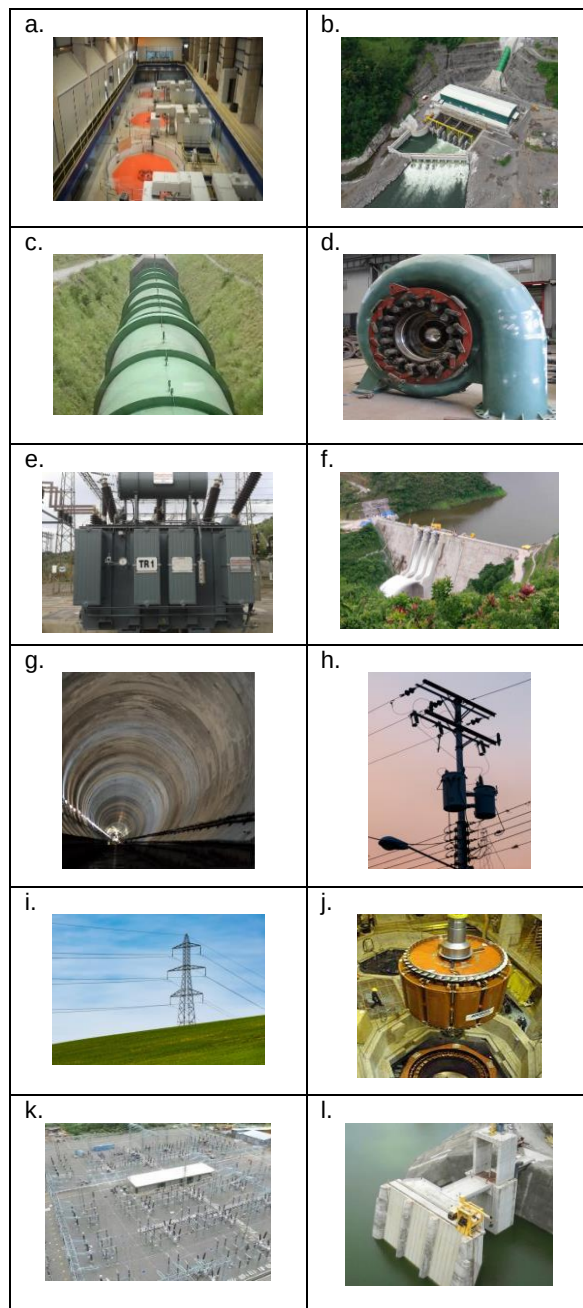
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Unit 3 - Lesson 2

Answer Key: Handout 2 - Pre-task 1

Instructions: In groups, match each technical definition with the corresponding picture by writing the letter in the correct box.

1. F	☐ Dam: A barrier that <u>prevents</u> the flow of a river to form a reservoir .
2. L	☐ Intake: An entrance that <u>directs</u> water from the reservoir towards the headrace tunnel and <u>prevents</u> the passage of foreign matter.
3. G	☐ Headrace tunnel: A large underground work that <u>conveys</u> water from the reservoir to the penstock.
4. C	☐ Penstock: A steel structure that <u>carries</u> water from the tunnel to the powerhouse at high pressure.
5. A	☐ Powerhouse: A structure that <u>houses</u> the turbo generator units to produce electricity.
6. K	☐ Substation: A facility that <u>converts</u> electricity generated by the powerhouse for transmission and distribution to the grid .
7. D	☐ Turbine: A rotary machine that <u>converts</u> the kinetic energy of a fluid into mechanical energy. It is <u>attached</u> to a generator by a long shaft .
8. J	☐ Generator: A machine that <u>converts</u> mechanical energy into electric power. It <u>consists of</u> a large spinning rotor and a stationary stator .
9. B	☐ Tailrace channel: A structure that <u>releases</u> water back into a river.
10. E	☐ Transformer: A machine that <u>increases</u> (<u>steps up</u>) or <u>reduces</u> (<u>steps down</u>) voltage.
11. I	☐ Overhead power line: A cable that <u>transmits</u> and <u>distributes</u> electrical power and that can be supported by transmission towers or poles .
12. H	☐ Utility pole: A column that <u>supports</u> distribution lines and other related equipment such as transformers and street lights.





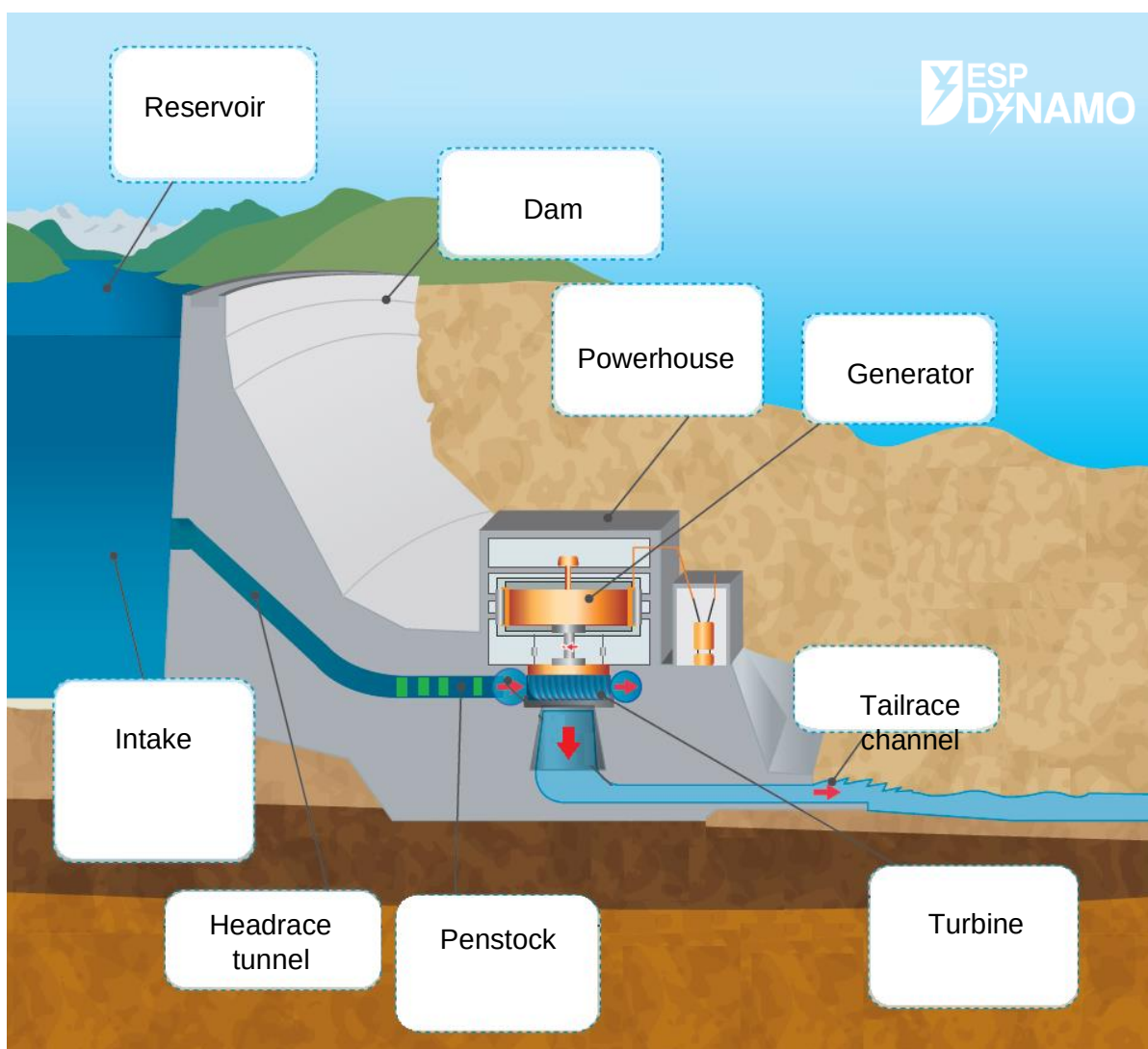
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Answer Key: Handout 3A - Pre-task 2

Part 1

Instructions: Work in groups. Analyze the following diagram about the hydroelectric power **generation** process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



1. penstock	2. powerhouse	3. headrace tunnel	4. reservoir	5. power line	6. intake
7. dam	8. grid	9. tailrace channel	10. pole	11. generator	12. turbine



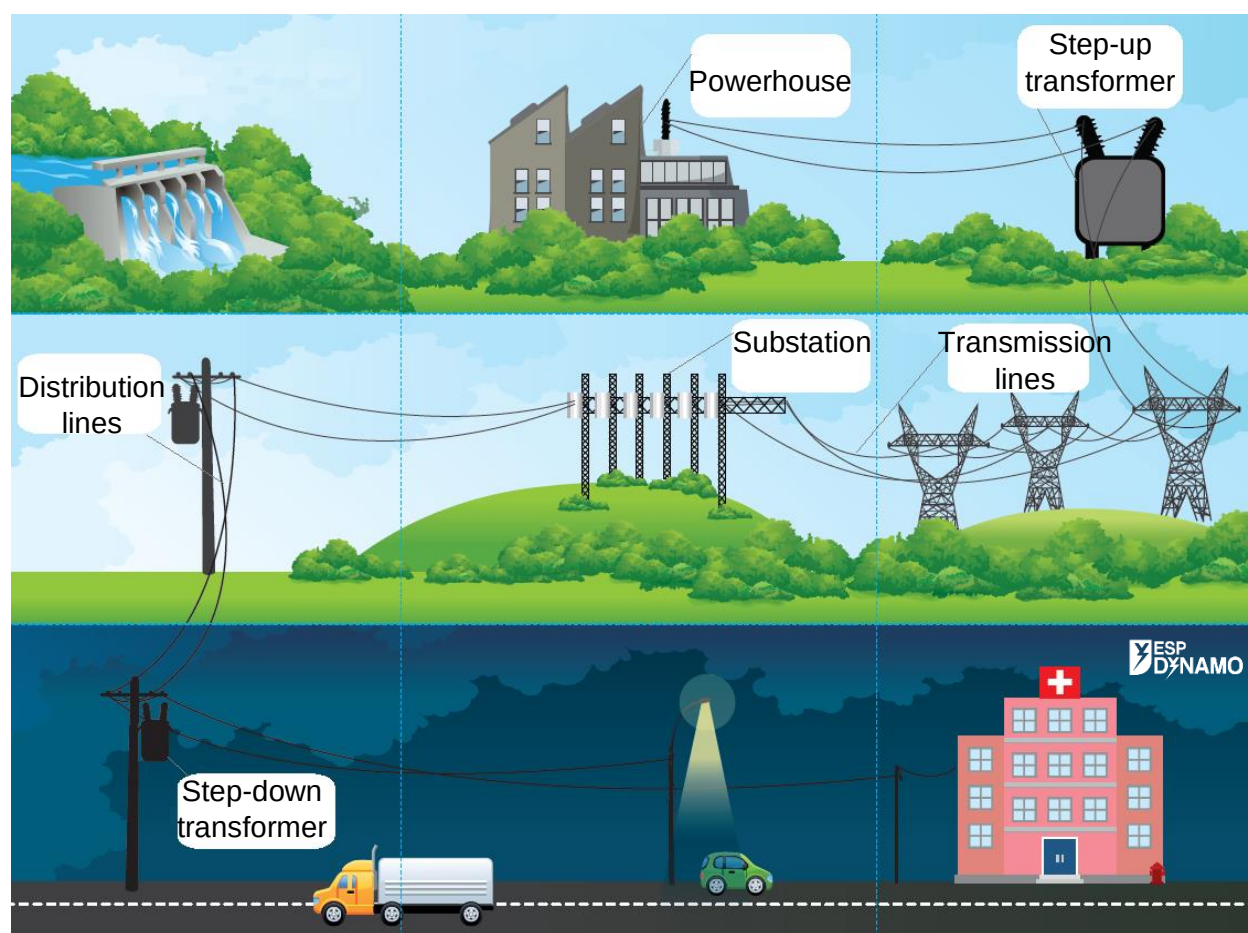
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Answer Key: Handout 3B - Pre-task 2

Part 2

Instructions: Work in groups. Analyze the following diagram about the hydroelectric power **transmission** and **distribution** process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



1. step-down transformer	2. powerhouse	3. towers and poles	4. distribution lines
5. transmission lines	6. substation	7. step-up transformer	8. street light



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Answer Key: Handout 4 - Pre-task 3

Instructions: Work in groups. Arrange the following steps in a logical sequence to explain the hydroelectric power generation, transmission, and distribution process by writing the number in the corresponding box. Once you finish, practice the sequence orally with a classmate and exchange roles. Use the time expressions at the bottom.

a. Electricity <u>is produced</u> by the generators connected to the turbines.	☐ 5
b. Once the reservoir <u>is filled</u> , water <u>enters</u> through an intake and <u>is directed</u> towards the headrace tunnel.	☐ 2
c. A dam <u>is built</u> to slow down the flow of a river and to create a reservoir.	☐ 1
d. Electricity <u>travels</u> along transmission lines to another substation where step-down transformers take the voltage back to a lower level for local distribution.	☐ 7
e. The headrace tunnel <u>conveys</u> water to a steel penstock, where water <u>flows</u> downhill at high pressure until it gets to the powerhouse.	☐ 3
f. Turbines inside the powerhouse <u>spin</u> by the force of falling water.	☐ 4
g. Electric power <u>is carried</u> from the powerhouse to a substation where transformers <u>step up</u> the voltage for efficient long-distance transmission.	☐ 6
h. Electricity <u>is provided</u> to commercial and residential customers.	☐ 8

Interesting fact:

The Reventazón Hydroelectric Power Plant is the largest infrastructure project in Costa Rica, with a power capacity of 305.5 MW.

It supplies clean energy for 525,000 Costa Rican families.

The dam is 130 m tall, and the reservoir area is 7 km².



Useful Language



Time expressions to describe a process

▪ First, Second, Third, ...	▪ Next, ...
▪ First of all, ...	▪ After that, ...
▪ Then, ...	▪ Finally, ...



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Answer Key: Handout 5 - Main Task

Instructions: Work in groups. Imagine that you are attending a meeting with a company interested in clean and sustainable electrical projects in Costa Rica. Choose a renewable resource (geothermal or wind), complete the exercises and then describe the power generation process orally. Rehearse with your partner(s) and be ready to present in front of the class.

Tips for a Successful Presentation:

- Decide which member of your group will present each idea.
- Greet the audience and include a brief introduction, a body (description of the components and the process), and a conclusion.
- Use visual aids.
- Take advantage of the following useful language to guide the audience during the presentation.



Useful Language



Starting	▪ Hello/Good [evening], everyone. ▪ Thank you very much for [inviting me here today].
Stating the purpose	▪ Our purpose/objective/aim today is [to describe clean energy]. ▪ I am here today to [describe power generation].
Giving the structure	▪ This presentation is divided into [number] parts. ▪ First of all, I'd like to look at [the main components]. ▪ Then, I'll be talking about [how the system works]. ▪ Finally, I'll be looking at...
Handling questions	▪ At the end of the presentation, I'll be happy to answer any questions. ▪ Please let me know if you have any questions that I can help you with.
Using visual aids	▪ As you can see [here], [there is a generator]. ▪ [On the right/left], we can see [the generator]. ▪ This diagram shows [the process]. ▪ Let's have a look at [the process].
Using transitions	▪ So, let me start by explaining [the background]. ▪ Now, let's move on to/turn to [the next topic]. ▪ Now, I'd like to go on to [the next topic].
Concluding	▪ Let me end by saying that [clean energy is important]. ▪ I'd like to finish by emphasizing that [clean energy is important]. ▪ Thank you for your attention/time.



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Answer Key: Handout 6A - Main Task

Situation 1 - Wind Power

Instructions: Work in groups. Analyze the following diagram about the wind power **generation** process. Then, complete the blank spaces with the correct technical component from the box.



- a. **Gear box:** A set of gears located between the turbine rotor and the generator to increase rotation speed
- b. **Nacelle:** A housing that protects the mechanical and electrical elements
- c. **Shaft:** A structure that connects the turbine with the generator
- d. **Tower:** A structure that supports the nacelle and the turbine rotor
- e. **Blades:** The main components that constitute and drive the turbine rotor
- f. **Generator:** A machine that converts mechanical energy into electric power.
- g. **Cables:** Conductors that convey electrical power from the tower to the power station
- h. **Sensors:** A set of devices to measure wind speed and weather conditions



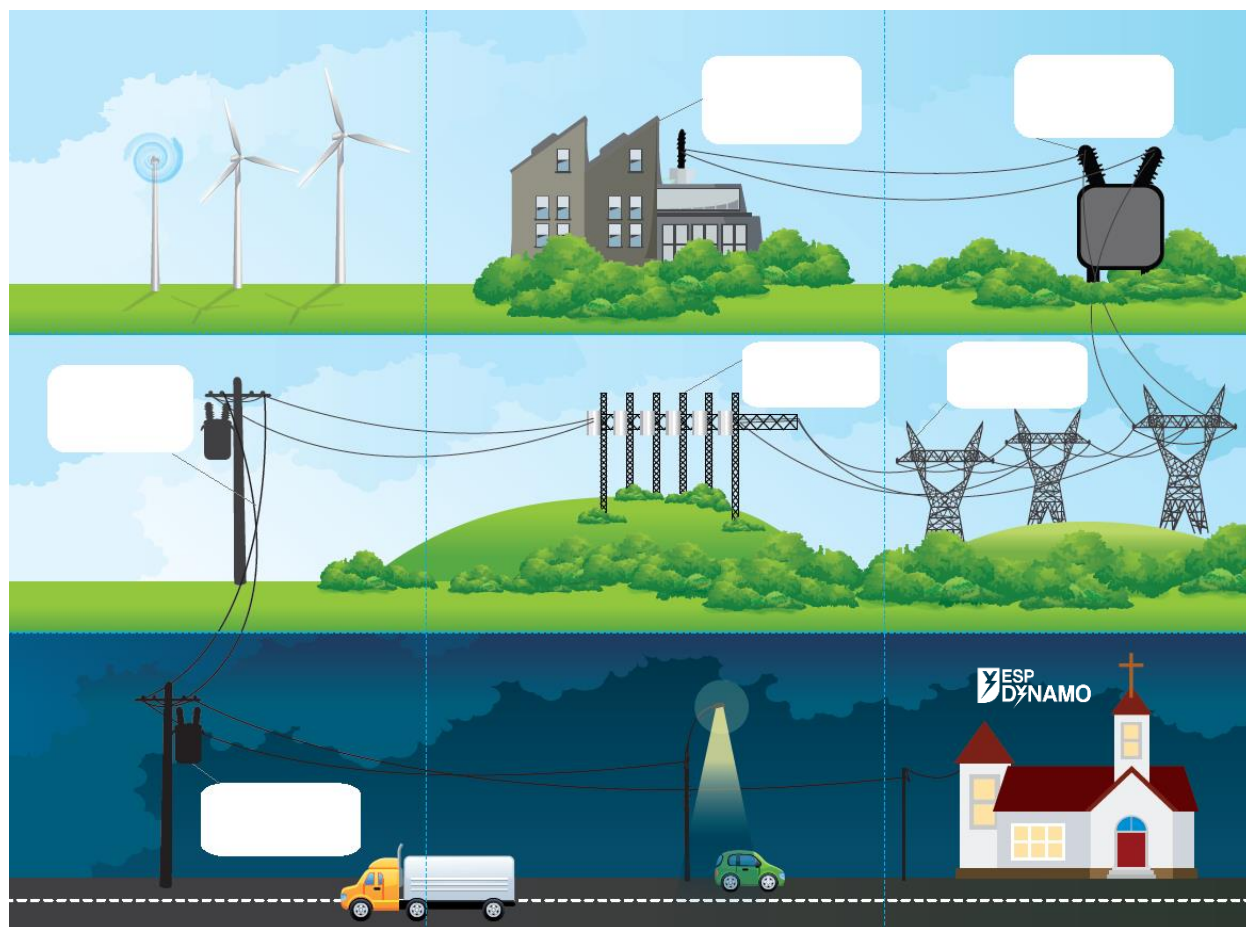
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Answer Key: Handout 6B - Main Task

Situation 1 - Wind Power

Instructions: Work in groups. Analyze the following diagram about the wind power **transmission** and **distribution** process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



1. step-down transformer	2. powerhouse	3. towers and poles	4. distribution lines
5. transmission lines	6. substation	7. step-up transformer	8. wind turbines



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Answer Key: Handout 6C - Main Task

Situation 1 - Wind Power

Instructions: Work in groups. Arrange the following steps in a logical sequence to explain the wind power generation, transmission, and distribution process by writing the number in the corresponding box. Once you finish, practice the sequence orally with a classmate and exchange roles. Use the time expressions at the bottom.

a. Electricity is distributed to consumers through the local network.	☐ 7
b. Electric power flows down the tower shaft so that it can transferred from the wind farm to a substation.	☐ 4
c. Generators convert mechanical energy into AC electricity.	☐ 3
d. Electricity is carried along transmission lines to another substation where step-down transformers reduce voltage for local distribution.	☐ 6
e. The gearbox increases the rotation speed transmitted to the generator.	☐ 2
f. In the substation, transformers step up the voltage for efficient long-distance transmission.	☐ 5
g. The wind blows and rotates the blades of the wind turbine. The higher the turbine, the more electricity it generates.	☐ 1



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Answer Key: Handout 6D - Main Task

Situation 1 - Wind Power

Instructions: Work in groups. After reviewing the components and the steps of the wind power generation process, create a mind map as a guide for your presentation. Think about any details and useful language you may add to describe the process and customize your map as necessary.



Introduction:

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Development:

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Conclusion:

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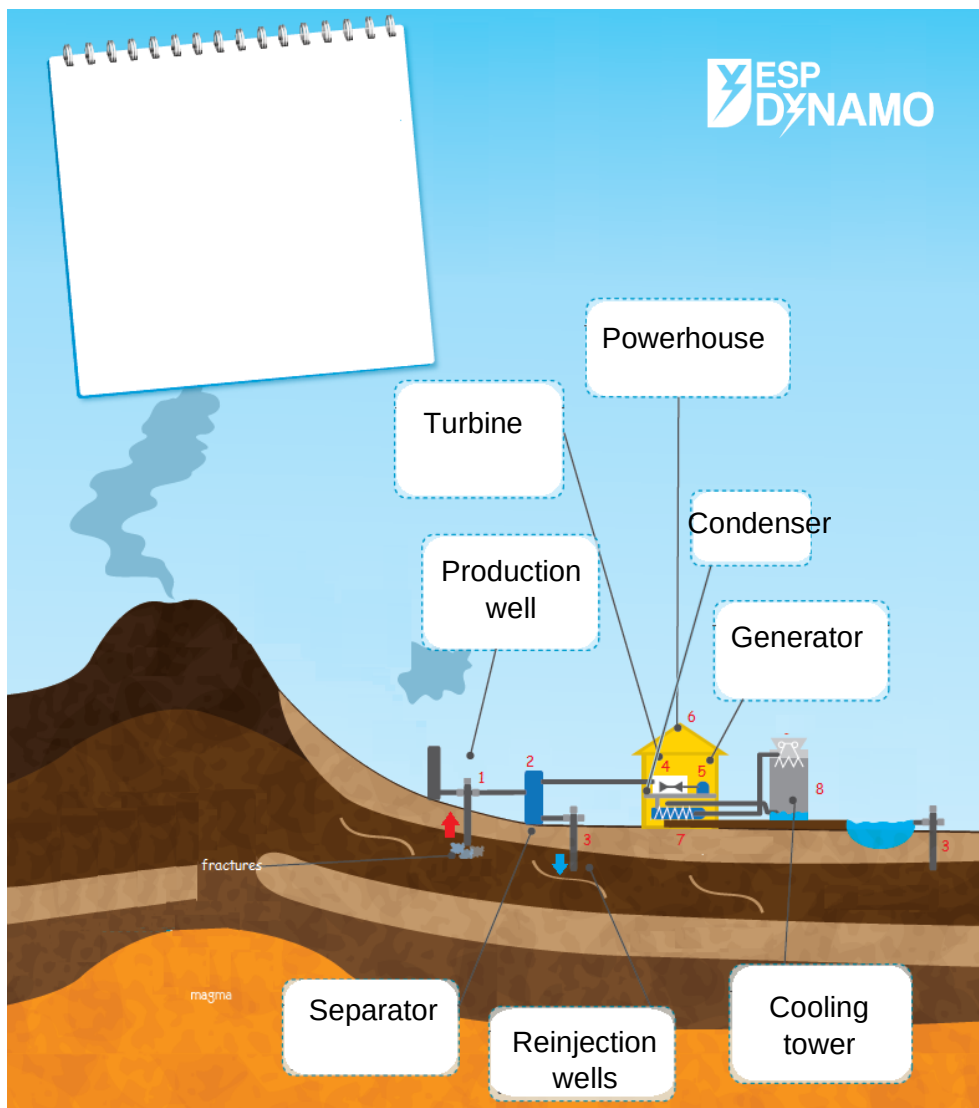
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Answer Key: Handout 7A - Main Task

Situation 2 - Geothermal Power

Instructions: Work in groups. Analyze the following diagram about the geothermal power **generation** process. Then, complete the blank spaces with the correct technical component from the box.



- | |
|---|
| a. Separator: A system that separates water from steam after extraction |
| b. Powerhouse: A building that houses the turbines and the generators |
| c. Cooling tower: A structure that keeps water from the condenser at low temperatures |
| d. Production well: A drilled hole that allows the upward extraction of geothermal fluid from the rock fractures |
| e. Condenser: A heat exchanger that transforms steam into liquid state |
| f. Generator: A machine that converts mechanical energy into electric power |
| g. Turbine: A rotary machine that converts the kinetic energy of steam into mechanical energy |
| h. Reinjection wells: Drilled holes that return geothermal fluids back into the earth |



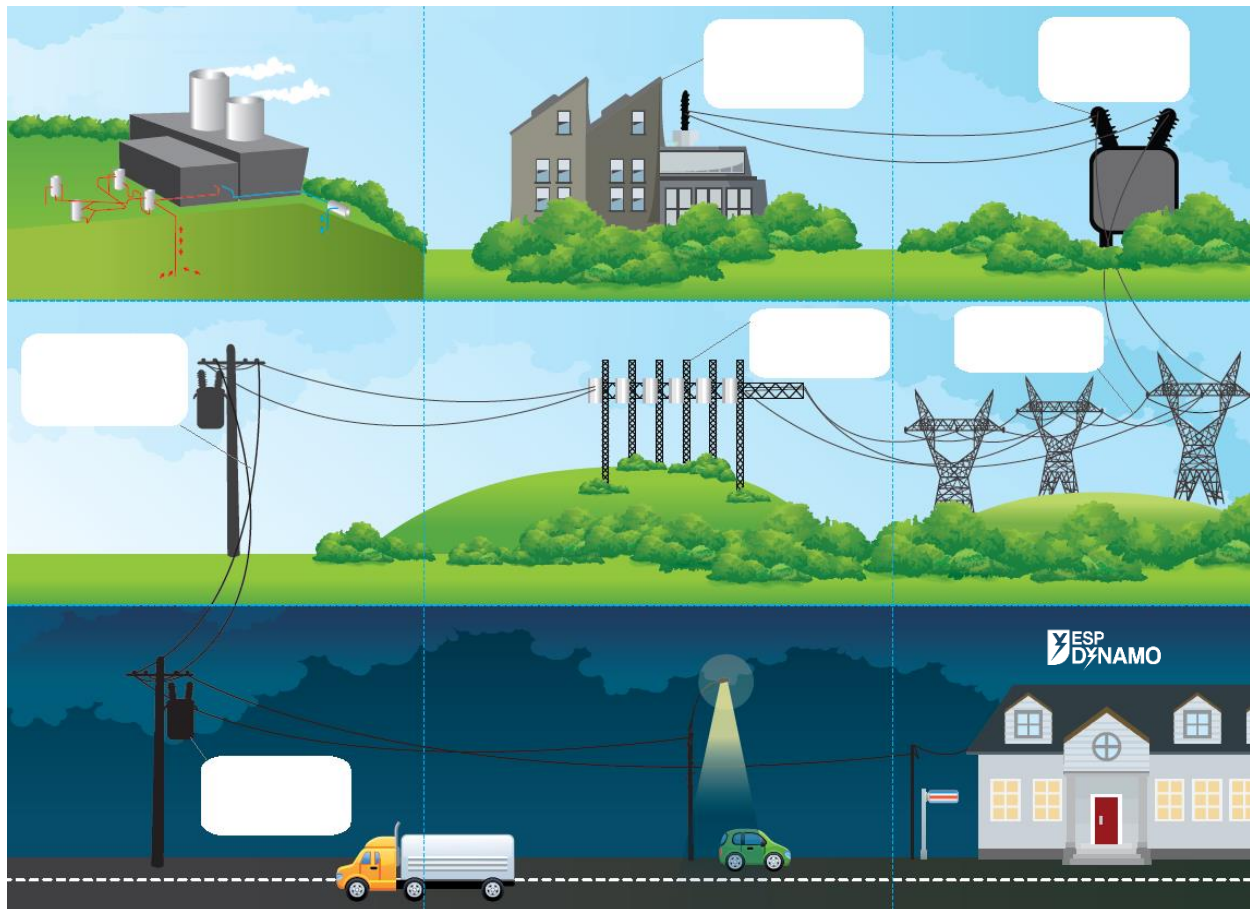
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Answer Key: Handout 7B - Main Task

Situation 2 - Geothermal Power

Instructions: Work in groups. Analyze the following diagram about the geothermal power **transmission** and **distribution** process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



1. step-down transformer	2. powerhouse	3. towers and poles	4. distribution lines
5. transmission lines	6. substation	7. step-up transformer	8. production well



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Answer Key: Handout 7C - Main Task

Situation 2 - Geothermal Power

Instructions: Work in groups. Arrange the following steps in a logical sequence to explain the geothermal power generation, transmission, and distribution process by writing the number in the corresponding box. Once you finish, practice the sequence orally with a classmate and exchange roles. Use the time expressions at the bottom.

a. Steam spins a turbine connected to a generator to produces electricity.	☐ 4
b. Geothermal fluid, a mixture of water and steam at high temperature, is pumped from underground to the surface through a production well under pressure.	☐ 1
c. A condenser converts steam back into water for maximum efficiency.	☐ 5
d. Electricity is increased by step-up transformers for transmission and then reduced by step-down transformers for distribution to consumers.	☐ 7
e. A steam-water separator is used to ensure that only clean steam enters the turbine.	☐ 3
f. The cooling tower cools off the water from the condenser, so that it can be pumped back through reinjection wells to begin the process again.	☐ 6
g. When hot water reaches the surface, the pressure is dropped, causing the water to turn into steam.	☐ 2



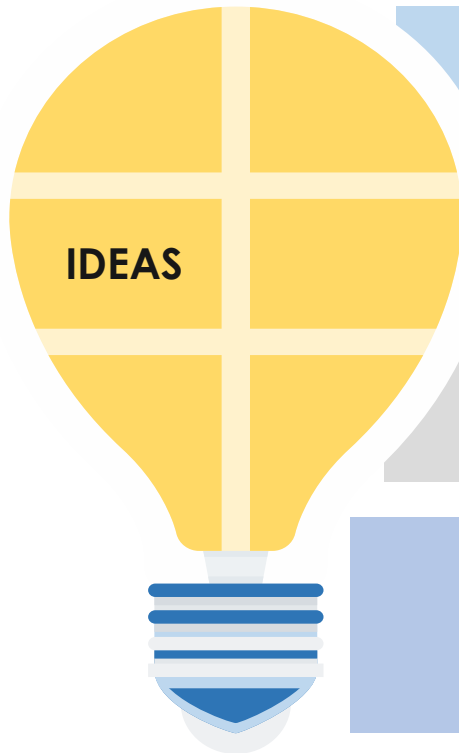
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Answer Key: Handout 7D - Main Task

Situation 2 - Geothermal Power

Instructions: Work in groups. After reviewing the components and the steps of the geothermal power generation process, create a mind map as a guide for your presentation. Think about any details and useful language you may add to describe the process and customize your map as necessary.



Introduction:

-
-
-

Development:

-
-
-

Conclusion:

-
-
-



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Answer Key: Handout 8 - Post-Task

The Passive Voice

Read the following sentences. What do they have in common?

- The turbines are attached to the generators by means of a shaft.
- Water was directed towards the tunnel.
- Electricity is provided to commercial and residential customers.

All of them use a form of the verb **to be + a past participle**. In English, this verb structure is called **the passive voice**.

To describe a product or a process, you can use the simple present tense, for example:

- The step-up transformer increases the voltage for long-distance transmission.
- The wind moves the blades to produce electric power.

However, it is also common to use the passive voice. This is because, when talking about a process, mentioning who performs an action is often not important or relevant.

- The dam is filled with water.
- The generators are stored in the powerhouse.

To specify who or what performs an action, use “by” with the passive.

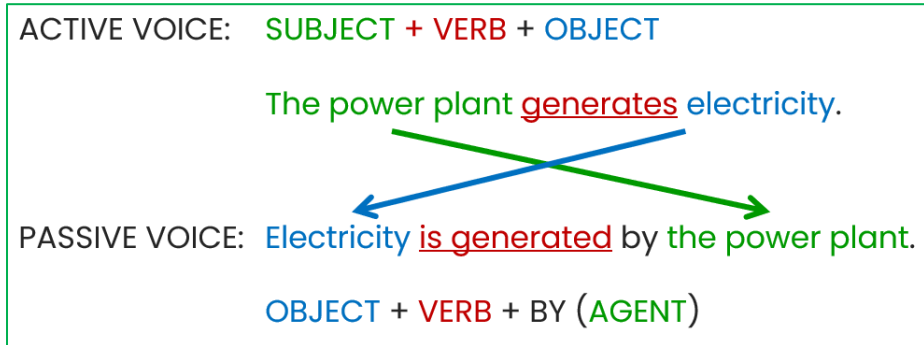
- A meeting was held **by the electrical engineering team** to identify trends in the field.
- Overhead power lines are supported **by transmission towers**.

Remember that verbs that do not take an object (e.g., travel) cannot be used in the passive voice.

- Electricity ~~is travelled~~ through the power lines.

How do you write sentences in the passive voice?

It is necessary to make some changes in the order of elements as follows:



Remember:

The passive voice a form of the verb TO BE + a past participle



Let's Practice

Instructions: Work individually. Rewrite the following sentences in the passive voice.

1. The penstock conveys pressurized water to the powerhouse. Pressurized water is conveyed by the penstock to the powerhouse.
2. The gearbox increases the rotation speed transmitted to the generator. The rotation speed transmitted to the generator is increased by the gearbox.
3. International journals recognized Costa Rica's efforts on renewable power generation. CR's efforts on renewable power generation were recognized by international journals.
4. The presentation included the latest hydropower process flow chart. The latest hydropower process flow chart was included in the presentation.
5. Solar panels capture sunlight to produce electricity. Sunlight is captured by solar panels to produce electricity.
6. The cooling tank lowers water temperature for reinjection into the earth. Water temperature is lowered by the cooling tank for reinjection into the earth.



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Unit 3: Engineering the Future

Lesson 3: Business Idea

Date: November 9, 2021

Unit Goal: By the end of the unit, the students will be able to effectively describe orally and in writing their interest in participating in an international trade fair, an innovative product or system in the field of Electrical Engineering, and a business idea for a solution to a problem.

General Objective: By the end of the lesson, the students will be able to effectively design and present a business idea in the field of Electrical Engineering, including information about the entrepreneurs, the problem to be solved, and the value proposition or competitive advantages of the proposed product or service.

Specific Objectives: By the end of this lesson, the students will be able to:

1. appropriately brainstorm key ideas related to concepts such as entrepreneur, business idea, and business pitch by discussing three questions while interacting in groups;
2. effectively demonstrate understanding of the concept of a “business idea” by discussing key aspects of a business idea design and problems that could be solved in the Electrical Engineering field while working in groups;
3. properly describe a business idea by discussing the problem to be solved, the proposed solution, the social and environmental impact of the product or service, the value proposition, and its features while working in groups;
4. appropriately describe the entrepreneurial team involved in the design of a business idea of their choice by completing a diagram with information about the team members’ backgrounds and goal, the proposed business’s commercial activities, and the team’s strengths while interacting in groups;
5. successfully design and present a business idea in the field of Electrical Engineering, including information about the entrepreneurs, the problem to be solved, and its value proposition;

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

6. effectively show understanding of the use of gerunds after prepositions by completing a fill-in-the-blanks exercise individually; and
7. demonstrate understanding of the use of simple, compound, and complex sentences by correcting punctuation errors in a series of email excerpts individually.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Brainstorming ideas T reviews the goal of the class and activates schemata by asking Ss about the meaning of words such as entrepreneur, business idea, and business pitch. T draws the learners' attention to the useful language. (Handout 1) Ss discuss the questions in breakout rooms first. Then, T goes over the answers as a whole group and further elaborates on the concepts to ensure they are all clear to Ss.	S, L	Giving an opinion: - I would say that... - It seems to me that... - As far as I know, ... Negotiating meaning: - What do you mean by...? - Could you repeat that again, please? - Could you please elaborate more on this topic? - Sure! What I mean is... Showing interest: - Alright! - Definitely! - I see. - I understand. - Really? - Sounds good. - That's a good idea. - That's interesting.	Cognitive: - Predicting Creative: - Brainstorming Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
2	Pre-task 1: Ss read the definition of a business idea and a value proposition. Ss also review a series of questions about aspects to be considered when designing a business idea. (Handout 2A) Using Handout 2B, Ss brainstorm at least three problems that could be addressed through a business solution in their area of specialization. Then, Ss choose one problem they would like to solve as a team. T monitors the activity and provides support as required.	W, S, L	Giving an opinion: - I would say that... - It seems to me that... - As far as I know, ... Negotiating meaning: - What do you mean by...? - Could you repeat that again, please? - Could you please elaborate more on this topic? - Sure! What I mean is... Showing interest: - Alright! - Definitely! - I see. - I understand. - Really? - Sounds good. - That's a good idea. - That's interesting.	Interpersonal: - Cooperating Affective: - Personalizing Creative: - Brainstorming	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: Then, Ss design a business idea that can solve the problem previously raised. Ss plan their idea by describing the need or problem, how the product or service can solve it, the social and environmental impact of the solution, the value proposition, and the product/service features. (Handout 3) T monitors the activity and provides support and useful language as necessary. As a group, T asks some volunteers to report their experience while designing their business idea.	R, S, L, W	Describing your value proposition: - Our system helps companies that... - One of the advantages of our system/product is that... - Let's look at its main components and attributes... Describing product attributes: advanced alternative automated cleantech compatible computerized cost-saving cutting-edge efficient eco-friendly fifth-generation full-scale futuristic hi-tech hybrid innovative interactive latest	Creative: - Brainstorming Affective: - Personalizing Interpersonal: - Cooperating	20 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			low-cost modern newest promising reliable revolutionary safe sophisticated speedy stand-alone sustainable technical technological trustworthy up-to-date user-friendly wearable wireless		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
4	Pre-task 3: In groups, Ss fill in a diagram with information about the entrepreneurial team involved in the design of their business idea. Ss describe the team members' backgrounds and goal, the proposed business's commercial activities, and the team's strengths. (Handout 4) T monitors the activity and provides support as required. As a whole class, T asks some volunteers to share their experience while interacting in groups. T also asks Ss if it was easy or difficult for them to summarize the information about the members of the team using the diagram.	R, S, L, W	Describing your team/business: - Our team is made up of... - We have experience (doing something → verb + ing). - We have experience with (process). - Our commercial activities include (doing something → verb + ing). - We are good at (doing something → verb+ing).	Creative: - Brainstorming Affective: - Personalizing Interpersonal: - Cooperating	20 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
5	Task: In groups, Ss simulate having been invited to an international trade fair and prepare an oral presentation or pitch to attract clients and sell their business idea. (Handout 5) T reads the instructions and provides some tips for a successful presentation. T monitors the activity and provides support as required. T asks all of the groups to present their business idea in front of the class.	W, S, L	Vocabulary and expressions studied during the pre-tasks, including: - Expressions for giving an opinion, negotiating meaning, showing interest, describing a team/business, describing the value proposition, and describing product attributes.	Linguistic: - Conversationa - I patterns - Practicing Affective: - Personalizing Interpersonal: - Cooperating	50 min Plan and practice 30 min + Present 20 min
6	Post-task: Individually, Ss read some information about the correct use of gerunds after prepositions. Then, they complete a fill-in-the-blanks exercise to practice. (Handout 7)	R, W	Grammar: Gerunds after prepositions: excited about, responsible for, insist on, concentrate on, etc.	Intrapersonal: - Individual student work	30 min.
7	Post-task: Individually, Ss read some information about the correct use of the simple, compound, and complex sentences to reinforce their writing skills. Then, Ss are required to read five email excerpts and correct the punctuation errors by rewriting them. (Handout 8)	R, W	Grammar and vocabulary: Modal auxiliaries: would Pronunciation: Would (silent /l/)	Intrapersonal: - Individual student work	30 min.

Reminders: - Have a 10-minute break.

Homework: N/A

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking
Ss:	The students	W:	Writing	L:	Listening

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

REFERENCES:

Universiteit Utrecht. (2017, September 19). *How to prepare for a job interview* [Video]. YouTube.
<https://www.youtube.com/watch?v=enD8mK9Zvwo>



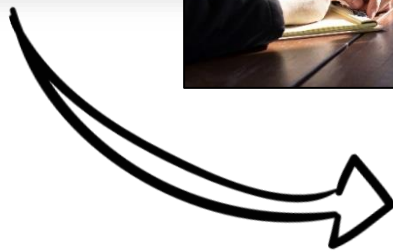
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Unit 3 - Lesson 3

Handout 1 - Warm-up

Instructions: In groups, look at the pictures and discuss the following questions. Then, share your ideas with the rest of the class.

- What is an entrepreneur?
- What is a business idea?
- What is a business pitch?



Useful Language:



Giving an opinion	▪ <u>I would say that</u> business ideas can bring industry-leading solutions. ▪ <u>It seems to me that</u> a business idea does not need to be unique, but it must have the potential to capture its target market. ▪ <u>As far as I know</u>, an entrepreneur is an individual who takes the risk to start a business based on an idea they have or a product they have created.									
Negotiating meaning	▪ <u>What do you mean by</u> “pitch”? ▪ <u>Could you repeat that again, please?</u> ▪ <u>Could you please elaborate more on</u> this topic? ▪ <u>Sure! What I mean</u> is a persuasive speech to sell a product or service.									
Showing interest	<table><tr><td>▪ Alright!</td><td>▪ I understand.</td><td>▪ That’s a good idea.</td></tr><tr><td>▪ Definitely!</td><td>▪ Really?</td><td>▪ That’s interesting.</td></tr><tr><td>▪ I see.</td><td>▪ Sounds good.</td><td></td></tr></table>	▪ Alright!	▪ I understand.	▪ That’s a good idea.	▪ Definitely!	▪ Really?	▪ That’s interesting.	▪ I see.	▪ Sounds good.	
▪ Alright!	▪ I understand.	▪ That’s a good idea.								
▪ Definitely!	▪ Really?	▪ That’s interesting.								
▪ I see.	▪ Sounds good.									



Handout 2A - Pre-task 1

Instructions: Work in groups. Read the following information and discuss the questions below. Then, complete the exercise on the next page.

What is a business idea?

A business idea is a concept that can be used for financial gain and that is usually centered on a product or service offered for money. An idea is the first milestone in the process of building a successful business.

Creating a product or service is not an easy job. It takes a lot of work and planning. The right business begins with a good description of your idea.

Your business idea should always consider your customers/clients' needs or a problem that requires a solution. A good business idea will be compatible with the sustainable use of natural resources, or it can also promote favorable social, educational, or cultural conditions.

Consider the following aspects when designing a business idea:

- *Have you heard of any problems that could be addressed through a business solution in the field of Electrical Engineering?*
- *What need or problem will your business idea address?*
- *What product or service will you sell to solve the problem?*
- *Have you taken the time to understand the background and the needs of prospective clients/customers prior to developing your business idea?*
- *What are the key advantages of your business idea?*
- *How much will your business idea help the society or the environment?*

What is a value proposition?

A value proposition describes the benefits and the value that customers/clients can expect from your products or services. The goal here is to quickly convey why a potential investor or client should care about your business. Keep it short and simple.

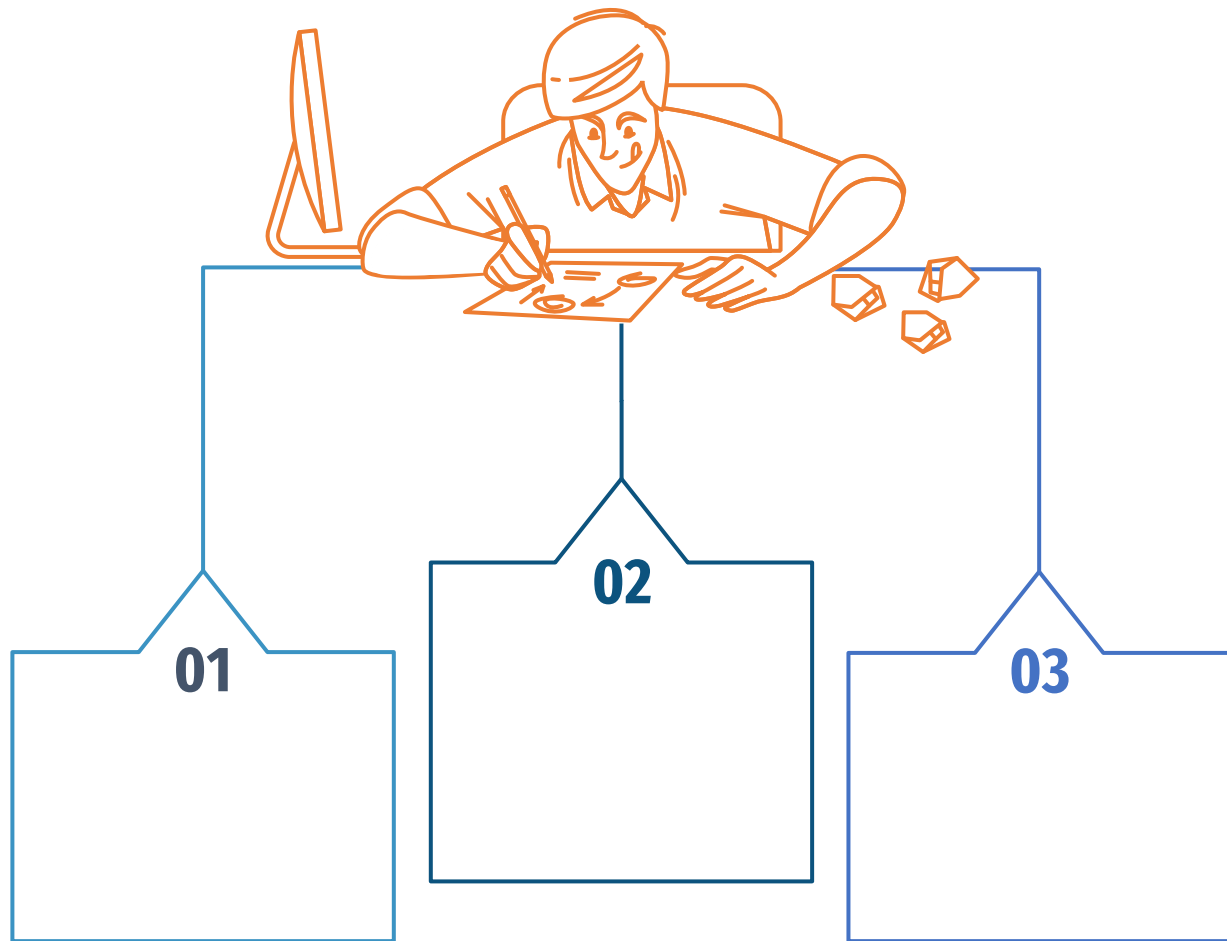


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Handout 2B - Pre-task 1

Instructions: Work in groups. Brainstorm at least three problems that could be addressed through a business solution in the field of Electrical Engineering, specifically in your area of specialization. Then, decide on one problem that all of you would like to solve as a team.





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Handout 3 - Pre-task 2

Instructions: Work in groups. Once you have agreed on a problem, design a business idea that can solve it. Use the form below to describe your proposed business solution including its value proposition.



	Business Idea
1. What specific need or problem does your business idea address?	
2. How does your product or service solve the problem?	
3. Does your product or service provide social or environmental benefits? Give examples (if any).	

4. List up to three key benefits or competitive advantages of your product/service in the market (value proposition).	
5. Describe the product/service features. Use the adjectives studied in Unit 3 – Lesson 1.	

Useful Language: 

Describing your value proposition	▪ <u>Our system helps companies that</u> are committed to making socially responsible business practices a hallmark of their brand. ▪ <u>One of the advantages of our system/product is that</u> it does not require rare materials. ▪ <u>Let's look at its main components and attributes...</u>		
Adjectives to describe product attributes	advanced alternative automated cleantech compatible computerized cost-saving cutting-edge efficient eco-friendly fifth-generation full-scale	futuristic hi-tech hybrid innovative interactive latest low-cost modern newest promising reliable revolutionary	safe sophisticated speedy stand-alone sustainable technical technological trustworthy up-to-date user-friendly wearable wireless



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Handout 4 - Pre-task 3

Instructions: Work in groups. Based on the selected business idea (Pre-task 2), describe your entrepreneurial team by filling in the diagram below with your information.



Useful Language: 

Describing your team/business	▪ <u>Our team is made up of</u> electrical engineers from the University of Costa Rica. ▪ <u>We have experience</u> designing digital circuits and microprocessors. ▪ <u>We have experience with</u> the power transmission and distribution process. ▪ <u>Our commercial activities</u> include preparing project specifications, creating test procedures, writing reports, and interpreting data. ▪ <u>We are good at</u> reducing manual processes through automation.



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Handout 5 - Main Task

Instructions: Work in groups. You have been invited as an entrepreneur to an international trade fair for Electrical Engineering. This is an opportunity to present your business idea and attract potential clients. To make the most of this trade fair, prepare a concise five-minute pitch¹⁹ to convince a group of prospective clients to acquire your product or service.

Consider the following aspects while presenting your pitch:

- Create a PowerPoint presentation as a visual aid.
- Give a name to your product/service.
- Click [here](#) to choose a logo and add it to your slideshow.
- Briefly provide information about your entrepreneurial team by highlighting their expertise.
- Talk about your business idea, specifically the problem to be solved, the proposed solution, and its social or environmental benefits (if any).
- Provide a complete view of the potential value that your product/service holds for customers/clients (benefits, competitive advantages, and features).
- Give the audience some time to ask questions at the end of your pitch.



Tips for a successful presentation:

- Pay attention to your body language. Maintain eye contact, have an open posture, and use hand gestures when appropriate.
- Vary your vocal delivery by adding inflection to your voice, raising or lowering your volume, and speeding up and slowing down.
- Try not to read from notes, except for special circumstances in which you must follow a step-by-step process.
- Answer difficult questions in a calm, confident manner. Be honest if you do not have the information to answer the question.



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Handout 6 - Post-Task

Grammar: Gerunds After Prepositions

The **gerund** is the only verb form used after prepositions. Use a gerund after these common **verb + preposition** combinations:

- Likes, dislikes, emotions: *be afraid of, care for, be excited about, worry about (or be worried about).*

For example: Hellen is excited about applying to the trade fair.

- Interests and efforts: *be interested in, learn about, be responsible for, be successful/good at.*

For example: Project managers (PMs) are responsible for planning, organizing, and directing the completion of specific projects for an organization.

- Communication: *complain about, hear of, insist on, talk about, be warned of.*

For example: They have always insisted on expanding the market in multiple dimensions.

- Thought: *be aware of, believe in, concentrate on, dream of, forget about.*

For example: Whatever the result is, they will concentrate on improving their products and growing sales.

Let's Practice!

Instructions: Work individually. Complete the sentences with prepositions + gerunds. Write the correct form of the verb.

1. I am very excited _____ (travel) to the United States to exhibit my business idea next week.
2. The investors are concentrated _____ (buy) stocks.
3. We are good _____ (sell) technological products.
4. Are you interested _____ (build) your professional career by funding a startup?
5. Steven dreams _____ (become) a project manager in the near future.



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Handout 7 - Post-Task

Writing: Simple, Compound, and Complex Sentences

Simple Sentence

Independent Clause
1. We worked until 7:00 p.m. last night.
2. I drove home after work.
3. I arrived at 8:00 p.m.

Note: A compound sentence is made up of two independent clauses joined by a coordinating conjunction (**for, and, nor, but, or, yet, or so**). Place a comma before the coordinating conjunction. If you are not using a coordinating conjunction, place a semicolon between each clause.

Compound Sentence



Independent Clause
1. This is a business that recycles steel,
2. Steve Jobs knows every word on each of his slides,
3. A company can achieve its marketing aims by visiting potential customers,

so

and

but

Independent Clause
it is good for the environment.
he knows exactly what he is going to say next.
this lacks the same impact as promoting one's image at a trade fair.

Complex Sentence

Independent Clause
1. I will email my new clients
2. We will start writing our business plan
3. You should give sufficient time to a visitor to look around

→

→

→

Dependent Clause
when I get home.
as soon as you arrive.
when he or she approaches your stand.



Note: While independent clauses are complete sentences on their own, dependent clauses are not. Dependent clauses always start with subordinating conjunctions such as **because, since, if, until, when, even though, in case, while, now that, before, and after**, among others.

Let's Practice!

Instructions: Work individually. Based on the explanation about simple, compound, and complex sentences, correct the punctuation errors in the following email excerpts by rewriting them in the blank space.

1. My name is Ronald Fonseca and I am writing about the trade show invitation we received via LinkedIn.

2. We have developed an innovative product for the biomedical engineering field and we would be honored to participate in this international event to exhibit it.

3. I will get back to you with more details when the prototype is ready so I would like to know if you have any other questions that I can help you with at the moment, it would be my pleasure to help.

4. It was a pleasure meeting you recently at the Global Concepts trade fair in Wisconsin, I am delighted to assist you in finding a suitable IT communications system for your company. As requested, I am enclosing our latest catalogue with details and prices.

5. I would like to arrange an appointment to meet you, as soon as you can in order to discuss your needs in more detail. Is Friday afternoon suitable for you I am busy all Friday morning but I think I have time on Friday afternoon.



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Answer Key: Handout 1 - Warm-up

Instructions: In groups, look at the pictures and discuss the following questions. Then, share your ideas with the rest of the class.

- What is an entrepreneur?

An entrepreneur is an individual who takes the risk to start a business based on an idea they have or a product they have created.

- What is a business idea?

A business idea is a concept that can be used for financial gain that is usually centered on a product or service that can be offered for money. An idea is the first milestone in the process of building a successful business.

- What is a business pitch?

Professionals commonly use business pitching to gain investors in a new or growing business or sell a business's products or services to customers/clients. When you pitch effectively, you can motivate and persuade your audience to follow your idea and make it a reality.



Useful Language:

Giving an opinion	▪ <u>I would say that</u> business ideas can bring industry-leading solutions. ▪ <u>It seems to me that</u> a business idea does not need to be unique, but it must have the potential to capture its target market. ▪ <u>As far as I know</u>, an entrepreneur is an individual who takes the risk to start a business based on an idea they have or a product they have created.
Negotiating meaning	▪ <u>What do you mean by</u> “pitch”? ▪ <u>Could you repeat that again, please?</u> ▪ <u>Could you please elaborate more on</u> this topic? ▪ <u>Sure! What I mean</u> is a persuasive speech to sell a product or service.
Showing interest	▪ Alright! ▪ Definitely! ▪ I see. ▪ I understand. ▪ Really? ▪ Sounds good. ▪ That’s a good idea. ▪ That’s interesting.
Describing your team/business	▪ <u>Our team is made up of</u> electrical engineers from the University of Costa Rica. ▪ <u>We have experience</u> designing digital circuits and microprocessors. ▪ <u>We have experience with</u> the power transmission and distribution process. ▪ <u>Our commercial activities</u> include preparing project specifications, creating test procedures, writing reports, and interpreting data. ▪ <u>We are good at</u> reducing manual processes through automation.
Describing your value proposition	▪ <u>Our system helps companies that</u> are committed to making socially responsible business practices a hallmark of their brand. ▪ <u>One of the advantages of our system/product is that</u> it does not require rare materials. ▪ <u>Let’s look at its main components and attributes...</u>



Answer Key: Handout 2A - Pre-task 1

Instructions: Work in groups. Read the following information and discuss the questions below. Then, complete the exercise on the next page.

What is a business idea?

A business idea is a concept that can be used for financial gain and that is usually centered on a product or service offered for money. An idea is the first milestone in the process of building a successful business.

Creating a product or service is not an easy job. It takes a lot of work and planning. The right business begins with a good description of your idea.

Your business idea should always consider your customers/clients' needs or a problem that requires a solution. A good business idea will be compatible with the sustainable use of natural resources, or it can also promote favorable social, educational, or cultural conditions.

Consider the following aspects when designing a business idea:

- *Have you heard of any problems that could be addressed through a business solution in the field of Electrical Engineering?*
- *What need or problem will your business idea address?*
- *What product or service will you sell to solve the problem?*
- *Have you taken the time to understand the background and the needs of prospective clients/customers prior to developing your business idea?*
- *What are the key advantages of your business idea?*
- *How much will your business idea help the society or the environment?*

What is a value proposition?

A value proposition describes the benefits and the value that customers/clients can expect from your products or services. The goal here is to quickly convey why a potential investor or client should care about your business. Keep it short and simple.



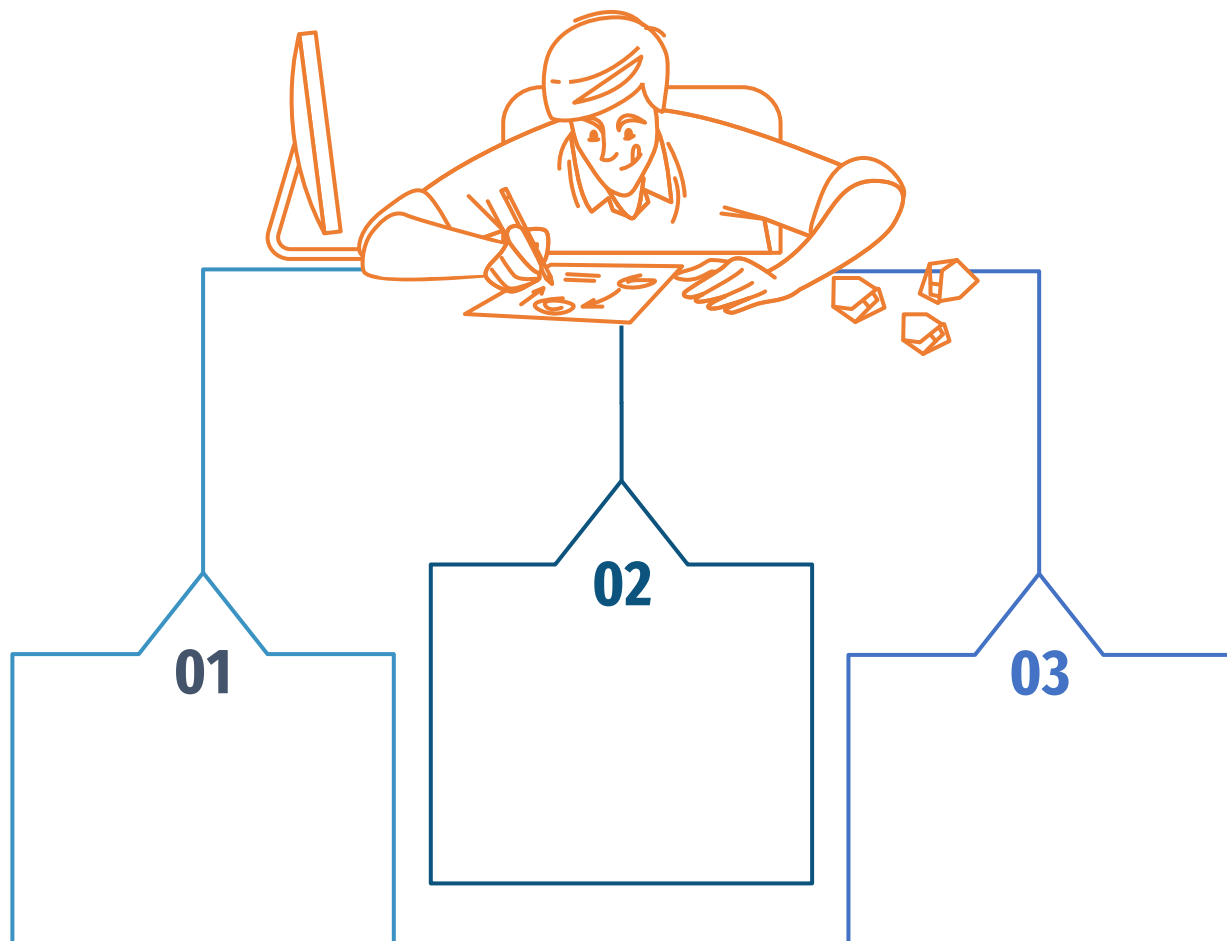
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Answer Key: Handout 2B - Pre-task 1

Instructions: Work in groups. Brainstorm at least three problems that could be addressed through a business solution in the field of Electrical Engineering, specifically in your area of specialization. Then, decide on one problem that all of you would like to solve as a team.

Answers will vary from group to group.





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Answer Key: Handout 3 - Pre-task 2

Instructions: Work in groups. Once you have agreed on a problem, design a business idea that can solve it. Use the form below to describe your proposed business solution including its value proposition. Answers will vary from group to group.

	Business Idea
1. What specific need or problem does your business idea address?	
2. How does your product or service solve the problem?	
3. Does your product or service provide social or environmental benefits? Give examples (if any).	

4. List up to three key benefits or competitive advantages of your product/service in the market (value proposition).	
5. Describe the product/service features. Use the adjectives studied in Unit 3 – Lesson 1.	

Useful Language: 

Describing your value proposition	▪ <u>Our system helps companies that</u> are committed to making socially responsible business practices a hallmark of their brand. ▪ <u>One of the advantages of our system/product is that</u> it does not require rare materials. ▪ <u>Let's look at its main components and attributes...</u>		
Adjectives to describe product attributes	advanced alternative automated cleantech compatible computerized cost-saving cutting-edge efficient eco-friendly fifth-generation full-scale	futuristic hi-tech hybrid innovative interactive latest low-cost modern newest promising reliable revolutionary	safe sophisticated speedy stand-alone sustainable technical technological trustworthy up-to-date user-friendly wearable wireless



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Answer Key: Handout 4 - Pre-task 3

Instructions: Work in groups. Based on the selected business idea (Pre-task 2), describe your entrepreneurial team by filling in the diagram below with your information. Answers will vary from group to group.



Useful Language:

Describing your team/business	▪ <u>Our team is made up of</u> electrical engineers from the University of Costa Rica. ▪ <u>We have experience</u> designing digital circuits and microprocessors. ▪ <u>We have experience with</u> the power transmission and distribution process. ▪ <u>Our commercial activities</u> include preparing project specifications, creating test procedures, writing reports, and interpreting data. ▪ <u>We are good at</u> reducing manual processes through automation.



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Morales, A.; Araya, M.

Unit 3 - Lesson 3

Answer Key: Handout 5 - Main Task

Instructions: Work in groups. You have been invited as an entrepreneur to an international trade fair for Electrical Engineering. This is an opportunity to present your business idea and attract potential clients. To make the most of this trade fair, prepare a concise five-minute pitch²⁰ to convince a group of prospective clients to acquire your product or service.

Consider the following aspects while presenting your pitch:

- Create a PowerPoint presentation as a visual aid.
- Give a name to your product/service.
- Click [here](#) to choose a logo and add it to your slideshow.
- Briefly provide information about your entrepreneurial team by highlighting their expertise.
- Talk about your business idea, specifically the problem to be solved, the proposed solution, and its social or environmental benefits (if any).
- Provide a complete view of the potential value that your product/service holds for customers/clients (benefits, competitive advantages, and features).
- Give the audience some time to ask questions at the end of your pitch.



Tips for a successful presentation:

- Pay attention to your body language. Maintain eye contact, have an open posture, and use hand gestures when appropriate.
- Vary your vocal delivery by adding inflection to your voice, raising or lowering your volume, and speeding up and slowing down.
- Try not to read from notes, except for special circumstances in which you must follow a step-by-step process.
- Answer difficult questions in a calm, confident manner. Be honest if you do not have the information to answer the question.



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Answer Key: Handout 6 - Post-Task

Grammar: Gerunds After Prepositions

The **gerund** is the only verb form used after prepositions. Use a gerund after these common **verb + preposition** combinations:

- Likes, dislikes, emotions: *be afraid of, care for, be excited about, worry about (or be worried about).*

For example: Hellen is excited about applying to the trade fair.

- Interests and efforts: *be interested in, learn about, be responsible for, be successful/good at.*

For example: Project managers (PMs) are responsible for planning, organizing, and directing the completion of specific projects for an organization.

- Communication: *complain about, hear of, insist on, talk about, be warned of.*

For example: They have always insisted on expanding the market in multiple dimensions.

- Thought: *be aware of, believe in, concentrate on, dream of, forget about.*

For example: Whatever the result is, they will concentrate on improving their products and growing sales.

Let's Practice!

Instructions: Work individually. Complete the sentences with prepositions + gerunds. Write the correct form of the verb.

1. I am very excited about traveling (travel) to the United States to exhibit my business idea next week.
2. The investors are concentrated on buying (buy) stocks.
3. We are good at selling (sell) technological products.
4. Are you interested in building (build) your professional career by funding a startup?
5. Steven dreams about becoming (become) a project manager in the near future.



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Answer Key: Handout 7 - Post-Task

Writing: Simple, Compound, and Complex Sentences

Simple Sentence

Independent Clause
1. We worked until 7:00 p.m. last night.
2. I drove home after work.
3. I arrived at 8:00 p.m.

Note: A compound sentence is made up of two independent clauses joined by a coordinating conjunction (**for, and, nor, but, or, yet, or so**). Place a comma before the coordinating conjunction. If you are not using a coordinating conjunction, place a semicolon between each clause.

Compound Sentence



Independent Clause
1. This is a business that recycles steel,
2. Steve Jobs knows every word on each of his slides,
3. A company can achieve its marketing aims by visiting potential customers,

so

and

but

Independent Clause
it is good for the environment.
he knows exactly what he is going to say next.
this lacks the same impact as promoting one's image at a trade fair.

Complex Sentence

Independent Clause
1. I will email my new clients
2. We will start writing our business plan
3. You should give sufficient time to a visitor to look around

→

→

→

Dependent Clause
when I get home.
as soon as you arrive.
when he or she approaches your stand.



Note: While independent clauses are complete sentences on their own, dependent clauses are not. Dependent clauses always start with subordinating conjunctions such as **because, since, if, until, when, even though, in case, while, now that, before, and after**, among others.

Let's Practice!

Instructions: Work individually. Based on the explanation about simple, compound, and complex sentences, correct the punctuation errors in the following email excerpts by rewriting them in the blank space.

1. My name is Ronald Fonseca and I am writing about the trade show invitation we received via LinkedIn.

My name is Ronald Fonseca, and I am writing about the trade show invitation we received via LinkedIn.

2. We have developed an innovative product for the biomedical field and we would be honored to participate in this international event to exhibit it.

We have developed an innovative product for the biomedical field, and we would be honored to participate in this international event to exhibit it.

3. I will get back to you with more details when the prototype is ready so I would like to know if you have any other questions that I can help you with at the moment, it would be my pleasure to help.

I will get back to you with more details when the prototype is ready, so I would like to know if you have any other questions that I can help you with at the moment. It would be my pleasure to help.

4. It was a pleasure meeting you recently at the Global Concepts trade fair in Wisconsin, I am delighted to assist you in finding a suitable IT communications system for your company. As requested, I am enclosing our latest catalogue with details and prices.

It was a pleasure meeting you recently at the Global Concepts trade fair in Wisconsin. I am delighted to assist you in finding a suitable IT communications system for your company. As requested, I am enclosing our latest catalogue with details and prices.

5. I would like to arrange an appointment to meet you, as soon as you can in order to discuss your needs in more detail. Is Friday afternoon suitable for you I am busy all Friday morning but I think I have time on Friday afternoon.

I would like to arrange an appointment to meet you as soon as you can in order to discuss your needs in more detail. Is Friday afternoon suitable for you? I am busy all Friday morning, but I think I have time on Friday afternoon.



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Unit 3: Engineering the Future

Lesson 4: Assessment task for Unit 3

Date: November 16, 2021

Unit Goal: By the end of the unit, the students will be able to effectively describe orally and in writing their interest in participating in an international trade fair, an innovative product or system in the field of Electrical Engineering, and a business idea for a solution to a problem.

General Objective: By the end of the lesson, the students will be able to successfully describe orally a solar power generation process in a meeting as a business idea to provide a sustainable power solution to indigenous communities in Costa Rica by producing chunks of language of different lengths, fluent speech, correct grammatical structures, appropriate pronunciation, and an adequate repertoire of vocabulary.

Specific Objectives: By the end of this lesson, the students will be able to:

1. effectively brainstorm general ideas about the solar power generation process and make predictions based on images, titles, and key words;
2. correctly show understanding of the technical components of the solar power generation process by matching the names to their corresponding definitions while working in groups;
3. accurately identify the location of the technical components of the solar power generation process by filling in the gaps of a diagram with the corresponding names while working in groups;
4. correctly explain the solar power generation process by arranging a list of general steps in a logical sequence and practicing the sequence orally in groups;

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5. successfully describe a solar power generation process orally in a meeting as a business idea to provide a sustainable power solution to indigenous communities in Costa Rica by explaining the problem to be solved, the solution (i.e., the main technical components of the system and the steps required for its operation in a logical sequence), and the value proposition or competitive advantages of the system while working in groups;
6. correctly recognize the correct pronunciation of lingua-dental and alveo-palatal sounds by completing a pronunciation exercise individually, and
7. properly show understanding of the basic stages of the writing process by writing an email about their business idea and its technical and socio-environmental features.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
1	Warm-up: Brainstorming ideas and making predictions T reviews the goal of the class and activates schemata by asking Ss to brainstorm ideas and predict the main topic of the class. For this, T shows images about solar power generation and indigenous communities. Ss also answer questions about the future of electrical engineering and its contribution to the society and the environment. T also reminds Ss of the steps to describe a technical product, system, or process, and a business idea. T reviews the ideas as a whole group and directs attention towards useful language for the class. Finally, T explains why describing is a key skill when referring to technical products, systems, or processes, and to business ideas. (Handout 1)	S, L	Giving an opinion: - I would say that... - It seems to me that... - As far as I know, ... Negotiating meaning: - What do you mean by...? - Could you repeat that again, please? - Could you please elaborate more on...? - Sure! What I mean is... Showing interest: - I see. - Sounds good. - Really? - That is a good idea.	Cognitive: - Predicting Creative: - Brainstorming Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
2	Pre-task 1: In groups, Ss match the name of the technical components of a solar power generation system with the corresponding definitions. (Handout 2) T monitors the activity and provides support as required.	R, S, L	Key vocabulary: - Battery - Breaker box - Cables - Circuit - Control board - Charge controller - Gage - Grid - Inverter - On-grid and off-grid - Overcharge - Photovoltaic - Power lines - Power meter - Shielding - Solar farm - Solar panel - Transformer - Wiring Key verbs: - Absorb - Connect - Convert - Distribute - Generate - Increase - Manage - Measure - Overload - Reduce - Release - Store - Transmit	Linguistic: - Practicing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
3	Pre-task 2: In groups, Ss analyze a visual diagram about the solar power generation process and identify the location of the technical components by filling in the gaps of the diagrams with the correct names from the bank of vocabulary. (Handouts 3) T monitors the activity and provides support and useful language as required.	S, L	Key vocabulary: - AC - Battery - Breaker box - Conductive wire - Consumer - Control board - Charge controller - DC - Inverter - On-grid and off-grid - Power lines - Power meter - Solar farm - Solar panel - Transformer	Linguistic: - Practicing Interpersonal: - Cooperating	15 min
4	Pre-task 3: In groups, Ss arrange the steps to explain a solar power generation process in a logical sequence. Then, Ss practice the sequence orally and exchange roles. (Handout 4) T also provides a fun fact about solar energy in Costa Rica and useful time expressions to describe a process.	R, S, L	Key vocabulary: - Technical components and verbs studied in pre-tasks 1 and 2. - Appliances - Electric field - Electrical devices - Exposure - Sunlight	Linguistic: - Conversationa l patterns - Practicing Interpersonal: - Cooperating	15 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Time expressions to describe a process: - First, ... Second, ... Third, ... - First of all, ... - Then, ... - Next, ... - After that, ... - Finally, ...		
5	Task: T reads the instructions for the Students' Performance Test. T also provides the contextual situation for the oral presentation and useful language related to signposting for meetings. (Handout 5A and 5B) Ss are sent into the breakout rooms for planning and organizing ideas before the oral presentation. In groups, Ss review the information that function as input for their presentation and create a mind map as a guide for planning the presentation. (Handout 5C) Then, Ss return to the main room to present the description of the topic assigned. T uses the speaking assessment rubric to grade each student's performance. (Handout 5D)	R, S, L	Signposting for presentations in meetings: Starting a presentation: - Hello/Good [evening], everyone. - Thank you very much for [inviting us here today]. Describing the team: - Our team is made up of [electrical engineers with experience in the field]. - We have experience in [renewable energy]. Stating the purpose: - Our purpose/objective/aim today is [to describe clean energy]. - I am here today to [describe power generation].	Linguistic: - Conversational patterns - Practicing Affective: - Personalizing Interpersonal: - Cooperating	50 min Plan and practice 30 min + Present 20 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
	Ss are reminded to use a formal and polite tone, visual aids, and useful language to guide the audience during the presentation. T monitors the activity and provides support as necessary.		Giving the structure: - This presentation is divided into [number] parts. - First of all, I'd like to look at [the main components]. - Then, I'll be talking about [how the system works]. - Finally, I'll be looking at... Describing the value proposition: - Our proposal is [committed to technological, social, and environmental challenges]. - One of the advantages of our system is that it is [low-cost]. Handling questions: - At the end of the presentation, I'll be happy to answer any questions. - Please let me know if you have any questions that I can help you with.		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Using visual aids: - As you can see [here], [there is a generator]. - [On the right/left], we can see [the generator]. - This diagram shows [the process]. - Let's have a look at [the process]. Using transitions: - So, let me start by explaining [the background]. - Now, let's move on to/turn to [the next topic]. - Now, I'd like to go on to [the next topic]. Concluding: - Let me end by saying that [clean energy is important]. - I'd like to finish by emphasizing that [clean energy is important]. - Thank you for your attention/time		

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
			Key vocabulary: - Adjectives to describe product attributes (studied in previous classes) - Climate change - Diffused light - Emissions - Fires - Handcrafted lamps - Remote - Threatened - Weather events		
6	Post-task 1: Individually, Ss recognize the correct pronunciation of speech sounds made with the tip of the tongue (lingua-dental or interdental) and with the back of the tongue (alveo-palatal) by completing a pronunciation exercise. (Handout 6)	S, L	Pronunciation: Speech sounds: - Interdental (/ θ / and /Y/) - Alveo-palatal (/š/, /ž/, /tš/ and /dž/) Note: Throughout the lesson, T pays attention to the following key details to provide Ss with suitable feedback after class, if required: - Verb tenses - /-s/ endings, /-ed/ endings - Pronunciation of key technical words	Linguistic: - Practicing Intrapersonal: - Individual student work	30 min

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Obj.	Procedure	Skills	Language Focus	Strategies	Time
7	Post-task 2: Individually, Ss apply the basic stages of the writing process reviewed in Unit 3 by writing an email about their business idea and its technical and socio-environmental features.	R, W	Vocabulary: - Transition words - Common expressions for email writing - Key technical vocabulary studied in class	Linguistic: - Practicing Affective: - Personalizing Intrapersonal: - Individual student work	30 min

Reminders:

- Have a 10-minute break.
- All the handouts are available in Google Classroom (access code 2yteyhw).

Homework:

- Ask Ss to check the language pills (feedback posted in Google Classroom) and the post-task answer keys.

ABBREVIATIONS:

T:	The teacher	R:	Reading	S:	Speaking
Ss:	The students	W:	Writing	L:	Listening

COPIES AND MATERIALS:

Handouts for students and supervisors, online materials (pictures, videos, and interactive activities), computer, speakers, internet access, and access to online platforms

REFERENCES:

Grupo ICE. (n.d.). *Somos autodidactas*. Dirección de Comunicación.

Grupo ICE. (n.d.). *Recorrido energía eléctrica*. Dirección de Comunicación.



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Unit 3 - Lesson 4

Handout 1 - Warm-up

Part 1

Instructions: Make predictions about the topic of the class based on the following pictures:



What do you think today's class is going to be about?

Part 2

Instructions: Think about the following questions and share your ideas with the rest of the class:

Engineering the Future: Electrical Engineering for Society

- What do you think about the future of Electrical Engineering? Do you see yourself developing any technological solutions that could contribute to social or environmental improvements?
- Based on the previous classes, what aspects could you take into account to describe a technical product, a system, or a process?
- If you had to present a product or a service as a business idea in the field of Electrical Engineering, what sections would you include in your description?

Useful Language



Giving an opinion	▪ <u>I would say that</u> today's class will be about cutting-edge projects in the field of power and telecommunications. ▪ <u>It seems to me that</u> engineers should care about safety and environmental protection in their designs. ▪ <u>As far as I know</u> the power system can fail and cause blackouts in remote areas of the country.									
Negotiating meaning	▪ <u>What do you mean by "AC"?</u> ▪ <u>Could you repeat that again, please?</u> ▪ <u>Could you please elaborate more on</u> this topic? ▪ <u>Sure! What I mean is</u> that we don't need three-phase AC in our homes. Single-phase is enough.									
Showing interest	<table><tr><td>▪ Alright!</td><td>▪ I understand.</td><td>▪ That's a good idea.</td></tr><tr><td>▪ Definitely!</td><td>▪ Really?</td><td>▪ That's interesting.</td></tr><tr><td>▪ I see.</td><td>▪ Sounds good.</td><td></td></tr></table>	▪ Alright!	▪ I understand.	▪ That's a good idea.	▪ Definitely!	▪ Really?	▪ That's interesting.	▪ I see.	▪ Sounds good.	
▪ Alright!	▪ I understand.	▪ That's a good idea.								
▪ Definitely!	▪ Really?	▪ That's interesting.								
▪ I see.	▪ Sounds good.									

A quick reminder:

Describing is an essential skill that helps people understand more about the specific characteristics and details of a person, place, or thing. For example, to describe **a technical product, a system, or a process**, you can refer to its main components and then explain the steps required for its operation. If you are describing **a business idea**, refer to the entrepreneurs, the problem you expect to solve, and the competitive advantages of your proposal.

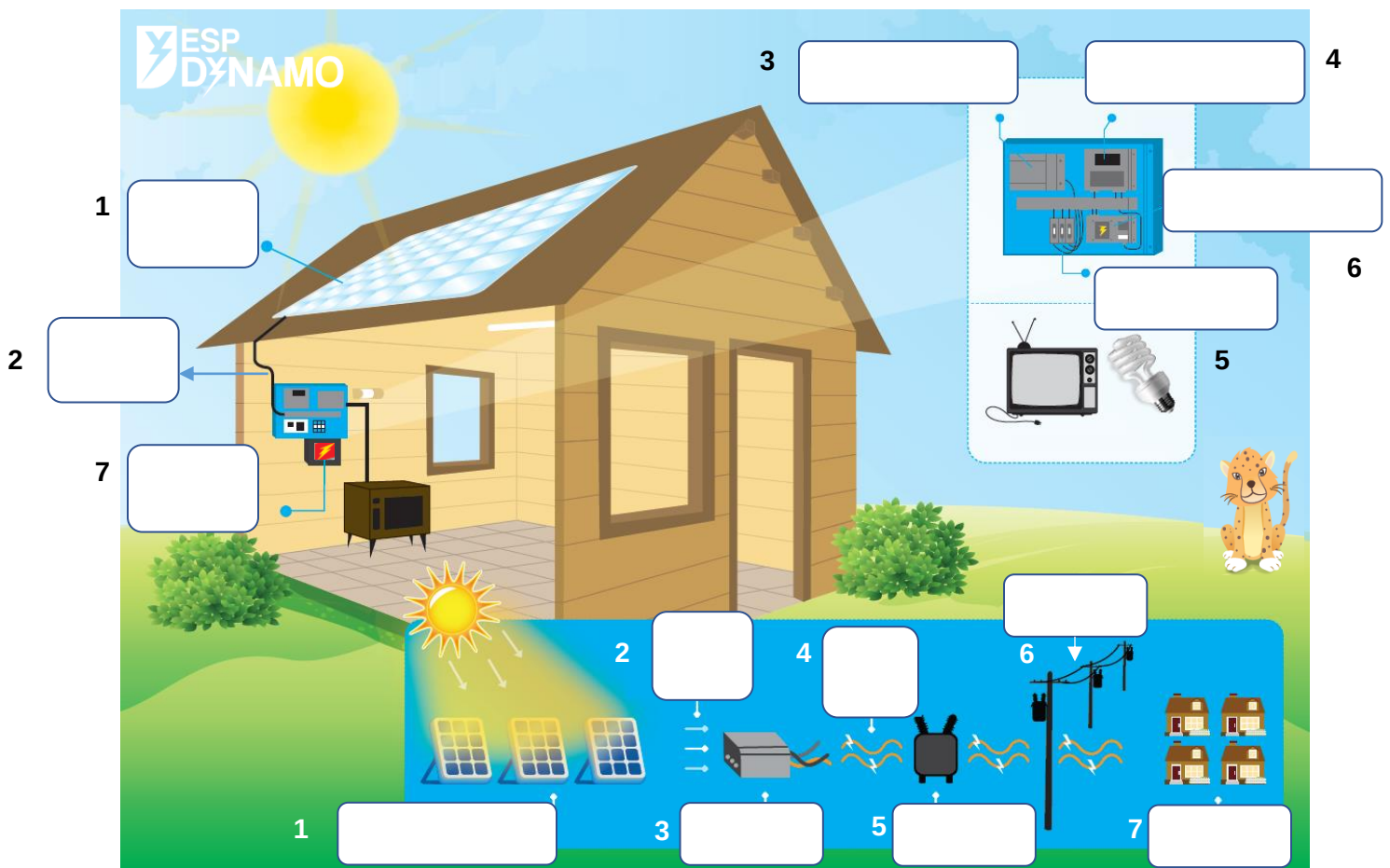


Handout 2 - Pre-task 1

Instructions: In groups, match each technical word with the corresponding definition by writing the letter in the correct box.

1. ☐ Solar panel	a. A machine that increases (steps up) or reduces (steps down) voltage
2. ☐ Solar farm	b. A device used for storing power generated by the solar panels
3. ☐ Wiring	c. A device used to absorb energy from the sun to generate electricity. It is the most important element of the system
4. ☐ Inverter	d. A device that measures how much electricity is used at home and how much is exported to the grid
5. ☐ Battery	e. A device that converts direct current (DC) electricity generated from the solar panels into alternating current (AC)
6. ☐ Breaker box	f. Cables that transmit and distribute electrical power and that can be supported by transmission towers or poles
7. ☐ Charge controller	g. A device that manages the flow of energy and prevents the batteries from overcharging
8. ☐ Transformer	h. A large collection of photovoltaic (PV) solar panels that absorb energy from the sun
9. ☐ Power lines	i. A device designed to distribute the flow of electricity and automatically stop it if a circuit becomes overloaded
10. ☐ Power meter	j. Cables with the right gage and shielding to connect all the parts together safely and effectively
11. ☐ Control board	k. Solar energy systems depending on whether the user is connected or not to the utility grid
12. ☐ On-grid and off-grid	l. A component made up of key elements for operation of the solar system: the inverter, the charger controller, and the breaker.

Instructions: Work in groups. Analyze the following diagram about the solar power generation process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



a. Inverter	b. Consumers	c. AC power	d. Control board	e. Battery
f. Solar farm	g. Power lines	h. Conductive wire	i. Breaker	j. Transformer
k. DC power	l. Inverter	m. Solar panel	n. Charge controller	o. Power meter

Adapted from:
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Handout 4 - Pre-task 3

Instructions: Work in groups. Arrange the following steps in a logical sequence to explain the solar power generation process by writing the number in the corresponding box. Once you finish, practice the sequence orally with a classmate and exchange roles. Use the time expressions at the bottom.

☐	a. As unused electricity is exported, the power meter runs backwards, crediting the property for excess generation.
☐	b. The electricity generated flows to the edge of the panel and into a conductive wire.
☐	c. Once installed, the solar panels absorb sunlight and create an electric field.
☐	d. The inverter transforms DC electricity into AC electricity to power the building.
☐	e. The breaker box distributes AC electricity throughout the building as needed to power lights, appliances, and other electrical devices.
☐	f. The solar panels are installed at a suitable location with maximum exposure to sunlight.
☐	g. Electricity that is not consumed via the breaker box is exported to the public utility grid through the power meter.
☐	h. The conductive wire brings the electricity to the inverter.
☐	i. All solar panels are wired together and connected to the rest of equipment, ensuring proper insulation to withstand wet weather conditions and power leakage.

Interesting fact:

Solar energy is the most abundant energy source on the planet; however, in Costa Rica, it accounts for less than 1% of the total electric power generated with renewable resources.

In addition to the Miravalles solar farm in Guanacaste, the government has provided approximately 1,600 solar panels for remote areas, especially national parks and indigenous communities.



Useful Language



Time expressions to describe a process

▪ First, Second, Third, ...	▪ Next, ...
▪ First of all, ...	▪ After that, ...
▪ Then, ...	▪ Finally, ...



Handout 5A - Main Task

Students' Performance Test

This test is part of the assessment plan of ESP Dynamo: An Online English Course for Electrical Engineering Students. The main purpose of the test is to evaluate the students' ability to describe orally a solar power generation process in a meeting as a business idea to provide a sustainable power solution to indigenous communities in Costa Rica by producing chunks of language of different lengths, fluent speech, correct grammatical structures, appropriate pronunciation, and an adequate repertoire of vocabulary.

General Instructions:

1. Make sure you are in a quiet, undisturbed location, and turn on your camera. Check that you can hear and be heard.
2. You will be provided with a situation to be used as a basis for an oral presentation in groups. The groups will be formed at random.
3. Each group of students has a maximum of five minutes to give the presentation. The teachers will grant the students sufficient time for planning and organizing ideas before the presentation.
4. Remember to find a balance when interacting by giving your peer opportunities for participating. A student should not monopolize the presentation.
5. If you have a question, use the "raise hand" tool or submit your question to the teachers via chat. The teachers will help you as soon as possible. Please do not interrupt your classmates' presentations.
6. This session will be recorded as a backup of having performed the test.
7. The speaking test is 25 points (25%). A minimum passing grade of 7 is required.



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Unit 3 - Lesson 4

Handout 5B - Main Task

Instructions: Work in groups. Imagine that you are attending a meeting with a company interested in developing a solar power generation project for indigenous communities in Costa Rica. Read the following information to design and propose a business idea and then describe the proposal orally to convince the investors to acquire your products or services. Rehearse with your partner(s) and be ready to present in front of the class.

Tips for a Successful Presentation:



- Decide which member of your group will present each idea.
- Greet the audience.
- Introduce your team by highlighting their expertise.
- Include a brief introduction, a body, and a conclusion.
- Refer to the following details as part of the body:
 - A summary of **the problem** to be solved
 - The **type of system** proposed as a solution (on-grid, off-grid, or a hybrid model)
 - The main **components** of the solar power system
 - The **steps** of the solar power generation process
 - The **potential value** of your business idea in terms of social or environmental benefits or any other differentiator
- Use visual aids.
- Take advantage of the useful language to guide the audience during the presentation.
- Use the mind map as a guide to your presentation (optional).

Situation

The Cabécar people live in the rain forest in the Talamanca region of Costa Rica, and their communities are not on the national electrical grid. Our company is interested in investing \$1,000,000 toward the construction of solar power systems in ten remote mountain villages that are home to 200 families.

Nowadays, the only sources of light these people have available are fires or handcrafted lamps. These sources are only capable of providing diffused light, and their emissions are harmful to both the Cabécars and to the environment on which they depend.

The population is mainly dedicated to small-scale agriculture and lives in harmony with the rain forest. However, their way of life is threatened by extreme weather events resulting from climate change.

The aim of the project is to provide the Cabécars with clean solar power. Access to sustainable forms of energy will improve their lives by providing them with new possibilities for development.

The companies interested in the project should consider the provision of training to allow the Cabécar communities to operate the solar equipment. Additional benefits related to effective ways of protecting the environment, and telecommunications or computing services for future projects to be developed will be a plus for selecting the company successfully.



Useful Language



Starting	- Hello/Good [evening], everyone. - Thank you very much for [inviting us here today].
Describing the team	- Our team is made up of electrical engineers with vast experience in the field. - We have experience in energy, telecommunications, and computing.
Stating the purpose	- Our purpose/objective/aim today is [to describe clean energy]. - I am here today to [describe power generation].
Giving the structure	- This presentation is divided into [number] parts. - First of all, I'd like to look at [the main components]. - Then, I'll be talking about [how the system works]. - Finally, I'll be looking at...
Describing the value proposition	- Our proposal is committed to technological, social, and environmental challenges. - One of the advantages of our system is that it is low-cost
Handling questions	- At the end of the presentation, I'll be happy to answer any questions. - Please let me know if you have any questions that I can help you with.
Using visual aids	- As you can see [here], [there is a solar panel]. [On the right/left], we can see [the generator]. - This diagram shows [the process]. - Let's have a look at [the process].
Using transitions	- So, let me start by explaining [the background]. - Now, let's move on to/turn to [the next topic]. - Now, I'd like to go on to [the next topic].
Concluding	- Let me end by saying that [clean energy is important]. - I'd like to finish by emphasizing that [clean energy is important]. - Thank you for your attention/time.

Useful Language:

Adjectives to describe product attributes		
advanced alternative automated computerized cost-saving cutting-edge efficient eco-friendly fifth-generation	hi-tech hybrid innovative latest low-cost modern newest promising reliable	safe sophisticated sustainable technical technological up-to-date user-friendly wearable wireless

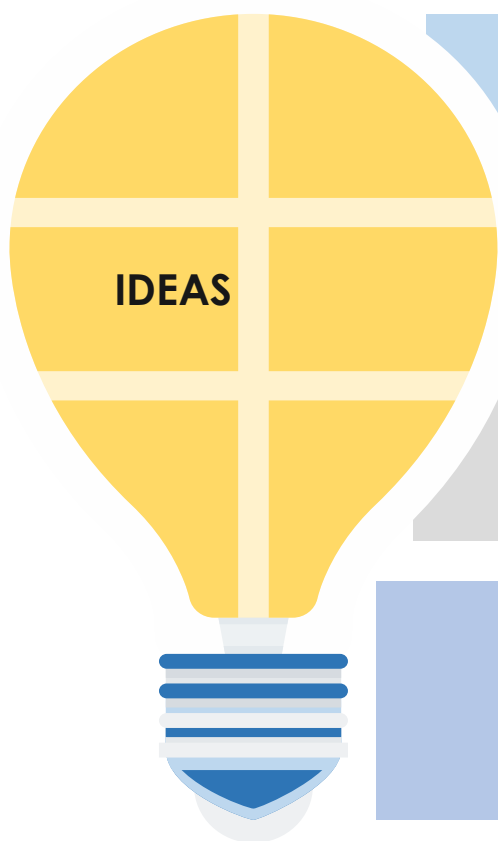


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Handout 5C - Main Task

Instructions: Work in groups. Create a mind map as a guide for your presentation. Think about any details and useful language you may add to describe your business idea and customize your map as necessary.



A large yellow lightbulb graphic with a blue base. The word "IDEAS" is written in black capital letters inside the yellow part of the bulb. The bulb is divided into four quadrants by a white cross.

Introduction:

-
-
-
-

Development:

-
-
-
-

Conclusion:

-
-
-
-

Handout 5D - Main Task

Speaking Assessment Rubric

Student's Name: _____ Role-Play Situation: _____

Score	Content
1	- Ability to ask and answer questions about personal details. Simple communication totally dependent on repetition, rephrasing and repair. - Poor development of information and knowledge of the topic.
2	- Ability to ask and answer questions and respond to simple statements, mainly on familiar topics or areas of immediate need. - Little information and knowledge of the topic.
3	- Ability to maintain a simple conversation on topics that are familiar or of personal interest, and to provide a brief description or narration. - Fair development of information and knowledge of the topic.
4	- Ability to develop relevant ideas and viewpoints on most general and specialized topics, and to give a detailed description or narration. - Sufficient information and knowledge of the topic.
5	Ability to develop a wide range of ideas and viewpoints on complex topics, even integrating subthemes.
Score	Fluency
1	- Very short, isolated, pre-packaged utterances. - Long pauses to search for expressions or to repair communication. - Hesitant and incomplete statements.
2	- Short utterances. - Some pauses, false starts and reformulation. - Flow of speech disrupted by several gaps.
3	- Fair stretches of language. - Occasional use of pauses for planning followed by recovery, especially in longer stretches of free production.
4	- Long stretches of language with few hesitations. - Few pauses for searching for expressions. - Continuous flow of speech.
5	- Fluent and spontaneous speech, almost effortless. - Smooth flow of speech with no hesitations.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Score	Grammar
1	- Limited control of a few simple grammatical structures and sentence patterns. - Very inaccurate communication. Meaning disrupted by too many errors and structural problems.
2	- Use of some simple grammatical structures and sentence patterns. - Inaccurate communication. Meaning disrupted by some errors and structural problems.
3	- Reasonable repertoire of patterns related to predictable situations. - Accurate communication with a few errors and structural problems.
4	- Relatively high degree of grammar accuracy. Use of some complex sentence forms. - Very accurate communication with minor structural problems that do not affect meaning. Self-correction.
5	- High degree of grammar accuracy. Use of complex sentence forms. - Errors are rare and difficult to spot. Self-correction.
Score	Pronunciation
1	Poor pronunciation. Too many errors.
2	Several pronunciation and intonation problems. Meaning is often unclear.
3	Some pronunciation and intonation problems. Meaning is understood but with problems.
4	Minor pronunciation errors but immediately continued.
5	Few errors. Clear and correct pronunciation.
Score	Vocabulary
1	- Very basic repertoire of words and simple phrases related to personal details and particular concrete situations. - Meaning disrupted by too many errors.
2	- Basic groups of words and memorized phrases to communicate limited information on simple everyday situations. - Many vocabulary errors. Meaning is often unclear.
3	- Sufficient vocabulary to get by. Some hesitation and circum-locutions. - Some vocabulary errors, but the meaning is clear.
4	- Sufficient vocabulary to give descriptions and express viewpoints on most general and specialized topics. - Lack of errors. The meaning is clear.
5	- Good command of a broad range of vocabulary to express on a wide range of general, academic, and professional topics. - Lack of errors. The meaning is clear.
Total:	Comments:

Score obtained: _____

Percentage: _____

Final grade: _____



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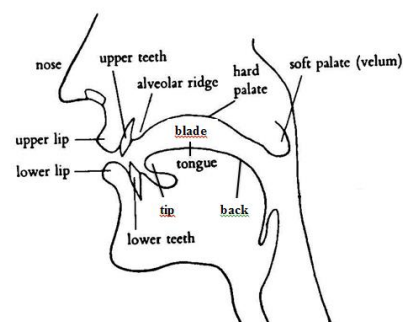
Unit 3 - Lesson 4



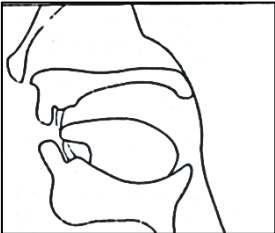
Handout 6 - Post-Task

Speech Sounds

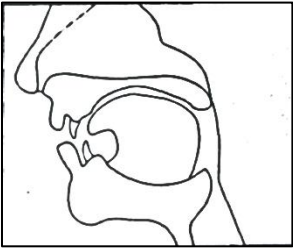
The fundamental method by which a student learns to pronounce English is by imitating the pronunciation of English-speaking people. Every time you have the opportunity to imitate the speech sounds in the English class, do it as accurately and often as you can. The strange sounds and rhythms may seem a little funny at first, but you must try to forget that, and imitate without reservations.



Sounds made with the tip of the tongue

LINGUA-DENTAL OR INTERDENTAL: The obstruction of air occurs because the tip of the tongue is placed between the teeth or just behind the teeth.	 The position of the tongue in the production of the th sounds (/ θ / and / ʝ /)	/θ/ voiceless	thick thin threat third throw thought thousand	everything method healthy nothing birthday authorize worthy	death strength earth south north both twelfth
		/ʝ/ voiced	this these they then them their than	either weather bother father	Northern although otherwise breathe with

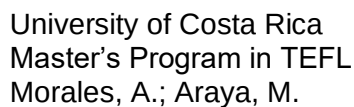
Sounds made with the back of the tongue

ALVEO-PALATAL: These sounds are made with the blade of the tongue approaching the hard palate just behind the tooth ridge.	 The position of the tongue in the production of /š/, /ž/, /tš/ and /dž/	/š/ voiceless	shell shadow shop sugar show	machine delicious nation commercial ocean precaution	English cash wash flash Spanish fresh	Chicago Michigan chef ocean permission
		/ž/ voiced		decision pleasure measure television explosion usual	beige garage massage	
		/tš/ voiceless	change cheap chief children check choice	teacher nature kitchen picture question situation temperature future suggestion	each speech which sandwich French much search catch	
		/dž/ voiced	jeep jet January just jump junior individual	religion individual major schedule project education graduate	image bridge page edge charge language usage package	

Let's Practice

Instructions: Work individually. The following words were studied in today's class. Read the words aloud and identify the correct pronunciation.

Word	Sound
1. Charge	
2. Gage	
3. Shielding	
4. Distribution	
5. Manage	
6. Measure	
7. Transmission	
8. Exposure	
9. Change	
10. Weather	



Writing Assignment

Consider the following aspects when writing the email:

- Write an appropriate subject line
- Introduce yourself and briefly describe your academic and professional experience
- Provide three reasons why they should select your business idea as the best sustainable power solution for the Cabécars by highlighting the technical features of your proposal and its social and environmental benefits.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



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Answer Key: Handout 1 - Warm-up

Part 1

Instructions: Make predictions about the topic of the class based on the following pictures:



What do you think today's class is going to be about?

Part 2

Instructions: Think about the following questions and share your ideas with the rest of the class:

Engineering the Future: Electrical Engineering for Society

- What do you think about the future of Electrical Engineering? Do you see yourself developing any technological solutions that could contribute to social or environmental improvements?
- Based on the previous classes, what aspects could you take into account to describe a technical product, a system, or a process?
- If you had to present a product or a service as a business idea in the field of Electrical Engineering, what sections would you include in your description?

Useful Language



Giving an opinion	▪ <u>I would say that</u> today's class will be about cutting-edge projects in the field of power and telecommunications. ▪ <u>It seems to me that</u> engineers should care about safety and environmental protection in their designs. ▪ <u>As far as I know</u> the power system can fail and cause blackouts in remote areas of the country.									
Negotiating meaning	▪ <u>What do you mean by "AC"?</u> ▪ <u>Could you repeat that again, please?</u> ▪ <u>Could you please elaborate more on</u> this topic? ▪ <u>Sure! What I mean is</u> that we don't need three-phase AC in our homes. Single-phase is enough.									
Showing interest	<table><tr><td>▪ Alright!</td><td>▪ I understand.</td><td>▪ That's a good idea.</td></tr><tr><td>▪ Definitely!</td><td>▪ Really?</td><td>▪ That's interesting.</td></tr><tr><td>▪ I see.</td><td>▪ Sounds good.</td><td></td></tr></table>	▪ Alright!	▪ I understand.	▪ That's a good idea.	▪ Definitely!	▪ Really?	▪ That's interesting.	▪ I see.	▪ Sounds good.	
▪ Alright!	▪ I understand.	▪ That's a good idea.								
▪ Definitely!	▪ Really?	▪ That's interesting.								
▪ I see.	▪ Sounds good.									

A quick reminder:

Describing is an essential skill that helps people understand more about the specific characteristics and details of a person, place, or thing. For example, to describe **a technical product, a system, or a process**, you can refer to its main components and then explain the steps required for its operation. If you are describing **a business idea**, refer to the entrepreneurs, the problem you expect to solve, and the competitive advantages of your proposal.



Answer Key: Handout 2 - Pre-task 1

Instructions: In groups, match each technical word with the corresponding definition by writing the letter in the correct box.

1. ☐ C Solar panel	a. A machine that increases (steps up) or reduces (steps down) voltage
2. ☐ H Solar farm	b. A device used for storing power generated by the solar panels
3. ☐ J Wiring	c. A device used to absorb energy from the sun to generate electricity. It is the most important element of the system
4. ☐ E Inverter	d. A device that measures how much electricity is used at home and how much is exported to the grid
5. ☐ B Battery	e. A device that converts direct current (DC) electricity generated from the solar panels into alternating current (AC)
6. ☐ I Breaker box	f. Cables that transmit and distribute electrical power and that can be supported by transmission towers or poles
7. ☐ G Charge controller	g. A device that manages the flow of energy and prevents the batteries from overcharging
8. ☐ A Transformer	h. A large collection of photovoltaic (PV) solar panels that absorb energy from the sun
9. ☐ F Power lines	i. A device designed to distribute the flow of electricity and automatically stop it if a circuit becomes overloaded
10. ☐ D Power meter	j. Cables with the right gage and shielding to connect all the parts together safely and effectively
11. ☐ L Control board	k. Solar energy systems depending on whether the user is connected or not to the utility grid
12. ☐ K On-grid and off-grid	l. A component made up of key elements for operation of the solar system: the inverter, the charger controller, and the breaker.



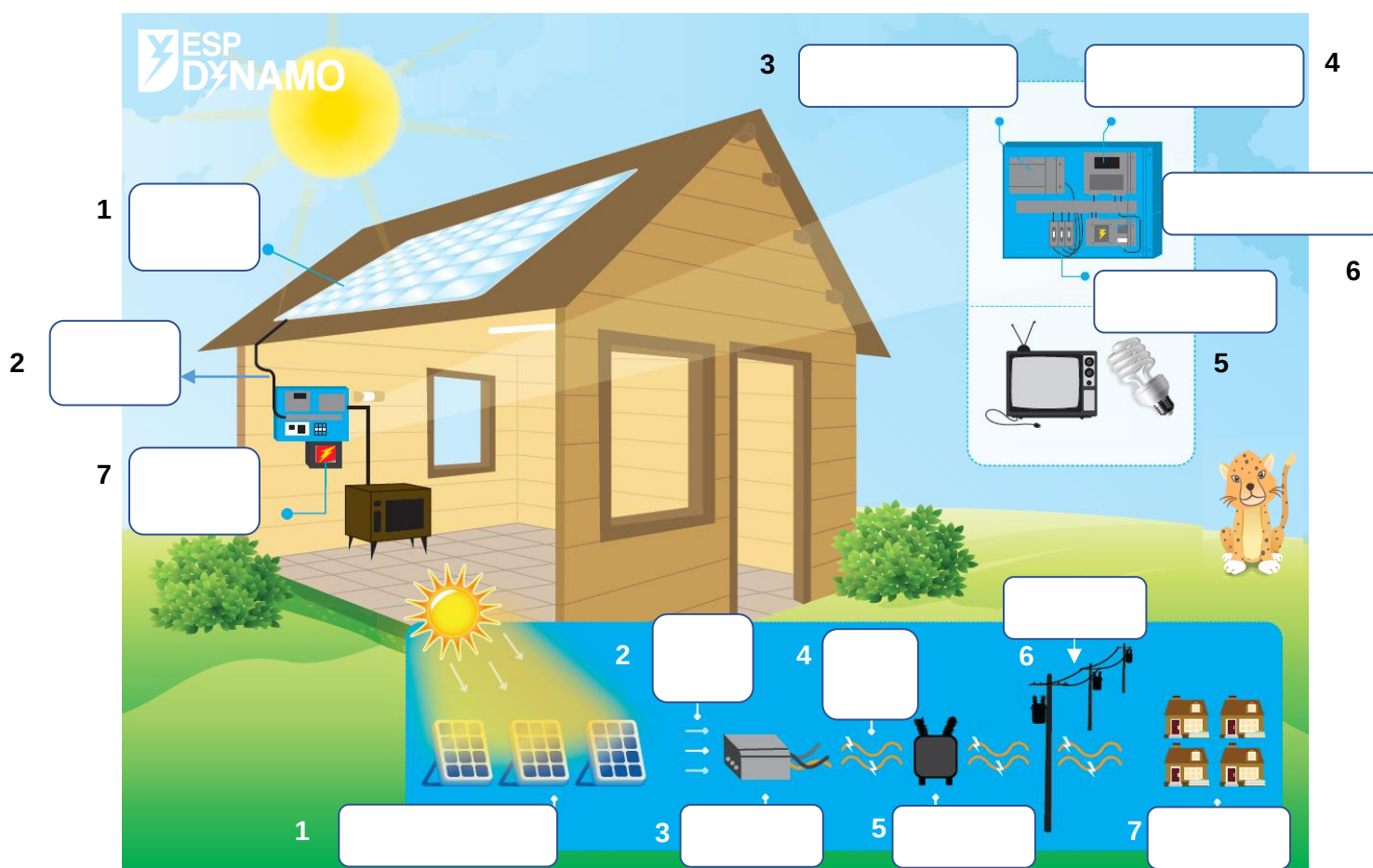
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Answer Key: Handout 3 - Pre-task 2

Part 1

Instructions: Work in groups. Analyze the following diagram about the solar power generation process. Then, complete the blank spaces with the correct technical component from the box. You will not use all of the words from the vocabulary bank.



a. Inverter 3A	b. Consumers 7B	c. AC power 4B	d. Control board 6A	e. Battery 7A
f. Solar farm 1B	g. Power lines 6B	h. Conductive wire 2A	i. Breaker 5A	j. Transformer 5B
k. DC power 2B	l. Inverter 3B	m. Solar panel 1A	n. Charge controller 4A	o. Power meter -



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Answer Key: Handout 4 - Pre-task 3

Instructions: Work in groups. Arrange the following steps in a logical sequence to explain the solar power generation process by writing the number in the corresponding box. Once you finish, practice the sequence orally with a classmate and exchange roles. Use the time expressions at the bottom.

☐ 9	a. As unused electricity is exported, the power meter runs backwards, crediting the property for excess generation.
☐ 4	b. The electricity generated flows to the edge of the panel and into a conductive wire.
☐ 3	c. Once installed, the solar panels absorb sunlight and create an electric field.
☐ 6	d. The inverter transforms DC electricity into AC electricity to power the building.
☐ 7	e. The breaker box distributes AC electricity throughout the building as needed to power lights, appliances, and other electrical devices.
☐ 1	f. The solar panels are installed at a suitable location with maximum exposure to sunlight.
☐ 8	g. Electricity that is not consumed via the breaker box is exported to the public utility grid through the power meter.
☐ 5	h. The conductive wire brings the electricity to the inverter.
☐ 2	i. All solar panels are wired together and connected to the rest of equipment, ensuring proper insulation to withstand wet weather conditions and power leakage.

Interesting fact:

Solar energy is the most abundant energy source on the planet; however, in Costa Rica, it accounts for less than 1% of the total electric power generated with renewable resources. In addition to the Miravalles solar farm in Guanacaste, the government has provided approximately 1,600 solar panels for remote areas, especially national parks and indigenous communities.



Useful Language



Time expressions to describe a process

▪ First, Second, Third, ...	▪ Next, ...
▪ First of all, ...	▪ After that, ...
▪ Then, ...	▪ Finally, ...



Answer Key: Handout 5A - Main Task

Students' Performance Test

This test is part of the assessment plan of ESP Dynamo: An Online English Course for Electrical Engineering Students. The main purpose of the test is to evaluate the students' ability to describe orally a solar power generation process in a meeting as a business idea to provide a sustainable power solution to indigenous communities in Costa Rica by producing chunks of language of different lengths, fluent speech, correct grammatical structures, appropriate pronunciation, and an adequate repertoire of vocabulary.

General Instructions:

1. Make sure you are in a quiet, undisturbed location, and turn on your camera. Check that you can hear and be heard.
2. You will be provided with a situation to be used as a basis for an oral presentation in groups. The groups will be formed at random.
3. Each group of students has a maximum of five minutes to give the presentation. The teachers will grant the students sufficient time for planning and organizing ideas before the presentation.
4. Remember to find a balance when interacting by giving your peer opportunities for participating. A student should not monopolize the presentation.
5. If you have a question, use the "raise hand" tool or submit your question to the teachers via chat. The teachers will help you as soon as possible. Please do not interrupt your classmates' presentations.
6. This session will be recorded as a backup of having performed the test.
7. The speaking test is 25 points (25%). A minimum passing grade of 7 is required.



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Unit 3 - Lesson 4

Answer Key: Handout 5B - Main Task

Instructions: Work in groups. Imagine that you are attending a meeting with a company interested in developing a solar power generation project for indigenous communities in Costa Rica. Read the following information to design and propose a business idea and then describe the proposal orally to convince the investors to acquire your products or services. Rehearse with your partner(s) and be ready to present in front of the class.

Tips for a Successful Presentation:



- Decide which member of your group will present each idea.
- Greet the audience.
- Introduce your team by highlighting their expertise.
- Include a brief introduction, a body, and a conclusion.
- Refer to the following details as part of the body:
 - A summary of **the problem** to be solved
 - The **type of system** proposed as a solution (on-grid, off-grid, or a hybrid model)
 - The main **components** of the solar power system
 - The **steps** of the solar power generation process
 - The **potential value** of your business idea in terms of social or environmental benefits or any other differentiator
- Use visual aids.
- Take advantage of the useful language to guide the audience during the presentation.
- Use the mind map as a guide to your presentation (optional).

Situation

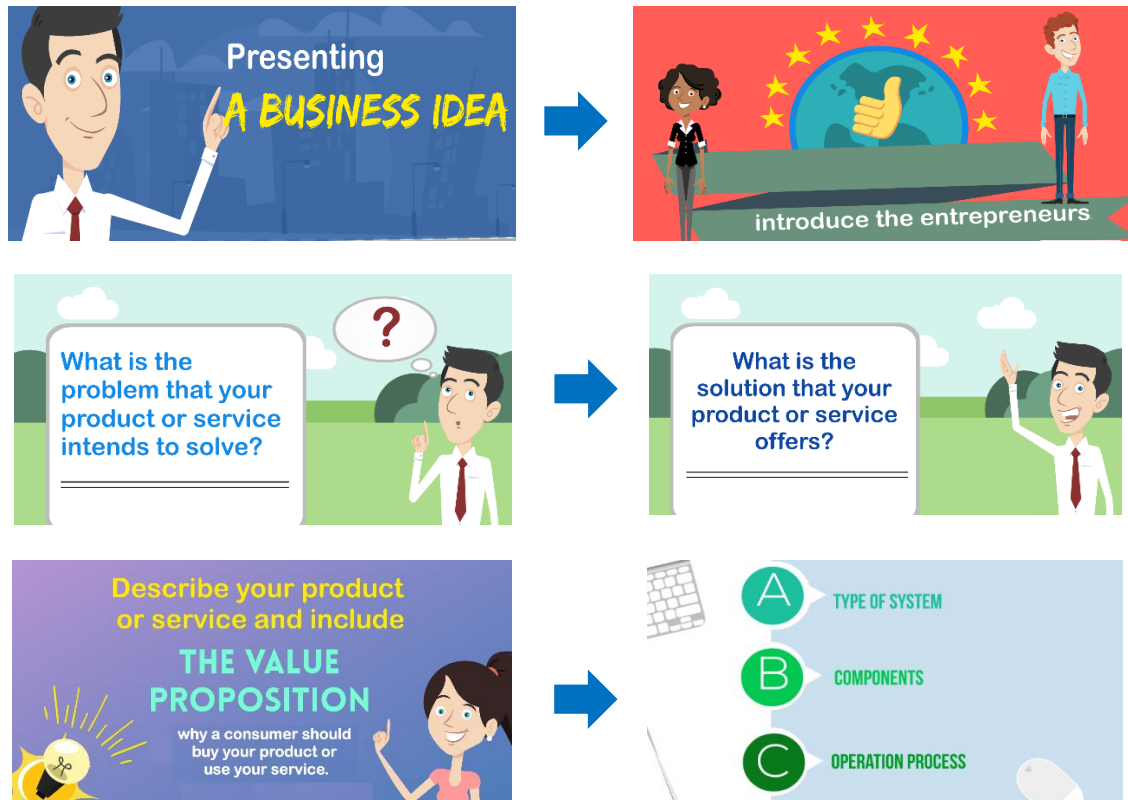
The Cabécar people live in the rain forest in the Talamanca region of Costa Rica, and their communities are not on the national electrical grid. Our company is interested in investing \$1,000,000 toward the construction of solar power systems in ten remote mountain villages that are home to 200 families.

Nowadays, the only sources of light these people have available are fires or handcrafted lamps. These sources are only capable of providing diffused light, and their emissions are harmful to both the Cabécars and to the environment on which they depend.

The population is mainly dedicated to small-scale agriculture and lives in harmony with the rain forest. However, their way of life is threatened by extreme weather events resulting from climate change.

The aim of the project is to provide the Cabécars with clean solar power. Access to sustainable forms of energy will improve their lives by providing them with new possibilities for development.

The companies interested in the project should consider the provision of training to allow the Cabécar communities to operate the solar equipment. Additional benefits related to effective ways of protecting the environment, and telecommunications or computing services for future projects to be developed will be a plus for selecting the company successfully.



Useful Language



Starting	- Hello/Good [evening], everyone. - Thank you very much for [inviting us here today].
Describing the team	- Our team is made up of electrical engineers with vast experience in the field. - We have experience in energy, telecommunications, and computing.
Stating the purpose	- Our purpose/objective/aim today is [to describe clean energy]. - I am here today to [describe power generation].
Giving the structure	- This presentation is divided into [number] parts. - First of all, I'd like to look at [the main components]. - Then, I'll be talking about [how the system works]. - Finally, I'll be looking at...
Describing the value proposition	- Our proposal is committed to technological, social, and environmental challenges. - One of the advantages of our system is that it is low-cost
Handling questions	- At the end of the presentation, I'll be happy to answer any questions. - Please let me know if you have any questions that I can help you with.
Using visual aids	- As you can see [here], [there is a solar panel]. [On the right/left], we can see [the generator]. - This diagram shows [the process]. - Let's have a look at [the process].
Using transitions	- So, let me start by explaining [the background]. - Now, let's move on to/turn to [the next topic]. - Now, I'd like to go on to [the next topic].
Concluding	- Let me end by saying that [clean energy is important]. - I'd like to finish by emphasizing that [clean energy is important]. - Thank you for your attention/time.

Useful Language:

Adjectives to describe product attributes		
advanced alternative automated computerized cost-saving cutting-edge efficient eco-friendly fifth-generation	hi-tech hybrid innovative latest low-cost modern newest promising reliable	safe sophisticated sustainable technical technological up-to-date user-friendly wearable wireless

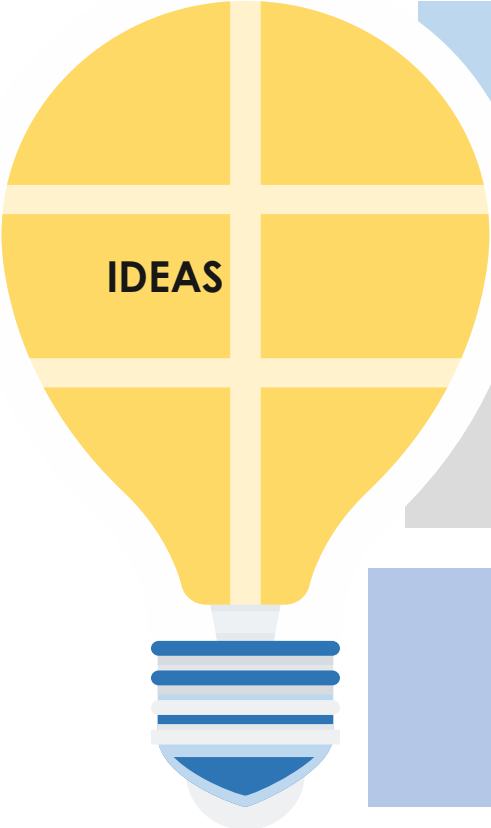


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Answer Key: Handout 5C - Main Task

Instructions: Work in groups. Create a mind map as a guide for your presentation. Think about any details and useful language you may add to describe your business idea and customize your map as necessary.



A large yellow lightbulb graphic with a white cross inside, divided into four quadrants. The word "IDEAS" is written in bold black letters in the top-left quadrant. The base of the lightbulb is blue and white.

Introduction:

-
-
-
-

Development:

-
-
-
-

Conclusion:

-
-
-
-

Answer Key: Handout 5D - Main Task

Speaking Assessment Rubric

Student's Name: _____ Role-Play Situation: _____

Score	Content
1	- Ability to ask and answer questions about personal details. Simple communication totally dependent on repetition, rephrasing and repair. - Poor development of information and knowledge of the topic.
2	- Ability to ask and answer questions and respond to simple statements, mainly on familiar topics or areas of immediate need. - Little information and knowledge of the topic.
3	- Ability to maintain a simple conversation on topics that are familiar or of personal interest, and to provide a brief description or narration. - Fair development of information and knowledge of the topic.
4	- Ability to develop relevant ideas and viewpoints on most general and specialized topics, and to give a detailed description or narration. - Sufficient information and knowledge of the topic.
5	Ability to develop a wide range of ideas and viewpoints on complex topics, even integrating subthemes.
Score	Fluency
1	- Very short, isolated, pre-packaged utterances. - Long pauses to search for expressions or to repair communication. - Hesitant and incomplete statements.
2	- Short utterances. - Some pauses, false starts and reformulation. - Flow of speech disrupted by several gaps.
3	- Fair stretches of language. - Occasional use of pauses for planning followed by recovery, especially in longer stretches of free production.
4	- Long stretches of language with few hesitations. - Few pauses for searching for expressions. - Continuous flow of speech.
5	- Fluent and spontaneous speech, almost effortless. - Smooth flow of speech with no hesitations.

ENGLISH FOR ELECTRICAL ENGINEERING STUDENTS

Score	Grammar
1	- Limited control of a few simple grammatical structures and sentence patterns. - Very inaccurate communication. Meaning disrupted by too many errors and structural problems.
2	- Use of some simple grammatical structures and sentence patterns. - Inaccurate communication. Meaning disrupted by some errors and structural problems.
3	- Reasonable repertoire of patterns related to predictable situations. - Accurate communication with a few errors and structural problems.
4	- Relatively high degree of grammar accuracy. Use of some complex sentence forms. - Very accurate communication with minor structural problems that do not affect meaning. Self-correction.
5	- High degree of grammar accuracy. Use of complex sentence forms. - Errors are rare and difficult to spot. Self-correction.
Score	Pronunciation
1	Poor pronunciation. Too many errors.
2	Several pronunciation and intonation problems. Meaning is often unclear.
3	Some pronunciation and intonation problems. Meaning is understood but with problems.
4	Minor pronunciation errors but immediately continued.
5	Few errors. Clear and correct pronunciation.
Score	Vocabulary
1	- Very basic repertoire of words and simple phrases related to personal details and particular concrete situations. - Meaning disrupted by too many errors.
2	- Basic groups of words and memorized phrases to communicate limited information on simple everyday situations. - Many vocabulary errors. Meaning is often unclear.
3	- Sufficient vocabulary to get by. Some hesitation and circum-locutions. - Some vocabulary errors, but the meaning is clear.
4	- Sufficient vocabulary to give descriptions and express viewpoints on most general and specialized topics. - Lack of errors. The meaning is clear.
5	- Good command of a broad range of vocabulary to express on a wide range of general, academic, and professional topics. - Lack of errors. The meaning is clear.
Total:	Comments:

Score obtained: _____

Percentage: _____

Final grade: _____



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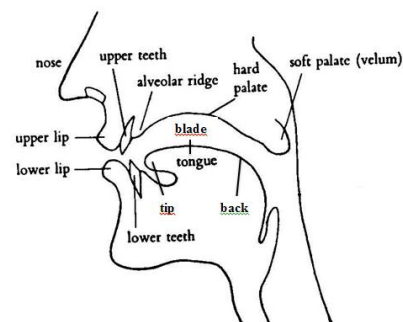
Unit 3 - Lesson 4



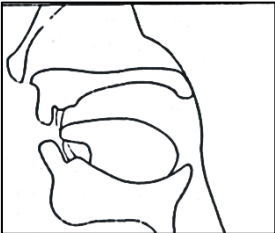
Answer Key: Handout 6 - Post-Task

Speech Sounds

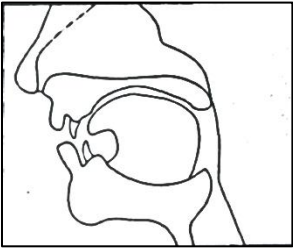
The fundamental method by which a student learns to pronounce English is by imitating the pronunciation of English-speaking people. Every time you have the opportunity to imitate the speech sounds in the English class, do it as accurately and often as you can. The strange sounds and rhythms may seem a little funny at first, but you must try to forget that, and imitate without reservations.



Sounds made with the tip of the tongue

LINGUA-DENTAL OR INTERDENTAL: The obstruction of air occurs because the tip of the tongue is placed between the teeth or just behind the teeth.	 The position of the tongue in the production of the th sounds (/ θ / and / ʝ /)	/θ/ voiceless	thick thin threat third throw thought thousand	everything method healthy nothing birthday authorize worthy	death strength earth south north both twelfth
		/ʝ/ voiced	this these they then them their than	either weather bother father	Northern although otherwise breathe with

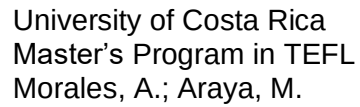
Sounds made with the back of the tongue

ALVEO-PALATAL: These sounds are made with the blade of the tongue approaching the hard palate just behind the tooth ridge.	 The position of the tongue in the production of /š/, /ž/, /tš/ and /dž/	/š/ voiceless	shell shadow shop sugar show machine delicious nation commercial ocean precaution	English cash wash flash Spanish fresh	Chicago Michigan chef ocean permission
		/ž/ voiced	decision pleasure measure television explosion usual	beige garage massage	
		/tš/ voiceless	change cheap chief children check choice	teacher nature kitchen picture question situation temperature future suggestion	each speech which sandwich French much search catch
		/dž/ voiced	jeep jet January just jump junior individual	religion individual major schedule project education graduate	image bridge page edge charge language usage package

Let's Practice

Instructions: Work individually. The following words were studied in today's class. Read the words aloud and identify the correct pronunciation.

Word	Sound
1. Charge	/dž/
2. Gage	/dž/
3. Shielding	/š/
4. Distribution	/š/
5. Manage	/dž/
6. Measure	/ž/
7. Transmission	/š/
8. Exposure	/ž/
9. Change	/dž/
10. Weather	/Y/



Writing Assignment

Consider the following aspects when writing the email:

-
- This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

Appendix O

Classroom and Student-Teacher Observation Forms Used by Supervisors

UNIVERSIDAD DE COSTA RICA
 Maestría en la Enseñanza del Inglés como Lengua Extranjera
 PF-0311 Práctica Profesional II – 2020
 Córdoba, Rodríguez, Solís & Zúñiga
Mode: 100% Virtual

**TEAMWORK: LESSON PLAN****NAMES:****DATE:****OBSERVER:** Randolph Zúñiga Coudin

GRADING SCALE

10: Excellent	8: Average	6.9 or less: Poor
9: Above Average	7: Needs Improvement	NA: Not applicable

A. LESSON PLANNING / MATERIALS (70%)

1. The objectives are clear and precise.	
2. The objectives, materials, and activities (as a unit) work toward students' needs and wants with a clear ESP focus.	
3. The task cycle is appropriately designed (pre-task, task, post-task, feedback, evaluation).	
4. There is variety of activities to provide for individual learning styles in a virtual environment.	
5. Activities integrate the language skills when appropriate.	
6. Materials and activities are appropriately designed or adapted.	
7. Materials and activities show authenticity in purpose, sources, and outcomes.	
8. The lesson plan and materials provide evidence of planning with team member(s). There is a logical connection between this lesson plan and the previous one within the corresponding unit.	
9. The designated assistant(s) effectively supported the instruction.	
10. Suggestions from preceding lesson plans have been incorporated.	

B. Correct language use (30%) Language use in the lesson plan (objectives, procedures, language to be taught, tasks, materials, etc.) is correct and appropriate.

TOTAL

Notes: If the designated assistant is absent, he or she will get a zero.

If the lead teacher is absent for justifiable reasons, the assistants must take over.

Strengths	Weaknesses

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 PF-0311 Práctica Profesional II-2020
 Córdoba, Rodríguez, Solís & Zúñiga
Mode: 100% Virtual



STUDENT TEACHER OBSERVATION FORM

NAME:

DATE:

OBSERVER: Randolph Zúñiga Coudin

GRADING SCALE		
10: Excellent	8: Average	6.9 or less: Poor
9: Above Average	7: Needs Improvement	NA: Not applicable

▪ **Important Notes:**

1. After the grade has been calculated, up to two full points might be deducted for problems in language use, and/or errors in subject matter/language being taught. The following scale will be used to grade your teaching session after the grade has been averaged:

- 0.50 points: one to three errors - 1.00 points: four to six errors - 1.50 points: seven to nine errors - 2.00 points: More than ten language errors Errors in subject matter being taught Errors which have already been pointed out by an observer

2. After the grade has been calculated, up to two full points will be deducted if a student teacher arrives late or shows inappropriate or disrespectful behavior during the class.
3. Positive / professional attitude toward feedback from observers is a must. One full point will be deducted if a disrespectful attitude is shown during feedback sessions.

PERSONAL CHARACTERISTICS	
1. Communication skills	
2. Ability to successfully deal with unanticipated situations	
3. Well informed about the field	
TEACHING	
4. The class material and objectives were explained in an understandable way, taking advantage of available resources.	
5. The lesson was well paced.	
6. The teacher followed appropriate procedures to carry out tasks.	
7. The teacher presented the new vocabulary necessary for each task.	
8. The teacher helped the students develop different strategies required for their specific needs.	
9. The teacher answered students' questions satisfactorily.	
10. The teacher promoted English for real communication, focusing on the students' field.	
11. The class led to student autonomy.	
12. The teacher perceived and corrected salient errors appropriately, taking into account the students' needs.	
CLASS MANAGEMENT	
13. The instructions were clear and concise for students to do the tasks.	
14. The teacher helped the students practice useful language to effectively carry out tasks.	

Strengths	Weaknesses

Appendix P**Assessment Instrument for ESP Course Evaluation after Unit 1, 2, and 3**

University of Costa Rica

Master's Program

Instructors: Andrea Morales Oliverio and María Araya Porras

II-2021 - Online modality

ESP Course Evaluation

The purpose of this evaluation form is to gain insight into the students' opinion about the usefulness and the quality of the English course for Electrical Engineering Students. The information gathered in this questionnaire is strictly confidential.

Part I

Instructions: Please indicate your level of agreement with the statements below.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. The objectives of Unit X were clear, precise, and specific.				
2. The course was well organized and easy to follow.				
3. Unit X included a variety of activities and strategies to encourage participation.				
4. The course materials used in Unit X were appealing and appropriate.				
5. The course evaluation for Unit X was related to the tasks done in class.				
6. The contents of Unit X were useful and relevant for my <u>academic</u> development.				
7. The contents of Unit X were useful and relevant for my <u>professional</u> development.				
8. The workload of Unit X was manageable.				
9. The level of difficulty of Unit X was appropriate.				

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	Strongly Disagree	Disagree	Agree	Strongly Agree
10. Unit X gave me the opportunity to improve my language skills.				
11. Unit X promoted critical, diverse, and innovative thinking.				
12. Overall, I feel satisfied with the course so far.				

Part II

Instructions: Please rate the following learning preferences based on their level of usefulness for you, where 1 is “the least useful” and 4 is “the most useful.”

	1	2	3	4
1. Multimedia exercises (audios, videos, games, etc.)				
2. Conversations with my classmates				
3. Oral presentations				
4. Forums				
5. Pronunciation exercises				
6. Language tips posted in Google Classroom				
7. Use of visual aids (diagrams, graphs, images, etc.)				
8. Individual work				
9. Group or pair work				
10. Corrections made individually right at the moment (immediate feedback)				
11. Corrections made individually after class (delayed feedback)				
12. Corrections made as a group (whole-class)				

Part III

Instructions: Please answer the following questions.

1. What aspects of Unit X did you find the most worthwhile? Provide examples.

2. What aspects of Unit X did you find the least worthwhile? Provide examples.

3. What specific recommendations would you provide to improve Unit X and the course in general?

4. Do you have any additional comments?

5. In general, what grade from 1 to 10 would you give to Unit X of the ESP Dynamo Course (with 1 being the lowest and 10 being the highest score)?

1	2	3	4	5	6	7	8	9	10

Thank you for your participation!