UNIVERSIDAD DE ALMERÍA
CENTRO DE POSTGRADO Y FORMACIÓN CONTINUA

Máster en Profesorado de Educación Secundaria Obligatoria y Bachillerato, Formación Profesional y Enseñanza de Idiomas

Use of podcasts in STEM, CLIL-implemented subjects to improve oral production skills of secondary school students

Uso de podcasts para la mejora de la producción oral de alumnos de secundaria en asignaturas STEM/AICLE

Curso académico: **2019/2020**
Convocatoria: **Julio 2020**

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SUMMARY

In today's world technological and language skills appear to be essential in order to success in the labour market. Foreign language learning has been around since ancient times and pedagogical methodologies have been many and varied. In modern history, Canadian immersion programmes were the starting point of Content and Language Integrated Learning (CLIL) methodologies in Europe in the mid-1990s. The EU has encouraged the adoption of programmes and methodologies that foster proficiency in, at least, two additional EU languages and, thus, CLIL have become a very popular methodology in the EU. CLIL has another noteworthy characteristic, that is, it emphasises the learning of content through the use of a FL.

STEM professions, that is, technological, scientific and engineering careers require high skilled professionals and the final products are of high added value. Unfortunately, the number of students in STEM classes or degrees has decreased in the last few decades. STEM subjects are regarded as uninterested and difficult due to the oftentimes abstract theory and their quality has been found somewhat lacking. In order to attract a higher number of students, steps to make STEM subjects more attractive have been taken, such as real-life application of their content.

Podcasts are downloadable audio recordings that have been mainly used in higher education as supplemental materials. They have also been used as a tool to teach FL, paying special attention to oral productive and comprehensive skills. There is a dearth of studies on the use of podcasts as a STEM, CLIL learning tool, particularly student-generated ones. In the few studies available, students have expressed their higher motivation, satisfaction and engagement when learning content.

Therefore, a combination of all three, that is, STEM, CLIL student-generated podcasts should provide a positive influence on students' content- and language-knowledge acquisition.

RESUMEN

Para poder triunfar en el mercado laboral actual, los conocimientos tecnológicos y lingüísticos resultan imprescindibles. El aprendizaje de idiomas es un fenómeno conocido desde la antigüedad y las metodologías empleadas han sido variadas. Más recientemente, los programas canadienses de immersión fueron el origen de la metodología AICLE (Aprendizaje Integrado de Contenidos y Lenguas Extranjeras) en Europa a mediados de los 90. La UE ha abanderado la adopción de programas y metodologías que promuevan dominar, al menos, dos idiomas de la UE, además de la lengua materna, por lo que AICLE es muy popular. Además, la AICLE permite el aprendizaje de contenido a través de un idioma extranjero.

Las profesiones tecnológicas, científicas e ingenieriles (STEM) requieren profesionales altamente cualificados y producen productos de alto valor añadido. Desafortunadamente, el número de alumnos en estas carreras se ha reducido en las últimas décadas pues consideran estas asignaturas poco interesantes y complicadas ya que, con frecuencia, son muy abstractas y la calidad de la enseñanza deficiente. Para atraer un mayor número de alumnos, se han tomado los pasos necesarios para hacerlas más atractivas como, por ejemplo, con la aplicación de lo aprendido a la vida real.

Los podcasts son archivos de audios descargables que se usan sobre todo en la educación universitaria como material de apoyo, aunque también se usan en la enseñanza de idiomas para mejorar la producción y comprensión oral. Existen pocos estudios en los que se utilicen podcasts, en especial creados por alumnos, como recurso en asignaturas STEM/AICLE. Sin embargo, en ellos los estudiantes han expresado una mayor motivación, satisfacción y participación cuando se usaban para aprender contenido.

Por ello, el uso de podcasts creados por alumnos en asignaturas STEM/AICLE podría ejercer una influencia positiva en la adquisición de conocimientos de los contenidos y de una lengua extranjera.

1. JUSTIFICATION OF THE TOPIC AND OBJECTIVES

1.1. Linguistic background in the EU

Our actual society belongs to a globalised world, which provides people with a myriad of opportunities in, among others, the working or educational fields. In order to 'create' qualified workers, improve competitiveness and promote jobs, education and training must be of major importance. In this sense, our place in society will be determined by our capacity to learn and master fundamental knowledge (European Commission, 1995). Therefore, the main educational challenge of the next few years will be adapting the different education systems and national curricula in order to train free, critically minded, autonomous citizens (Opinion of the European Economic and Social Committee 2008/C 204/20) that will have acquired the necessary skills and competencies (e.g. communicate effectively in several languages, specializations in STEM subjects, learning how to learn or showing initiative) needed to make a successful transition to employment (Gikopoulou et al., 2019).

In the European context, the Council of the European Union recognised the need for a common strategic framework for European cooperation in education and training (Council conclusions 2009/C 119/02). Even though each Member State is responsible for their own education system and national curriculum, the European Commission promotes education based on common historic roots. An example of this is the cooperation between higher education establishments via the Erasmus programme, from which hundreds of thousands of European students have benefited since its inception in 1987. The free movement of people within the EU makes the coordination of national education and training systems essential to ensure equal opportunities for each one of its citizens (European Commission, 1995).

In the EU, there are 24 official languages and more than 60 regional ones. For this reason, proficiency in several languages is key for the occupational and personal opportunities of EU citizens in a border-free single market. Furthermore, it has been linked with doing well at school, as multilingualism helps to stimulate intellectual agility and broaden our cultural horizons. It becomes, thus, an important part of our European identity. In this sense, the European Commission believes it is a priority for every student to be able to communicate in, at least, two foreign languages by the time they conclude their compulsory education, in addition to their mother tongue. For this to happen, the European Commission also highlighted that it is desirable to start learning foreign languages at preschool level in their White Paper on Education and Training (European Commission, 1995). At the 2002 Barcelona European Council, EU Member States were encouraged to take the necessary actions to ensure that all

EU students had access to, at least, two foreign languages learning from an early age (Eurydice report, 2017).

The Eurydice Network (https://eacea.ec.europa.eu/national-policies/eurydice) is a EU organisation whose goal is to support and facilitate European cooperation in the field of lifelong learning by providing information on education systems and policies in 38 countries and by producing studies on issues common to European education systems. It provides, among others, a detailed description and overview of national education systems. The Eurydice report of 2017 is the last one published by the European Commission and it gathers the results from Member States in 2014. In that year, about 83.8% of primary school students studied at least one foreign language. In fact, in most countries the teaching of a first foreign language is compulsory for students between the ages of six and eight, and in 12 of them it applied to almost all primary school students. For secondary school students, about 59.7% studied two foreign languages or more, which is compulsory in 11 countries (Eurydice report, 2017).

1.2. Linguistic situation in Spain

In 1990 a new Education Law, the LOGSE (*Ley Orgánica de Ordenación General del Sistema Educativo*) came into force in Spain. One of the novelties was the introduction of foreign language learning from primary education. Bilingual education in Spain was first implemented in the 1996/97 academic year as a result of the agreement signed between the Spanish Ministry of Education and the British Council. CLIL programmes were launched in Spain in the 2004/2005 academic year with the implementation of the so-called bilingual section projects only in primary and compulsory secondary education (ESO) in several regions (Martínez Agudo, 2020a). In Andalusia, when the LOGSE came into force, a second foreign language became mandatory among elective subjects in ESO and compulsory in Baccalaureate. This meant a wider and more diversified language offer within the educational centres in the region. However, prior to the adoption of the LOGSE, Andalusia introduced the compulsory learning of two foreign languages in primary, secondary and baccalaureate education under the '*Plan de la Reforma de las Enseñanzas Medias*' and, in 1987, several secondary and vocational centres took part in the Programme '*Langues Vivantes*' launched by the Council of Europe. In 2005, the regional government adopted and implemented the Plurilingualism Promotion Plan ('Plan de Fomento del Plurilingüismo'), from which an integrated curriculum was drawn up for all languages, mother and foreign, for each one of the educational levels and modalities. The main aim of this plan is for students to develop their oral and written comprehension and

production skills, at different levels of competences for a specific number of languages (Plan de Fomento del Plurilingüismo, 2005).

In Spain there are 17 Autonomous Communities (AC) and two Autonomous Cities, each one of them is the Competent Authority regarding education (Merino and Lasagabaster, 2018; Martínez Agudo, 2020a), which means that each AC implements their own bi- or plurilingual policy. All students must start learning a foreign language as a compulsory subject from the age of 6, although in some AC the starting age is three (Cantabria, Castilla-La Mancha, Castilla y León, and Comunidad Valenciana) or four (Asturias and Canarias). In some (Castilla-La Mancha, Comunidad Valenciana, Asturias, Canarias, and La Rioja) this language must be English. In secondary education (between the ages of 12 and 18), although learning two foreign languages is not mandatory, it is an entitlement and, therefore, they must be offered from the beginning of this educational level. However, in four AC a second foreign language is a compulsory subject from age 10 (Murcia and Canarias) or 12 (Cantabria and Galicia) (Eurydice report, 2017).

In the academic year 2017/18*, the percentage of students enrolled in bilingual education through the means of English is shown in Figure 1 (Ministerio de Educación y Formación Profesional).

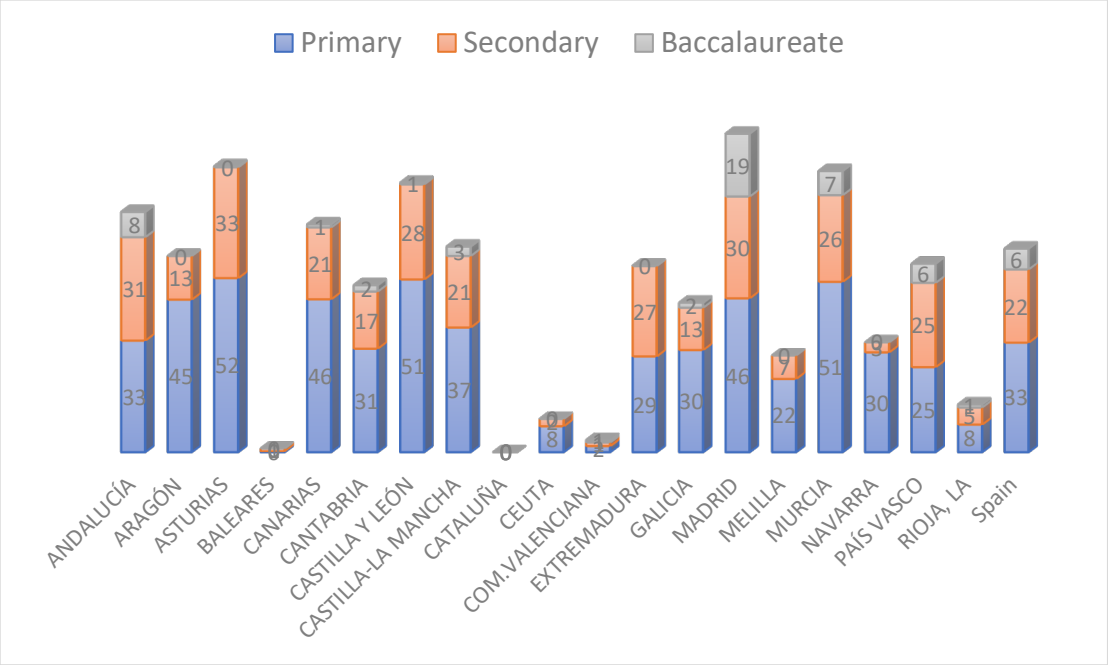

Figure 1. Percentage of students enrolled in bilingual education (English) at different educational levels per AC (*Cataluña did not provide data for this academic year). *Source:* Own elaboration

From this graph it is clear that bilingual education in Spain has been implemented mainly in primary (33% of total students) and secondary education (22% of total students), an to a lesser extent in baccalaureate (6% of total students). It is curious how in two AC with a co-official or minority language (Balearic Islands and Valencia) the percentage of students enrolled in bilingual programmes is practically negligible at every educational level, alongside La Rioja and Ceuta. Enrolment in bilingual education is above national average in nine AC at primary level, seven at secondary level and three in baccalaureate. Only in three AC these percentages are above the national average at every educational level (Andalucía, Madrid and Murcia).

For the academic year 2017/18, at every educational level, the percentage of total students enrolled at bi- or trilingual (AC with co-official language) education in Spain per language is shown in Figure 2 (Ministerio de Educación y Formación Profesional).

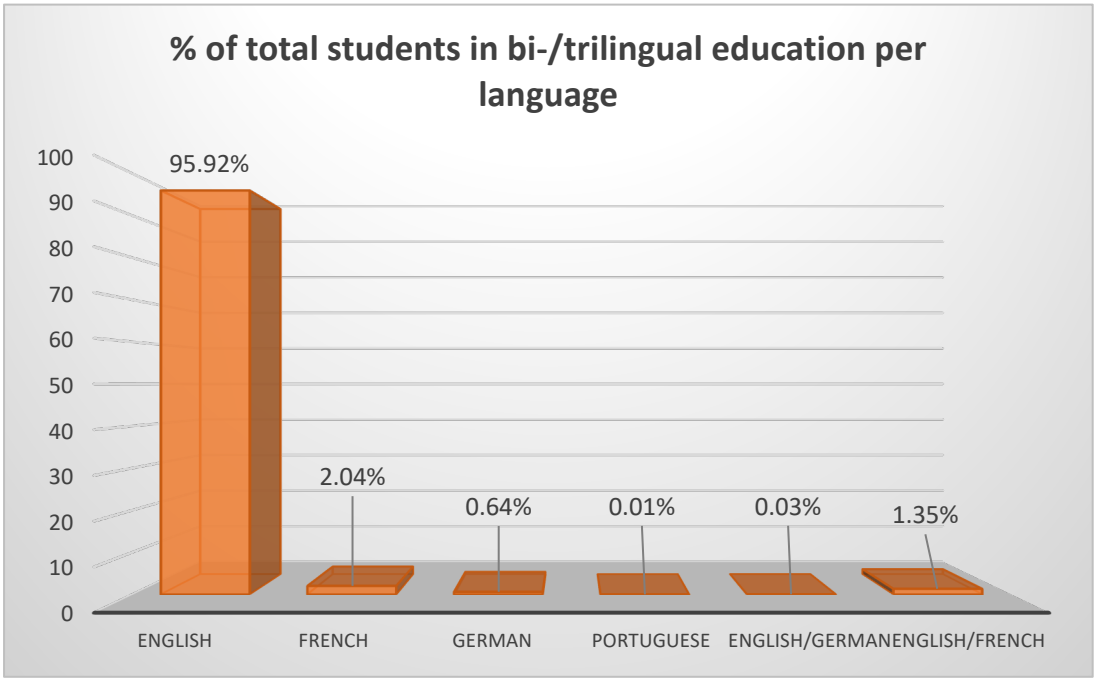

Figure 2. Percentage of students enrolled at bi- or trilingual education in Spain per language. *Source:* Own elaboration

According to the data published by Eurostat, in 2017 English was the most studied language in Spain at all educational levels (99.5%, 99.9% and 82.3%), followed by French (19.0%, 41.4% and 18.6%) and German (1.1%, 4.7% and 1.9%).

1.3. Foreign language learning

Foreign language learning has been among us from ancient times. It is believed that after conquering the Sumerians, around 5,000 years ago, the Akkadians learnt the local language by

using it as the language of instruction. Other groups living in multilingual territories have made used of their bi- or plurilingualism as a survival method (Hanesová, 2015).

In the 1960s, the first immersion programs, designed for teaching the content in the non-native language without weakening the command of the mother tongue, were launched in French-speaking Quebec, Canada. English-speaking parents wanted their children to have equal opportunities by becoming competent in French and appreciate the traditions and culture of both French- and English-speaking Canadians. These children were voluntarily enrolled at school to learn subjects (content) in French together with the French-speaking children (Hanesová, 2015).

The success of these programs soon reached across the ocean, and in 1978 the European Commission encouraged teaching in schools through the medium of more than one language (Marsh, 2002). In 1995, in its White Paper on Education and Training, the European Commission adopted an educational approach which was meant to enhance language proficiency in the EU (European Commission, 1995). These programs, known as content and language integrated learning (CLIL), where developed following the Canadian immersion programs and some previous European programs, such as the European schools (Turner, 2013b).

Although there are some differences between Canadian immersion and European CLIL, in both non-language content is used as a vehicle for promoting second language proficiency (Lasagabaster and Sierra, 2009). In fact, whether a particular program is referred to as immersion or CLIL often depends as much on its cultural and political frame of reference as on the actual characteristics of the programme. Some of those characteristics are that CLIL uses a foreign language or a *lingua franca* and not a second language (L2) or that teachers are mainly non-native, content ones (Marsh, 2002; Lasagabaster and Sierra, 2009; Dalton-Puffer, 2011).

Since its inception, CLIL has spread to regions such as Australia, Asia and South America due to both its coherent theoretical framework and the enthusiastic attention received within Europe, although it might need to be adapted to suit different contexts (Turner, 2013a). In the particular case of Spain, due to the decentralization of the educational system, different CLIL models coexist. Nevertheless, bilingual schools must follow certain common features. For example, bilingual schools must teach at least 50% of their curriculum (two to four subjects) through CLIL in the foreign language, bilingual sections can coexist with regular mainstream groups taught in their first language (L1) or the CLIL stream must receive daily exposure in L2 in both Primary and Secondary education (minimum of 5 hours/week). Each school can

determine the subjects taught through the L2, although at least one must belong to the area of Natural and Social Sciences. The most common ones being implemented via CLIL include Science, Art, and Physical Education at Primary level, and Social and Natural Sciences, Mathematics, Physical Education, and Technology in Secondary Education (Cañado, 2018).

1.4. Language learning and podcasts as a motivational tool

English, considered the actual *lingua franca*, is one of the most-widely spoken languages nowadays and thus, when referring to foreign language learning, it is the most-widely studied one. However, in many countries it is taught using a more traditional approach, that is, lessons are especially focused on learning grammar and vocabulary, but not so much on developing oral skills, such as speaking or listening. Furthermore, these skills are hardly encouraged outside the classroom. This can result in a lack of confidence and an increasing anxiety when students have to use a foreign language (Hamzaoglu and Koçoglu, 2016).

Dörnyei (2007), in Coyle (2013), stated that long-term, sustained learning (like in the case of FL) is only possible if motivation is boosted, as it is thought to be one of the most powerful influences on learning. In fact, little can be learnt without motivation (Lasagabaster, 2011; Doiz et al., 2014), although it is also known that motivation is a complex phenomenon dependent on a large number of factors (Dörnyei and Ushioda, 2011 in Coyle, 2013). Three aspects of learner motivation are consistently identified: the importance of the classroom environment (pedagogies), learner engagement (investment, challenge and interest), and the development of learner identities (values, attitudes and notions of self) (Coyle, 2013).

When it comes to learning a foreign language, one of the main negative influences on students' motivation is the insufficient contact with the target language (Doiz et al., 2014). Since CLIL uses the foreign language as a vehicle to teach non-language related content, it provides more contexts to use the foreign language and could, therefore, increase the motivation and need to learn a foreign language of both teachers and students (Coyle, 2008 in Doiz et al., 2014). In fact, some studies on CLIL students' motivation observed some beneficial effects of this methodology with regard to students' degree of motivation to learn English (Lasagabaster, 2011; Doiz et al., 2014).

Computers and the Internet play an essential role in today's society. Thanks to the technological boom of the last few decades, people have access to more and more resources, that can be used in- and outside the classroom. This is also true for foreign language learning. The original concept of the Internet as a static source of information, the Web 1.0, has evolved into the Web 2.0, a more participative, democratic network focused on the creation and sharing

of resources in blogs, wikis, podcasts and videos. Any of these platforms or applications allows students direct contact with native speakers (Chacón and Pérez, 2011).

The term podcast first appeared in 2004 and was appointed as "Word of the Year" in 2005 by The New Oxford American Dictionary (Kavaliauskiené and Anusiené, 2009). There are several definitions of the term podcast; however, the most-widely accepted is a combination of the words 'iPod' and 'broadcast' (McLoughlin et al., 2007; Chacón and Pérez, 2011, Sevilla, 2018). They are downloadable audio recordings that can be listened to on portable devices or computers (Kavaliauskiené and Anusiené, 2009), linked by one syndication feed. Some of their most appealing characteristics are that new episodes can be automatically downloaded (Sutton-Brady et al., 2009) and that podcasts can deal with different fields, such as sciences, technologies or arts (Sevilla, 2018).

Podcasts have been mostly used in higher education, for example as supplemental materials for lectures or exam preparation materials (Lane, 2006; O'Bryan and Hegelheimer, 2007; McLoughlin et al., 2007; Sutton-Brady et al., 2009). Podcasts have also been introduced in the field of foreign language learning (Kavaliauskiené and Anusiené, 2009). In this field, several researchers have reported a significant improvement in students' listening and speaking skills, who have also shown a positive response and higher motivation towards learning English through the use of podcasts (Lu, 2007 in Abdulrahman et al., 2018; Kavaliuskiné and Anusiené, 2009). At the secondary school level, fewer studies are available. However, in them researchers have found students to be very receptive to their use, as they claimed their listening and speaking skills had been noticeably enhanced (Li, 2010).

Most of these studies are based on listening materials made available to students. Very few studies have focused on the students' creation of podcasts. In one of these studies, carried out by McLoughlin et al. (2007), students expressed their satisfaction with the production of podcasts. Stoltenkamp et al. (2011) found that listening to their peers' 'recordings' enhanced both teamwork and the sense of collaboration; promoting engagement with the subject matter and the sharing of views.

Based on the studies found in literature, it is obvious that there is a lack of research in the use and creation of podcasts at the secondary school level. From those few studies it is apparent that integrating podcasts in the curriculum, not only in foreign language learning, but also in non-language content subjects, could offer beneficial effects on the development of both students' oral comprehension and production skills. This can be achieved thanks to the positive characteristics of podcasts, among which constant accessibility, customized content or authenticity of materials are included. Furthermore, if the students' themselves participate on

their creation, the benefits can be even higher, because they become the protagonist of their own learning process and their motivation, engagement and enthusiasm are enhanced.

It is, therefore, of interest at secondary school level to implement activities in which students can produce their own podcasts about different topics, such as famous scientists, historical events, orcurrent affairs, to share with their peers and determine the positive and/or negative impacts on their learning process.

1.5. Objectives

This work intends to achieve several objectives at the secondary educational level:

1. To provide a literature review on CLIL implementation to learn non-language content through a target language.
2. To highlight the advantages and disadvantages of implementing CLIL methodologies to learn non-language content through a target language.
3. To highlight the influence of the Web 2.0, podcasts in particular, as a tool to learn non-language content through a target language.
4. To propose a project-based learning (PBL) activity using podcasts as a tool to assess 2nd-year-ESO students' performance and oral production skills in CLIL-implemented STEM subjects, specifically technology.

2. THEORETICAL FRAMEWORK

Nowadays, three main pedagogical methods are used in mainstream education: content-based instruction (CBI), content and language integrated learning (CLIL) and English-medium instruction (EMI). In Table 1, a comparison of the characteristics of each one is shown (Lasagabaster and Sierra, 2009; Dalton-Puffer et al., 2011; Genesee and Lindholm-Leary, 2013; Brown and Braford 2017; Cenoz, 2015).

	CBI	**CLIL**	**EMI**
Origin	Canadian immersion and US bilingual programmes	Europe	Europe
	Mid-1960s	Mid-1990s	Late 1990s
Language of instruction	Second (minority or foreign) language	Foreign language* (mainly English)	English
Educational level	From preschool to higher education	From preschool to higher education	Primarily in higher education
Type of programme	Part of entire programme	CLIL camps outside schools	English-taught degree programmes

	Specific classes/courses	One/two-CLIL subject courses	
	Entire educational programme	Long-term programmes (immersion/bilingual)	
Teachers	Bilingual, language teachers	Non-native, content teachers	Non-native, content or language teachers
Lessons	Content-driven for total immersion	Content-driven lessons	Content-driven lessons
	Language-driven for content- and theme-based courses		
% Curriculum taught in target language	90% for total immersion	Less than 50% (1 or more subjects)	
	Content-based themes in FL lessons		
Implementation of methodology	Students have similar L2 level	Mainly in secondary school once learners acquired literacy skills in L1	
Outcomes	Language/content-oriented	Language/content-oriented	Mainly content-oriented
	Aims at bilingualism		
Assessment	Language	Language and content	Content

Table 1. Comparison of CBI, CLIL and EMI

Source: Own elaboration

** L2 can be the second language in bilingual regions (e.g. Catalonia or Basque Country), therefore CLIL language of instruction is a foreign language, not a second language (Cenoz, 2015)*

CBI has been described as an umbrella term for educational approaches that aims to integrate language and content learning, although not necessarily in equal terms (Stoller, 2008 in Cenoz, 2015). CLIL has also been described as an umbrella term in which a foreign language is used to learn a non-language subject focusing in both language and content learning (Marsh, 2002). Thus, their main common feature is that they use non-language content to promote proficiency in a second/foreign language (Coyle, 2007; Genesee and Lindholm-Leary, 2013). Lasagabaster and Sierra (2009) are of the opinion that CBI and CLIL programmes differ on their respective goals, participating students, target languages and their emphasis on content or

language, although Genesee and Lindholm-Leary (2013) believed that they are not pedagogically different.

EMI is another programme in which English is used to teach academic subjects in countries where the L1 is not English (Brown and Bradford, 2017) and has been described as an umbrella term for academic subjects taught through English, but with no aim at improving language proficiency (Dearden and Macaro, 2016). This is the main aspect that differentiates EMI from CLIL and CBI.

In the specific case of this work, the focus will be on CLIL as it is the most widely spread methodology in the European educational context.

2.1. Content and Language Integrated Learning (CLIL)

The term CLIL (Content and Language Integrated Learning) was first introduced in 1994 by David Marsh (Cinganotto and Cuccurullo, 2015). Coyle (2002) supported the basis of this methodology in four key principles:

- To ensure students become proficient in the mother tongue and foreign language.
- To learn the foreign language by using it in real situations.
- To challenge students to develop and acquire social, cultural, cognitive, linguistic and academic competences.
- To provide students with a wider multicultural environment.

Coyle also proposed a CLIL methodology model comprised of four dimensions, or the 4Cs model (Coyle, 2007). The 4Cs refer to:

- Content: learners being active participants in acquiring their own knowledge and understanding and developing their own skills.
- Cognition: the content studied and how students interpret, analyse and process them.
- Communication: the need of reconstructing the content and its related cognitive processes.
- Culture: intercultural awareness and the relationship between cultural background and languages.

As previously stated, CLIL is an umbrella term used to describe those programmes in which a FL is used as the medium of instruction to teach non-language content in mainstream education (Arribas, 2016). It is also believed to foster plurilingualism (Cinganotto, 2016). This approach has become very popular in many European countries, although its implementation has been quite heterogeneous due to the variety of projects and programmes that reflect the diverse educational policies and priorities of each country (Cinganotto and Cuccurullo, 2015).

The reasons behind this diversity are several, such as the lack of regulation or official guidelines, teachers' linguistic competence and training, students' language level expectations, distribution of CLIL hours, compulsory status or starting level (Coyle, 2007; Arribas, 2016).

CLIL methodologies present both positive and negative features. On the one hand, CLIL students are able to learn a foreign language alongside content. By using the target (foreign) language for content learning, implicit learning is enhanced and higher levels of proficiency are achieved (Admiraal et al., 2006; Alonso, 2015; Lasagabaster, 2008; Arribas, 2016; Martínez Agudo, 2020a). In general, the exposure to spoken skills in traditional EFL lessons is limited and reduced to everyday situations (Goris et al., 2020). CLIL learners' exposure to the target language in foreign language learning contexts increases (Artieda et al., 2020) and, by doing this they are exposed to meaningful and authentic, real communication. This is essential for second language acquisition and can help reduce learners' stress (Heras and Lasagabaster, 2014). Furthermore, the implementation of CLIL methodologies presents a series of benefits, such as developing intercultural communication and oral and writing productive and comprehension skills (pronunciation, syntax, pragmatics, informal use of language), providing opportunities to study content through different perspectives, and improving overall language competence (Admiraal et al., 2006; Dalton-Puffer, 2011; Lasagabaster, 2008; Arribas, 2016; Martínez Agudo, 2020a), without being detrimental to the L1.

The success of CLIL programmes is based on several factors. One of those is students' motivation (Lasagabaster, 2011; Arribas, 2016), which in turn can be influenced by gender or social class, among others (Lasagabaster and Sierra, 2009; Arribas, 2016). Furthermore, CLIL is also believed to have a positive impact on socio-affective variables such as language attitudes (Lasagabaster, 2009; Méndez García, 2012). In fact, Lasagabaster (2011) found that CLIL students were more motivated and their attitude towards English was higher, establishing a correlation between motivation and the level of linguistic attainment. These results are similar to those of Doiz et al. (2014).

On the other hand, Bruton (2011) and Cañado (2017) questioned some of the satisfactory results found by other researchers. They pointed out that most of the research had been done without including valid comparison groups or learning contexts, moderating variables or without using longitudinal designs or mixed-methods designs. Furthermore, CLIL can have negative effects on students' emotions, such as their self-esteem and self-perception (Dalton-Puffer, 2011).

One challenge that the implementation of CLIL methodologies faces is stakeholders', teachers' and students' lack of knowledge regarding CLIL aims. When it comes to teachers, sometimes they do not know what is expected from them. They are usually content teachers teaching in a language which is not their mother tongue and they more likely need the support of a teaching assistant. Otherwise, unnecessary translation between L1 and FL occurs, which hinders both content and language learning (Mehisto, 2008 in Banegas, 2012). Content and language teachers need to collaborate for a successful CLIL implementation. Thus, stakeholders, especially school managers, need to be involved in this process promoting faculty development (Banegas, 2012).

According to Marsh (2013), implementing CLIL programmes in mainstream education can provide younger students with a wider range of opportunities to improve their linguistic development. CLIL programmes are supposed to be egalitarian, that is, they should be open to everyone and could help tackle social exclusion, such as socioeconomic barriers or poor learning environments. In some countries, like France, Poland or Hungary, prospective CLIL students are selected based on their performance on entrance exams both on the target language and on subject knowledge. In contrast, in other countries, like Spain, Germany, Finland or Sweden, CLIL is normally opened to every student (Arribas, 2016). This means that non-CLIL students are at a disadvantage (Artieda et al., 2020), which could lead to perpetuation of social exclusion.

In spite of these drawbacks, CLIL has proven to be a successful methodology to improve students' FL skills. It should be noted though that further research is needed taking into account variables such as students' emotions and motivation or socioeconomic status (SES), among others (Cañado, 2017).

2.2. STEM (Science, Technology, Engineering and Mathematics) education

STEM is the acronym for science, technology, engineering, and mathematics that was first coined in the early 2000s (Dugger, 2010). Both scientific inquiry and engineering design involve the formulation of a question or problem that can be solved through investigation (science) or building it and evaluating the results afterwards (Kennedy and Odell, 2014). STEM education brings all four disciplines together creating a multi-disciplinary subject (Dugger, 2010). The content of all four disciplines are interwoven and students can participate in multi-disciplinary projects/activities that require the combined knowledge of scientific, technological, mathematical or engineering concepts and are focused on real problem solving. Thanks to STEM education, engineering and the scientific method have been incorporated into

national curricula worldwide (Capraro and Slough, 2009 in Rebollo, 2017) and should equip every single citizen with STEM literacy skills and competences.

A study has estimated that, between 2013 and 2025, there will be around 2.3 million science- and engineering-related vacancies in the EU. This fact highlights the importance of STEM subjects and the need for further investment in this field. For this purpose, STEM organisations of Member States have created the EU STEM Coalition, whose main goal is to increase the number of STEM graduates to fill up these vacancies and reduce the skills gap (Amato et al., 2019a). Interest and motivation are the main factors influencing STEM (or any other subject) performance. One of the main reasons students see scientific subjects as uninteresting is that they cannot find a relationship between the theoretical content and everyday life. Thus, by using real cases in the classroom, it is possible to attract students, spark their interest and enhance their STEM literacy (Amato et al., 2019b). The lack of quality in STEM-specific content in national curricula at the secondary educational level is another reason why STEM graduates numbers are decreasing (De Philippis, 2017).

In many OECD countries, students' science performance seems to have dropped in the last three years, although some have shown a slight improvement (OECD, 2020). At EU level, these results are important because the strategic framework for European cooperation in the field of education and training is based on them. In this framework, Member States aim at reducing the number of underachieving pupils to below 15% by 2020. In the 2018 PISA report, this percentage was 21.7% in reading, 22.4% in mathematics and 21.6% in science. These results clearly indicate that EU State Members are far from reaching this goal, even though some countries, such as Estonia, Poland or Ireland, have managed to improve their performance. In fact, in the particular case of science, underachievement have increased in science in the last three years (European Commision, 2019).

In general, and even though countries are making efforts to remedy this situation, women's presence in STEM disciplines has been lacking up until very recently. In primary and lower secondary education, there are no significant differences in performance between boys and girls in scientific disciplines (Kahn and Ginther, 2017). However, girls are not encouraged to take up STEM professions, there are few female role models or they fall into gender-related profession stereotypes (Ing, 2014 in Amato et al., 2019b).

In Spain, a platform called ChicaSTEM has been launched in order to tackle this issue and promote women's access to engineering and other scientific degrees. Several initiatives are gathered in this platform, such as Django girls, which organises workshops for girls/women to learn basic coding, Inspira STEAM, which promotes girls' scientific and technological

vocation, or STEM Talent Girl, which inspires, educates and empowers girls/women in the pursuit of a STEM career (Estrategias STEAM, Ministerio de Educación y Formación Profesional).

2.3. STEM teaching via CLIL

As previously stated, CLIL programmes in secondary education have been applied to subjects such as and natural sciences, mathematics or technology (Cañado, 2018). CLIL implementation in STEM subjects has been controversial. On the one hand, it has been argued that scientific disciplines are difficult, abstract and the terminology is too technical (Kircher, 2004 in Piesche et al., 2016). On the other hand, it has been argued that STEM subjects are particularly suitable for CLIL instruction because of a highly standardised language, the widely-spread use of visual aids (graphs, images or real objects) and the possibility of working with objects and conducting experiments (Piesche et al., 2016). As an example, mathematics is an exact science in which there is usually one interpretation, visual aids (graphs) can be used, leaves little room for misinterpretation and most specific vocabulary comes from Latin, which would make easier for natives of Romance languages to understand the relatively new concepts (Bobadilla-Pérez and Galán-Rodríguez, 2015).

In STEM subjects, traditional teaching methods have led to students' disengagement and lack of motivation, which in turn has led students to pursue different subjects in the future. Something similar occurs within FL teaching, which hinders students' performances and language proficiency (Gikopoulou et al., 2019). Coyle et al. (2010) established the relationship between linguistic demands and cognitive demands (content) in the so-called CLIL matrix.

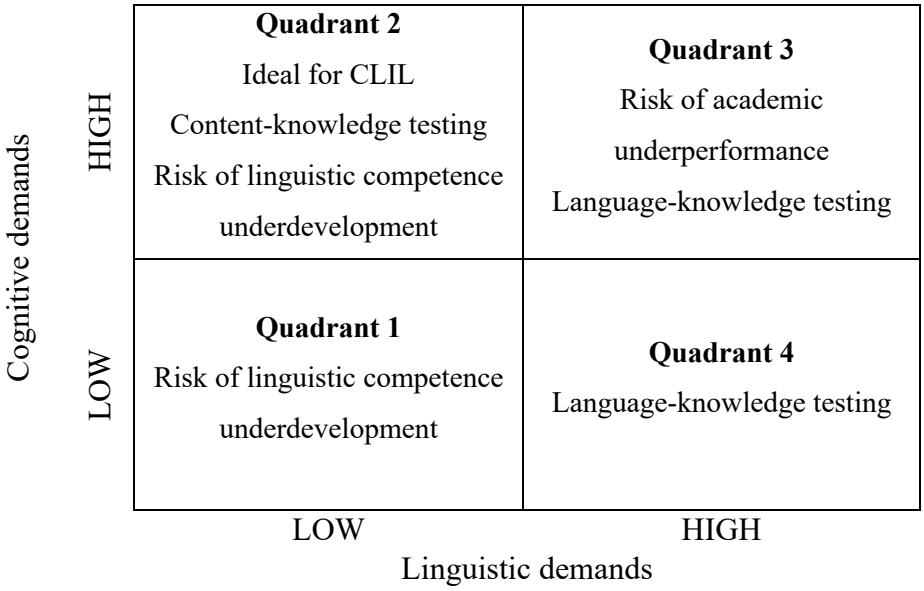

Figure 3. The CLIL matrix. *Source:* adapted from Coyle et al. (2010)

According to the CLIL matrix, for students to benefit from CLIL programmes quadrant 2 is the most suitable. This way, the students' language level does not hinder learning. However, for students' linguistic competence to develop properly, it is necessary to move to Quadrant 3 regularly (Coyle et al., 2010). Thus, both content and language have to be adapted in order to achieve the knowledge and competences required in the curriculum without language difficulty being detrimental to knowledge acquisition. If the linguistic demands are too high (Quadrant 3), there is an important risk of academic underperformance and, if they are too low (Quadrants 1 or 2), students' linguistic proficiency could be underdeveloped. In the specific case of mathematics, Surmont et al. (2016) found that the use of FL affected students' assessments (they claimed to find English-worded problems more difficult than Spanish ones), took them longer to solve and lack of knowledge of non-mathematical vocabulary. This is related to FL proficiency, as for students with an adequate FL proficiency bilingualism had no effect on mathematical problem-solving. They also concluded that higher-difficulty mathematical problems presented a higher difficulty in English than lower-difficulty problems. Therefore, it might result interesting to test content-related knowledge using high-difficulty problems and language-related one using low-difficulty problems (Pavón and Cabezuelo, 2019).

In order to establish an appropriate task-based learning, CLIL and STEM methodology, a 3-year transnational project (13 partners in four Eastern European countries) known as Schools: Future Labs (*s:fl*) was launched and funded by the Key Action 2 of the Erasmus+ programme. It was proposed after recognising that the then current teaching methodologies in STEM subjects, Spanish and German proved ineffectual, albeit its importance to employment prospects in the EU economies. The main goal of *s:fl* was to promote the teaching and learning of languages and STEM subjects so that students become active, self-directed, exploratory participants (Schools:Future Labs, Erasmus+ programme). The programme also intended to produce lesson plans that teachers can use in the classroom or a virtual student-learning portfolio in which teachers and students can share their work. The programme was implemented with great success in all the participating schools and students' attitude, motivation and performance improved greatly in both STEM and FL (Gikopoulou et al., 2019).

2.4. Podcasts as a learning tool

A podcast is a series of audio recordings, usually in MP3 format, that can be downloaded onto portable devices, such as MP3 players, smartphones or tablets, but can also be listened to on a personal computer (Kavaliauskiené and Anusiené, 2009). They can be downloaded via a URL containing a Really Simple Syndication (RSS) or compressed data online, which means

the latest podcast episodes can be downloaded automatically (Bolliger et al., 2010; Sevilla, 2018; Sutton-Brady et al., 2009). Currently, three types of podcasts are used: audio-podcast, enhanced podcasts, and video podcasts. Audio-podcasts include audio only, are small-sized files and do not require large storage space. Enhanced podcasts are a combination of audio and digital still images and video podcasts (or vodcasts) include audio and video and require larger storage space (Bolliger et al., 2010).

An important application of podcasts is their suitability as an educational resource. In education, they can be either teacher- or student-generated. Teacher-generated podcasts have been used mainly in higher education as lectures recordings or supplementary material, so students can access them outside the classroom (Sutton-Brady et al., 2009; Bolliger et al., 2010; Sevilla, 2018). Student-generated podcasts can result in a personalised learning experience, as it develops collaborative work and the student's sense of community (Al Qasim and Al Fadda, 2013). They have an active role in their own learning process, they can record themselves, monitoring what they are going to say and interact with their peers to reach an agreement in regard to the contents (Sevilla, 2018).

The advantages and disadvantages of using podcasts as an educational tool have been collected and included in Table 2.

Advantages	**Disadvantages**
Easy and constant accessibility (Lee and Chan, 2007; Bolliger et al., 2010; Stoltenkamp et al., 2011; Sutton-Brady et al., 2009)	Audio quality (Lane, 2006)
On-demand, flexible learning (Lee and Chan, 2007; Lane, 2006; Bolliger et al., 2010; Stoltenkamp et al., 2011; Sutton-Brady et al., 2009)	Lack of visual information (Lane, 2006; Sevilla, 2018; Stoltenkamp et al., 2011)
Personalised learning process (Lee and Chan, 2007; Bolliger et al., 2010; Sevilla, 2018; Stoltenkamp et al., 2011)	Drop in attendance to lessons (Lane, 2006)
Promote second language learning (Abdous et al., 2009, Sevilla, 2018)	Requires digital competence (Sevilla, 2018)
Educational and entertainment value (Abdulrahman et al., 2018)	Traditional methods are more comfortable (Stoltenkamp et al., 2011; Walls et al., 2010)

Enhances autonomy (Sevilla, 2018; Kavaliauskiené and Anusiené, 2009)	Cognitive overload if used with multiple learning resources (Walls et al., 2010)
Authentic, real life speaking and listening materials (Kavaliauskiené and Anusiené, 2009, Abdulrahman et al., 2018; Stanley, 2006)	
Increase motivation and confidence (Abdulrahman et al., 2018)	
Decrease in anxiety (Chacón and Pérez, 2011)	
Improvement of listening comprehension, vocabulary, pronunciation, grammar and writing skills (Abdulrahman et al., 2018, Chacón and Pérez, 2011; Ramli and Kurniawan, 2017)	
Improvement of students' communicative skills by generating podcasts (Abdulrahman et al., 2018, Chacón and Pérez, 2011; Ramli and Kurniawan, 2017)	
Promotes collaborative work and student engagement (Stoltenkamp et al., 2011)	
Enhances digital competence (Sevilla, 2018)	
Short-length podcasts (Lee and Chan, 2007, Sevilla, 2018; Stoltenkamp et al., 2011; Clark et al., 2012)	
Wide variety of topics (Li, 2010; Stoltenkamp et al., 2011; Sutton-Brady et al., 2009)	
Supplementary materials (Stanley, 2006)	

Table 2. Advantages and disadvantages of podcasts as an educational tool
Source: Own elaboration

As can be observed, podcasts present a series of advantages as an educational resource. For example, they give learners control over their learning process and allows them some independency. This shows the flexibility of this type of resources, especially if they can be use outside the classroom (Kavaliauskiené and Anusiené, 2009). In a study, students identified podcasts not only useful as study aids, but they also helped them clarify content covered in

lectures or fill in gaps in their notes (Lane, 2006). In fact, Thompson (2007), in Sevilla (2018), found the use of podcasts to be beneficial as supplementing material, especially with dull tasks such as learning grammar. Podcasts should be short, ideally between 3-5 minutes (Lee and Chan, 2007; Sutton-Brady et al., 2009). Short podcasts allow students to balance work and school, listen to them when commuting or at home (Sutton-Brady et al., 2009) and it is easier to stay focused on them. In fact, the study of Bell, Cockburn and Wingkvisit (2007), in Sutton-Brady et al. (2009), showed that computer science students stopped listening to podcasts because they were too long (8 minutes).

Podcasts, however, present also a series of weaknesses. Hew (2008), in Sevilla (2018), classified them in two groups: first- and second-order barriers. In the former, lack of time and technical problems can be named; whereas in the latter, obstacles intrinsic to the participants. As a rule, the so-called Y and Z generations are known as digital natives, which makes the presumption that all of them are technological savvies. This is dangerous, as technological competence does not systematically apply to every single student. Students reported some difficulty to hear properly the recording, it was challenging to search for specific information and that they could not relay visual information (Lane, 2006).

2.5. Podcasts as a CLIL learning tool

There are two main skills in communicative processes: listening and speaking, which are of great importance when learning a foreign language. Listening is not a passive process, but one through which information is received, selected and interpreted from auditory and visual clues. Most of the information processed occurs during pauses in speech, which allow students time to process, and comprehension involves drawing inferences and storing said information (Kavaliauskiené and Anusiené, 2009).

Speaking is an active skill through which the information previously received and processed is used to communicate ideas or opinions with others. Learners might experience anxiety when they need to use the FL to communicate because they have yet to master it (Doiz et al., 2014); however, contradictory results have been obtained. Several authors have found that CLIL students suffer from a lower anxiety than their FL peers, mainly because the focus is on content and communication in situations applicable to real life (Lasagabaster, 2008; De Smet et al., 2018; Heras and Lasagabaster, 2015).

The use of technology nowadays is of key importance in assisting students with FL learning (Abdulrahman et al., 2018). Podcasts have proven to be effective in FL acquisition, as they help develop oral skills, such as fluency, pronunciation or vocabulary (Abdous et al., 2009).

For example, a Taiwanese student found that their listening comprehension was positively influenced by the use of podcasts, as well as his self-confidence in his overall comprehension skills (Lu, 2007 in Al Qasim and Al Fadda, 2013). There are other studies that have also shown a positive perception of both teachers and students (Kavaliauskiené and Anusiené, 2009; Li, 2010).

Podcasts can help students become proficient in both oral comprehension and production (Ramli and Kurniawan, 2017). Oral comprehension skills can be improved by listening to authentic English podcasts (Kavaliauskiené and Anusiené, 2009). In order to learn a new language, listening to authentic materials is a vital asset, because it means listening to the "real" language, which is also the hardest to understand (Abdulrahman et al., 2018; Kavaliauskiené and Anusiené, 2009). Listening training should happen with the appropriate language materials, mainly auditory as visual resources can distract the learner from the objective (Abdulrahman et al., 2018). Regarding oral production skills, students first need to learn to "listen", that is, they need a good command of their listening abilities to be able to speak properly in a FL (Ramli and Kurniawan, 2017). Oral presentations, reports or storytelling can be possible applications to improve students' speaking skills (Sze, 2006 in Hamzaoglu and Koçoglu, 2016).

Stanley (2005), in Hamzaoglu and Koçoglu (2016), distinguished three different types of podcasts in foreign language learning:

a. *Authentic podcast*. It is especially appropriate for advanced learners, as it is usually recorded by native speakers and their target audience is non-educational.
b. *Teacher-generated podcast*. It has been created by teachers for their students for oral comprehension or content revision.
c. *Student-generated podcast*. These are created by the students with their teacher guidance to develop their oral comprehension and production skills.

Depending on the type of podcast, some contain printable transcripts for students to read as they follow along with the audio. In others, the hosts will speak slowly and enunciating every word; whereas in others a slower version of the dialogue or story will be provided, followed by the same content at a faster rate of speech (O'Bryan and Hegelheimer, 2007).

Podcasts can also increase student motivation. Appealing tasks, those that look interesting and challenging, produce enjoyment and, therefore, increase motivation (O'Bryan and Hegelheimer, 2007). In fact, student motivation could be further increased by sharing online their own podcasts worldwide (Sze, 2007 in Al Qasim and Al Fadda, 2013; McLoughlin et al., 2007), as well as working collaboratively (Stoltenkamp et al., 2011). Moreover, producing

podcasts is an authentic activity that allows learners to communicate regarding topics discussed in their FL classes, such as food, culture, body language, geography, animals, sports, habits and religion (Al Qasim and Al Fadda, 2013).

3. METHODOLOGY

3.1. Bibliometric review

A systematic review of the available published literature about STEM subjects and the use of podcasts in CLIL secondary education and the use of podcasts was followed as detailed by Tarifa-Fernández and De Burgos-Jiménez (2017).

The review was conducted by searching in two main databases: Web of Science (WoS) and Linguistic Abstracts Online (LAO). The latter was used first; however, the results obtained were very limited (133 articles on CLIL implementation in secondary schools). For that reason, the WoS database was used and, although it is mostly used in the science field, a higher number of publications was obtained (323 articles).

In order to lead a successful, accurate search, the use of the appropriate keywords is fundamental. In this work, the keywords chosen were "CLIL", "Content and Language Integrated Learning", "secondary school" and its derivatives and "podcasts". The search was limited to title and/or abstract (represented as TS) to ensure a minimal level of relevance. Subsequently, the keywords were entered in the databases using excluding syntax (AND, OR operators) in the WoS database.

At first, general search was conducted to find publications related to CLIL methodologies in secondary school. The results were found with the combination:

- *TS = ("CLIL" OR "Content and Language Integrated Learning") AND TS = ("secondary education" OR "high school" OR "junior high" OR "middle school*" OR "secondary school*").*

Secondly, a more specific search was done to find publications related to CLIL methodologies in secondary school in STEM subjects. The results, which would be included in the first, more general search, were found with the combination:

- *TS = ("CLIL" OR "Content and Language Integrated Learning") AND TS = ("secondary education" OR "high school" OR "junior high" OR "middle school*" OR "secondary school*") AND TS = ("STEM" OR "math*" OR "technology" OR "engineering" OR "science").*

Finally, a third search was performed to include publications which included podcasts in CLIL STEM subjects in secondary schools. The results were found with the combination:

- *TS = ("podcast*") AND TS = ("CLIL" OR "Content and Language Integrated Learning") AND TS = ("secondary education" OR "high school" OR "junior high" OR "middle school*" OR "secondary school*") AND TS = ("STEM" OR "math*" OR "technology" OR "engineering" OR "science").*

Because this search returned no results, the STEM-related terms were dropped. The results were found with the combination:

- *TS = ("podcast*") AND TS = ("CLIL" OR "Content and Language Integrated Learning") AND TS = ("secondary education" OR "high school" OR "junior high" OR "middle school*" OR "secondary school*").*

Consequently, 323 articles were returned from WoS and 133 from LAO.

	WoS	**LAO**
CLIL + secondary school	256	133
CLIL + secondary school + STEM	65*	24*
Podcasts + secondary school + STEM	0	0
Podcasts + secondary school	67	0
TOTAL	**323**	**133**

Table 3. Results from bibliometric search (*Duplicated entries)

Once the search concluded, a title and abstract analysis was then conducted to determine which articles fell within the scope of this work. In order to do this, several exclusion criteria were taken into account: English as Foreign Language, vocational training, primary and higher education or material preparation articles were discarded.

4. PROPOSED ACTIVITY

The use of podcasts has been chosen because it promotes collaborative work, which has demonstrated to increase students' motivation and improve their oral production and comprehension skills.

The rapid development of the Web 2.0 and its application in education has been useful in adapting the teaching-learning process to the technological world. These applications promote creativity and interactive learning, and students and teachers alike can easily communicate, produce, edit and share content worldwide. Thus, it promotes collaborative work in the classroom (Dogan et al., 2012; Sevilla, 2018), which is an essential transferable skill highly demanded in the labour market. In the particular case of podcasts, the process of writing and

rewriting the scripts involves collaborative work: students have to make joint decisions (Lee and Chan 2007), which enhanced both teamwork and team spirit, promoting their engagement with the subject (Stoltenkamp et al., 2011).

4.1. School and participants

IES Aguadulce is a state-owned centre located in the town of Aguadulce, a middle-class residential area west of Almeria. This is a bilingual (English) centre, where compulsory secondary education (ESO), baccalaureate and intermediate and higher vocational training (classroom- and distance-based) are offered and receives students from different primary and secondary schools from centres of the area. Nowadays, about 1,000 students attend this centre, with ages ranging from 12 to 20, although in higher vocational training the age can be higher.

The activity here proposed was meant to be developed in one course of 2º ESO comprising 32 students. About two thirds of the students have attended bilingual education since the beginning of secondary education. The rest started bilingual education on the second cycle of primary education. This fact implies that the class has a similar English level, A1.2-A2.1 as per CEFR.

4.2. Relevant legislation, objectives and competences

The activity proposed is framed within the Royal Decree 1105/2014 of 26 December and the Order of 14 July 2016, which establish the curriculum for compulsory secondary education nationwide and in Andalusia, respectively. The Order of 28 June 2011 is also applicable, as it regulates bilingual teaching in educational institutions in Andalusia.

The Order ECD/65/2015 of 21 January established seven key competences that students must cultivate, and the educational authorities must foster. With this activity, five of these competences are expected to be promoted and developed: a) communication in foreign languages (CLL), b) mathematical competence and basic competences in science and technology (CMCT), c) digital competence (CD), d) learning to learn (CAA) and, e) sense of initiative and entrepreneurship (SIEP).

The main objective of this proposal is the implementation of an integrated didactic unit (IDU), '*Energy, its production and the environment*', which includes two different units ('Energía' and 'Servicios web y acceso y puesta a disposición de recursos compartidos en redes locales') of the subject Technology in 2º ESO (Order of 14 July 2016), using English as the vehicular language.

With this activity there are also partial objectives to be met:

- To develop oral communication skills in a foreign language (English).

- To create a blog to publish students' work.
- To record and edit podcasts.
- To raise students' awareness about renewable and non-renewable energy production.

4.3. Research questions

One of the objectives of this work consisted in assessing the effect on students oral production skill of using podcasts in a CLIL technology classroom at a secondary education level. As proven by several authors (Ramli and Kurniawan, 2017; Abdous et al., 2009; Li, 2010; Chacón and Pérez, 2011; Hamzaoglu and Koçoglu, 2016), podcasts are effective tools to gain and develop oral skills, such as fluency, pronunciation and vocabulary. At the same time, CLIL implementation in STEM subjects at the secondary educational level is discussed in this work. Thus, two research questions arise:

1. *Does the use of student-generated podcasts help improve students' FL oral skills?*
2. *Does the use of student-generated podcasts have a positive impact on students' STEM knowledge acquisition?*

4.4. Methodology

The methodology chosen was a project-based learning (PBL) activity. With this type of activities students are exposed to practical, real projects through which they face real-life problems, usually working in groups. PBL presents several advantages, such us a better understanding of mathematical and scientific concepts and the implementation of this knowledge (von Solms and Nel, 2017).

In order to answer the research questions proposed in the previous subsection, an initial productive vocabulary level test (PVLT), a pre- and a post-questionnaires were handed to the students (see Annex I). Because the students attended their 2nd year of ESO, their English level should be A1.2 - A2.1. Thus, the pre-questionnaire was formulated in both English and Spanish to facilitate understanding and a 2,000 PVLT was chosen. PVLT are based on frequency lists (2,000-, 3,000-, 5,000- and 10,000-word band) and measure students' ability to recognise words from them (Canga Alonso and Arribas, 2015; Castro García, 2017). The first 2,000 word list is made up of 'high frequency vocabulary' (Laufer and Nation, 1999 in Castro García, 2017) and, thus, it was chosen for this activity.

The pre-questionnaire comprised of 25 items and it was designed to determine students' motivation towards bilingual learning, their degree of familiarisation with ICTs and collaborative work. This way, the activity can be adapted to match students' abilities. The post-questionnaire comprised of 45 items and it was designed to analyse students' experience and

responses to the activity. For example, it will provide some insight into their degree of satisfaction and motivation when using this type of technologies and methodologies, especially in a FL. Besides, it will unveil any problems or difficulties that will lead to improvements for future activities.

4.5. Activity proposed

The activity was framed within the IDU '*Energy, its production and the environment*', in which students learn about how electricity is produced and the different types of power generation plants, renewable and non-renewable. The estimated completion time for this activity was four weeks.

The activity consisted of the recording and edition of podcasts, 3-5 minutes long, about different power generation plants and the creation of a blog in which students uploaded them. In total, eight different power generation plants were chosen: 1) fossil fuel thermal power plant, 2) nuclear plant, 3) hydroelectric power plant, 4) wind power plant, 5) solar power plant, 6) biomass power plant, 7) geothermal power plant, and 8) tidal power plant.

To complete this activity, several resources are needed:

- Students were granted access to the multimedia room once a week for four weeks to use the computers to find information on their given energy production plant and complete the script for their podcasts. Besides, if they chose to create a cover for their podcast, they could use the software available at the centre.
- They were also granted access to the resources of the technology department, such as books or journals, to find information.
- To record and edit their podcasts students were asked to download a recording app (Anchor, Speaker Studio, Podbean) on their mobiles. Some of these apps have also a desktop version, so students could choose to record and edit on their laptops or PCs.
- It is advisable, but not mandatory, to use a headset with a built-in microphone. This way, background noise can be greatly reduced, and the voice recording is clearer and louder.

The steps to follow to complete this activity were:

1. To divide students into eight groups of four students by the teacher, in order to for homogeneously distributed groups.
2. To randomly assign one power generation plant to each group.
3. To search for information on the following points:
    a. main characteristics,

   b. power generation capacity,
   c. resources needed,
   d. advantages and disadvantages of this type of power plant, and
   e. possible risks and environmental impact of energy production.
4. To prepare a short script including, at least, a couple of sentences for each of the aforementioned points. The teacher handed a template of this script to each group and the students had to complete it with the information found. However, the students could choose to create their own script and expand the minimum contents.
5. To record an mp3 file using a mobile app (i.e. Anchor, Podbean) or the computers on the multimedia classroom. Every student must participate on the recording and speak for, at least, 30 seconds.
6. To edit the recording done.
7. To create, voluntarily, a cover for the podcasts (1,400x1,400 pixels) in png or jpg format.
8. To host the podcasts in a hosting (i.e. Archive, Ivoox, SoundCloud) and upload the RSS Feed in a class blog (wordpress.com o blogger.com).
9. To create a QR code for each podcast.

By the end of this activity, it is expected that students will have acquired the specific energy production-related content reflected in the curriculum for the 2º-ESO technology subject, as well as the corresponding vocabulary in English. They will also be able to describe the energy production characteristics, resources or effects on the environment of different energy production plants. At the same time, they will have worked with Web 2.0 tools, podcasts in particular. In essence, this activity will help students develop the competences CCL (by searching for information, writing the script and recording the podcast), CMCT (by acquiring energy and environment-related knowledge), CD (by using different apps or software to record, edit and host podcasts, and create QR codes), and CAA (by working in groups autonomously) and SIEP (by taking charge of their own learning process).

5. EXPECTED RESULTS AND DISCUSSION

The information gathered from the questionnaires and PVLT after the completion of the activity here proposed are expected to shed some light into the following aspects:

1. Promotion of students' collaborative work.
2. Development of students' sense of initiative, learning to learn and digital competences.

3. Improvement of students' FL oral production skills, especially in acquiring vocabulary, or fluency, among others.
4. Improvement of students' motivation and engagement in STEM, CLIL-implemented subjects in secondary education.

5.1. Collaborative work and competences development

Expected results number 1 and 2 are tied together with the answers of the pre-questionnaire. Several of the questions have to do with students' familiarity with ICTs and previous experience with collaborative work and PBL. First of all, the proposed activity was designed for the technology classroom, in which students' active participation is highly desirable, especially when it comes to practical work. As previously mentioned, in Spain there are 17 different Educational Authorities and the scheduled hours and nature of technology as a subject can vary. In Andalusia, it is an elective subject in 1º ESO (2 hours per week) and mandatory in 2º and 3º ESO (3 hours per week). Thus, it cannot be assumed beforehand that every student has done PBL work. In this sense, some difficulties might arise when students participate in this kind of work. In order to tackle this, it might be interesting to conduct, with help from the school counselors, an initial assessment of students' abilities to take part in PBL activities at the same level than the rest of their peers. The aim of this assessment would be detecting any possible gaps that could lead to students being unable to follow the 'normal' progress of the rest of the class. If difficulties can be detected early, then, under guidance from school counselors the necessary adaptations can be made, fostering thus the integration and support of all students, diverse as the group might be. Nevertheless, major problems are not expected as PBL is also used in other subjects and in some primary schools. It is expected, therefore, that students should be able to assume different roles within the group and work collaboratively, which would help them develop their sense of initiative and learning to learn competences. Additionally, students nowadays are very well-versed in the use of digital technologies, even though some might not have access to the Internet or own digital devices. Ease with technology notwithstanding, they probably have never used podcast-recording apps or software, which could lead to some difficulties. This, however, could be seen as a challenge to develop their digital competence. Student-produced podcasts have proven successful in promoting engagement and enhancing students' motivation at the higher education level (McLoughlin et al., 2007). This type of podcasts represents an innovative way to engage students and promote their sense of initiative because it encourages them to research and study independently (Nie et al., 2018). Thus, it is expected that students will respond better to this

type of activities, as it appeals to their sense of comradeship, represents a challenge both technologically and linguistically and, by sharing their work with their peers, they self-esteem and motivation might be positively affected.

5.2. Oral production skills (Research question 1)

The first research question is whether the use of student-generated podcasts will help them improve their oral production skills, it is tied to expected result number 3 and can be analysed thanks to the PVLT and the post-questionnaire. There is a lack of literature regarding the use of student-generated podcasts in STEM, CLIL-implemented subjects at all educational levels, therefore, the factors their use could potentially influence positively remain somewhat unclear. However, two very closely linked factors, exposure time to FL and vocabulary size growth, can be analysed.

5.2.1. Exposure time to FL

Oral skills acquisition is heavily influenced by exposure time to an L2/FL (Admiraal et al., 2006; Lasagabaster, 2011). In fact, when exposure to the target language is scarce, older learners appear to be more efficient learners than younger ones (Artieda et al., 2020). Thus, CLIL-implemented lessons are seen as a way to enhance students' exposure to a FL (Artieda et al., 2020). To determine its effects, studies should be conducted by comparing CLIL and non-CLIL groups. Non-CLIL groups can be chosen within the same age group, but having an older age group (preferably CLIL and non-CLIL) for comparison purposes is essential. In this sense, two scenarios can be observed. On the one hand, CLIL students are compared to non-CLIL ones with similar hours of exposure, but older (2-3 years ahead). In this case, it has been found that older learners were more efficient at learning a new language (Artidea et al., 2020), mostly due to their superior cognitive development and analytical skills (Muñoz, 2006 and Villarreal, 2011 in Artieda et al., 2020). On the other hand, CLIL students are compared to non-CLIL ones with similar age but different FL exposure time. In this case, significant differences between both groups were observed when a threshold (around 300 h) was surpassed (Muñoz, 2015 in Artieda et al., 2020).

The students participating in this activity would have been in bilingual education since, at least, their 1st year of ESO, although some of them participated in bilingual branches during primary education. CLIL students are more exposed to English than their non-CLIL counterparts, as they learn English as a Foreign Language (4 hours per week in 1st year and 3 hours per week in 2nd year) and, at least, two non-language subjects. In this sense, it stands to reason that, if two non-CLIL groups (2º and 3º/4º ESO) also participated in the activity, the

CLIL group would outperform their contemporaries and, possibly, the older non-CLIL group. This has been the case of studies from the LASLAB (Language and Speech Laboratory) Research Group in the Basque Country. Lasagabaster (2008) carried out a study on three groups (3º ESO CLIL, 4º ESO CLIL and 4º ESO non-CLIL group, the latter with similar exposure time as the first group) in which both CLIL groups scored higher than their non-CLIL peers in the speaking skill. Thus, it was highlighted that younger CLIL learners caught up with their non-CLIL peers. These results seem to be in agreement with those of Del Puerto and Lacabex (2017), who found that the CLIL and non-CLIL group (2 years ahead) obtained similar results; while the same-year non-CLIL group performed worse in every variable measured except for pronunciation. The discrepancy in pronunciation might be due to teachers being non-native speakers. Villarreal (2011) and Schoonjans (2013), in Artieda et al., 2020, found similar effects. Artieda et al. (2020), however, found that non-CLIL students (2 years ahead) performed significantly better than their CLIL peers in listening skills and some dimensions of writing. They postulated that age seemed to counterbalance the positive impacts of CLIL, as confirmed by several studies (Muñoz, 2015, Villarreal, 2011 and Schoonjans, 2013 in Artieda et al. 2020).

5.2.2. Vocabulary size growth

In CLIL lessons, vocabulary knowledge is essential in order for students to be able to communicate with the teacher and their classmates (Alonso, 2015). In this sense, another factor that CLIL seems to foster is vocabulary size growth, which is doubtlessly related to FL proficiency level, which in turn is related to exposure to the FL. In fact, Alonso (2015) compared non-CLIL students at the end of primary and secondary education and found out important differences in vocabulary acquisition in favour of the older students. In order to complete the activity here proposed, students will use a template script, which they will have to fill in with the relevant vocabulary. Besides, they will have received a list of vocabulary at the beginning of the didactic unit with the most important terms they will need and, therefore, this task should be completed with relative ease. CLIL implementation seems to further foster vocabulary learning, as they can use technical vocabulary in meaningful, real-life situations (Muñoz, 2007 in Alonso, 2015). Thus, in the particular case of this activity it is expected that students acquire and widen their energy-related vocabulary.

A relationship between vocabulary size and exposure times has been summarised by Alonso (2015): an estimated of 1,200 words can be achieved after 900 hours of exposure, 2,000 words after 1,350–1,500 hours and 4,500 words after 3,000 hours. In Andalusia, at the end of primary

education students from non-bilingual centres have had up to 575 hours of FL instruction (3 hours per week); whereas students from bilingual centres would have studied in the FL, at least, Social and Natural Sciences (2 hours per week each), which amounts to up to 750 extra hours of FL instruction. This means that students could potentially start secondary education with FL exposure times ranging from 575 to 1,325 hours, without taking into account extramural activities. In this sense, students from bilingual primary centres should have a vocabulary size at the beginning of secondary school of between 1,200–2,000 words. Furthermore, at IES Aguadulce in 1º ESO students receive 19 hours per week of FL instruction, which translates into another 600 hours, upping the total FL exposure time to 1,375–1,925 hours and an expected vocabulary size above 2,000 words. This is in contradiction with the results obtained by Canga Alonso and Arribas (2015), who found that 15–16 years old, CLIL and non-CLIL students had a productive vocabulary lower than 1,000 words, although CLIL students performed better. If this were the case, both groups would have problems understanding spoken and written language, because in order to have a good command of a FL, about 2,000 words are needed to understand 90–94% of spoken discourse and 6,000–7,000 word families to understand 98% of written language (Canga Alonso and Arribas, 2015).

5.3. Students' emotions on STEM, CLIL-implemented subjects

Expected result number 4 can be analysed with the answers to the post-questionnaire, as students are asked about their experiences with podcasts, bilingual education and their feelings towards CLIL lessons. There are numerous factors that can affect students' performance, both in CLIL and mainstream education. Psycho-affective factors (motivation, absence of anxiety, indifference, and self-demand) and language attitudes are strongly influenced by variables such as socioeconomic status, setting (urban vs. rural), type of school (public, charter or private), gender or age, among others. (Lasagabaster, 2009, 2011; Doiz et al., 2014).

Motivation is, without a doubt, one of the most powerful factors affecting learning and, as previously stated, very little can be learnt without motivation (Lasagabaster, 2011; Doiz et al., 2014). Up until recently, motivation research on language learning has been focused on EFL programmes and CLIL has not been taken into account (Dalton-Puffer, 2011). There is, therefore, little research on how CLIL programs affect motivation. In the studies conducted, CLIL has proven to increase motivation towards learning English (Arribas, 2016; Doiz et al., 2014; Herrate and Beloqui, 2015), and the more motivated, the better their performance (Lasagabaster, 2011) at both the primary and secondary educational level. An example of CLIL positive influence to students' motivation is the study of Grandinetti et al. (2013). In Italy, the

Educational Reform Law of 2010 made it compulsory, from the academic year 2013/14 onwards, to implement CLIL methodologies in all upper secondary centres. The authors found that students with no interest whatsoever in learning were actually motivated and interested enough that it facilitated science learning through appropriately designed CLIL learning materials.

Regarding the attitude towards English of CLIL and non-CLIL students, contradictory results has been found. Attitude has been shown to be similar, although higher for older students (Arribas, 2016) or better towards FL learning (Lasagabaster and Sierra, 2009; Lasagabaster, 2011; Thompson and Sylvén, 2015 in De Smet et al., 2018). Anxiety is also a factor to consider when implementing CLIL. CLIL pupils might experience higher anxiety levels than their non-CLIL peers, especially for the younger ones as CLIL programmes might be more demanding (Doiz et al., 2014). However, Thompson and Sylvén (2015) and Möllet (2016), in De Smet et al. (2018), found that CLIL students presented less anxiety. In this case, both authors inferred that CLIL was not responsible for students' lower anxiety (or higher motivation) levels, but because they could choose voluntary to take part in CLIL programmes, which highlights the non-egalitarian nature of CLIL in certain countries, in this case, Germany and Sweden.

Attitude and motivation towards English are higher in CLIL programmes because of its status as *lingua franca* and parents from all SES consider it essential for their children's future. This change of attitude in Spain, a country where FL learning has traditionally not been considered important, this finding underscores an important qualitative change of attitude (Lasagabaster and Sierra, 2010 in Doiz et al., 2014).

In STEM subjects, the traditional approach usually fails to engage students or motivate them to pursue a career in STEM fields. Besides, the current approach to FL teaching, combined with large classroom sizes, makes it very difficult for students to actually learn the language, and to engage with the FL in an active way or appreciate the practical use of it. Therefore, at least in Europe, a number of projects have been proposed to increase students' motivation in STEM subjects, such as the Schools: Future Labs project. Their promoters expected students to achieve a higher interest and engagement in STEM and FL subjects, a deeper level of knowledge in STEM, develop better fluency in their chosen FL and acquire useful skills. The evaluation of the project showed that it resulted feasible, useful and successful, making STEM subject more interesting and fun for students. The responses to the questionnaires showed a significant improvement students' attitudes, motivation and performance in both STEM and FL (Giankopoulou et al., 2019).

5.4. Effect of podcasts on students' STEM knowledge (Research question 2)

Research question number two (Does the use of student-generated podcasts have a positive impact on students' STEM knowledge acquisition?) remains, unfortunately, unanswered. The lack of STEM, student-generated podcasts literature hampers a realistic discussion of their possible beneficial effects. With the current literature, it can be extrapolated that student-generated podcasts in STEM subjects could possibly be very suitable to encourage students to take up STEM subjects and possibly continue on this path at higher educational levels.

6. CONCLUSSIONS

As a pedagogical methodology, CLIL has revolutionised the way languages are taught, especially in Europe where it has become very popular, as it is believed to foster proficiency in the FL (Coyle, 2007; Genesee and Lindholm-Leary, 2013), mainly English, due to its consideration as the world's *lingua franca*. Furthermore, it has the unconditional support of the European institutions, which encourages European citizens to master, at least, two more EU languages in addition to their mother tongue (European Commission, 1995).

The literature on the implementation of CLIL methodologies to learn non-language content through a FL (Objective 1) is extensive, although the results are often contradictory. This fact hinders a meaningful, reproducible analysis of its suitability as a role methodology to be widely adopted. Too many factors can influence its suitability, such as students' selection, motivation, attitude, FL level, school type and setting or exposure time to FL. Among the many studies conducted on CLIL implementation, positive and negative characteristics have been found (Objective 2). Regarding its positive features, it has been reported that CLIL students have been able to learn both content and language by using a FL (mainly English) in non-language subjects, because they can 'understand' their usefulness in real-life situations and, most importantly, without compromising their L1 skills (Admiraal et al., 2006; Alonso, 2015; Lasagabaster, 2008; Arribas, 2016; Martínez Agudo, 2020a). Nonetheless, there are some negative connotations to CLIL. As previously stated, if stakeholders are not appropriately engaged in the implementation process, this will most likely fail (Banegas, 2012). It is, thus, imperative to get them to work together for a successful methodology implementation.

The main objective of this study was to gauge 13-14 year old students' motivational and content- and language-knowledge acquisition in STEM, CLIL-implemented lessons through the use of student-generated podcasts (Objectives 3 and 4). In fact, two main aspects have been studied: the beneficial effect of CLIL methodologies in STEM subjects, and the aptness of

using podcasts to improve students' oral skills and their views on STEM, CLIL-implemented lessons.

Literature on STEM CLIL programmes is, however, not so extensive at the secondary school level, even though STEM subjects would make a suitable choice because of the highly standardised language, the widely-spread use of visual aids (graphs, images or real objects) and the possibility of working with objects and conducting experiments (Piesche et al., 2016). In the particular case of STEM subjects, there has been a decline in the number of STEM students in secondary and higher education, even though these type of professions are often in high demand of new professionals and offer good benefit packages. The lack of skilled STEM professionals, although worrying, is being tackled, at least at EU level, with several initiatives to help increase the number of STEM graduates (Amato et al., 2019a).

If the literature on student-generated podcasts is limited, it is even more so regarding STEM subjects. Podcasts as a tool to learn non-language content have proven to be of help in order to gain and develop students' oral skills in a FL (Abdous et al., 2009). They are a flexible resource that allow students to adapt their learning process to their own pace (Kavaliauskiené and Anusiené, 2009). Most importantly, it has been shown that student-generated podcasts increase their motivation, especially as they are attractive and challenging tasks that students can share with the whole world (O'Bryan and Hegelheimer, 2007; McLoughlin et al., 2007), usually based on authentic situations. It stands to reason then, that if the creation of podcasts by students produce an increase in their motivation to learn both language and content, the same can be said about conducting this type of activities in STEM, CLIL-implemented lessons.

To conclude, as previously stated the literature on CLIL implementation to learn non-language content through a target language (Objective 1) is extensive, but not so so much at the secondary school level. This field has undergone a boom in the last few decades, especially in Spain, which has become one of the leading countries in Europe implementing CLIL programmes and researching this field (Doiz et al., 2014). This objective is related to Objective 2, in which advantages and disadvantages of the implementation of this methodologies are discussed. If the variables are controlled (SES, motivation, school setting, school type, exposure time, stakeholders' involvement and engagement), CLIL has the potential to transform the way content and language are imparted at the primary and secondary level and students can profit from this methodology to achieve the goal proposed by the European Commission. If these programmes are properly and homogeneously implemented, not only in Spain but EU-wide, CLIL can be the answer to tackle language proficiency problems and to improve students' general performance.

Objective 3, highlighting the influence of podcasts as a tool to learn non-language content through a target language, podcasts have proven to be very effective to increase students' motivation and performance both on content and language learning, especially when it deals with authentic materials on real-life situations. The Web 2.0 is an excellent resource base, due to its dynamic characteristics. As previously stated, generations Y and Z are known as 'digital natives' and are quite apt at using these resources. Thus, it would be interesting if teachers were to incorporate them to the classroom, as it could help engage the most discouraged students by appealing to their 'natural' competences.

Finally, this PBL activity is proposed to exploit the benefit of digital resources to help students improve their oral production skills in the foreign language (English) by creating their energy production-related podcasts. By doing this, students learn to work together with their classmates and play different roles within the group. They can challenge themselves to overcome their limitations, because they will realise that their peers are in a similar situation and, by working together, they can mutually conquer them.

7. LIMITATIONS OF THE STUDY AND PROPOSAL FOR FUTURE RESEARCH

7.1. Limitations of the study

As have been discussed beforehand, CLIL methodologies present a series of advantages and disadvantages and numerous studies have been conducted to prove or disprove them. However, those studies, including the one here proposed, present several limitations. If an accurate, in-depth comparison between CLIL and non-CLIL groups is intended, it is important to determine the effects this type of methodology has, not only on students' FL skills, but also on their content knowledge acquisition. In the case of this activity:

1. It is limited to only one CLIL group in a single, urban secondary centre. Generally, most studies are carried out in one or a few close schools. This limits the sample size and results could be hardly reproducible.
2. The target group is not homogeneous. There are students from different SES and not all of them have attended bilingual primary schools, which means their exposure time to FL can vary up to 750 hours. There are other factors that can also influence students' performance, such as gender, language limitations or excessive reliance on the use of L1 (Albero-Posac, 2019; Pavón and Cabezuelo, 2019).
3. This study is punctual, that is, it analyses only one CLIL group at a specific point in the academic year and there are no follow-ups planned. This is also true for most studies, where follow-ups are not common practice (Bruton, 2011).

4. The questionnaires here used measure several factors, mostly related to students' emotions, assessment of the bilingual programmes or their familiarity with ICTs and podcasts in particular. However, there are no standardised tests or questionnaires (Surmont et al., 2016) to measure both FL and content learning in order to compare groups from different backgrounds and countries (such as the PISA report). The main focus has been on students' linguistic outcomes (Admiraal et al., 2006; Lasagabaster, 2008) and not on the effects of CLIL on content knowledge (Dalton-Puffer, 2011). In this case, comparison among countries might result complicated, because even though there are basic content taught everywhere, each country is responsible for their curriculum.
5. Although in Andalusia CLIL branches are open to every student, studies have usually been conducted with positively preselected classes (Bruton, 2011). As a consequence, it results very difficult to validate the findings.

School settings (rural vs. urban) or SES seem to play a role in students' performance in CLIL students. Nonetheless, as students progress, the influence on CLIL programmes of variables such as SES diminish (Hughes and Madrid, 2020). In Spain, as a rule, most bilingual schools can be found in major towns and cities. This implies that students in urban settings have a higher exposure to FL than those in rural areas (Hughes and Madrid, 2020). Differences in motivation and indifference seem to emerge between both settings, with students from rural schools showing a significantly lower motivation and higher lack of interest. Nevertheless, in rural areas where these programmes have been implemented, no differences can be observed between both settings, especially at secondary education level (Pavón Vázquez, 2018). In fact, Pavón Vázquez (2018) compared urban and rural CLIL education and found a clear beneficial effect of CLIL-taught science lessons, especially if both urban and rural groups had been privy to CLIL beforehand.

Regarding SES, students from primarily higher SES settings enroll in bilingual branches (especially when they or their legal guardians are given the choice) and it can, therefore, be concluded that they are in advantageous position with respect to their lower-SES peers. Nonetheless, when the selection effect of SES is controlled, together with other factors, such as gender or motivation in the FL, CLIL students of any SES outperform their non-CLIL classmates (Madrid and Barrios, 2018). In fact, according to a PISA report on private schools (OECD, 2011), these students outperform state school ones in their PISA tests only when they belong to higher SES. When private- and public-school students come from a similar SES backgrounds, the difference is negligible. Taking into account the type of school, at the primary

educational level students from charter and private schools tend to achieve better results, irrespective of CLIL lessons. However, by the end of secondary education, no noteworthy differences between public- and charter-school students are observed, although differences in favor of CLIL groups are observed in public schools (Hughes and Madrid, 2020). These results are partially in agreement with those of Madrid and Barrios (2018), who found that CLIL groups performed better than non-CLIL ones, irrespective of type of school (charter or public). Furthermore, they did not find differences between public and charter schools except for the number of hours of FL instruction. In this case, CLIL and non-CLIL public-school students outperformed their charter-school counterparts.

Students that participate in bilingual primary education may initially achieve lower scores on content areas, which could be expected as these students would be at a linguistic disadvantage when they begin their studies in L2, although they can assimilate content at a similar pace that their non-CLIL counterparts during primary education (Martínez Agudo, 2020b). However, Hughes and Madrid (2020) found that this situation appeared to be mitigated by the end of secondary education, as confirmed by Martínez Agudo (2020b).

7.2. Proposal for future research

Due to the limitations of the work here presented, further research is a must. In order to determine the influence of factors such as motivation (and other psycho-affective factors), SES, school setting and type, exposure time to FL, content- and language-knowledge acquisition or ICT competence on CLIL and mainstream, non-CLIL STEM programmes, it would be interesting to conduct a nationwide (EU-wide would be preferable) study in which students from rural and urban public, charter and public schools took part.

The study should be longitudinal and spanning, at least, the four years of ESO. PVLT (or other FL level tests deemed acceptable) should be given, at least, twice in each academic year to monitor students' performance language-wise. The influence of exposure time can also be determined, because some of the participating students would have come from bilingual primary education. To compare content-knowledge acquisition it would be interesting to compare the STEM curricula of each AC. Curricula should be fairly similar, as they are drawn upon RD 1105/2014, although each AC have the competence to adjust them to better match their particular circumstances. The best way to monitor content-knowledge acquisition is through common, standardised tasks or exams. This might be harder to achieve, as the participating centres and CLIL teachers would have to agree on them. Nonetheless, standardisation is the best way to ensure that results are reliable and reproducible.

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ANNEX I. PVLT, PRE- AND POST-QUESTIONNAIRES

Productive Vocabulary Level Test (PVLT)

2,000-word PVLT adapted from Laufer and Nation (1995, 1999) as shown in Canga Alonso and Arribas (2015) and Castro García (2017). This test takes 15 minutes to complete.

In the following sentences we have omitted the end of a word. Complete the sentences with the right word. For examples: He was riding a bic_____; you should have completed the sentence as follows: He was riding a bicycle.

Example: He was riding a bicycle.

1. They will restore the house to its **orig**_____ state.
2. Each room has its own **priv**_____ bath and WC.
3. The **tot**_____ number of students at the university is 12,347.
4. They met to **ele**_____ a president.
5. Many companies were **manufac**_____ computers.
6. The lakes become ice-free and the snow **mel**_____.
7. They managed to steal and **hi**_____ some knives.
8. I asked the group to **inv**_____ her to the party.
9. She shouted at him for **spoi**_____ her lovely evening.
10. You must spend less until your **deb**_____ are paid.
11. His mother looked at him will love and **pri**_____.
12. The wind **roa**_____through the forest.
13. There was **fle**_____ and blood everywhere.
14. She earns a high **sal**_____ as a lawyer.
15. The sick child had a very high **tempe**_____.
16. The **bir**_____ of her first child was a difficult time.
17. My favourite **spo**_____ is football.
18. In A.D. 636 an Arab army won a famous **vic**_____ over another army.
19. I'm glad we had this **opp**_____ to talk.
20. There are a **doz**_____ eggs in the basket.
21. Every working person must pay income **t**_____.
22. The pirates buried the **trea**_____ on a desert island.
23. Her beauty and **ch**_____ had a powerful effect on men.
24. **La**_____ of rain led to a shortage of water in the city.

25. He takes **cr**_____ and sugar in his coffee.
26. **Pup**_____ must hand in their papers by the end of the week.
27. Ann **intro**_____ her boyfriend to her mother.
28. Teenagers often **adm**_____ and worship pop singers.
29. In order to be accepted into the university, he had to **impr**_____ his grades.
30. The dress you're wearing is **lo**_____.

Pre-Questionnaire

The answers to this questionnaire are based on a five-point Likert scale: 1) I totally disagree, 2) I disagree, 3) Neither agree nor disagree, 4) I agree, and 5) I totally agree.

Technology (adapted from Li, 2010)	
1. I would like to use technology more frequently to learn English	
2. I have a computer at home	
3. I have a mp3 player	
4. I have Internet access	
5. I use my computer more than 5 hours per week	
6. I usually access Internet at home	
7. I use technology (mobile, tablets, computers, etc.) to help me with my studies	
8. I have used/listened to podcasts before	
9. I believe that podcasts are useful to learn a FL	
Bilingual lessons (adapted from Meyerhöffer and Dreesmann, 2019)	
10. I think I am up to the difficulty of the bilingual unit	
11. I probably will not manage to do well in the bilingual unit	
12. I think anyone could do well in the bilingual unit	
13. After hearing about the bilingual unit, it seems very interesting to me	
14. Bilingual classes will be fun without rewards	

15. If the topic is interesting, I would watch videos or listen to music/radio/podcasts in English voluntarily	
16. I feel under pressure to do well in bilingual class	
17. I am afraid I will make a fool of myself	
18. It would be embarrassing to fail in bilingual class	
19. I would prefer to learn about the topic in Spanish instead	
Collaborative work	
20. I have previously work in PBL tasks	
21. I have previously carried out PBL tasks in groups/pairs	
22. I enjoy working with my classmates in groups/pairs	
23. My classmates help me when I have doubts	
24. My classmates and I discuss any problems in a rational, respectful way	
25. I believe that working in groups/pairs has helped me to understand better the content	

Post-questionnaire

The answers to this questionnaire are based on a five-point Likert scale: 1) I totally disagree, 2) I disagree, 3) Neither agree nor disagree, 4) I agree, and 5) I totally agree.

Students' emotions in FL lessons (adapted from Hamzaoglu and Koçoglu, 2016; Coyle, 2013; De Smet et al., 2018; Doiz et al., 2014)	
1. I feel more comfortable in class when I come to class prepared	
2. I feel nervous when I have to speak in English in class	
3. In class, I am afraid to make mistakes when speaking in English	
4. I don't like being forced to speak English in my classes	
5. I feel anxious when I don't understand what the teacher is saying in English	
6. I feel more tense and nervous in subjects taught in English	

7. I am afraid that the other students will laugh at me when I speak English	
8. I feel 'silly' talking in a different language to my classmates	
9. I am less anxious in class when I am not the only person answering a question	
10. I am more willing to speak in class when we discuss interesting topics	
11. During classes in English …	
11.1. … I get bored	
11.2. … I enjoy myself	
11.3. … I feel confident	
11.4. … I feel proud of what I achieve	
11.5. … I feel good	
Use of podcasts (extracted from Li, 2010)	
12. I enjoy listening to podcasts	
13. I don't know how to use this new technology	
14. Podcasts are useful for language learning	
15. I think podcasts can help me in language learning	
16. Podcasts are easy to handle	
17. The content of podcasts is not suitable for us	
18. I will listen to/create podcasts in future	
Use of English in content-based subjects (extracted from Coyle, 2013)	
19. Learning and improving my English level is important to me	
20. You need a high level of English to learn new content	
21. Using a foreign language to learn new things is a challenge	
22. I have to concentrate more in class if we use a FL to learn new content	

23. Learning content in a FL is more difficult	
24. It feels more 'natural' to use the FL to learn new content than in FL lessons	
25. I feel I learn as much about the subject in my mother tongue and in the FL	
26. Using more than one language helps my brain develop	
Learning English (adapted from Doiz et al., 2014; Lasagabaster and Doiz, 2017; Mirmán Flores and García Jiménez, 2018)	
27. I really enjoy learning English	
28. I enjoy using English in class	
29. Studying English is important because I'll need it for my future studies	
30. Studying English is important because it will be useful in getting a job	
31. Studying English is important because I can meet and talk with more people	
32. I am learning English to understand films, videos, music, games, etc.	
33. I would like to learn different foreign languages	
34. Studying foreign languages is an important part of my education	
35. I can communicate in English with foreign relatives, friends, etc.	
36. I watch the TV in OV (English)	
37. I use the Internet to watch programs and videos in English	
38. I read books, magazines, newspapers, etc. in English	
Students' opinions on bilingual programmes (extracted from Oxbrow, 2020)	
39. My English has improved thanks to my participation in a bilingual programme	
40. My Spanish has improved thanks to my participation in a bilingual programme	
41. My knowledge of subjects taught in English has improved thanks to my participation in a bilingual programme	
42. I have more self-confidence in the bilingual class	

43. I'm interested in the bilingual class	
44. I would like to use more English in bilingual classes	
45. I have satisfactory skills in English listening and speaking.	

Open questions

Several open questions were also asked to students so they could express their opinions on the activity here proposed (adapted from Coyle, 2013; Goris et al., 2020), such as:

1. What did you most look forward to in lessons when you used a different language to learn new things?
2. What did you least look forward to in lessons when you used a different language to learn new things?
3. What do you think you achieved through learning new things in a different language?
4. What kind of skills do you think you developed whilst learning new things in a different language?
5. Give an example of what you learnt better in a different language in technology lessons.
6. Give an example of how you used a different language in technology lessons.
7. Do you watch television programmes in English in your free time? (e.g. films, soaps, the news) How many minutes per day on average?

   I watch programmes in English: with subtitles ___ minutes per day/ without subtitles ___ minutes per day.
8. Do you listen to pop songs in English in your free time? How many minutes per day on average?

   I listen to pop songs in English about ___ minutes per day.