

Master's Dissertation/
Trabajo Fin de Máster

**“IF RENEWABLE ENERGY IS
SO GREAT, WHY AREN'T WE
USING IT ALL THE TIME?”:
A CLIL PROPOSAL FOR
STEAM-BASED SUBJECTS**

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ABSTRACT AND KEYWORDS

This Master's Dissertation aims to synthesize all the knowledge acquired in the Intercollegiate Master's Degree in Bilingual Education and Content and Language Integrated Learning (MIEB). For this, a didactic unit based on CLIL teaching in the area of STEAM subjects is proposed.

The first part of this paper develops a theoretical framework for CLIL teaching and its application in STEAM subjects. After analysing aspects such as the origins, the main characteristics and the advantages and disadvantages inherent to this approach, an analysis of the aspects in common with the STEAM subjects in Spain, specifically with the subject called *Tecnología*, will be carried out, and different didactic proposals will be collected for apply CLIL teaching in this field.

This theoretical basis set the guidelines for the development of the second part of this paper, in which a CLIL didactic unit has been designed for the *Tecnología* subject in the 3rd year of ESO called "If renewable energy is so great, why aren't we using it all the time?". This CLIL unit will introduce the contents of energy generation and aims for students to know both the technical characteristics of the different energy generation methods and their social aspects, with the aim that students develop a critical opinion of the use of each of them and the impact they have on society and the environment.

Keywords: CLIL, Technology, ICT, role play, cooperative work, power generation, environment, ESO.

RESUMEN

El presente Trabajo Fin de Máster pretende sintetizar todos los conocimientos adquiridos en el Máster Interuniversitario en Enseñanza Bilingüe y Aprendizaje Integrado de Contenidos y Lenguas Extranjeras (MIEB). Para ello, se propone una unidad didáctica basada en la enseñanza AICLE en el área de las asignaturas STEAM.

La primera parte del trabajo desarrolla un marco teórico contextualizador de la enseñanza AICLE y de su aplicación en las asignaturas STEAM. Tras analizar aspectos como los orígenes, las principales características y las ventajas e inconvenientes inherentes a esta estrategia, se realizará un análisis de los aspectos en común con las asignaturas STEAM en España, concretamente con la asignatura de Tecnología, y se recogerán distintas propuestas didácticas para aplicar la enseñanza AICLE en este ámbito.

Esta base teórica marcó las pautas para el desarrollo de la segunda parte de este trabajo, en el que se ha diseñado una unidad didáctica AICLE para la asignatura de Tecnología en 3º de ESO llamada “If renewable energy is so great, why aren’t we using it all the time?”. Esta unidad, a través de la enseñanza CLIL, introducirá los contenidos de la generación de energía y pretende que el alumnado conozca tanto las características técnicas de los distintos métodos de generación de energía como sus aspectos sociales, con el objetivo de que los estudiantes desarrollen una opinión crítica del uso de cada una de ellas y el impacto que tienen en la sociedad y el medio ambiente.

Palabras clave: AICLE, Tecnología, TIC, juego de rol, trabajo cooperativo, generación de energía, medio ambiente, ESO.

1. INTRODUCTION

There is no doubt that in recent decades the concern for mastering a foreign language to meet the demands of a globalized world has become evident in Europe. The 1990s was a particularly active period in terms of reforms in the field of language teaching, in which both European bodies and national officials in education expressed a marked political will to introduce the study of foreign languages in the first years of the student's schooling. It can be said that one of the main pieces of evidence of this concern was the publication of the *White Paper on Teaching and Learning. Towards the Learning Society* of the European Commission (1995), which broadly established the need for European citizens to master three European languages.

In this context, the CLIL approach emerged in various European countries in the early 1990s in response to these demands, and soon became what Marsh (2002, pp. 11) calls a "European solution to a European need". In a few words, CLIL teaching allows for the effective integration of content and language in the classroom, and has become a key tool in improving the foreign language proficiency of European citizens which has helped to achieve the European Commission's objectives (Lasagabaster & Sierra, 2009).

The situation regarding the teaching of a foreign language was especially alarming in Spain: according to the 2006 Eurobarometer, 56% of the population admitted to being monolingual. As Marsh stated, the change to achieve these goals had to start in the educational curriculum. For this reason, at the end of the 1990s, the bilingual program and the CLIL approach were implemented.

In Spain, in general, the impressions gathered about CLIL throughout these decades are very optimistic, helping students to improve oral skills and pronunciation, offering them greater confidence and security in the production of the language (Ortega-Martín et al., 2018). In addition, the concern for mastering a foreign language is still the order of the day in Spain. So much so that one of the novelties of the new educational reform, the LOMLOE (which will begin to be implemented the next academic year 2022/2023 in the courses you teach) concerning Key Competences is the segregation of Multilingual competence with respect to Linguistic Competence, enhanced by the importance of mastering more than one language in today's society and by the natural distance that exists between mastering the mother tongue and mastering a second or foreign language.

However, despite the efforts to implement the CLIL methodology in Spanish schools and the excellent results it has offered, there are still some weaknesses that must be improved (Ortega-Martín et al., 2018): the lack of training for teachers in non-linguistic areas regarding the CLIL methodology and the mastery of the foreign language, the lack of collaboration between them, the implementation of ICT in the CLIL classroom, the planning of activities and their adaptation to students with more difficulties...all of this means, on occasions, a poor implementation of this system. In addition, although the Spanish educational legislation allows the implementation of this approach in various subjects in non-linguistic areas, in Secondary Education, there is a tendency to apply it in subjects such as Geography, History or Science (Pérez-Cañado, 2012), which means that its application in STEAM subjects (traditionally with more practical content and tasks) is sometimes dismissed. However, its application in this type of subjects has great potential, since it shares many of the methodological orientations of the CLIL approach.

In this context, this Final Master's Project (TFM), which is the result of the main learning acquired in the Master's Degree in Bilingual Education and Content and Language Integrated Learning at the University of Jaén, based on a theoretical framework on the CLIL approach and its impact on STEAM subjects, presents a new didactic proposal based on CLIL teaching for the subject of *Tecnología*¹ in 3rd year of Secondary Education. It should be noted that for the design of the didactic unit, the learning of the MIEB in different areas has been essential. Thus, the different knowledge on methodology, design and development of materials, evaluation, etc, acquired throughout the master's degree has been considered for planning the CLIL unit.

2. OBJECTIVES

According to the general or specific character of the main objectives of this paper:

2.1. General objective

The general objective of this paper is to develop a didactic unit for specific contents of the subject called *Tecnología* aimed at 3rd ESO students. This didactic unit aims to fully integrate the CLIL methodology in it.

2.2. Specific objectives

¹ As will be explained in later sections, it has been decided not to translate the Spanish name of the subject due to the lack of equivalence in the English-speaking system.

The specific objectives of this paper are:

- To analyse the current situation of CLIL teaching and its application in *Tecnología* as a subject in the Compulsory Secondary Education stage.
- To identify the central elements of the subject and analyse how linguistic tasks can be integrated into them.
- To show the benefits of using different linguistic strategies in *Tecnología* subject.
- To design a CLIL unit that unites the three pillars on which *Tecnología* subject is based: theoretical aspects, practical developments, and ICTs.

3. THEORETICAL FRAMEWORK

This section introduces the theoretical framework on which this project is based. To that end, both CLIL methodology and its current application in *Tecnología* subject are going to be described, and some of the previous works related to these topics are going to be reviewed.

3.1. The CLIL approach

3.1.1. CLIL definition

The term CLIL (Content and Language Integrated Learning) was first used in 1994 at the University of Jyväskylä (Finland) by David Marsh. Since then, many definitions of the term have been provided. However, the most often used is that provided by Marsh & Langé (2000): CLIL aims to teach content subjects or special modules through another language, so the learning of language and other subjects is mixed. That is why Marsh sometimes describes CLIL as “dual-focused education” since there are two main aims: one related to the subject and one linked to the languages.

This dual approach is what separated CLIL from other bilingual education initiatives. This is what Coyle (2007) described as the 4 C’s Framework, which focuses on the interrelation between content (subject matter), communication (the language), cognition (learning and thinking), and culture (social awareness of self and “otherness”) and takes account of *integration* on different levels.

3.1.2. CLIL Characterization

Although CLIL implementation varies from classroom to classroom, any CLIL project shares some specific characteristics throughout the world. According to Mehisto et al. (2008, p.29), the core features of the CLIL methodology are:

- CLIL has a **multiple focus approach** since it supports language learning in content classes and content learning in language classes. In addition, it integrates several subjects and organize learning through cross-curricular themes and projects.
- It promotes a **safe and enriching learning environment**, using routine activities and discourse to build students' confidence to experiment with both language and content, and guiding access to authentic learning materials and environments increasing student language awareness.
- It is **authentic** since it connects the contents with the real world and the students' interests. In addition, it favours the use of the language in real contexts, allowing students to experiment with the use of the language and connecting them with other CLIL English speakers.
- It promotes an **active learning**, since CLIL students communicate more than the teacher, evaluate progress in achieving learning outcomes.
- CLIL uses **scaffolding** as a way of building on a student's existing knowledge, skills, attitudes, interests and experiences and repackaging information in user-friendly ways, responding to different learning styles.
- It involves **co-operation**, since for the success of the implementation of CLIL teaching, cooperation between content and language teachers, cooperation with families and co-operation with the local community is necessary.

3.1.3. Assets and pitfalls

There is no doubt that, since its implementation, CLIL teaching has proven to have numerous benefits for students, although it also has certain drawbacks. Pérez Cañado, (2013) describes in detail the main benefits of this set of methodological practices, according to different categories.

Regarding the *linguistic dimension*, CLIL teaching makes it possible to greatly increase the students' exposure to FL in a real and authentic context, which is why it represents an improvement in traditional language teaching without harming the development of the L1. In addition, it favours communication between FL students in real-life situations.

Regarding *content knowledge*, several studies (such as the one carried out by Pérez Cañado, (2018) to study the effects of CLIL on L1 and content learning) have shown that CLIL teaching is not only not detrimental to the learning of the contents of the non-linguistic subject, but can benefit this learning by presenting the contents in different situations and perspectives.

Concerning the *learning dimension*, the author affirms that CLIL teaching creates an environment for more significant learning of the language, based on the use of FL for real communicative purposes.

With regard to the *cognitive dimension*, CLIL teaching develops a wide range of skills, not only related to communicative competence, but also problem-solving, interpersonal skills, etc. Moreover, CLIL units develop Low-Order and High-Order Thinking skills (LOTS and HOTS) that allow a constructivist approach to language learning (Casal, 2007).

Other advantages refer to the *social or cultural scopes*. Socially, CLIL teaching brings language learning closer to all students, allowing everyone to learn languages regardless of their social class or economic level. Several studies, such as the one carried out by Lorenzo et al. (2021) in Andalusia, have shown that bilingual schools neutralize the differences in language between the different social classes. In other words, CLIL is inclusive and egalitarian. In addition, it favours the construction of intercultural knowledge and intercultural communication, bringing students closer to other cultures and providing them with a vision of a globalized world.

Certainly, CLIL teaching also has downsides. Among those commented by Pérez Cañado, (2013), the several obstacles *teachers* face when implementing this methodology stand out for various reasons: lack of prior training, the lack of CLIL materials and the fact that develop their own materials is really time-consuming; a low mastery of the L2, the lack of support from the educational authorities, etc. *Students* also find drawbacks in CLIL teaching; the acquisition of content through a foreign language can be more complex, which can generate initial fears or frustrations.

The *methodological requirements* of CLIL teaching can also be a disadvantage for those teachers who do not have experience with more innovative pedagogical practices, and the difficulty increases if they must be implemented through FL.

Finally, *evaluation* in a CLIL context is complicated, since there are several teachers involved in the teaching-learning process and there is doubt as to who should evaluate, how content and

language can be evaluated simultaneously and whether the focus should be on the first or the second, etc.

3.1.4. CLIL design

"Content comes first" is one of the mottos of CLIL teaching since, as has already been explained, this approach does not lie in teaching content and teaching a foreign language, but in teaching content through the foreign language. This essence of CLIL can, however, generate numerous doubts about CLIL lessons planning: is a mere translation into the foreign language of the content classes enough? Should the entire syllabus be taught in the foreign language, or can it be combined with the L1? How is the new vocabulary introduced to the students? Should different language skills be considered regardless of the subject?

Sometimes the answer is not simple because, in the design of CLIL units, numerous factors that are the core of CLIL teaching must be considered since, without them, we would not achieve effective learning of the language, in addition to the contents' learning. Although it should not be forgotten that the contents must govern the teaching-learning process, as Vollmer (2008) stated "every learning involves language learning or is language learning at the same time and communication, therefore is of overriding importance also in subject learning" (p.273), so it is essential to plan the teaching-learning process to facilitate the presentation and acquisition of the language naturally and effectively through the contents of the unit.

This, however, is not an easy task. The lack of knowledge of the principles of CLIL teaching is one of the main problems that teachers face in their beginnings (Pérez-Cañado, 2012) because, as mentioned in the previous section, at least in Spain it is not common for CLIL to be taught in initial teacher training. In addition, despite the importance of proper planning of CLIL units and the design of materials that ensure meaningful learning of the language (without losing focus on the main objective, the acquisition of content), as Meyer (2010) states, one of the main problems faced by non-native teachers is the lack of CLIL material and guidance for teaching the subject through CLIL with a multiple approach. In addition, it is common for publishers to present CLIL materials that, however, are a mere translation of the textbook in the L1, but that do not introduce changes in their methodological approaches, leaving behind the essential linguistic tasks for the development of the L2.

So, what are these aspects that a CLIL unit must include? The answer lies in the basic foundations of CLIL described in the previous sections, which are essential for a correct design

of the CLIL lessons and must be present in the different elements of the unit. Special attention should be paid to the interrelationship of the methodology used, the techniques, approaches and materials designed. Numerous authors have described the different criteria necessary for the design of CLIL units. Among the most relevant aspects of a CLIL unit that differentiates them from a unit in their L1, scaffolding, tasks, outputs in the form of projects, language of learning and language for learning are some of the most outstanding.

For example, Meyer (2010) states that elements such as tasks, outputs or scaffolding are core elements of the CLIL methodology, which differentiates them from other types of teaching, and insists on the need for a balance between them to achieve cognitive development that facilitate the acquisition of the language through the contents. The *scaffolding* process is essential in CLIL teaching, as it facilitates the understanding of the L2, improving language learning. Furthermore, as Casal (2007) states, CLIL has a constructivist approach, in which the language is presented through a *cognitive gradation of the tasks*, from LOTS to HOTS. Other elements that a CLIL unit must include that differentiate it from a conventional content unit in their L1 are, among others, the development of *language of learning* and *language for learning* (Coyle, 2007), the language necessary to interact with the content and with the stakeholders of the teaching-learning process.

Furthermore, it is very important to keep in mind that the CLIL lessons designed should favour all language skills: reading, writing, speaking, and listening. To do this, CLIL lessons should encourage student participation and communication, including a variety of oral and written texts, etc, making sure that there is a balance in the use the linguistic skills in the tasks. Tomlinson (2011) made an extensive description of the criteria that must be considered when selecting and developing CLIL material, among which "expose the learners to language in authentic use, provide the learners with opportunities to use the target language to achieve communicative purposes, and more experiential than analytical activities from the language point of view. Thus, a CLIL unit implies a methodological change in which communicative competence is stressed and the activities enable students to use the L2 (always with support or scaffolding to simplify the language).

These principles described by some of the most relevant authors in the field of developing CLIL material are included in educational legislation in Spain, which gives us some guidelines on how these units should be designed. CLIL in Andalusia is currently regulated by the Order of 28 June 2011 and, especially the Instructions of 15 July 2021, reference elements for the

curricular development of the CLIL units in this autonomous community. This Instruction, in its fifth and sixth sections, provides crucial reference elements on methodological approaches and material resources. Regarding the implementation, in addition to establishing that the Integrated Learning and Foreign Language (CLIL) approach should be used, it emphasizes the use of active methodologies that directly involve the user of the language, as well as the use of open, playful, and creative (both oral and written), and integrated tasks. In addition, it states that the use of ICT is an essential tool in CLIL teaching, which should enhance digital competence. Regarding resources and materials, the legislation also emphasizes the use of scaffolding and various visual and auditory resources. Although it introduces some valuable guidelines, this information is in most cases insufficient for a complete development of a CLIL unit, especially for those teachers with little or no experience in this field.

In short, the development of CLIL materials should not be based on a mere translation of the materials in L1, and the key aspects mentioned above should be introduced to ensure that duality between content and language. However, this is not an easy task, especially for those non-native content teachers who, in most cases, have not received previous training in CLIL teaching. The guidelines established by educational legislation, although consistent with the principles of CLIL teaching, are scarce for an effective development of CLIL materials, and teachers need auxiliary information to carry out this design process. To facilitate the development of CLIL units, some authors have developed different guidelines and guides for the development of CLIL materials that include the elements mentioned above. Among them, it is worth mentioning the book “CLIL classroom practices in multilingual education in Kazakhstan: guidelines and examples” (San Isidro-Smith et al., 2020) an invaluable practical resource that describes twenty steps to plan a CLIL unit and create enriching lessons based on the theoretical foundations of CLIL teaching exposed in the previous sections: 4Cs Frameworks, Meyer's CLIL Pyramid and Bloom's Taxonomy... This resource will be used as a guide for the design of the didactic unit that is presented in the following sections.

3.2. STEAM-based subjects and the CLIL approach

3.2.1. STEAM-based subjects in the Spanish curriculum

There is no doubt that, nowadays, a global and integrated technological culture is necessary. The quote that opens the Appendix II of the Royal Decree 1105/2014 summarizes quite well the basic principles by which we educate in Technology, and that is that "technological development shapes the current world that we know". Today it is impossible to conceive of a

world without technology, and this seems to be recognized by the LOMCE (2013), which makes numerous references to technological training as a cross-curricular content.

In the Spanish curriculum, the main STEAM subject is called *Tecnología*. This subject appeared for the first time in the Secondary School curriculum in Spain in 1990 with the aim of helping students to function in a technological society that is constantly changing and developing. Since its appearance, the subject has undergone slight changes with each legislative reform, although it has maintained its essence, focusing on content based mainly on industrial development and ICTs and on project-based work methodology. Currently, in Andalusia the subject is compulsory in 2nd and 3rd ESO, and both have three teaching hours.

It should be noted that, despite the similarities in terms of *Tecnología* subject contents with some STEAM subjects in the UK curriculum, the *Tecnología* subject does not have a direct equivalence in the UK curriculum, so it has been decided to use its name in Spanish instead of a translation throughout this dissertation. However, in the contents of *Tecnología* there are great similarities with the *Design and Technology* and *Computing* subjects of the UK curriculum. Therefore, we could describe *Tecnología* as a subject that combines several of the contents of the Design and Technology subjects (such as the design process, technical knowledge of materials and manufacturing, analysis of structures and electrical and electronic devices, control systems and robotics...) and the Computing subject contents (programming, software and hardware, safe use of technology...). Figure 1 and Table 1 show the equivalence of the *Tecnología* subject with the contents of the UK subjects.

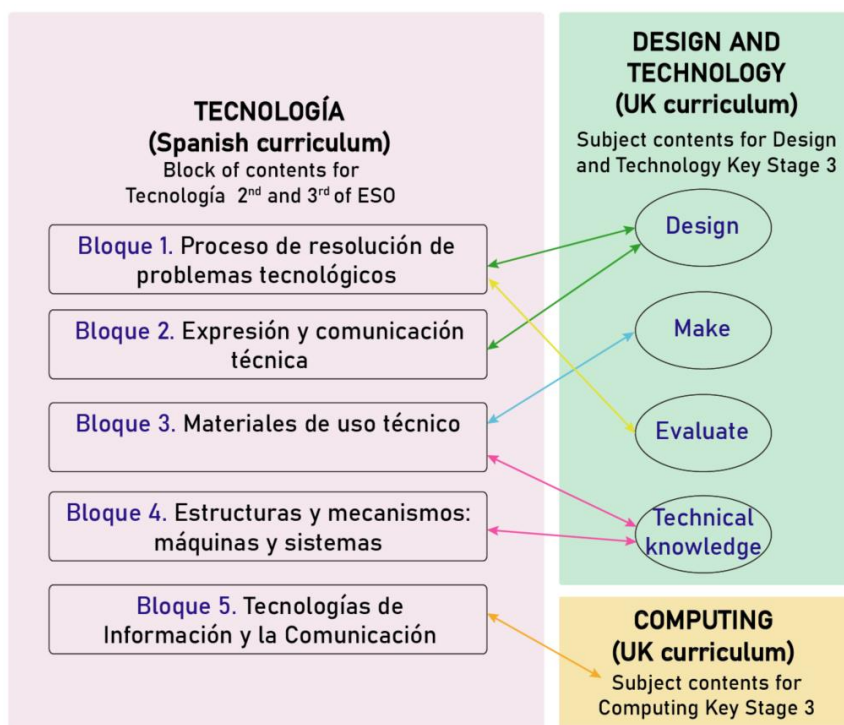


Figure 1. Interrelation of Tecnología (Spain), Design and Technology (UK) and Computing (UK) subjects' blocks of contents. Source: Real Decreto 1105/2014 and The national curriculum in England: Key Stages 3 and 4 framework document.

SPANISH CURRICULUM (TECNOLOGÍA SUBJECT)		UK CURRICULUM	
Bloque 1. Proceso de resolución de problemas tecnológicos		Design	DESIGN AND TECHNOLOGY
Fases del proyecto técnico: búsqueda de información, diseño, planificación, construcción y evaluación. El informe técnico. El aula-taller. Normas de seguridad e higiene en el entorno de trabajo.	1. Identificar las etapas necesarias para la creación de un producto tecnológico desde su origen hasta su comercialización, describiendo cada una de ellas, investigando su influencia en la sociedad, proponiendo mejoras tanto desde el punto de vista de su utilidad como de su posible impacto social y empleando las tecnologías de la información y la comunicación para las diferentes fases del proceso tecnológico. 2. Realizar las operaciones técnicas previstas en un plan de trabajo utilizando los recursos materiales y organizativos con criterios de economía, seguridad y respeto al medio ambiente, valorando las condiciones del entorno de trabajo y realizando adecuadamente los documentos técnicos necesarios en un proceso tecnológico, respetando la	use research and exploration, such as the study of different cultures, to identify and understand user needs identify and solve their own design problems and understand how to reformulate problems given to them develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations use a variety of approaches [for example, biomimicry and user-centred design], to generate creative ideas and avoid stereotypical responses Evaluate analyse the work of past and present professionals and others	

	normalización y utilizando las TICs para ello.	to develop and broaden their understanding investigate new and emerging technologies test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers and technologists	
Bloque 2. Expresión y comunicación técnica		Design	
Instrumentos de dibujo. Bocetos, croquis y planos. Escalas. Acotación. Sistemas de representación gráfica: vistas y perspectivas isométrica y caballera. Diseño gráfico por ordenador (2D y 3D).	Representar objetos mediante vistas y perspectivas (isométrica y caballera) aplicando criterios de normalización y escalas, conociendo y mejorando los principales instrumentos del dibujo técnico. Interpretar y elaborar croquis y bocetos como elementos de información de productos tecnológicos, representando objetos mediante instrumentos de dibujo técnico y aplicaciones de diseño asistido por ordenador. Explicar y elaborar la documentación técnica necesaria para el desarrollo de un proyecto técnico, desde su diseño hasta su comercialización.	Develop and communicate design ideas using annotated sketches, detailed plans, 3-D and mathematical modelling, oral and digital presentations and computer-based tools.	
Bloque 3. Materiales de uso técnico		Make	
Materiales de uso técnico. Clasificación, propiedades y aplicaciones. Técnicas de trabajo en el taller. Repercusiones medioambientales	Conocer y analizar las propiedades y aplicaciones de los materiales de uso técnico utilizados en la construcción de objetos tecnológicos, reconociendo su estructura interna y relacionándola con las propiedades que se presentan y las modificaciones que se puedan producir. Identificar, manipular y mecanizar materiales convencionales asociando la documentación técnica al proceso de producción de un objeto, respetando sus características y empleando	Select from and use specialist tools, techniques, processes, equipment and machinery precisely, including computer-aided manufacture. Select from a use a wider, more complex range of materials, components and ingredients, taking into account their properties. Technical knowledge Understand and use the properties of materials	

	técnicas y herramientas adecuadas con especial atención a las normas de seguridad y salud		
Bloque 4. Estructuras y mecanismos: máquinas y sistemas (I)		Technical knowledge	
Estructuras. Carga y esfuerzo. Elementos de una estructura y esfuerzos básicos a los que están sometidos. Tipos de estructuras. Condiciones que debe cumplir una estructura: estabilidad, rigidez y resistencia. Mecanismos y máquinas. Máquinas simples. Mecanismos de transmisión y transformación de movimiento. Parámetros básicos de los sistemas mecánicos. Aplicaciones. Uso de simuladores de operadores mecánicos.	1. Analizar y describir los esfuerzos a los que están sometidas las estructuras experimentando en prototipos, identificando los distintos tipos de estructuras y proponiendo medidas para mejorar su resistencia, rigidez y estabilidad. 2. Observar, conocer y manejar operadores mecánicos responsables de transformar y transmitir movimientos, en máquinas y sistemas, integrados en una estructura, calculando sus parámetros principales.	Understand and use the performance of structural elements to achieve functioning solutions understand how more advanced mechanical systems used in their products enable changes in movement and force	
Bloque 4. Estructuras y mecanismos: máquinas y sistemas (II)		Technical knowledge	
Electricidad. Efectos de la corriente eléctrica. El circuito eléctrico: elementos y simbología. Magnitudes eléctricas básicas. Ley de Ohm y sus aplicaciones. Medida de magnitudes eléctricas. Uso de simuladores para el diseño y comprobación de circuitos. Dispositivos electrónicos básicos y aplicaciones. Montaje de circuitos. Control eléctrico y electrónico. Generación y transporte de la electricidad. Centrales eléctricas. La electricidad y el medio ambiente.	3. Relacionar los efectos de la energía eléctrica y su capacidad de conversión en otras manifestaciones energéticas, conociendo cómo se genera y transporta la electricidad y su impacto medioambiental, describiendo de forma esquemática el funcionamiento de las diferentes centrales eléctricas renovables y no renovables. 4. Experimentar con instrumentos de medida y obtener las magnitudes eléctricas básicas, conociendo y calculando las principales magnitudes de los circuitos eléctricos y electrónicos, y aplicando las leyes de Ohm y de Joule. 5. Diseñar y simular circuitos con simbología adecuada que proporcionen soluciones técnicas a problemas sencillos, y montar circuitos con operadores	Understand how more advanced electrical and electronic systems can be powered and used in their products [for example, circuits with heat, light, sound and movement as inputs and outputs] apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers].	

	elementales a partir de un esquema predeterminado, conociendo sus principales elementos, y la función que realizan en el circuito.		
Bloque 5. Tecnologías de Información y la Comunicación			
Hardware y software. El ordenador y sus periféricos. Sistemas operativos. Concepto de software libre y privativo. Tipos de licencias y uso. Herramientas ofimáticas básicas: procesadores de texto, editores de presentaciones y hojas de cálculo. Instalación de programas y tareas de mantenimiento básico. Internet: conceptos, servicios, estructura y funcionamiento. Seguridad en la red. Servicios web (buscadores, documentos web colaborativos, nubes, blogs, wikis, etc). Acceso y puesta a disposición de recursos compartidos en redes locales. Programación gráfica por bloques de instrucciones. Entorno, bloques y control de flujo. Interacción con el usuario y entre objetos. Introducción a los sistemas automáticos programados y robóticos: sensores, elementos de control y actuadores. Control programado de automatismos y robots sencillos	1. Distinguir las partes operativas de un equipo informático, localizando el conexionado funcional, sus unidades de almacenamiento y sus principales periféricos. 2. Utilizar de forma segura sistemas de intercambio de información, manteniendo y optimizando el funcionamiento de un equipo informático (instalar, desinstalar y actualizar programas, etc.); aplicando las destrezas básicas para manejar sistemas operativos, distinguiendo software libre de privativo; aplicando las destrezas básicas para manejar herramientas de ofimática elementales (procesador de textos, editor de presentaciones y hoja de cálculo); y conociendo y utilizando Internet de forma segura y responsable para buscar, publicar e intercambiar información a través de servicios web, citando correctamente el tipo de licencia del contenido (copyright o licencias colaborativas). 3. Utilizar un equipo informático para elaborar y comunicar proyectos técnicos, manejando un entorno de programación, que permita resolver problemas y controlar sistemas automáticos programados y robóticos sencillos, comprendiendo y describiendo su funcionamiento.		COMPUTING

Table 1. Equivalence of *Tecnología* (Spain), *Design and Technology* (UK) and *Computing* (UK) subjects' contents.
Source: Real Decreto 1105/2014 and The national curriculum in England: Key Stages 3 and 4

As can be seen in Figure 1 and Table 1, the *Tecnología* subject does not correspond to one or the other subject, but to a mixture of both, all of them based on STEAM teaching. Therefore,

as previously mentioned, we will refer to the subject by its name in Spanish due to the lack of equivalence in the English-speaking systems.

Having said this, many aspects make the subject *Tecnología* deserve a place in the Secondary Education curriculum in Spain. In the first place, the integrating nature of different disciplines is a fundamental element of the subject: it is essential to apply the knowledge acquired in Physics and Chemistry or Mathematics, among others, to solve technological problems, which allows theoretical content to be brought closer to real problems.

In addition, the importance of *Tecnología* subject lies not only in its content but also in its core method, "problem solving" (as stated in the Royal Decree 1105/2014). This methodology is essential in achieving key competences and meaningful learning. Therefore, the *Tecnología* subject contributes enormously to developing most of the key competences.

Regarding the organization of the subject, as stated by Blazquez et al. (2013), the *Tecnología* subject is mainly made up of three pillars:

- Theoretical aspects
- Practical developments
- ICTs: use of computers as a tool.

Regarding the methodologies used, even though problem-solving is the main methodology of the subject, as Cervera (2010) states, in the *Tecnología* subject we can resort to different didactic models:

- Expository academic model
- Problem-solving model
- Project resolution model
- Discovery learning model
- Incidental learning model
- Interdisciplinary model
- Models with specific teaching materials
- Scientific model
- Analysis model

In addition, the author distinguishes four main spaces in which the teaching of the subject is developed:

- **Classroom-class**, where mainly conceptual work is carried out.
- **Workshop classroom**, where practical work is mainly carried out.
- **Computer room**, where computers are used, focused on the development of ICT skills.
- **Other situations**: different situations that allow knowledge to be related to the real world (an experiment in the schoolyard, etc.)

In short, the main characteristics of *Tecnología* as a subject show that it has a very important role in student development, as it contributes to the achievement of key competences while using a variety of methodologies and techniques that achieve significant learning in students. However, there is no doubt that the practical part plays a fundamental role in the development of the subject. The answer is, are STEAM-based subjects as *Tecnología* teaching characteristics compatible with CLIL methodological practices?

3.2.2. CLIL methodology in STEAM-based subjects

Tecnología subject, which belongs to the Non-Linguistic Areas (ANL), is on the list of subjects that can be taught in bilingual education in the educational stage of compulsory secondary education according to the Instructions of 15 July 2021 (section 3.1) in Spain. The legislation allows the subject to be taught in English in 2nd and 3rd of ESO, whereas in 4th of ESO should be taught in English exceptionally.

As can be seen in the previous sections, the *Tecnología* subject shares many of the core aspects of CLIL approach: it has a multiple approach, which combines different subjects and knowledge to carry out projects; uses multidisciplinary and cross-curricular themes. It uses methodologies that favour the development of Higher Order Thinking Skills (HOTS), such as problem-solving or the project method. In addition, among the contents of the subject there is an essential cross-curricular content in the Secondary curriculum, the use of ICT, and which is also a backbone of CLIL teaching.

Despite this, and the assorted didactic models that the *Tecnología* subject allows, combining them with the CLIL methodology sometimes seems to be a challenge that leads to dismissing the application of CLIL teaching in *Tecnología*. As stated by Pérez-Cañado, (2012) even though a multitude of subjects can be taught through the CLIL methodology, "the scope tends to narrow down and focus on History, Geography, Science and Social Sciences, particularly in Secondary Education", and in my own experience, *Tecnología* is usually excluded from the bilingual offer. Sometimes, the many hours dedicated to the workshop classroom and imminently practical

projects lead to a false belief that it is difficult to combine it with CLIL teaching. However, proper planning and design of CLIL teaching in *Tecnología* can have many advantages for students.

However, there is no single way to organize CLIL *Tecnología*. One of the most adopted proposals is that of Blazquez et al. (2013), who defends that the application of CLIL teaching in the *Tecnología* subject must begin by maintaining the core of the subject, based on the development of tasks and projects, but which must be separated into two areas: Technical tasks and Linguistic tasks. As the authors state, "the balance of both in the daily work with students" is the basis for the success of CLIL teaching in the *Tecnología* subject.

Among the former, the *technical tasks* in *Tecnología* subject, the author distinguishes the following:

- Creation of designs
- Elaboration of mechanical sketches
- Preparation of modular electrical diagrams
- Tools use
- Control and supervision of a manufacturing process carried out in the workshop-class
- Redesign of versions
- Updating of products considering dimension contributions
- Measurement of dimensions and parameters
- Organization and development of a problem by sequence of tasks
- Use of common software applications
- Organization of the class in teams

Regarding the *linguistic tasks* that can be carried out in the subject, the author highlights:

- Listening comprehension of the language of instructions and technical messages
- Reading comprehension by technical documents
- Improving writing skills by creating technical documents
- The improvement of social skills by the participation of team members in brainstorming and discussions as part of the problem-solving process or conversations with peers and teachers to give opinions, show solutions, negotiate alternatives in a work group, conduct interviews, etc.

- Design of charts, mind maps, timelines, correction of errors as part of the inspection of documentation, organization of images and texts in a project document...

To favour the application of CLIL, the contribution of the different *Tecnología* departments of various institutes is especially useful, which, based on their experience in the implementation of CLIL in the *Tecnología* subject, propose different linguistic activities that can be developed in the subject. Most of these linguistic activities are a complement to the technical activities mentioned above and play a fundamental role in *Tecnología*. For example, the *Tecnología* department in the Instituto Ramiro de Maeztu (Blazquez et al., 2013) have successfully applied the following linguistic activities in *Tecnología* lessons:

- Short experiences and simulations
- Brainstorming meetings and debates
- Problem solving and comparison with other cases
- External visits.
- Finding information
- Role-play
- Analysis of Case Studies

Other authors have made a classification of different CLIL activities to teach *Tecnología* through English in Secondary Schools based on the linguistic skills that are developed in them. For instance, Fernández Alba (2014) has carried out a valuable guide with examples of several activities for this subject based on different language skills:

- **Vocabulary activities:** activities focused on knowing the vocabulary related to Technology. For example, the author proposes using matching pair, complete the spaces or bingo activities to review vocabulary frequently through activities and games (using support sheets, cards, ICTs...). She also presents different activities for organising information such as matching, sequencing, conceptual maps, classifying activities or internet research (see Figure 2).
- **Writing activities,** in which support sheets are an essential element. The author proposes, among others, finish the sentence and dicto-comp activities, fill the gaps exercises, running dictation, pair spelling practice, etc. Figure 3 shows some examples of writing activities.

Matching pairs:



Classifying

For example: Connect four

Materials Connect 4			
It is tough	It is flexible	It is light	It is soft
It is transparent	It is heavy	It is hard	It is flexible
It is hard	It is brittle	It is tough	It is heavy
It is rigid	It is translucent	It is transparent	It is brittle
It is soft	It is opaque	It is rigid	It is opaque

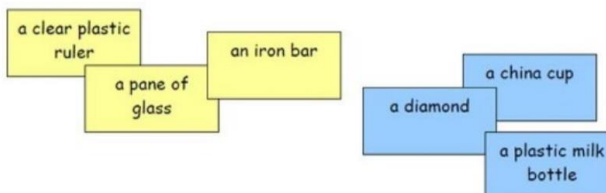


Figure 2. Vocabulary activity examples (Fernández Alba, 2014)

Finish the sentence.

1. Look at the following objects; they are made of different materials:

Ceramics and Glass:

Metal:

Wood:

Plastic:

2. Now finish the sentences:

The vase is made of _____

The scissors are made _____

The box is _____

The _____

Running dictation.

7. HEALTH AND SAFETY RULES

Running dictation. Choose a writer, a running person and a spelling checker

Text:

HEALTH AND SAFETY RULES

To protect our health we have to follow rules when we are in the workshop. Tools and machines can be dangerous if we don't use them properly. Safety rules prevent accidents and reduce the risk of hurting ourselves. To prevent accidents in the workshop, you must follow your teacher's instructions.

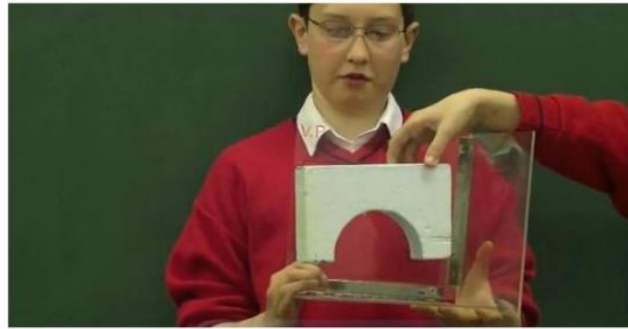
Below is some advice and some compulsory rules:

1. Ask your teacher if you have any doubts.
2. Obey signs. There are four types of signs: mandatory, danger, first aid and emergency, and prohibition.
3. Find out how to use each type of tool, equipment and machine correctly before you start. Don't work with tools, equipment or materials you don't know how to use.
4. Tell your teacher immediately if you have any kind of accident (cut, burns, dust in your eyes, etc.).
5. Too much noise makes people irritable and aggressive and interrupts concentration. Try to work quietly.

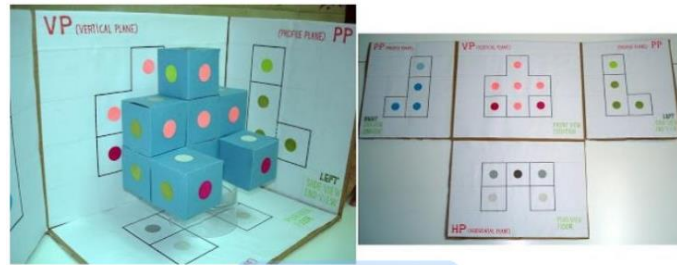


Figure 3. Writing activities examples (Fernández Alba, 2014)

- Reading and listening activities.** The author proposes different types of reading and listening activities for the subject, such as list/read and label a diagram/picture/map/graph/chart, listen/read, and fill in a table, listen/read and rearrange information, among others. In *Tecnología* subject, it is especially recommended to use realia and examples in their environment, such as those proposed by the author shown in Figure 4.



[Ver el video en youtube](#)



[Ver video en photopeach](#)

Figure 4. Realia examples used in Tecnología subject (Fernández Alba, 2014)

- **Speaking activities.** Among the different speaking activities, the author highlights question loops, info gap, trivia search, Word guessing games, class surveys, making presentations or record your voice activities (see Figure 5).

Example of Record your voice...

Based on support sheets on walls, students have to copy an information and create a [Voki](#) to record their voices explaining the info.



Take a look at the activity: [Safety at the workshop](#) an [results](#).

[Instructions for the task in a Voki:](#)



[An example of the task done by student:](#)



Figure 5. Speaking activities examples (Fernández Alba, 2014)

4. DIDACTIC UNIT

4.1. Justification

It is a fact that energy moves the world. The technological development that shapes our current society as we know it would not have been possible without all those devices capable of transforming different types of energy into electrical energy. We need energy for practically everything: to light, to heat and cool interiors, for transport, to produce food, to manufacture everything we need...

In just two centuries we have gone from obtaining energy from the force of animals, from ourselves or from fire to obtain it from the most diverse types of energy sources, from uranium to coal. This technological transformation has had a great impact on our society, to the point that our way of living is thanks to the energy, which is the social, economic, and vital support of our current society, so much so that the degree of development of a country is measured by its energy consumption.

Currently, power generation is a burning issue. In recent years we have been bombarded with news about the rise in the price of electricity, the scarcity of raw materials (on the order of the day due to the conflict in Ukraine), or the debate on renewable and non-renewable energies and

their impact on the environment. Our students are constantly exposed to information about the impact that energy has on our society. And, despite this, few students know how to answer how electricity reaches the plugs in our homes.

In this context, a didactic unit based on the generation of energy as the backbone of the contents is proposed. This unit aims to give an understanding of the types of energy that we find today, showing the characteristics and the advantages and disadvantages of each one of them. Special attention has been paid to knowing not only the technical characteristics of each type of power plant and energy transformation (indispensable in a STEAM subject such as *Tecnología*) but also knowing the social and environmental repercussions that each one of them has, with the aim that the students develop a critical opinion of each of them with their understanding and their application in their daily use. The objective is not only for students to know the technology behind them but also how they affect their environment.

Having this knowledge will help students to develop their own well-founded opinions about how we use energy and to what extent we depend on it; it will teach them to be more aware of what we use it for and where it comes from, to value the real need for that use and to develop favourable attitudes towards the environment in order to know how to save without having to give up our level of well-being. Knowing the energy generation process will help improve students' environmental awareness, generating more environmentally friendly habits.

In addition, the contents of this didactic unit are essential for the development of many contents of the entire course, both in the *Tecnología* subject and in other subjects, for example, it will help to understand the repercussion of energy development in History. In short, knowing the entire energy generation process will undoubtedly help students to understand and critically assess the environment in which they live.

4.2. Context

4.2.1. The school

The school in which the didactic unit will be applied is a public school located in the city of Malaga in Andalusia (a monolingual community in Spain), with levels from Pre-primary Education to Secondary Education. It is a public high school located in the western part of the city, attended mainly by students from the surrounding neighbourhood in which the economic and sociological profile of the students' families is lower-middle class.

The centre is quite small and has limited spaces and material resources, among which a laboratory and a small technology workshop stand out. Despite the scarce resources, thanks to the efforts of the management team to promote the use of ICT, three computer rooms have been set up, so there is enough availability to use these classes.

The *Tecnología* Department has two teachers, among whom there is a great collaboration. Regarding the material resources of the department, they are scarce. The workshop has basic tools and worktables.

In relation to language learning, the bilingual section started in the academic course 2014-2015. The school Bilingual Project for Secondary Education has been developed according to the bilingual legal framework in Andalusia. In the 3rd Secondary Education stage, 6 hours a week are taught in the L2 (English). Among the CLIL subjects, *Tecnología* is included.

4.2.2. The students

The didactic unit proposal is addressed to 3rd year of ESO students with an age range of 14-15 years old. The target group is made up of 24 students. It is a heterogeneous group, with different learning rhythms. In general, students show interest in the world and issues around them, ask questions and debate the issues that arise in class. Their relationship with teachers is usually positive, and they participate in the activities proposed in the classroom without much difficulty.

In this stage of life, adolescence, pupils of this age are characterized by changes in the aspects of personality and puberty. Self-esteem problems arise, the feeling of shame emerges, and they sometimes need the recognition of others to feel valued. These aspects intrinsic to puberty will be considered in the design of the didactic unit, since it will be considered that the classroom activities carried out to represent an opportunity to increase confidence in themselves and in their abilities.

With respect to diversity, two students with special educational needs stand out. The first student is a gifted student. The second one has a much slower learning pace than his classmates, although he has, in general, a very good attitude and willingness towards studies, and does not have curricular adaptation. For the development of the didactic unit, activities must be designed that cover the entire cognitive spectrum, with activities that promote their LOTS and HOTS to attend to the diversity of the classroom.

Regarding the level of English of the students in this academic year, the Instructions of 15 July 2021 indicate that it is considered that the students who study bilingual education should reach a level of linguistic competence in L2 corresponding to a B1, as defined in the Common European Framework of Reference for Language. Therefore, it is expected that the students in 3rd ESO have at least an A2 level. These data are consistent with the level of the students to whom the didactic unit is addressed, since thanks to the information provided by the English Department of the centre, it is known that in the classroom the level varies from A2 to B2 (6 students have a B2, 12 have a B1 and 6 have an A2). The designed activities must present a balance between communication and communication and develop different linguistic skills (listening, reading, speaking, writing).

4.3. Objectives

4.3.1. Content objectives

At the end of this unit, students will be able:

- To know the different types of energy and the energy transformations that occur in the devices we use on a daily basis.
- To know how electricity is obtained, transported, and distributed.
- To know the operation of the different types of power generation plants, as well as their advantages and disadvantages from the economic, social and environmental point of view.
- To become aware of the environmental impact that occurs as a result of the generation, transport and use of electrical energy.
- To become aware of the importance of renewable energy sources and the socio-economic progress derived from the possibility of using electrical energy.

4.3.2. Language objectives

At the end of this unit, students will be able:

- Regarding language of learning:
 - o To understand and know vocabulary and expressions related to energy and power generation: mechanical energy, potential energy, kinetic energy, nuclear energy, chemical energy, light energy, sound energy, electrical energy, energy conservation, energy efficiency, solar cell, generator, renewable resources, non-

renewable resources, fossil fuels, turbine, nuclear reactor, nuclear energy, fission, fusion, nuclear meltdown, uranium and plutonium, hydroelectric energy, hydroelectric power plant, solar energy, global warming, greenhouse effect, biomass energy, tidal energy, geothermal energy, wind energy, wind turbines, wind farms.

- To use the zero-type conditional to explain energy transformations.
 - To use the present tense in order to explain how a power plant works.
 - To use the future tense and conditions for the expression of giving opinions and argument defending your role in a role-play game about power generation.
- Regarding language *for* learning
- To use language for comparing
 - To use language for justification
 - To use language for expressing cause and effect
 - To use language for giving opinions
- Regarding language *through* learning
- To watch a video in English about energy forms.
 - To read in English a procedure text to construct a mini generator.
 - To read what is a Turbine generator and a solar panel in English.
 - To read how different power plants work.
 - To read the scenario of a role-playing game.

4.4. Contents

4.4.1. General curricular contents

The curricular contents of the *Tecnología* subject are published in the Order of January 15, 2021, by which the curriculum corresponding to the Secondary Education stage in the Autonomous Community of Andalusia is developed, regulating certain aspects of attention to diversity, the organization of the evaluation of the student's learning process is established and the transit process between different educational stages is determined. The curricular contents of this didactic unit belong to Block 4. Structures and mechanisms: machines and systems, in which said didactic unit is framed.

1. Electricity. Effects of electric current. (*Electricidad. Efectos de la corriente eléctrica*)

2. Power generation and transport (*Generación y transporte de la electricidad.*)
3. Power plants (*Centrales eléctricas*)
4. Electricity and the environment (*La electricidad y el medio ambiente*)

4.4.2. Specific curricular contents

1. Contents related to language skills
 - Vocabulary related to energy sources, energy forms and power generation.
 - Comprehension of oral messages.
 - Comprehension of written texts
 - Production of oral texts in a role play setting
 - Comprehension and use of verbal tenses: present simple, future, zero and first conditional.
2. Cross-curricular contents:
 - Access to Energy
 - Energy saving

4.5. Contribution to the development of the key competences

This didactic unit has been designed to develop the seven key competencies described in the Order ECD/65/2015, of January 21, which describes the relationships between the competencies, the contents and the evaluation criteria of primary, compulsory secondary education, and high school. The key competencies will be enhanced as follows:

1. **Competence in Linguistic Communication (CLC):** Throughout the unit, students will develop listening, speaking, reading, and writing skills using the English language. This competence will be worked on by interpreting written texts, using the specific vocabulary with precision... In addition, the student will face specific and contextualized situations (like a role-play) in which he must communicate, and which will force him to prepare written documents.
2. **Competence in Mathematics, Science and Technology (CMST):** This is, due to the nature of the unit contents, one of the competences that will be worked on the most during the unit since the contents belong to the area of Science and Technology. The development of the contents of the subject requires skills and abilities of manipulation

of tools, identification, and solution of technological problems. Therefore, this competence will be enhanced through knowledge and understanding of objects, processes, systems, and technological environments.

3. **Digital Competence (DC):** Throughout the unit, ICTs will be used fluently to investigate and document information, for the creation and design of graphic resources, etc.
4. **Learning to Learn (L2L):** Using ICT tools, strategies for searching, obtaining, selecting and analysing information will be developed through different methodologies based on research and inquiry for problem solving, which will contribute to the acquisition of this competence.
5. **Social and Civic Competences (SCC):** This competence will be achieved through cooperative and collaborative work, which promotes values such as tolerance, the ability to communicate assertively among equals, empathy... In addition, it will be promoted through respect for workplace safety standards in the workshop.
6. **Sense of Initiative and Entrepreneurship (SIE):** the active methodologies and strategies used during the different tasks of the unit, such as the puzzle technique or the role-playing game, require work planning and organization, collaborative group work, assumption of responsibilities, decision-making... to achieve objectives, which will guarantee the acquisition of this competence throughout the unit.
7. **Cultural Awareness and Expression (CAE):** The nature of the contents will allow the student to reflect on the influence of energy development on social models throughout history and become aware of the environmental impact of the generation, transport and use of energy.

4.6. Methodology

4.6.1. General methodological principles

As has already been explained throughout this paper, according to Article 5 of the Instructions of 15 July 2021 (methodological approaches), bilingual education must be taught from the CLIL approach. Among the strategies that characterize the CLIL approach, the use of active methodologies such as cooperative work or autonomous learning that involve the student in the use of the language and maintain a high level of motivation stand out.

In addition, the regulations provide other methodological guidelines, among which are the design of open, playful and recreational activities that include both oral and written skills, and

the performance of integrated interdisciplinary tasks that involve the development of a relevant final product linked to real life. Furthermore, it is convenient that this final product involves the use of new technologies, essential in bilingual education, and that will reinforce digital competence.

These methodological guidelines have been considered in the planning and design of the tasks of the CLIL unit. In the following sections, the main methodological strategies considered, and other aspects related to the methodology that will favour a meaningful learning of the contents and the language are explained.

4.6.2. Cooperative learning

Cooperative learning will be an essential methodological resource to meet the objectives and develop the different competences throughout the unit. Thus, different techniques will be used, such as Think-Pair-Share in task 1, the Jigsaw technique in task 8 or the role-playing game in task 11.

4.6.3. Cognition

For the design of the different tasks, it has been considered that, in order to acquire the different key competences, it is necessary to put cognitive skills at the front line of teaching practice. In addition, it has been taken into account that in the different sessions there is a cognitive balance between less and more cognitively demanding tasks, considering Bloom's Taxonomy, so that the diversity of the students is addressed while Higher Order Thinking Skills (HOTS) are ensured to provide students with challenging tasks and drive for learning to happen. Some of the cognitive demands implicit in the objectives of the unit, ordered from less to more cognitively demanding are:

- List different energy resources
- Classify the energy resources in renewable and non-renewable
- Describe how electricity gets our home
- Identify different forms of energy
- Recognize the main characteristics of different power plants.
- Argue about the impact of different power plants in a role-play acting
- Defend your ideas about power generation in a role-play acting

- Investigate the different ways of transforming energy
- Construct a mini Faraday generator
- Design a 2-minute video

4.6.4. Use of scaffolding strategies

Providing scaffolding in the language, in the content and in the process is essential to improve the teaching-learning process and to attend to the diversity of the student body. Therefore, assessment tasks generally incorporate appropriate scaffolding through. In the step-by-step section, the scaffolding instruments used in each session and task have been explained. Generally, the most used scaffolding tools are:

- Language boxes – with task-specific linguistic scaffolding, such as vocabulary for sharing ideas, defending an argument or voice-over a video.
- Use of glossaries, mainly in text-based tasks.
- Simplify instruction and procedure texts using visuals.

4.6.5. Classroom arrangement.

The classroom will be organized to help create a pleasant atmosphere and, above all, to facilitate the organization of the different activities and tasks, ensuring visibility, mobility and change of layout. The designed unit has numerous activities in which they must work in cooperative pairs or cooperative groups, so the most effective organization is one that allows to change the configuration of the classroom depending on the task needs. Students will normally be seated in rows of two, which can be easily modified to create 4 or 8 people clusters. In addition, a runway layout will be used when enacting the role-play game (see Task 11 in section 4.6).

On the other hand, the digital screen will be in the centre of the front wall, and there are two speakers located on both sides of the classroom to ensure equality in that activities or tasks that involve listening skills.

4.6.6. Use of ICT

As explained in the previous sections, the methodological orientations of CLIL teaching present ICT as an essential resource to favour the teaching-learning process in the foreign language.

Therefore, the use of ICT will be integrated throughout the unit. In general, new technologies will be used to:

- Present the content to the students: both in written form and on video.
- Search for information, as in task 10, where the Internet will be an essential tool to investigate and complete the required information
- Use of online simulators, as in task 5, in which they will use a simulation tool to investigate energy transformations.
- Content creation by students, with the use of applications such as Flipgrid in task 12.
- Collaborative work online, as in task 3 by using the page <https://www.wordclouds.com/>

4.7. Attention to Diversity

According to Article 8 of the Instructions of 15 July 2021, bilingual education is a program aimed at all students. This implies that it must include educational actions and measures that respond to the needs and differences of each and every one of the students, adopting the same measures for attention to diversity as in ordinary education, such as the proposal of methodological alternatives and assessment according to the needs of the students. For this reason, it has been essential during the design and planning of the didactic unit to take into account the diversity of our context, which can be presented in a diversity of interests and motivations and in its learning pace.

To cater to diversity in the classroom, in the design and planning of the tasks, different aspects have been taken into account that aim to attend to the different learning paces and styles. Thus, it has been checked that the tasks cover the entire cognitive spectrum; that there is a variety in the methods used, that there are enough scaffolding strategies, and that there are differentiated tasks throughout the unit.

Due to the context of the students, it is also especially important to pay attention to the educational needs with high capacities. As Hernández (2005) states, it can be said that gifted students adapt better to methods that favour their cognitive activity, based on research, discovery and open practices.

To this end, according to Bueno (2011), adopting right methodological strategies is the easiest way to modify the curriculum and cater diversity. Therefore, the use of the different methodologies and strategies (which have been explained in the previous section) throughout

the unit, such as cooperative learning or role-playing, in which inquiry and research are necessary, aims to attend to the different learning styles.

The use of this type of methodology can cause those students with a slower learning pace to feel lost or stagnant, which is why the support of the teacher is essential as a companion and guide in the process for this type of student.

In addition, as students with diverse language skills are in the classroom, the use of scaffolding is essential to attend to diversity and the difference in skills in the English language. These have the objective of attending to the different abilities in the classroom, both in terms of content and language ability. These strategies will ensure that students can work autonomously and meet the challenges of different tasks despite their foreign language skills.

Finally, in the design of the unit, it has been taken into account that the tasks created have differentiated goals that involve different levels of intellectual challenge for the students. To do this, in the planning of the goals, Gardner's theory of multiple intelligences has been taken into account, and different types of intelligence have been considered for carrying out the tasks and create differentiated goals. Some of them are:

- **Verbal intelligence:** create a 280 characters Tweet about energy generation, tell different energy sources to create a word cloud, write and perform your role introduction in a role play, defend an argument in a role play, etc.
- **Visual/spatial intelligence:** watch a video about different energy forms, create a video using ICT, use Plickers, etc.
- **Kinaesthetic intelligence:** do a role-play, decide on the features of your role, plan your performance in the role play, create a mini Faraday generator, etc.
- **Musical intelligence:** choose the song for a 2-minute video about power generation and energy efficiency.
- **Interpersonal intelligence:** plan a role-play in groups, work cooperatively using the Jigsaw Technique to learn about different power plants, etc.
- **Intrapersonal intelligence:** complete a worksheet about energy resource, complete a fill in the gap's activity about power plants, turbines, generators and solar photovoltaic cells, etc.
- **Naturalistic intelligence:** observe a mini Faraday generator to learn about power generation, explore a virtual simulator to learn how energy transformations occur, etc.

4.8. Transversality

The designed tasks will develop several of the cross-curricular contents included in article 6 of Decree 111/2016 and in article 6 of Royal Decree 1105/2014:

- **Development of social skills and participation; education for coexistence and respect in interpersonal relationships and the development of basic skills for interpersonal communication, the ability to listen actively and agreement through dialogue.** They will work through teamwork that they must carry out throughout the didactic unit and especially through the role-playing game.
- **The promotion of the principles of equal opportunities and universal accessibility, as well as awareness of issues and problems that affect all people in the globalized world, such as poverty or inequality between people.** Work will be carried out throughout the unit and especially in tasks 10 and 11 through reflection on access to energy for the entire population.
- **Critical use and self-control in the use of information and communication technologies and audiovisual media, their contribution to teaching, learning and student work, and the processes of transforming information into knowledge.** Likewise, work will be carried out throughout the entire unit with the integrated use of ICT in the search for information that helps to solve the tasks.

4.9. Resources and materials

For a successful development of the proposal, the following spaces and resources will be necessary:

- Usual classroom: the usual classroom has a touch screen, a computer with Internet access and a conventional blackboard. The desks are individual, thus allowing temporary arrangement.
- IT classroom: the IT classroom has 30 computers with internet access.
- Workshop classroom: the workshop classroom has basic tools for cutting, clamping, drilling, and joining.
- Material for the development of the project: the body of a pen, a neodymium magnet, a copper wire and a LED diode.
- Printable resources for students and teacher, which can be found in Appendix 2: Unit materials.

4.10. Step-by-step and timing

For the design of the sessions and activities, the *introduction-investigation-consolidation-creation* structure described by San Isidro-Smith et al., (2020) has been followed, which is characterized by a cognitive progression in the tasks (from LOTS to HOTS).

The didactic proposal has been designed to be implemented in the third quarter of the school year. It will be carried out in 8 one-hour sessions. Therefore, the structure of the didactic unit will be:

- **Introduction stage:** Session 1 will act as the introduction to the unit. In it, tasks focused on helping the student to check what they know about the subject will be carried out.
- **Investigation stage:** In sessions 2, 3 and 4 there will be tasks in which students will have to manipulate the content, investigate and discover. This stage is focused on tasks of relating, classifying, in depth reading...
- **Consolidation stage:** in the consolidation phase, which will be developed in sessions 5 and 6, students will structure what they have learned and discovered throughout the previous phases.
- **Creation stage:** Sessions 7 and 8 will be the culmination of the unit. In the creation phase, they will carry out tasks that involve the use of H.O.T.S to analyse, evaluate, create and share what they have learned throughout the unit.

4.10.1. Introduction stage: *Can you light up a room with a potato?*

4.10.1.1. Session 1

By the end of this session, students will learn about the different energy forms and its transformations. The tasks are aimed at activating prior knowledge about energy forms. The driving question (Can you light up a room with a potato?) is a way to grab the students' attention, and refers to one of the different energy forms, chemical energy.

Task 1: Where's my electricity from and how does it get to my home?

The first activity is a warm-up activity, based on a variant of the cooperative technique **Think-Pare-Share (TPS)**, called **Think-Pair-Tweet**. Before starting the topic, the students will be asked the question “*Where's my electricity from and how does it get to my home?*” and in pairs,

they will discuss their answer for three minutes. Next, they think of a response and then generate a Tweet (280 characters), which will be projected on the digital whiteboard in the classroom.

As scaffolding strategies for the students, different vocabulary for sharing ideas and showing agreement/disagreement will be provided (see appendix 2, p.2). By doing this task, students can develop speaking, writing, and listening skills.

Task 2: Identifying forms of energy

Watch a video about the different forms of energy (<https://www.youtube.com/watch?v=FX7T-QYTPho>) and, in pairs, identify the different energy forms in an image and name them. The video contains some scaffolding written support. In order to help students, the video can be stopped after the main points are mentioned and ask questions on it to clarify. After watching the video and identifying the energy forms, students will be asked to share their answers. A glossary with the main energy forms translation is also provided as a way of scaffolding. This task is focused on listening and speaking skills. The materials needed in this tasks are shown in appendix 2, p.3.

Task 3: Energy resources word cloud

Once the students know the different forms of energy, a "brainstorming session" will be organized by which the students can formulate the content of the keywords they are going to work with (see appendix 2, p.4). On the website <https://www.wordclouds.com/> a word cloud with the content related to energy sources will be created with the whole class. When the word cloud is ready, the class will be asked to read the words to practice their pronunciation and remember their meaning. This task is aimed at activating their prior knowledge about energy sources and it is focused on developing language skills such as listening, reading or speaking (pronunciation).

Task 4: Classification of Energy resources

Classify the energy resources in renewable and non-renewable, find similarities and differences and discuss with your partner the advantages and disadvantages you think each type of resource has. The language skills involved are output speaking and writing. The template for this task is shown in appendix 2, p.4.

4.10.2. Investigation stage: Are you able to turn on a light bulb using a pen, a cable and a magnet?

4.10.2.1. Session 2

At the end of this session, students will be able to understand that the transformations that allow the generation of energy are carried out in power plants, and that turbines, alternators and photovoltaic cells are the main elements responsible for carrying out said transformation.

Task 5: What is used to transform energy?

With the help of a computer, students must visit the virtual simulator included in appendix 2, p.5 and investigate the different ways of transforming energy, discovering the main systems that allow this transformation.

Then, students must think of different objects that carry out some energy transformations and complete the table shown in appendix 2, p.5.

Task 6: Power plants, turbines and generators and solar photovoltaic cells text.

In this task, students will read a descriptive text. Before reading the text, ask students three warm-up questions to activate their prior knowledge.

- How can mechanical energy be transformed into electrical energy?
- What form of energy do we have in our wall sockets?
- Where are energy resources transformed into electrical energy?

Read the text and then fill in the missing gaps individually. The text is of a descriptive type explaining the characteristics of power plants and the two main ways of generating energy: generators and solar photovoltaic cells. Each student must read the text by using the scanning strategy in order to develop their reading skills and complete the task. Then, check the answers.

As a scaffolding strategy for students, a dictionary and different images will be provided. The images show the different parts of the elements in a power plant. In this task, students can develop reading, writing and speaking skills. The text, the scaffolding tools and the fill in the gap's activity are shown in appendix 2, pp.6-7.

4.10.2.2. Session 3

At the end of this session, students will understand how generators can produce electricity with movement thanks to the electromagnetic effect. To do this, students will build their own mini generator. This session takes place in the workshop classroom.

Task 7: Building your own mini Faraday generator.

In this task, students will carry out a small project in the workshop classroom, following the project methodology that characterizes *Tecnología* as a subject. To do this, they will create a mini generator using very simple elements, with which they will be able to light an LED using movement and better understand how generators and electromagnetic effect work. Students will read a procedure text to build the generator (Procedure texts describe what is needed to conduct an experiment and outline—in chronological order—the steps to be followed). In this activity, mainly reading skills will be developed. As scaffolding strategies, images of the different necessary elements and a glossary of keywords will be provided. The materials are shown in appendix 2, p.8.

4.10.2.3. *Session 4*

At the end of this session, students will know the different types of power plants, what their energy source is (renewable or non-renewable) and what are the energy transformations in them and their main components. For this, the Jigsaw cooperative technique will be used (Aronson, 1978).

Task 8: Learning about types of power plants for energy generation using the Jigsaw Technique.

The objective of this activity is to learn about the different power plants and their technical characteristics (what energy source they use, how they work, what their parts are, etc.) To that end, the Jigsaw cooperative technique will be used.

Students will be divided into 8-person jigsaw groups. In each group, each student will be assigned a power plant to learn about:

- Student 1: Fossil fuels energy
- Student 2: Nuclear energy
- Student 3: Hydropower energy
- Student 4: Solar energy
- Student 5: Wind energy
- Student 6: Geothermal energy
- Student 7: Tidal energy
- Student 8: Biomass energy

Students will have time to read over their power plant type documentation (see appendix 2, p.8) and become familiar with it. Then, students with the same segment will be joined together, creating temporary “expert groups”. They will have time to discuss the main points of their power plant and to rehearse the presentation they will make to their jigsaw group. Finally, students will come back to their jigsaw groups, and each student will present her or his power plant to the group.

In order to provide the students with input scaffolding, some pictures will be provided with texts, and students can use dictionaries. In this task, reading, listening and speaking skills will be developed.

Task 9: Power plants Plickers

This task is aimed at checking how well the students understand the information about the different power plants. To that end, the teacher will read different statements about power plants and the students will have to match them with the different plants studied in the previous activity (this is an individual task). For this, Plickers cards will be used.

As a scaffolding strategy, different images that illustrate the gist of the questions will be displayed on the video projector. With the help of this task, students will develop listening skills.

4.10.3. Consolidation stage: Would you mind living next to a power plant?

Two sessions will be used for the preparation and enactment of a role-playing game. While in the previous activities the emphasis has been on the technical operation of power plants, the main objective of the role-playing game is to discover the impact that the different power plants have on society: the environment, on people... knowing their main advantages and disadvantages. The driving question refers to the main topic that will be discussed in the role-playing game, that is if there is a power plant better than others and what impact they have on society.

Therefore, the following role-playing game is aimed at knowing the current debate on renewable and non-renewable energies, the scientific-technological knowledge involved, and the different positions adopted in society before both energies.

4.10.3.1. Session 5

The objective of the following tasks is to prepare and enact a role-playing game, aimed at knowing the environmental impacts and the advantages and disadvantages of the different power plants.

Task 10: Role play preparation: selecting roles, setting the scenario and preparing the observers.

First, the scenario and the different roles will be presented to students (see materials in appendix 2, pp.12-14) Then, students will be divided into groups of two or three people. Each group will be assigned one role. During session 5, the students will investigate the scenario location and the relation with their role and complete the first column of the second report sheet (see session 6) and prepare their presentations.

This task develops the student's writing, listening, speaking and reading skills.

4.10.3.2. Session 6

Task 11: Role Playing game enactment

One session will be used for the role play enactment. The different phases of the game are explained below.

The moderator starts the role-playing game with the presentation of the debate and will present each role, as well as the mechanics of the game (the times and the two parts that the program has)

1. First part of the game – Round of introductions.

The spokesperson for each role will have 2-3 minutes to make their introduction, sharing their opening arguments. The rest of the participants who do not intervene (advisory teams) must write down their weak and strong arguments and incorporate them into the first record sheet, shown in appendix 2, p.16.

2. Ad-break

After the round of presentations, and ad-break is given. At that time, the groups will take the opportunity to comment on the contrary arguments that they have been collecting on the first record sheet. Counterarguments should begin to be prepared within 5-6 minutes of publicity before the final debate.

3. Second part of the game – final debate

The final debate takes place, lasting about 30 minutes, where each of the parties will try to launch counterarguments to the weaknesses detected in the opposing arguments. The moderator may give the floor to each of the parties according to his own criteria or according to the order in which the spokespersons ask him to speak, but he and his team must control the intervention times of the participants. A language box will be provided as a way of scaffolding. (see appendix 2, p.16)

4.10.4. Creation stage: What could we do to reduce the impact of power generation?

4.10.4.1. Session 7 and Session 8

In this session, students will create a video using digital technologies and will share it online (in the private educational application called Flipgrid). The objective of said video is to disclose to the population what processes are carried out in energy generation, and how can we minimize energy consumption. The driving question for this session refers to the video theme.

Task 12: Creating a 2-minute “Did you know...?” video.

Each group of students must create a 2-minute video by means of digital technologies including the information:

- How a power plant works (each group will be given a specific power plant).
- Tips for energy efficiency.

Students should create a script, then record audio and create the video (which should include pictures or short videos and the audio) with Flipgrid (they will be provided with computers).

The language of the video should be English. They should use their whole linguistic repertoire but supporting output scaffolding will be provided with language that they can use for the voice-over narration (see appendix 2, p.17). Reading, writing and speaking skills will be developed.

4.11. Assessment

As indicated in Article 9 of Instructions of 15 July 2021, in subjects of non-linguistic areas, the evaluation of competence in linguistic communication must be integrated with the evaluation criteria of the contents. This evaluation will be formative, global, summative and continuous, and will take into account both the development of key competences and the acquisition of

linguistic skills in the foreign language. In addition, a variety of evaluation strategies and instruments should be used.

4.11.1. Initial assessment

Task 1, as explained, is a cooperative activity (Think-Pair-Share) whose objective is to serve as a warm-up activity and activate the students' prior knowledge. This task will serve, in addition to evaluating students' prior knowledge, to detect some important gaps (and make any necessary curricular adjustments in the unit) and to detect individual differences with the aim of attend diversity.

4.11.2. Formative assessment

Assessment must be continuous throughout the teaching-learning process, what Llul et al., (2016) call *assessment FOR learning*, which will allow the teacher to analyse the performance of the students as well as their communicative competence during the unit.

Throughout the unit, and especially during the introduction, investigation and consolidation phases, numerous assessment tasks have been created that include various formats and that will allow observing various aspects such as the attitude and disposition towards the subject and the topic or knowledge, competences or skills for both language and content. In addition, assessment will also focus on cognitive skills, collaboration, communication skills or critical thinking.

4.11.3. Summative assessment

At the end of the unit instruction, as a complement to formative assessment, summative assessment (what Llul et al., (2016) call *assessment OF learning*) will be carried out. Some of the summative assessment instruments that will be used are observation checklists in the workshop project or a rubric to assess the creation of a video using ICTs.

4.11.4. Assessment criteria and learning standards for Tecnología

To evaluate the contents of the unit, the evaluation criteria and learning standards for the contents of the subject of *Tecnología* in Andalusia, which are found in the Order of January 15th, 2021, will be considered. These are:

1. Relate the effects of electrical energy and its conversion capacity in other energy forms, knowing how electricity is generated and transported and its environmental impact,

describing in a schematic way the operation of the different renewable and non-renewable power plants.

1.1. Explain the main effects of electric current and its conversion

4.11.5. Assessment procedure and tools

As explained above, regardless of the type of assessment, the instruments must be varied, adapting to different learning styles and needs. In addition, they must allow a co-evaluation and self-evaluation of the students. Table 2 shows a list of the evaluation procedures and tools that will be used throughout the unit.

ASSESSMENT PROCEDURE	ASSESSMENT TOOL
Direct observation	Classroom diary
	Rubrics and observation charts
	Observations checklist for workshop session (task 7)
Analysis of oral production	Brainstorming
	Rubric to assess a role play enactment
Feedback on the final Flipgrid project	Rubric to assess the creation of a video using ICTs (see appendix 3. Section 1)
Peer assessment and group assessment	Rubric
	Target evaluation (see appendix 3. Section 2)
	Peer assessment checklist
Feedback on the final Flipgrid project	Rubric to assess the creation of a video using ICTs (see appendix 3. Section 1)

Table 2. Assessment procedures and tools.

4.11.6. Assessment of the teaching practices

At the end of the unit, it is also essential to carry out an evaluation of the teaching practice and the materials used, with the aim of obtaining evidence that allows the teacher to detect the main

weaknesses and strengths of his proposal and reflect on the teaching process and improve it, adapting or modifying the materials used. Thus, at the end of the unit the following instruments will be used to assess teaching practice:

- Students will answer a questionnaire to evaluate the teaching practice and the materials used
- The teacher will perform a self-assessment.

5. CONCLUSIONS

This dissertation signifies the completion of the MIEB and brings together most of the learning acquired throughout the master's degree. When carrying out this work, various aspects studied in the master's degree have been applied, such as the development of CLIL materials, different methodological strategies in the CLIL approach, content and language evaluation, use of scaffolding... resulting in a CLIL didactic unit for STEAM subjects, specifically for the subject of *Tecnología* in the Spanish curriculum.

The creation of this unit has been justified for several reasons. In the first place, due to the lack of CLIL material in STEAM subjects and, secondly, because of the importance of the contents of the subject, due to the importance of knowing where the electrical energy comes from in order to develop favourable attitudes and a critical vision towards its use. In addition to the CLIL approach, for the design of the unit the contents, objectives, evaluation criteria, etc, included in the Andalusian regulations in the curriculum of the *Tecnología* subject have been considered. Furthermore, the realization of a previous theoretical framework has been essential to face the challenge of building a CLIL unit for STEAM subjects, integrating linguistic and technical tasks.

The result has been a didactic unit to be developed in 8 one-hour sessions, which includes a multitude of tasks of various types with different materials that work on the different linguistic skills (Reading, speaking, listening, writing) while the contents are studied, with tasks whose cognitive requirement it is gradual and applying active methodologies, which has made it possible to create a unit with a double focus on content and language, which attends to the diversity of the context of the students to which it is addressed. For its realization, in addition to the learning acquired throughout the master's degree, the indications and guidelines of experts in the development of CLIL material, such as The 20 Steps of San Isidro-Smith et al., (2020) have been followed.

Given the scarcity of CLIL material related to STEAM subjects, the planning and design of this CLIL unit has not only managed to provide CLIL material in the area of STEAM subjects that can be used by other teachers, but has also shown that it is possible to efficiently integrate linguistic tasks in the area of STEAM subjects, traditionally considered practical, with those differentiating aspects of these subjects, such as work in the workshop or the use of ICT, and demonstrating that the CLIL approach can be an excellent way to unite the different pillars on which the subject is based, since this approach has many similarities with the methodological strategies used in said subject.

For all this, although this didactic unit has not been implemented in a real classroom, so it is not possible to provide empirical data on the results obtained and their impact on students, we can affirm that the general and specific objectives set by the beginning of this paper have been successfully accomplished. The culmination of this paper would be, of course, the implementation of the unit in a real classroom to observe the benefits obtained in the students and evaluate the didactic proposal itself, the syllabus and the teaching materials, in order to check if they are effective and adequate.

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Orden de 28 de junio de 2011, por la que se regula la enseñanza bilingüe en los centros docentes de la Comunidad Autónoma de Andalucía (2011). *Boletín Oficial de la Junta de Andalucía*, 135, de 12 de junio de 2011.
<https://www.juntadeandalucia.es/boja/2011/135/1>

Instrucción 12/2021, de 15 de julio, de la Dirección General de Ordenación y Evaluación Educativa, sobre la organización y funcionamiento de la enseñanza bilingüe en los centros andaluces para el curso 2021/22 (2021).
<https://www.juntadeandalucia.es/educacion/portals/delegate/content/1b9f3194-5018-4257-9d3d-576bdd4d4407/Instrucciones%20funcionamiento%20ense%C3%B1anza%20biling%C3%BCe%20curso%2021-22>

Other educational regulations

Department for Education (2014) The national curriculum in England: Key Stages 3 and 4 framework document. Available at:
<https://www.gov.uk/government/publications/national-curriculum-in-england-secondary-curriculum>

7. APPENDICES

7.1 APPENDIX 1: CLIL Planner. The 20 Steps: Components and Parts

7.2 APPENDIX 2: Unit materials

7.3 APPENDIX 3: Assessment tools

7.1. APPENDIX 1: CLIL Planner. The 20 Steps: Components and Parts

CLIL UNIT - POWER GENERATION: IF RENEWABLE ENERGY IS SO GREAT, WHY AREN'T WE USING IT ALL THE TIME?

I. Lesson Plan

a) Identification

- Unit title: “Power generation: how does electricity reach our home?”
- Content Subject: *Tecnología*
- Medium of instruction: English
- Languages related: Spanish
- Level: Secondary, 3rd ESO
- Student CERF-level: B1 - intermediate
- Cross-curricular links: Biology, Physics and Chemistry, Computer Science
- Timing (number of sessions): 8 sessions (1 hour)
- Types of grouping: individual work, pairs work, group work, teamwork and whole class work.
- Materials: material's book (see appendix II), video clips, texts.
- Resources: computers, an interactive whiteboard, a video projector, the body of a pen, one neodymium magnet, copper wire, one LED diode.

b) Previous knowledge (PK)

Content-related PK	Language-related PK	
	Specialised language (CALP)	Functional language (BICS)
Basic knowledge about different types of energy	Vocabulary related to the topic: energy, global warming, energy resources, power plants	Language for naming

Basic knowledge about power generation	Present, future, past tenses. E.g: Hydropower plants use falling water to generate electricity.	Language for giving opinions
Basic knowledge about energy sources	Conditional sentences type 0. e.g. If you burn fossil fuels, chemical energy turns into thermal energy.	Language for description and analysing
Basic knowledge about energy conservation	Conditional sentences type I. e.g. If a wind power plant were constructed, thousands of birds would die.	Language for comparison and evaluation.

c) CONTENT. Fronting content

Power generation (Generación de energía)	Lexicon related to power generation
Electricity. Effects of electric current. (<i>Electricidad. Efectos de la corriente eléctrica</i>)	Vocabulary related to energy
Power generation and transport (<i>Generación y transporte de la electricidad.</i>)	Expression of the past, present and future in relation to types of energy transformations and power plants
Power plants (<i>Centrales eléctricas</i>)	Comparative degrees of adjectives to compare the different power plants
Electricity and the environment (<i>La electricidad y el medio ambiente</i>)	Conditional sentences type I and II

d) COGNITION. Formulate subject-related goals

- Describe how electricity gets our home

- Investigate the different ways of transforming energy
- Identify different forms of energy
- List different energy resources
- Classify the energy resources in renewable and non-renewable
- Construct a mini Faraday generator
- Recognize the main characteristics of different power plants.
- Argue about the impact of different power plants in a role-play acting
- Defend your ideas about power generation in a role-play acting
- Design a 2-minute video

e) CULTURE-COMMUNITY-CONTEXT-CONNECTION. Integrate the culture-related component

- Understand the impact of different power plants on their life and develop their capacity for making connections between what happens in their place and what is happening in the rest of the world
- Understand the environmental impact of power plants and improve student's attitude towards renewable energy
- Learn about energy efficiency and learn tips for energy saving

f) COMMUNICATION. Create a language corpus

- | | | |
|-----------------------|-----------------------|------------------------|
| - Mechanical energy | - Renewable resources | - Hydroelectric Energy |
| - Potential energy | - Non-renewable | - Hydroelectric power |
| - Kinetic energy | resources | plant |
| - Nuclear energy | - Fossil Fuels | - Solar Energy |
| - Chemical energy | - Turbine | - Global Warming |
| - Light energy | - Nuclear Reactor | - Greenhouse Effect |
| - Sound energy | - Nuclear Energy | - Biomass Energy |
| - Electrical energy | - Fission | - Tidal Energy |
| - Energy conservation | - Fusion | - Geothermal Energy |
| - Energy efficiency | - Nuclear meltdown | - Wind energy |
| - Solar Cell | - Uranium and | - Wind turbines |
| - Generator | Plutonium | - Wind farms |

g) COMMUNICATION. Formulate language-related goals through the LANGUAGE TRIPTYCH

Language of	Language for	Language through
Understand and know vocabulary and expressions related to energy and power generation Use the zero-type conditional to explain energy transformations Use the present tense in order to explain how a power plant works Use the future tense and conditions for the expression of giving opinions and argument defending your role in a role-play game	Use language for comparing Use language for justification Use language for expressing cause and effect Use language for giving opinions	Watch a video in English about energy forms Read in English a procedure text to construct a mini generator Read what is a Turbine generator and a solar panel in English Read how different power plants work Read the scenario of a role-playing game

h) DIFFERENTIATION (Multiple intelligences). DIVERSITY

The task must involve different levels of intellectual challenge for students, so focus should be placed on different kinds of learning. According to Gardner's theory of multiple intelligence, goals can be planned considering the different kinds of intelligences.

Some of the goals of the tasks considering different intelligences are:

Intelligence	Differentiated goals
VERBAL INTELLIGENCE	-Create a 280 characters Tweet about energy generation

	-Tell different energy sources to create a word cloud -Write and perform your role introduction in a role play -Defend an argument in a role play
VISUAL/SPATIAL INTELLIGENCE	-Watch a video about different energy forms -Create a video using ICT -Use Plickers
KINAESTHETIC INTELLIGENCE	-Do a role-play -Decide on the features of your role -Plan your performance in the role play -Create a mini Faraday generator
MUSICAL INTELLIGENCE	-Choose the song for a 2-minute video about power generation and energy efficiency
INTERPERSONAL INTELLIGENCE	-Plan a role-play in groups -Work cooperatively using the Jigsaw Technique to learn about different power plants
INTRAPERSONAL INTELLIGENCE	-Complete a worksheet about energy resource -Complete a fill in the gap's activity about power plants, turbines, generators and solar photovoltaic cells.
NATURALISTIC INTELLIGENCE	-Observe a mini Faraday generator to learn about power generation -Explore a virtual simulator to learn how energy transformations occur

i) THE DRIVING QUESTION

Driving question for this unit: IF RENEWABLE ENERGY IS SO GREAT, WHY AREN'T WE USING IT ALL THE TIME?

II. Development of sessions

INTRODUCTION

Driving question: Can you light up a room with a potato?

The introduction stage includes activities or tasks which help the students see what they know about the topic (watch a video, read a story, brainstorming...).

Session 1

Students will learn about:

- Energy forms
- Energy transformations.

Task 1: Where's my electricity from and how does it get to my home?

- **Activity description:** Warm-up activity, based on a variant of the cooperative technique **Think-Pare-Share (TPS)**, called **Think-Pair-Tweet**. Students will be asked the question “*Where's my electricity from and how does it get to my home?*” and in pairs, they must think of a response and then generate a Tweet (280 characters)
- **Scaffolding:** vocabulary for sharing ideas and showing agreement/disagreement.
- **Language:** Speaking, writing, and listening skills.

Language box

How can I share my ideas?

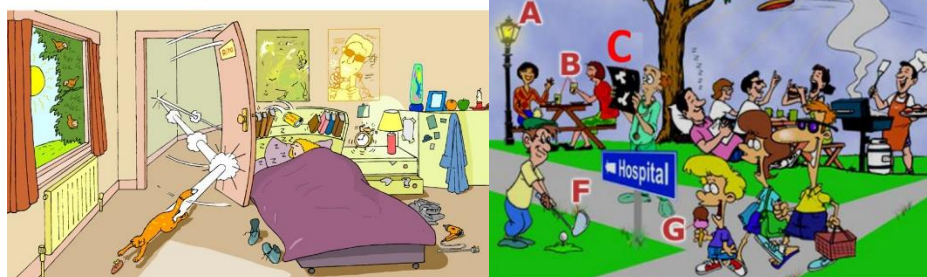
- I think / consider / find / feel / believe / suppose / assume that...
- Personally, I think that ...
- From my point of view ...
- I am sure / I am certain that ...

Task 2: Identifying forms of energy

- **Activity description:** Watch a video about the different forms of energy and, in pairs, identify the different energy forms in an image and name them. After watching the video and identifying the energy forms, students will be asked to share their answers

- **Resources:** YouTube video <https://www.youtube.com/watch?v=FX7T-QYTPho> and pictures.
- **Scaffolding:** The video contains some scaffolding written support. The video can be stooped to clarify. Glossary.
- **Language:** listening and speaking skills.

Identify all the forms of energy you see in the picture below.



(Pictures from: <https://slideplayer.com/slide/4490665/> <https://www.education.psu.edu/egee102/node/1905>)

Glossary

English	Spanish
Mechanical energy	Energía mecánica
Potential energy	Energía potencial
Kinetic energy	Energía cinética
Nuclear energy	Energía nuclear
Chemical energy	Energía química
Light energy	Energía luminosa
Sound energy	Energía sonora
Electrical energy	Energía eléctrica

Task 3: Energy resources word cloud

- **Activity description:** Brainstorming with content related to energy sources. When the word cloud is ready, the class will be asked to read the words to practice their pronunciation and remember their meaning.
- **Resources:** website <https://www.wordclouds.com/>.
- **Scaffolding:** glossary
- **Language:** listening, reading or speaking (pronunciation).



Glossary

English	Spanish
Natural gas	Gas natural
Oil	Petróleo
Nuclear fusion	Fusión nuclear
Biomass	Biomasa
Geothermal	Geotérmico

Task 4: Classification of Energy resources

- **Activity description:** Classify the energy resources in renewable and non-renewable, find similarities and differences and discuss with your partner the advantages and disadvantages you think each type of resource has.
- **Resources:** energy resources template
- **Language:** output speaking and writing

Renewable Resources

Non-renewable Resources

INVESTIGATION OR RESEARCH

Driving question: Are you able to turn on a light bulb using a pen, a cable and a magnet?

The investigation or research stage is related to tasks in which students have to manipulate, research and discover (matching, classifying, in-depth reading...).

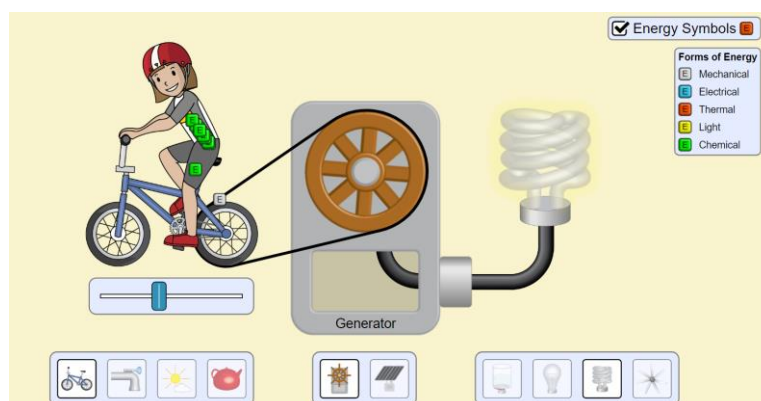
Session 2

At the end of this session, students will be able to

- Understand that the transformations that allow the generation of energy are carried out in power plants
- Know that turbines, alternators and photovoltaic cells are the main elements responsible for carrying out said transformation.

Task 5: What is used to transform energy?

- **Activity description:** students must visit the virtual simulator and investigate the different ways of transforming energy, discovering the main systems that allow this transformation. Then, think of different objects that carry out the following energy transformations and complete the table
- **Resources:** Computer, website https://phet.colorado.edu/sims/html/energy-forms-and-changes/latest/energy-forms-and-changes_en.html . Energy transformations worksheet.
- **Language:** reading, speaking and writing.



Input energy	Device	Output energy
Electrical Energy		Mechanical Energy
Chemical Energy		Mechanical Energy
Electrical Energy		Light Energy
Light Energy		Electrical Energy
		
		
		

Task 6: Power plants, turbines and generators and solar photovoltaic cells text.

- **Activity description:** students must read a descriptive text. Warm-up questions to active their prior knowledge will be asked before. Then, they must complete individually a fill in the gap activity.
- **Resources:** Text, fill in the gaps activity worksheet.
- **Scaffolding:** visuals.
- **Language:** reading, writing and speaking skills.

Power plants, turbines and generators and solar photovoltaic cells text

What is a power plant?

A power plant is an industrial facility that generates electricity from primary energy. Most power plants use one or more generators that convert mechanical energy into electrical energy in order to supply power to the electrical grid for society's electrical needs. The exception is solar power plants, which use photovoltaic cells (instead of a turbine) to generate this electricity.

Turbines and generators

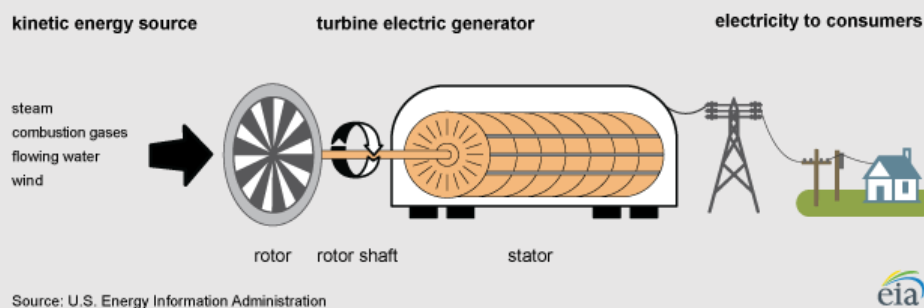
Most of U.S. and world electricity generation is from electric power plants that use a turbine to drive electricity generators. In a turbine generator, a

moving fluid—water, steam, combustion gases, or air—pushes a series of blades mounted on a rotor shaft. The force of the fluid on the blades spins/rotates the rotor shaft of a generator. The generator, in turn, converts the mechanical (kinetic) energy of the rotor to electrical energy. Different types of turbines include steam turbines, combustion (gas) turbines, hydroelectric turbines, and wind turbines.

Solar photovoltaic cells

Solar photovoltaic cells convert sunlight directly into electricity. They are used to power devices as small as wrist watches and can be connected together in panels that are connected together in arrays to power individual homes or form large power plants. Photovoltaic (PV) power plants are now one of the fastest growing sources of electricity generation around the world. In the United State, PV power plants were the source of about 2% of total utility-scale electricity generation in 2020.

Electricity generation from an electric turbine



(Adapted from the websites:

https://energyeducation.ca/encyclopedia/Power_plant

<https://www.eia.gov/energyexplained/electricity/how-electricity-is-generated.php>)

Fill in the gaps

1. A _____ is and industrial location that is utilized for the generation and distribution of electric power on a mass scale (Power plant)
2. Most of the power plants use turbine _____ (Generators)
3. _____ power plants use _____ instead of turbine generators (Solar, photovoltaic cells)

4. Generators convert _____ energy into _____ energy (Mechanical, electrical)
5. Solar photovoltaic cells convert _____ energy into _____ energy (Sunlight, Electrical)

Session 3

At the end of this session, students will:

- Understand how generators can produce electricity with movement thanks to the electromagnetic effect.

Task 7: Building your own mini Faraday generator.

- **Activity description:** students will read a procedure text and create a mini generator using very simple elements, following the project method that characterizes the subject. must read a descriptive text. Warm-up questions to active their prior knowledge will be asked before. Then, they must complete individually a fill in the gap activity.
- **Resources:** Workshop classroom, procedure text, materials for the project: The body of a pen, neodymium Magnet, copper wire and a LED diode
- **Scaffolding:** images of the different necessary elements
- **Language:** reading skills

Procedure text: Building a mini Faraday y generator

HOW TO BUILD A MINI FARADAY GENERATOR

Materials

- The body of a pen
- Neodymium Magnet
- Copper wire
- LED diode

Procedure

1. Rub the copper wire around the pen. The thinner the wire is and the more coils the better it'll turn out.
2. Strip off the edges of the wires.
3. Connect the two terminals of the LED to the copper wire.
4. Put a few magnets into the pen. Now, the generator is ready.
5. Take the pen in your hand, clench it and start doing progressive motions down and up. The LED will shine.
6. The faster you move, the brighter the LED will shine.

(Procedure text created from

<https://www.youtube.com/watch?v=pxxQMyC0RaM>

<https://www.youtube.com/watch?v=n4uQIOSp14o>)

Session 4

At the end of this session, students will:

- know the different types of power plants
- know what their energy source is (renewable or non-renewable)
- know what the energy transformations in the power plants and their main components are. For this, the Jigsaw cooperative technique will be used (Aronson, 1978).

Task 8: Learning about types of power plants for energy generation using the Jigsaw Technique.

- **Activity description:** Jigsaw cooperative technique will be used to learn about the different power plants and their technical characteristics.
 - o Students will be divided into 8-person jigsaw groups.
 - o In each group, each student will be assigned a power plant to learn about: Fossil fuels energy, nuclear energy, hydropower energy, solar energy, wind energy, geothermal energy, tidal energy, biomass energy
 - o Students will have time to read over their power plant type documentation
 - o Create temporary “expert groups”.
 - o They will have time to discuss the main points of their power plant and to rehearse the presentation they will make to their jigsaw group
 - o Students will come back to their jigsaw groups, and each student will present her or his power plant to the group.

- **Resources:** Jigsaw texts
- **Scaffolding:** glossary
- **Language:** reading, listening and speaking skills

Glossary

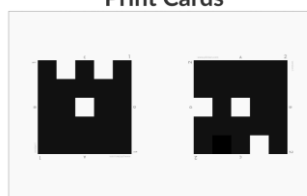
English	Spanish
Fossil fuels energy	Energía de combustibles fósiles
Nuclear energy	Energía nuclear
Hydropower energy	Energía hidráulica
Solar energy	Energía solar
Wind energy	Energía eólica
Geothermal energy	Energía geotérmica
Tidal energy	Energía mareomotriz
Biomass energy	Energía de la biomasa

Task 9: Power plants Plickers

- **Activity description:** task aimed at checking how well the students understand the information about the different power plants.
 - o The teacher will read different statements about power plants
 - o The students will have to match them with the different plants studied in the previous activity (this is an individual task).
- **Resources:** Plicker cards
- **Scaffolding:** different images that illustrate the gist of the questions
- **Language:** develop listening skills.



Print Cards



CONSOLIDATION

Driving question: Would you mind living next to a power plant?

In the consolidation stage, the students structure what they have learned/discovered by means of organising tasks (mapping, graphic organisers...).

Two sessions will be used for the preparation and enactment of a role-playing game. While in the previous activities the emphasis has been on the technical operation of power plants, the main objective of the role-playing game is to discover the impact that the different power plants have on society: the environment, on people... knowing their main advantages and disadvantages. The driving question refers to the main topic that will be discussed in the role-playing game, if there is a power plant better than others and what impact they have on society.

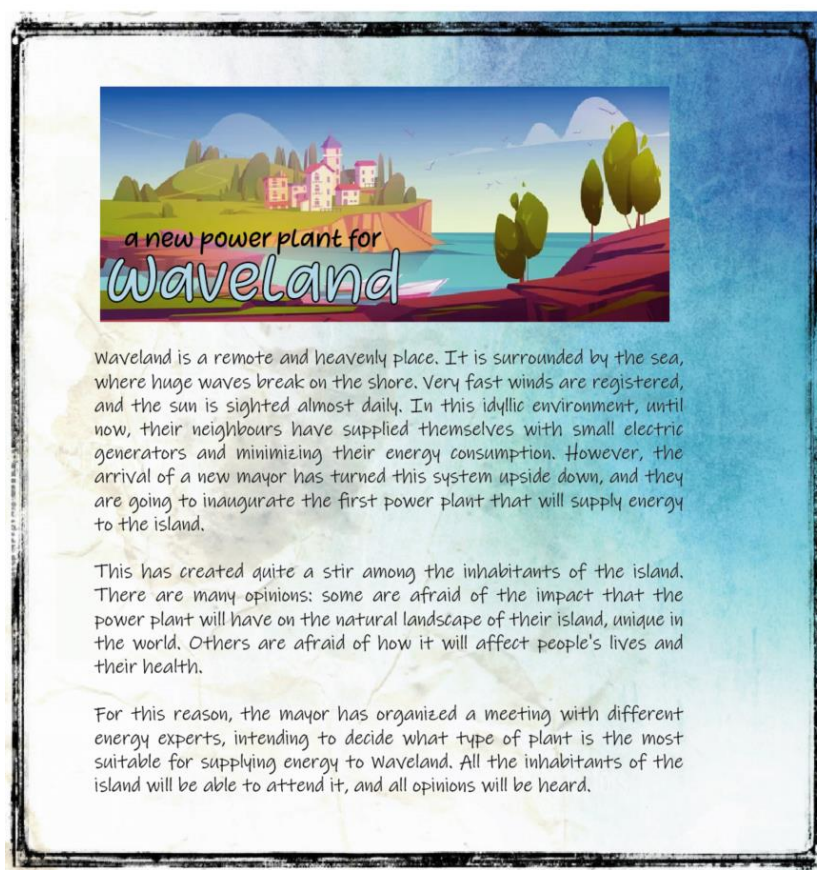
Therefore, the following role-playing game is aimed at knowing the current debate on renewable and non-renewable energies, the scientific-technological knowledge involved, and the different positions adopted in society before both energies.

Session 5

The objective of the following tasks is to prepare and enact a role-playing game, aimed at knowing the environmental impacts and the advantages and disadvantages of the different power plants.

Task 10: Role play preparation: selecting roles, setting the scenario and preparing the observers

- **Activity description:** Preparation of a role play.
 - First, the scenario and the different roles will be presented.
 - Students will be divided into groups of two or three people
 - Each group will be assigned one role
 - During session 5, the students will investigate the scenario location and the relation with their role
 - They must complete the first column of the second report sheet (see session 6)
 - They will prepare their presentations.
- **Resources:** Scenario description template, roles description table
- **Scaffolding:** visuals and a language box with vocabulary about introduce their role and share ideas.
- **Language:** writing, listening, speaking and reading skills



Role	Description
Nuclear scientist	He or she is in favour of building a nuclear power plant. You must seek information to position yourself in favour of installing a nuclear power plant based on its advantages.
Solar power promoter	He or she is in favour of building a solar powered plant. You must seek information to position yourself in favour of installing a solar plant based on its advantages.
Fossil-fuel scientist	He or she is in favour of building a thermal power station. You must seek information to position yourself in favour of installing a thermal power plant based on its advantages.
Wind power promoter	He or she is in favour of building a wind power station. You must seek information to position yourself in favour of installing a wind power plant based on its advantages.
Hydraulic power engineer	He or she is in favour of building a hydroelectric power station. You must seek information to position yourself in favour of installing a hydroelectric power plant based on its advantages.
Animal activist	He or she is against building those power plants that have a high impact on animal life. You must seek information to position yourself against those plants that affect the fauna of the island.

Environmental activist	He or she is against building those power plants that have the greatest impact on the nature and landscape of Waveland. You must seek information to position yourself against those plants that affect the landscape and infrastructure of the island.
Doctor	He or she is against those power plants that have a detrimental effect on people's health. You must seek information to position yourself against these plants: what are they, what effects do they produce on health, which plants do not affect people's health.
Disaster preparedness manager	He or she is against those power plants that are most at risk of causing a catastrophe. They must seek information to position themselves against those plants that can cause a catastrophe: what are they, what disasters can occur, etc.

Language box

How can I introduce my role and share my ideas?

- I think / consider / find / feel / believe / suppose / assume that...
- Personally, I think that ...
- From my point of view ...
- I am sure / I am certain that ...

Session 6

Task 11: Role Playing game enactment

- **Activity description:** Role playing enactment. There are different stages:
 - o First part of the game – Round of introductions.
 - o Ad-break
 - o Second part of the game – final debate
- **Resources:** First part and second part of the game record sheets.
- **Scaffolding:** visual, use of dictionaries and the Internet, language box with useful vocabulary about defending an argument
- **Language:** writing, listening, speaking and reading skills

FIRST PART OF THE GAME RECORD SHEET

WEAK / STRONG ARGUMENTS	
Nuclear scientist	• The argument about is weak because.... • The argument about Is strong because ...
Solar power promoter	• The argument about is weak because.... • The argument about Is strong because ...
Fossil-fuel scientist	• The argument about is weak because.... • The argument about Is strong because ...
Wind power promoter	• The argument about is weak because.... • The argument about Is strong because ...
Hydraulic power engineer	• The argument about is weak because.... • The argument about Is strong because ...
Animal activist	• The argument about is weak because.... • The argument about Is strong because ...
Environmental activist	• The argument about is weak because.... • The argument about Is strong because ...
Doctor	• The argument about is weak because.... • The argument about Is strong because ...
Disaster preparedness manager	• The argument about is weak because.... • The argument about Is strong because ...

SECOND PART OF THE GAME RECORD SHEET

Write down as many arguments as you need to defend your character's position. It will be easier to defend them by refuting the opponent's counterargument during the debate.

BEFORE THE GAME (To be completed in Task 9)	2nd PART OF THE GAME	2nd PART OF THE GAME
Initial argument	Counterargument	Refutation

Language box

How can I defend an argument?

- For this reason, ...
- Due to/Because of...
- Since ...
- That's why ...
- This is the reason why...
- Therefore ...

CREATION

Driving question: What could we do to reduce the impact of power generation?

In the creation stage, students use higher order thinking skills to analyse, evaluate or create as well as share what they have learned (make a presentation, record a video, make a poster...)

Session 7 and 8

In this session, students will:

- create a video using ICTs to disclose to the population what processes are carried out in energy generation, and how can we minimize energy consumption
- share it online (in the private educational application called Flipgrid).

Task 12: Creating a 2-minute “Did you know...?” video.

- **Activity description:** Each group of students must create a 2-minute video in English by means of digital technologies including the information: How a power plant works (each group will be given a specific power plant) and tips for energy efficiency. Students should create a script, then record audio and create the video (which should include pictures or short videos and the audio) with Flipgrid (they will be provided with computers).
- **Resources:** Computer with Internet access, Flipgrid app
- **Scaffolding:** supporting output scaffolding will be provided with language that they can use for the voice-over narration
- **Language:** . Reading, writing and speaking skills



Starting your purpose	I'd like to talk to you about... I'd like to begin by showing you...
Giving an overview	First, I'll be... Next, I'll Last, I'll
Talking about visuals	As you can see, Let's take a look at... Let's have a look at...
Highlighting Information	I'd like to highlight the fact that... I'd like you to focus on...
Giving examples	For example, For instance, To illustrate, A good example of this is...
Concluding	To conclude, To sum up. To summarize,

DOUBLE CHEC TASK-DESIGNING

i. Number of sessions and tasks planning.

	Introduction	Investigation	Consolidation	Creation
Session 1	Task 1 Task 2 Task 3 Task 4			
Session 2		Task 5 Task 6		
Session 3		Task 7		
Session 4		Task 8 Task 9		
Session 5			Task 10	
Session 6			Task 11	
Session 7				Task 12
Session 9				Task 12

ii. Craft a final task or project

The final task is the creation of a 2-minute video using ICT about power generation and energy efficiency.

iii. More driving questions for each stage

DRIVING QUESTION	
INTRODUCTION	Can you light up a room with a potato?
INVESTIGATION	Are you able to turn on a light bulb using a pen, a cable and a magnet?
CONSOLIDATION	Would you mind living next to a power plant?
CREATION	What could we do to reduce the impact of power generation?

iv. The 4 skills.

	Listening	Reading	Speaking	Writing
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INTRODUCTION				
Task 1	X		X	X
Task 2	X		X	
Task 3	X	X	X	
Task 4			X	X
INVESTIGATION				
Task 5				X
Task 6		X	X	X
Task 7		X		
Task 8	X	X	X	
Task 9	X			
CONSOLIDATION				
Task 10	X	X	X	X
Task 11	X		X	
CREATION				
Task 12		X	X	X

v. Balance between non-communication and communication.

	Presentation	Manipulation	Communication
INTRODUCTION			
Task 1			X
Task 2	X	X	
Task 3	X		
Task 4		X	
INVESTIGATION			
Task 5	X		
Task 6		X	X
Task 7	X		

Task 8	X	X	X
Task 9	X		
CONSOLIDATION			
Task 10	X	X	X
Task 11	X	X	X
CREATION			
Task 12		X	X

vi. Methods used.

Think-Pair-Share, the Jigsaw Technique, role-playing, research and investigation, project method.

vii. Scaffolding, materials and resources.

- Language boxes
- Glossaries
- Simplify instructions
- Visuals

viii. Individual and cooperative work.

	Individual	Pair	Group	Team	Whole class
INTRODUCTION					
Task 1		X			
Task 2		X			
Task 3					X
Task 4	X	X			
INVESTIGATION					
Task 5	X				
Task 6		X			
Task 7	X				

Task 8				X	
Task 9	X				
CONSOLIDATION					
Task 10				X	
Task 11					X
CREATION					
Task 12			X		

III. Assessment procedure and tools

Assessment procedures: peer assessment; group assessment; teacher's feedback on the final project.

Assessment tools: brainstorming, schemes, tables, Plickers quiz, oral presentations,

Rubric for the final task/project:

Criteria	Working below the expected level 1	Working towards the expected level 2	Working at the expected level 3	Working above the expected level 4
Category	STANDARDS			
COGNITION				
Use ICT app Flipgrid to create a 2-minute “Did you know...?” video about power plants and tips for saving energy	Does not show skill in using ICT to create a video, using only one or two audio-visual resources. The recorded audio is of poor quality, making it impossible to understand.	The student uses few resources to create the video and needs help using ICTs. The voice-over audio is not good quality.	Shows good skill in using ICT to create a video, using sufficient audio-visual resources. The recorded voiceover is heard correctly	Shows great skill in the use of ICT to create a video, using numerous audio-visual resources and more unexpected materials. Recorded voiceover is excellent.
CONTENT				
Identifies the main elements of the specific power plant and explains the interaction between them and the transformation of energy	The student describes the operation of a power plant in a general way, without identifying the specific features of the power plant	The student identifies some of the elements of the power plant, without explaining the energy transformations	The student identifies some of the elements of the power plant and names some of the energy transformations	The student identifies all the elements of the power plant (generator, turbine, photovoltaic panel...) and explains the energy transformations that occur between them
COMMUNICATION				
Create a video with written language	The written and oral expressions in the video	The written and oral expressions in the video	The written and oral expressions	The written and oral expressions in the video

accuracy and present capacity for oral communication in the voice-over narration	show serious grammar mistakes, include simple vocabulary, tends to repeat words and shows lack of elaboration	show several grammars mistakes, uses a limited number of content specific vocabulary, shows some elaboration through the use of descriptive words	in the video show few errors in grammar, uses sufficient number of content-specific vocabulary and essential phrases to elaborate on	show absence of serious grammar mistakes and present a wide range of specific vocabulary with complex grammatical structures.
Use of appropriate speech style and voice	The student uses casual and informal speech style, speaks in low volume and in a monotonous manner	The student uses some formal speech style, speaks with an uneven volume sometimes too fast or too slow	The student uses formal speech style, speaks in a satisfactory volume	The student uses formal speech style, speaks in an appropriate volume
COMMUNITY				
Present tips for energy efficiency	The student does not present tips for efficient energy saving	The student presents a limited number of general tips for energy saving	The student presents enough tips for energy saving, relating it to the plants studied.	The student presents a video with a critical vision of the use of energy and presents tips for energy efficiency and saving, coherent with the treated power plant.

7.2. APPENDIX 2: Unit materials

CLIL unit:

If renewable energy is so great, why aren't we using it all the time ?

Unit materials

Introduction stage

Can you light up a room with a potato?

Investigation stage

Are you able to turn on a light bulb using a pen, a cable and a magnet?

Consolidation stage

Would you mind living next to a power plant?

Creation stage

What could we do to reduce the impact of power generation?

Session

1

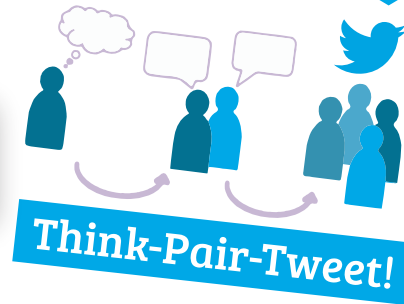
Driving
question

Can you light up a room with a potato?

INTRODUCTION

Task 1

Where's my electricity from and how
does it get to my home?



What's happening?

Everyone can reply



145

Tweet

(Picture from:

https://assets.inshorts.com/inshorts/images/v1/variants/jpg/m/2018/11_nov/30_fri/img_1543576895316_498.jpg)

Language box How can I share my ideas?

- I think / consider / find / feel / believe / suppose / assume that...
- Personally, I think that ...
- From my point of view ...
- I am sure / I am certain that ...

Session

1

Task 2

Identifying forms of energy

1. Watch the video



2. **Identify** the different energy forms in both pictures and name them



(Pictures from: <https://slideplayer.com/slide/4490665/> and <https://www.e-education.psu.edu/egee102/node/1905>)

Glossary

English	Spanish
Mechanical energy	Energía mecánica
Potential energy	Energía potencial
Kinetic energy	Energía cinética
Nuclear energy	Energía nuclear
Chemical energy	Energía química
Light energy	Energía luminosa
Sound energy	Energía sonora
Electrical energy	Energía eléctrica

Session

1

Task 3

Energy resources word cloud

Oil
Waves
Natural gas
Nuclear fusion
Geothermal
Biomass
Hydropower
Sun

<https://www.wordclouds.com/>



Brainstorming!

Glossary

English	Spanish
Natural gas	Gas natural
Oil	Petróleo
Nuclear fusion	Fusión nuclear
Biomass	Biomasa
Geothermal	Geotérmico

Task 4

Classification of Energy resources

Renewable resources

Non-renewable resources

Session

2

Driving
question

Are you able to turn on a light bulb using a pen, a cable and a magnet?

INVESTIGATION

Task 5

What is used to transform energy?

Explore!

https://phet.colorado.edu/sims/html/energy-forms-and-changes/latest/energy-forms-and-changes_en.html



Input energy	Device	Output energy
Electrical energy		Mechanical energy
Chemical energy		Mechanical energy
Electrical energy		Light energy
Light energy		Electrical energy
		
		
		

Session

2

Task 6

Power plants, turbines, generators and solar photovoltaic cells text.

Activating prior knowledge

How can mechanical energy be transformed into electrical energy?
What form of energy do we have in our wall sockets?
Where are energy resources transformed into electrical energy?

What is a power plant?

Reading

A power plant is an industrial facility that generates electricity from primary energy. Most power plants use a generator that converts mechanical energy into electrical energy in order to supply power to the electrical grid for society's electrical needs. The exception is solar power plants, which use photovoltaic cells (instead of a turbine) to generate this electricity.

Turbines and generators

The majority of the world's electricity generation is from electric power plants that use a turbine to move electricity generators. In a turbine generator, a moving fluid (water, steam, combustion gases, or air) pushes a series of blades mounted on a rotor shaft. The force of this fluid on the blades rotates the rotor shaft of a generator. The generator converts the mechanical (kinetic) energy of the rotor to electrical energy. Different types of turbines include steam turbines, combustion (gas) turbines, hydroelectric turbines, and wind turbines.

Solar photovoltaic cells

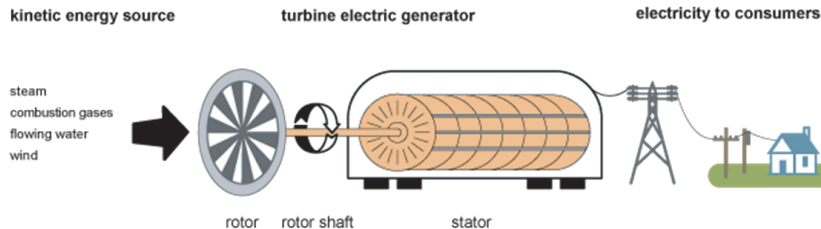
Solar photovoltaic cells convert sunlight directly into electricity. They are used to power devices as small as watches and can be connected together in panels that are connected together in photovoltaic arrays to power individual homes or form large power plants. Photovoltaic (PV) power plants are now one of the fastest growing sources of electricity generation around the world.

(Adapted from the websites:

https://energyeducation.ca/encyclopedia/Power_plant

<https://www.eia.gov/energyexplained/electricity/how-electricity-is-generated.php>)

Electricity generation from an electric turbine



Source: U.S. Energy Information Administration



Fill in the gaps

1. A _____ is and industrial location that is utilized for the generation and distribution of electric power on a mass scale
2. Most of the power plants use turbine _____
3. _____ power plants use _____ instead of turbine generators
4. Generators convert _____ energy into _____ energy
5. Solar photovoltaic cells convert _____ energy into _____ energy

ANSWER KEY

Fill in the gaps

1. A power plant is and industrial location that is utilized for the generation and distribution of electric power on a mass scale
2. Most of the power plants use turbine generators
3. Solar power plants use photovoltaic cells instead of turbine generators
4. Generators convert Mechanical energy into Electrical energy
5. Solar photovoltaic cells convert Sunlight energy into Electrical energy

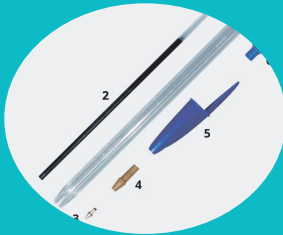
Session

3

Task 7

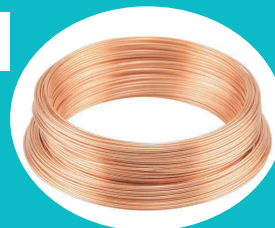
Building your own mini Faraday generator

Materials



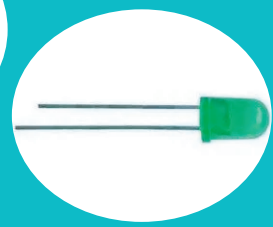
The body of a pen

Neodymium Magnet



Copper wire

LED diode



Procedure

1. Rub the copper wire around the pen. The thinner the wire is and the more coils the better it'll turn out.
2. Strip off the edges of the wires.
3. Connect the two terminals of the LED to the copper wire.
4. Put a few magnets into the pen. Now, the generator is ready.
5. Take the pen in your hand, clench it and start doing progressive motions down and up. The LED will shine.
6. The faster you move, the brighter the LED will shine.

(Procedure text created from

<https://www.youtube.com/watch?v=pxxQMyC0RaM>

<https://www.youtube.com/watch?v=n4uQIOSp14o>)

Task 8

Learning about types of power plants for energy generation using the Jigsaw Technique.



Jigsaw Technique

FOSSIL FUELS

Fossil fuels power plants burn a fossil fuel, such as coal or natural gas, to produce electricity. They have a large carbon footprint, but fossil fuel power plants produce nearly 40% of the world's energy needs. Coal run power plants burn coal to convert water into steam. This steam is then used to rotate turbines which produces electricity with the help of a generator.

A 1000MW coal power plant burns through 9000 tons of coal per day, a process which releases very high amounts of pollutants into the air.

NUCLEAR ENERGY

A nuclear power plant works by converting nuclear energy into electricity. The heat from the nuclear reactor is used to convert water into steam, which is then used to drive turbines connected to a generator. Nuclear power plant also top the list of power plants that can produce massive amounts of energy: nuclear power constitutes more than 10% of the world's energy needs.

As opposed to coal or natural gas power plants, a nuclear power plant doesn't have to burn anything to create heat. The heat source is nuclear fission. Low-enriched Uranium pellets are loaded into the nuclear power plant. Then the Uranium atom is split creating the nuclear fission. This process releases huge amounts of energy.

The advantage of a nuclear power plant is that they do not need to burn anything to create energy, so its carbon emission is very low. The disadvantages of a nuclear power plant are the nuclear waste that it creates and are expensive to build. In addition, the large-scale accidents can be catastrophic.

HYDROPOWER

Hydroelectric power plants are one of the most effective and eco-friendliest of all power plants. In a hydroelectric power plant, electricity is obtained from water.

In detail, the potential energy of water is converted to electrical energy. When water falls from a height on to a turbine, it rotates the turbine which is connected to a generator. When the turbine spins, the generator starts to produce electricity. This electricity is then routed to all the different substations and the electricity grid to distribute the power. One of the advantages of a hydroelectric power plant is that there is no waste generated from the creation of energy.

SOLAR ENERGY

Solar power plants use the energy of the sun to produce electricity. Solar panels capture the sunlight using photovoltaic cells (formed from semiconductor materials) and convert it into electricity. Another mechanism to produce solar energy is using the Sun's heat to boil water and move a turbine and a generator. Today, an increasing number of countries are looking towards solar energy to offset their dependence on fossil fuels.

WIND ENERGY

Wind power plants (also called wind farms) convert wind energy to electrical energy using wind turbines. They don't require burning any fossil fuel, so generating electricity from wind doesn't result in emissions, so it is clean and renewable. However, it depends on the weather and causes noise and visual pollution.

GEOTHERMAL ENERGY

Geothermal power plants use the heat from the earth's core to create steam. It is a clean and renewable energy, and geothermal plants are safe, long-lasting and reliable. However, the biggest limitation of geothermal energy is that there are only a few places of the earth where it can be installed, and the cost of drilling and building plants can be quite expensive.

TIDAL ENERGY

Tidal power plants use the natural movement of the tides and oceans to produce electricity. It is clean and renewable. However, the adoption rates for tidal power plants have been low since there are some critical limitations to implementing a tidal power plant.

Session

4

BIOMASS

Biomass refers to any organic material that comes from plants or animals. Biomass sources for energy include wood and wood processing waste, agricultural crops and waste materials, materials in municipal solid waste or animal manure and human sewage for producing biogas.

(Adapted from the websites:

<https://interestingengineering.com/3-different-types-of-power-plants-that-generate-electricity-for-us>

<https://dnr.mo.gov/energy/energy-resources>

<https://earth.org/the-advantages-and-disadvantages-of-nuclear-energy/#:~:text=Nuclear%20plants%20cost%20billions%20of,factor%20that%20improves%20its%20competitiveness.>)

Glossary

English	Spanish
Fossil fuels energy	Energía de combustibles fósiles
Nuclear energy	Energía nuclear
Hydropower energy	Energía hidráulica
Solar energy	Energía solar
Wind energy	Energía eólica
Geothermal energy	Energía geotérmica
Tidal energy	Energía mareomotriz
Biomass energy	Energía de la biomasa

Task 9

Power plants Plickers



Print Cards



Session

5

Driving
question

Would you mind living next to a power plant?

CONSOLIDATION

Task 10

Role play preparation: selecting roles, setting the scenario and preparing the observers.



Role play

Escenario



Waveland is a remote and heavenly place. It is surrounded by the sea, where huge waves break on the shore. Very fast winds are registered, and the sun is sighted almost daily. In this idyllic environment, until now, their neighbours have supplied themselves with small electric generators and minimizing their energy consumption. However, the arrival of a new mayor has turned this system upside down, and they are going to inaugurate the first power plant that will supply energy to the island.

This has created quite a stir among the inhabitants of the island. There are many opinions: some are afraid of the impact that the power plant will have on the natural landscape of their island, unique in the world. Others are afraid of how it will affect people's lives and their health.

For this reason, the mayor has organized a meeting with different energy experts, intending to decide what type of plant is the most suitable for supplying energy to Waveland. All the inhabitants of the island will be able to attend it, and all opinions will be heard.

Session

5



Roles

Role	Description
Nuclear scientist	He or she is in favour of building a nuclear power plant. You must seek information to position yourself in favour of installing a nuclear power plant based on its advantages.
Solar power promoter	He or she is in favour of building a solar powered plant. You must seek information to position yourself in favour of installing a solar plant based on its advantages.
Fossil-fuel scientist	He or she is in favour of building a thermal power station. You must seek information to position yourself in favour of installing a thermal power plant based on its advantages.
Wind power promoter	He or she is in favour of building a wind power station. You must seek information to position yourself in favour of installing a wind power plant based on its advantages.
Hydraulic power promoter	He or she is in favour of building a hydroelectric power station. You must seek information to position yourself in favour of installing a hydroelectric power plant based on its advantages.

Roles

Role	Description
Animal activist	He or she is against building those power plants that have a high impact on animal life. You must seek information to position yourself against those plants that affect the fauna of the island.
Environmental activist	He or she is against building those power plants that have the greatest impact on the nature and landscape of Waveland. You must seek information to position yourself against those plants that affect the landscape and infrastructure of the island.
Doctor	He or she is against those power plants that have a detrimental effect on people's health. You must seek information to position yourself against these plants: what are they, what effects do they produce on health, which plants do not affect people's health.
Disaster preparedness manager	He or she is against those power plants that are most at risk of causing a catastrophe. They must seek information to position themselves against those plants that can cause a catastrophe: what are they, what disasters can occur, etc.

Language box

How can I introduce my role and share my ideas?

- I think / consider / find / feel / believe / suppose / assume that...
- Personally, I think that ...
- From my point of view ...
- I am sure / I am certain that ...

Task 11

Role Playing game enactment

1. Round of introductions

WEAK / STRONG ARGUMENTS	
Nuclear scientist	• The argument about ... is weak because ... • The argument about ... is strong because ...
Solar power promoter	• The argument about ... is weak because ... • The argument about ... is strong because ...
Fossil-fuel scientist	• The argument about ... is weak because ... • The argument about ... is strong because ...
Wind power promoter	• The argument about ... is weak because ... • The argument about ... is strong because ...
Hydraulic power promoter	• The argument about ... is weak because ... • The argument about ... is strong because ...
Animal activist	• The argument about ... is weak because ... • The argument about ... is strong because ...
Environmental activist	• The argument about ... is weak because ... • The argument about ... is strong because ...
Doctor	• The argument about ... is weak because ... • The argument about ... is strong because ...
Disaster preparedness manager	• The argument about ... is weak because ... • The argument about ... is strong because ...

2. Ad-break



3. Second part of the game - final debate

BEFORE THE GAME (To be completed in Task 9)	2 nd PART OF THE GAME	2 nd PART OF THE GAME
	Counterargument	Refutation
Initial argument		

Language box How can I defend an argument?

- For this reason, ...
- Due to/Because of ...
- Since ...
- That's why ...
- This is the reason why ...
- Therefore ...

Session

7 & 8

Driving
question

What could we do to reduce the impact of power generation?

Task 12

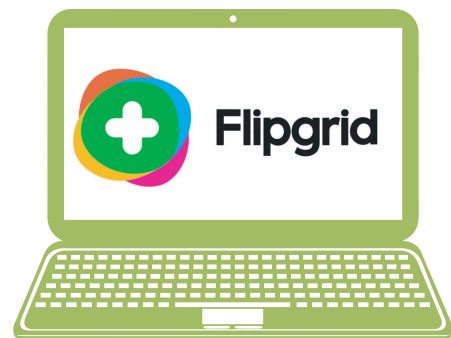
Creating a 2-minute "Did you know...?" video.

CREATION



Topic

- How a power plant works (each group will be given a specific power plant).
- Tips for energy efficiency.



Language box Voice-over narration

Starting your purpose	I'd like to talk to you about... I'd like to begin by showing you...
Giving an overview	First, I'll be... Next, I'll ... Last, I'll
Talking about visuals	As you can see, Let's take a look at... Let's have a look at...
Highlighting information	I'd like to highlight the fact that... I'd like you to focus on...
Giving examples	For example, For instance, To illustrate, A good example of this is...
Giving examples	To conclude, To sum up. To summarize,

7.3. APPENDIX 3: Assessment tools

1. Rubric for assessing the final project:

Criteria	Working below the expected level 1	Working towards the expected level 2	Working at the expected level 3	Working above the expected level 4
Category	STANDARDS			
COGNITION				
Use ICT app Flipgrid to create a 2-minute “Did you know...?” video about power plants and tips for saving energy	Does not show skill in using ICT to create a video, using only one or two audio-visual resources. The recorded audio is of poor quality, making it impossible to understand.	The student uses few resources to create the video and needs help using ICTs. The voice-over audio is not good quality.	Shows good skill in using ICT to create a video, using sufficient audio-visual resources. The recorded voiceover is heard correctly	Shows great skill in the use of ICT to create a video, using numerous audio-visual resources and more unexpected materials. Recorded voiceover is excellent.
CONTENT				
Identifies the main elements of the specific power plant and explains the interaction between them and the transformation of energy	The student describes the operation of a power plant in a general way, without identifying the specific features of the power plant	The student identifies some of the elements of the power plant, without explaining the energy transformations	The student identifies some of the elements of the power plant and names some of the energy transformations	The student identifies all the elements of the power plant (generator, turbine, photovoltaic panel...) and explains the energy transformations that occur between them
COMMUNICATION				
Create a video with written language accuracy and present capacity for oral communication in the voice-over narration	The written and oral expressions in the video show serious grammar mistakes, include simple vocabulary, tends to repeat words and shows lack of elaboration	The written and oral expressions in the video show several grammars mistakes, uses a limited number of content specific vocabulary, shows some elaboration through the use of	The written and oral expressions in the video show few errors in grammar, uses sufficient number of content-specific vocabulary and essential phrases to elaborate on	The written and oral expressions in the video show absence of serious grammar mistakes and present a wide range of specific vocabulary with complex grammatical structures.

		descriptive words		
Use of appropriate speech style and voice	The student uses casual and informal speech style, speaks in low volume and in a monotonous manner	The student uses some formal speech style, speaks with an uneven volume sometimes too fast or too slow	The student uses formal speech style, speaks in a satisfactory volume	The student uses formal speech style, speaks in an appropriate volume
COMMUNITY				
Present tips for energy efficiency	The student does not present tips for efficient energy saving	The student presents a limited number of general tips for energy saving	The student presents enough tips for energy saving, relating it to the plants studied.	The student presents a video with a critical vision of the use of energy and presents tips for energy efficiency and saving, coherent with the treated power plant.

2. Target evaluation for self-assessment

The following target evaluation has been created using the assessment criteria and for *Tecnología* subject found in the Order of January 15th, 2021.

On a scale of 1 to 5 – where 1 is “I know perfectly” and 5 is “I am not sure”- please rate the following assessment criteria of our power generation unit

