

# Using Digital Resources for Content and Language Integrated Learning: A Proposal for the ICT-Enrichment of a Course on Biology and Geology

Uso de recursos digitales para el Aprendizaje Integrado de Contenidos y Lenguas Extranjeras: propuesta para el enriquecimiento de un curso de Biología y Geología mediante TIC

Ús de recursos digitals per a l'Aprenentatge Integrat de Continguts i Llengües Estrangeres: proposta per a l'enriquiment d'un curs de Biologia i Geologia mitjançant TIC

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**ABSTRACT:** Nowadays a wide range of digital tools are used to support the teaching and learning of languages. Their potential positive effects in the learning process can be particularly useful to address the challenges that may arise in approaches such as Content and Language Integrated Learning (CLIL), where students are expected not only to gain mastery in the content of the subject, but also the foreign language that is used as a vehicle of communication. This paper aims to offer a proposal for the ICT-enrichment of CLIL subjects which has been implemented in a course of Biology and Geology in English taught in a Spanish Secondary School. A semi-structured interview with the teacher was used to analyse the needs faced in that particular educational setting. The results obtained, together with current literature on CLIL, were subsequently considered as the starting point for the judicious selection of digital platforms and tools to create and curate the supplementary resources from a principle-based approach. This process of ICT-enrichment is presented as a practice that could be applied in different CLIL courses to adapt them to the specific needs of each context.

**KEYWORDS:** Content and Language Integrated Learning (CLIL); language learning; ICT-enrichment; materials design

**RESUMEN:** Hoy en día se utiliza una gran variedad de herramientas digitales para apoyar la enseñanza y el aprendizaje de lenguas. Sus potenciales efectos positivos en el proceso de aprendizaje pueden ser particularmente útiles para abordar los retos que surgen en enfoques como el Aprendizaje Integrado de Contenidos y Lenguas Extranjeras (AICLE), donde se espera que los estudiantes consigan dominar no solo el contenido de la asignatura, sino también la lengua extranjera que se utiliza como medio de comunicación. Este artículo tiene como objetivo ofrecer una propuesta de enriquecimiento digital de cursos AICLE, la cual ha sido implementada en una asignatura de Biología y Geología en inglés impartida en un instituto de Educación Secundaria español. Se utilizó una entrevista semi-estructurada a la profesora para analizar las necesidades de aquel contexto educativo concreto. Los resultados obtenidos, junto con la literatura actual sobre AICLE, fueron considerados como punto de partida en la selección adecuada de plataformas y herramientas digitales para crear

y curar los recursos complementarios desde un enfoque basado en principios. Este proceso de enriquecimiento digital se presenta como una práctica que podría aplicarse a diferentes cursos AICLE para adaptarlos a las necesidades específicas de cada contexto.

**PALABRAS CLAVE:** Aprendizaje Integrado de Contenidos y Lenguas Extranjeras (AICLE); aprendizaje de lenguas; diseño de materiales; enriquecimiento digital

**RESUM:** Hui dia s'utilitza una gran varietat d'eines digitals per donar suport a l'ensenyament i l'aprenentatge de llengües. Els seus potencials efectes positius en el procés d'aprenentatge poden ser particularment útils per a abordar els reptes que sorgeixen en enfocaments com l'Aprenentatge Integrat de Continguts i Llengües Estrangeres (AICLE), on s'espera que els estudiants aconseguisquen dominar no solament el contingut de l'assignatura, sinó també la llengua estrangera que s'utilitza com a mitjà de comunicació. Aquest article té com a objectiu oferir una proposta d'enriquiment digital de cursos AICLE, la qual ha sigut implementada en una assignatura de Biologia i Geologia en anglés impartida en un institut d'Educació Secundària espanyol. Es va utilitzar una entrevista semi-estructurada a la professora per a analitzar les necessitats d'aquell context educatiu concret. Els resultats obtinguts, juntament amb la literatura actual sobre AICLE, van ser considerats com a punt de partida en la selecció adequada de plataformes i eines digitals per a crear i curar els recursos complementaris des d'un enfocament basat en principis. Aquest procés d'enriquiment digital es presenta com una pràctica que podria aplicar-se a diferents cursos AICLE per a adaptar-los a les necessitats específiques de cada context.

**PARAULES CLAU:** Aprenentatge Integrat de Continguts i Llengües Extranjeres (AICLE); aprenentatge de llengües; diseny de materials; enriquiment digital

## Practitioner Notes

### What is already known about the topic

- Content and Language Integrated Learning (CLIL) can pose certain difficulties for teachers and students, and appropriate materials can contribute to the successful achievement of the double objective of this type of subjects.
- An appropriate use of Information and Communications Technologies (ICT) can have a positive impact in the process of language learning.

### What this paper adds

- A proposal for the ICT-enrichment of a CLIL course informed by current literature on CLIL and based on specific pedagogical principles. Examples of digital tools and platforms that can be used accordingly, to create and curate resources in order to supplement the materials of a CLIL course.

### Implications of this research and/ or practice

- There are different digital tools available for education that can be used to provide CLIL students with extra materials, so that they can continue learning at their own pace.
- The creation and curation of supplementary digital materials from a principle-based approach can be used to adapt other different CLIL courses to the needs of each particular educational context, with the aim of supporting the students' simultaneous learning of content and language.

## 1. INTRODUCTION

In the past decades, the world of education has experienced considerable changes as a result of the emergence of new technologies. A wide variety of Information and Communications Technologies (ICT) and Educational Technology (EdTech) tools are currently available for teachers to maximise students' learning experiences, and they are frequently integrated into teaching practices of different subjects. In the case of language learning, multimedia can provide learners with a sense of not only

acquiring but also experiencing content, and they may lead to better understanding and retention, stimulating the students' senses, involving them in the learning process and arising emotions, among other aspects (Hoogeveen, 1995, p. 350). One way of exploiting the benefits of technology is through the ICT-enrichment of textbooks, understood here as the addition of supplementary digital resources to the materials used in a specific course in order to improve the students' learning process. For instance, Mitsikopoulou (2014) provides an account of the principles and procedures adopted in the creation of a set of resources to enhance English as a Foreign Language (ELF) textbooks for different stages in the Greek State.

The advantages of using technology could be especially relevant in Content and Language Integrated Learning (CLIL), which refers to subjects where learners are expected to acquire knowledge, understanding and abilities related to a content area, while also developing their skills in a foreign language that is used as a vehicle for communication (Marsh, 1994). The double nature of these subjects implies, among other aspects, that students need to understand and work with concepts in a foreign language, using discipline-specific vocabulary (Richards & Rodgers, 2014). This poses certain challenges both for content teachers, who are not usually experts in the language (Dalton-Puffer, 2011, p. 183), and for learners, who may present different cognitive and language levels (Coyle, Hood, and Marsh, 2010, p. 43). Harnessing the affordances that ICT offer could help address these problems by providing students with different forms of support in order to facilitate their comprehension of key ideas, as well as the learning of the language that they need to talk about those notions. For this reason, and in line with aforementioned previous research which has focused on the digital enhancement of general EFL textbooks, this paper presents a proposal for the ICT-enrichment of a CLIL course.

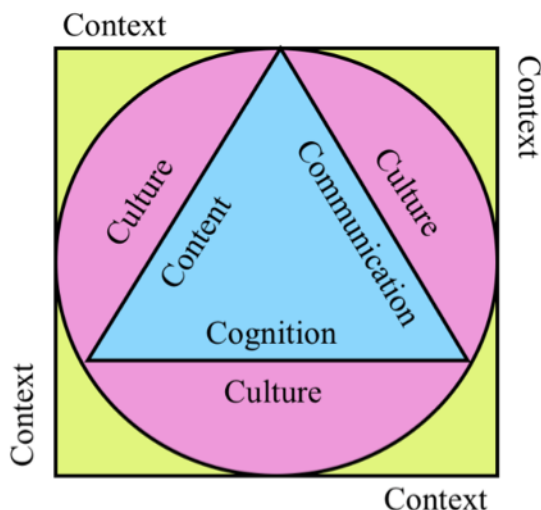
This proposal has been implemented in a CLIL course on Biology and Geology taught in a Spanish Secondary School. A needs analysis was carried out in the form of a semi-structured interview to the teacher in order to identify the challenges she faced in that particular context, and proceed to the design and selection of materials that could help address those difficulties.

## 2. THEORETICAL FRAMEWORK

### 2.1. CLIL: core features and challenges

The term CLIL was coined in 1994 by Marsh as referring to “situations where subjects, or parts of subjects, are taught through a foreign language with dual-focused aims, namely the learning of content and the simultaneous learning of a foreign language” Marsh (1994). Coyle (1999) regards it as a combination of four essential elements, namely content, communication, cognition and culture (see Figure 1). First, by content she refers to the knowledge, understanding and skills students need to acquire in relation to the subject-matter. Second, communication points to the need to foster the learning and use of language to interact while learning the content mentioned above, so that students improve their language proficiency at the same time. The third aspect, cognition, alludes to the development of students' learning processes and thinking skills, which is paramount in CLIL and would involve not only lower-order thinking skills (LOTS), such as remembering, understanding or applying, but also higher-order thinking skills (HOTS), such as analysing, evaluating and creating (cf. Anderson et al., 2001 for a Revision of Bloom's Taxonomy). Finally, culture refers to the role of the CLIL classroom as an environment where students can raise their awareness of the existence of different perspectives, so that they develop their intercultural competence as global citizens (Coyle, 1999; Coyle et al., 2010).

Regarding its theory of language, Allueva (2007); Ball, Kelly, and Clegg (2015); Nation (2001); Richards and Rodgers (2014) explain that CLIL is based on several main



**Figure 1.** The 4Cs Framework (Coyle et al., 2010, p. 41).

ideas (p. 120). Firstly, lexis is a key aspect in CLIL, since usually specific vocabulary is necessary to understand and express ideas about a particular subject-matter. Therefore, the learning of high-frequency words for the specific area may be essential. Secondly, grammar is seen as a tool which serves to communicate content, and thus it is sequenced according to the linguistic demands of that content. Indeed, Richards and Rodgers (2014) emphasize as one of the main pillars of CLIL the idea that “people learn a second language more successfully when they use the language as a means of understanding content, rather than as an end in itself” (p. 118). Thirdly, texts and discourse are essential elements in CLIL, which is connected to the importance of the genres that mediate communication in a specific discipline (cf. Llinares, Morton, and Whittaker, 2012, pp. 109-153). Finally, the integration of different skills takes place as it would occur in real life, and grammar is contained within those skills, rather than viewed as a separate area of language.

As for the theory of learning underlying CLIL, Richards and Rodgers (2014) stress the importance of aspects such as comprehension, negotiation of meaning, corrective feedback and activation of previous knowledge (p. 121). The latter is particularly relevant, since, as emphasized by Coyle et al. 2010, p. 42), learners need to be encouraged to discover, process and link new information to what they already know in order to rebuild their mental schemata, which would comply with a constructivist approach. In line with this, Richards and Rodgers (2014) explain that learners should be provided with different types of scaffolding that help them understand the content and do the tasks within, what Vygotsky (1978) calls, their zone of proximal development (p. 86). Indeed, it is essential that the instructor “facilitates exposure to input at a (just) challenging level” (De Graaff, Koopman, and Westhoff, 2007, p. 13, their brackets) and “(i)n CLIL contexts, teachers’ scaffolding is even more necessary as students need to process and express complex ideas in a foreign language” (Llinares et al., 2012, p. 91).

Although CLIL can be a good opportunity for the students to learn about a subject-matter and a language at the same time, it may be a difficult enterprise that requires a complex process of planning and entails certain challenges. Among these, Dalton-Puffer (2011) mentions the fact that the teachers of the subjects which are within a CLIL programme are not usually experts in that language, but rather in the subject-matter that is taught (p. 183), and that the amount of lessons delivered in that language tend to account for less than half of the curriculum (p. 184), which means that the amount of input may be limited. In addition, specialised vocabulary also poses difficulties for

many students (Alonso, Grisaleña, and Campo, 2008, p. 46). Taking these aspects into consideration, the task of CLIL teachers who are not experts in the language can be facilitated by materials that enhance connections between content and language (Ball, 2018, p. 226).

Coyle et al. (2010) also note that in many cases the learners' language level does not equate their cognitive level (p. 43), and this mismatch between language skills and cognitive abilities can hinder effective learning. If the linguistic demands are too high in a class, students may not be able to perform well, even if they are cognitively able to do the tasks. As a result, some CLIL teachers might overuse translation to the L1 as the main means of linguistic support (Escobar-Urmeneta, 2019; Mehisto, 2008), resorting to it as a common practice even when it is not necessary, instead of combining it with other valid types of scaffolding that could also enable students to do the tasks while helping them to improve their language proficiency. At the same time, the activities need to be cognitively challenging at the appropriate level for language learning to take place (Smith and Patterson, 1998, p. 1). In this way, students need, on the one hand, to receive linguistic support, and on the other, to be challenged in cognitive terms, so that they can engage in "dialogic learning" (Coyle et al., 2010, p. 43). In relation to this, Ball et al. (2015), adopting a three-dimensional perspective, recommend to always keep an adequate adjustment between conceptual, linguistic and procedural demands, as if it was a "mixing desk in a music studio" (p. 52), preventing them from being all too high at the same time so as to avoid students' mental overload.

## 2.2. The use of ICT in CLIL

In this context, technology can be used to adapt a coursebook in order to address the aforementioned issues. Although there are different ways of understanding the concept of enrichment (Feng, 2005; Mitsikopoulou, 2014), ICT-enriching could be considered to consist of the addition of supplementary digital resources to the set of materials of a specific subject with the purpose of enhancing them to improve and increase the students' learning opportunities. This needs to be done in a judicious way, bearing in mind that if digital tools are integrated into a course, they need to be included not simply for their own sake, but rather to facilitate the students' learning. Indeed, it is necessary to identify "what technical attributes specific to the new technologies can be profitably exploited for pedagogical purposes" (Salaberry, 2001, p. 51) and check whether they maximize the efficiency with which both material and human resources are used (Salaberry, 2001).

One way in which ICT-enrichment can be advantageous in a CLIL context is through the addition of hypertext and hypermedia, since these allow learners to access information about specific concepts or ideas in different forms (e.g. written texts, images, videos) just by clicking on the word about which they want to continue learning. Therefore, there can be several layers of resources that are easily and quickly accessible for the user, something that a traditional book does not offer (Bolter, 1991, p. 15). Hyperlinking and hypermedia can contribute to maximising students' exposure to the target language by providing more sources which offer them the opportunity to access relevant information in alternative ways, with different wordings and/or formats. This may be useful in terms of understanding the content, as well as regarding the development of different communicative skills and the learning of vocabulary, since successive encounters of words can be crucial for the actual acquisition of a word (Nation, 2001). A good example of a platform that makes use of hyperlinking is *Clilstore* and the tools *Wordlink* and *Multidict* (<http://www.multidict.net>), which offer a service that allows teachers to create and share learning materials where words are linked to online dictionaries (cf. Ó Dónaill and Gimeno-Sanz, 2013).



Additionally, technologies can be helpful in providing students with extra linguistic support, as well as other ways of scaffolding. Indeed, multimedia resources may facilitate learning through the combination of different modes of conveying information, in a way that each type of information can be delivered through the most appropriate mode so that explanations gain in clarity. Moreover, different complementary representations of the same information can lead not only to better comprehension, but also to better retention (Mayer, 2009). Furthermore, from the perspective of Neuro-linguistic programming and VARK (visual, aural, read/write and kinesthetic) learning styles (cf. Fleming, 2006), presenting the same information in a variety of formats through the use of technology can enable teachers to reach different types of learners, and at the same time it can help address students' multiple intelligences (Gardner, 1999). In this way, ICT may be a useful tool to integrate differentiation in a course, respecting diversity in terms of level, aptitudes and interests.

Likewise, the use of technology can bring other benefits. It can help to develop the students' autonomy and the key competence of learning to learn (Beatty, 2003; Nieto-Moreno-de Diezmas, 2016), by offering them "not just a body of knowledge, but the tools to modify and expand that knowledge beyond their formal classroom education" (Beatty, 2003, p. 46). Moreover, the European Commission's report (Scott & Beadle, 2014) presents CLIL and Computer-assisted language learning as powerful tools that could give rise to an improvement in language competences (p. 27), and the use of technologies seems to be beneficial in that it can help increase motivation while lowering anxiety levels (LeLoup & Ponterio, 2003). In fact, as Bozdoğan (2015) argues, "(t)echnology integrated tasks with clear guidelines which students can perform ubiquitously, attract students' attention and enhance their motivation" (p. 164).

### 3. RESEARCH STUDY

#### 3.1. Research context

The present study aims to offer a proposal for the ICT-enrichment of a CLIL subject and illustrate it with the case of a course which makes use of the textbook Biology and Geology 1 (Green et al., 2015). The teacher in charge of this course works at a Spanish Secondary School, where she teaches Biology and Geology in English to 4 groups of 1<sup>st</sup>-year-ESO<sup>1</sup> students (12-13 years old), within the Integral Programme for Bilingualism in Foreign Languages in Aragon ("Programa integral de bilingüismo en lenguas extranjeras en Aragón, PIBLEA"). In this school, the students enrolled in the bilingual programme, which is not compulsory, are taught one content subject in French and another one in English.

#### 3.2. Methodology

In order to develop the proposal for this specific context, first, a needs analysis was carried out in the form of a semi-structured interview with the aforementioned teacher. The interview helped identify the main difficulties that she faced when teaching this subject and elucidate the type of support that she considered necessary and beneficial for the students' learning. Then, the whole coursebook was read thoroughly in search for possible ways of enriching it, taking the results of the previous needs analysis as a guide. Afterwards, there was an exploration of resources available on the Internet and a reflection on the types of activities that could be designed with them, considering their affordances, with a view to addressing those problems. Later, the materials were created and curated in the Moodle site of the targeted course.

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<sup>1</sup>ESO stands for "Educación Secundaria Obligatoria", which means Compulsory Secondary Education.

### 3.3. Needs analysis

The teacher who was interviewed answered different types of questions regarding a variety of aspects related to her own experience as a teacher of CLIL and her practices and opinion about the use of ICT in a CLIL course. The main issues she mentioned were the existence of heterogeneity regarding the students' level of English, which tends to be very low in certain cases; the subsequent language limitations when explaining certain concepts that some students do not understand; and an excessive reliance on the receptive and productive use of Spanish on behalf of some students who do not seem to make enough effort to communicate in English. Some of these findings show similarities to those obtained by [Wegner \(2012\)](#), which include the perception of specialist terms and understanding of concepts as a problem and a “somewhat superficial treatment of complex subjects” (p. 32).

As for the role of technology in the course, in her opinion the use of ICT is important in education, particularly in bilingual lessons, where resources such as audio-visuals can facilitate the students' learning. In her experience, the use of digital tools can be motivating, especially for students with high capacities, who tend to get excited when asked to browse the web to look for information. Nevertheless, she explained that in-class digital activities involve technical aspects that often make them time-consuming, and therefore she expressed her preference for the design of supplementary activities that students can do at home.

Additionally, she pointed to the importance of integrating automatic correction in most of the supplementary activities to avoid an excessive increase in the teacher's workload. She also commented on the units and topics with which students tend to have more difficulties, as well as on the type of exams and activities they usually do and the way they are assessed. This was crucial for the ICT-enrichment of the coursebook, since it needed to be aligned with the rest of the elements of the curriculum as specified and understood by this teacher in this particular educational context.

## 4. PROPOSAL

Given the characteristics of CLIL and the challenges it may pose, the design of supplementary resources for the students to do at home can help mitigate those problems and facilitate the learning process. Since class time is very limited, these materials should help students review what they learn in class, providing also extra support for those who may need it and offering students the opportunity to deepen their knowledge, working both at the level of language and at the level of content.

Different modes of representation can be used to facilitate the understanding of the content. Static and dynamic pictures such as GIF files could be included to illustrate some complex ideas and clarify possible doubts students may have with the definitions of specific concepts. Likewise, videos allow them to visualise a graphic representation of the content while listening to an explanation. In this way, multimodality offers certain affordances which may be useful to overcome some of the limitations mentioned by this teacher in the interview.

It is also advisable to include resources that help students process information and work with it in a different mode or way. Subsequent encounters with key terms can be programmed in different activities where students are required to recycle and manipulate them in various ways to achieve different non-linguistic outcomes (e.g. making suggestions, classifications), which may be necessary for students to actually learn the vocabulary ([Nation, 2001](#)). Exercises need to try to foster the students' learning of the target language through its use, complying with the principles of a Communicative Language Teaching (CLT) approach.

In the same way, the present proposal argues for the adoption of a perspective that is close to what [Long \(1991\)](#) refers to as “focus on form”, which consists of paying

attention to grammar items and structures as the need arises in students during the fulfillment of a task. In the case of online learning activities designed to be completed when the teacher is not present, it is essential to identify potential difficulties that could arise in each task and provide linguistic scaffolding accordingly, for instance through examples of sentences containing useful structures, making use of text enhancement, so that students can notice certain linguistic forms. Nevertheless, it is recommended that these language items are not presented as a goal in themselves for students to reach, but rather as a tool for them to be able to communicate, making their learning meaningful.

Furthermore, activities can be designed to help students develop three different types of thinking, namely convergent thinking, divergent thinking and metacognition. There can be some activities with a closed answer where students are required to find out specific data or make certain connections through a particular mental path, and the way of achieving the goal of the activity is quite restricted or predefined (e.g. multiple choice questions). These activities are useful to develop learners' convergent thinking, which is the type of thinking "that looks for an only solution to a problem, which is the most apt, appropriate or correct one" (Allueva, 2007, p. 138, my translation).

Other activities need to be open-ended, so that students are required to look for alternative mental paths, adopting their own way of solving a problem or carrying out a task. In this type of exercises students are not expected to give a specific answer, since there is not only one way of solving them adequately. In fact, these activities develop students' divergent thinking, which, according to Guilford (1967) is characterised by the fact that, unlike convergent thinking, it is used when there are not so many limitations that restrict the answer to an only possible solution (pp. 214 & 271). In this way, they contribute to fostering aspects such as creativity and problem-solving skills, which could be highly valued features in 21<sup>st</sup> century citizens, since they are areas that the human brain needs to control because technology alone may not be able to cover them.

Finally, the third type of thinking, metacognition (term coined by Flavell 1976), consists of thinking about our own thinking and would include aspects such as planning, self-assessment and reflection about our own learning progress. It is fundamental to give students the opportunity to reflect on what they know and what they do not, what they would like to know about and what they have learned, as well as on their strengths and weaknesses and possible ways to improve as students in a CLIL course.

Moreover, students need to develop not only their LOTS, such as remembering, understanding different concepts and applying theory in practical exercises, but also their HOTS. It is important that they are asked to analyse, evaluate and create. Nonetheless, following Ball et al. (2015) recommendations, a balance has to be sought between linguistic, conceptual and procedural demands to try to avoid the students' cognitive overload. For these reasons, those activities where procedural demands are higher can be presented after the concepts involved have been explained and reviewed, including at some points links to previous steps where students can go back to the basic theory before carrying out the task if they feel insecure or unable to succeed. Likewise, students can previously have the opportunity to work on the vocabulary related to those concepts, and, as has been mentioned, linguistic support can be provided in tasks to lower the linguistic demands.

In addition to content, communication and cognition, culture, which is the fourth element of Coyle's (1999) 4Cs framework, also needs to be integrated. It is advisable to include activities that promote students' awareness of the existence of different, equally valid points of view from which to observe certain phenomena, and the Internet, which connects people from all over the world, can be regarded as an opportunity to learn about and from other perspectives if it is used adequately.



Another key aspect is the importance of differentiation, which needs to be sought at different dimensions. First, there should be differentiation in levels, so that students can choose between different options depending on their knowledge and self-confidence with certain topics. It also has to be taken into consideration that the use of online resources gives students the opportunity to do activities at their own pace and that they can use the resources to review and revise as much as they need. Likewise, the possibility of stopping and rewinding videos offers a degree of flexibility of which both learners and teachers can take advantage, since some platforms allow the latter to keep a record of the amount of times each student has watched each fragment and get an insight into what the most difficult explanations may be for the learners, identifying in this way potential difficulties to address. Besides, the ICT-enrichment of a course can try to help not only students with a lower level either in terms of content or in terms of language, but also more advanced students, including those with high capacities. Open-ended activities where each student deepens as much as they want or can, virtual labs, investigation exercises, creative tasks and additional resources can be useful for this purpose.

Furthermore, the existence of different learning styles (Fleming, 2006) needs to be taken into consideration to provide different types of materials that could help not only reading/writing learners (e.g. reading texts in digital sources, written activities), but also visual learners (e.g. videos, and graphic representations, dynamic images, mind maps), auditory learners (e.g. videos) and kinesthetic learners (e.g. interactive resources). In this way, they aim to contribute to the understanding and progress of all the students, independently of the learning style they have. Similarly, ICT-enrichment can be useful to address Gardner's (1999) multiple intelligences through the inclusion of a wide variety of resources.

Besides, it is advisable to integrate differentiation in interests, for instance by giving students the opportunity to choose the elements on which they want to work in certain activities. This can be done with the aim of increasing the motivation, which may also be pursued by asking learners to reflect on the importance of what they learn for real life and how it relates to their immediate context. Additionally, resources such as games, experiments and investigation activities can contribute to presenting the learning path as a journey where students can review and widen their knowledge while having fun.

Finally, it is necessary that any ICT-enrichment is aligned with the corresponding legal provisions in each case. In the digital enhancement of this Spanish course on Biology and Geology in English, apart from observing the Spanish national curriculum, the design of supplementary digital materials has tried to contribute to the development of the key competences proposed by the Commission (2006)<sup>2</sup>.

#### 4.1. Platforms, tools and resources

This section will present some digital platforms, tools and resources that have been used to design activities that enrich the aforementioned CLIL course on Biology and Geology adopting the principle-based approach described above.

##### 4.1.1. Curation of the resources

One aspect to consider is the curation of materials. There are different platforms that can be chosen according to the needs of each particular teacher, subject and group of students. In the case of this course on Biology and Geology, the platform selected

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<sup>2</sup>The key competences for lifelong learning proposed by the European Commission (2006/962/EC) are communication in the mother tongue and communication in a foreign language, mathematical, scientific and technological competence, digital competence, learning to learn, social and civic competences, sense of initiative and entrepreneurship, and cultural awareness and expression.

was *Moodle2*, since the students used it for other subjects and were already familiar with it. This platform offers a resource called “lesson”, which allows teachers to create and curate different content in a sequence, so that one page follows the former, with the possibility of creating alternative paths for students to choose. Learners, whose progress can be tracked by the teacher, have the chance to stop doing each “lesson” at any moment, and continue working on it later from the last page they have visited. “Lessons” can include both activities created with *Moodle* resources and external exercises which can be embedded.

#### 4.1.2. Resources to create activities involving closed answers

A series of resources have been used to create activities for students to work with vocabulary and review key disciplinary content. They allow to check comprehension and to review learning, and most of them primarily involve LOTS (e.g. understanding and remembering information), although some of them also work on HOTS (e.g. comparing and contrasting).

*Moodle* offers a resource called “Glossary”, which consists of a small encyclopaedia that students can be asked to generate collaboratively as they find terms that they do not understand. Each student can look for information about those words and create new entries including an image, a brief definition and any other content they may find useful, as well as keywords related to the concept. Then, each time the defined term or any of the keywords associated to it appears throughout the whole course, students can click on it and a window with this entry of the glossary will pop up. Thus, hyperlinking allows students to access different layers of knowledge immediately and solve doubts instantaneously, which may be useful in a CLIL subject.

The platform *Flippity* (<https://www.flippity.net>) has also been used to create resources that offer students the opportunity to revise with interactive flashcards (see Figure 2) containing the term and its definition, and then check their knowledge by playing different games, such as matching all the terms to their definitions by clicking on them, writing the term to which each definition refers, or finding pairs of term and definition in a memory game. This can help students to review specific vocabulary in an interactive way.



Figure 2. Flashcards from Unit 1

Similarly, labelling activities have been designed using the digital platform *Educaplay* (<https://www.educaplay.com>), and they ask students to identify and name important parts of specific systems or ensembles in a picture. They can help learners revise key scientific vocabulary that is needed to carry out more complex tasks. In these activities students can review the name of each section first, and then they are asked either to read a name on the top bar and click on the corresponding part of the

picture, or to type in the name on each label.

Matching activities have also been created with *Educaplay* or with Moodle “matching” activity. This type of exercises can be used to develop students’ comparing and classifying skills, guiding their mental processes to help them make specific connections between aspects that in the book are explained on different separate pages. For instance, a brief comment or explanation about specific elements (e.g. limbs, types of skin, body temperature) and the categories they can adopt (e.g. types of limbs: wings, legs, etc.) is given at the beginning, and then learners need to classify a series of animals that are seen in different pictures according to these elements by clicking on the corresponding categories. Additionally, matching activities have been used to ask students to match a feature to its unit of measurement. Likewise, in Figure 3 there is an example of an activity which has been designed to address the problem some students have when they confuse key words such as “which” or “why”, and, accordingly, it aims for students to identify the main types of questions and the type of answer expected in each case.

**ANSWERING QUESTIONS**

Read each **question** carefully and **match it to its answer**.  
Pay attention to words such as why, where, when, etc.

TYPES OF Q

0/4 NUM. TRIES

100 SCORE

01:28 LEFT TIME

WHY IS THE EARTH CALLED "THE BLUE PLANET"?

BECAUSE ITS WATER MAKES IT LOOK BLUE FROM THE OUTER SPACE.

HOW MANY SATELLITES DOES THE EARTH HAVE?

YES, IT IS.

IS THE MOON A SATELLITE?

ONE.

WHEN IS IT ONLY NIGHT IN ONE OF THE POLES?

THE EARTH.

WHERE IS THE SUN?

WHEN THAT POLE FACES AWAY FROM THE SUN.

WHICH IS THE THIRD PLANET IN THE SOLAR SYSTEM STARTING FROM THE SUN?

YES, IT DOES.

DOES THE MOON ORBIT THE EARTH?

IN THE CENTRE OF THE SOLAR SYSTEM.

Figure 3. Matching Activity from Unit 1

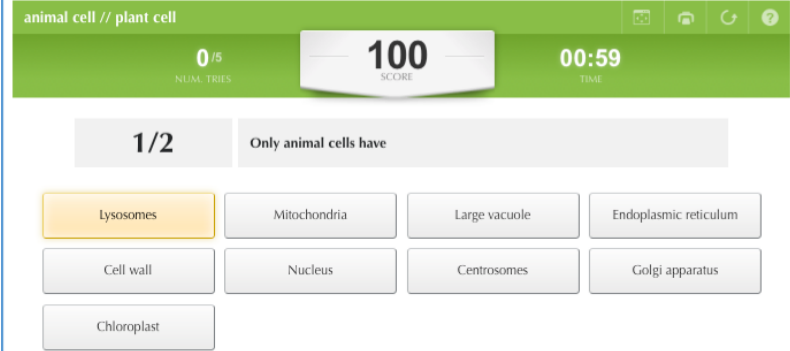
In other activities which have also been created with *Educaplay*, students are asked to compare and contrast the features of different categories by selecting not only the aspects or elements that are exclusive of each of them, but also the ones that they have in common. When clicking on one card, the name of the category to which it pertains appears on the top bar, and the student needs to click on the rest of the cards belonging to that group (see Figure 4).

**ANIMAL AND PLANT CELLS: LET'S COMPARE THEM!**

Can you distinguish between the characteristics of an animal cell and those of a plant cell? What are the differences? And what do they have in common? Have a try and play the following game!

First **click on an element**. Then **read the message above** and **select the rest of the elements that also correspond to it**. Do the same with the other two groups.

Good luck!!



*Figure 4. Identification of the Elements of a Group. Activity from Unit 5*

Additionally, multiple choice activities have been designed using Moodle resources to help students draw some conclusions from the information they have learned, while reviewing useful language structures in a meaningful context (see Figure 5).

**Which layer of the Earth is the hottest?**

Inner core

Outer core

Mantle

Crust

*Figure 5. Multiple Choice Activity from Unit 2*

#### 4.1.3. Resources to create open tasks

Some activities with open answers have been designed in order to help students develop their communicative skills while connecting what they are learning to their own context and life. For instance, different authentic educational videos about specific content have been selected and adapted using the *EdPuzzle* platform (<https://www.edpuzzle.com>). This platform allows us to cut the selected videos and add comments and open questions to check students' understanding or make them reflect about certain ideas. Likewise, it is also possible to include closed multiple choice and yes or no questions. Additionally, the teacher can keep a track of the actions made by each student, and English subtitles can be activated by the learners if necessary. Audio-visual resources can help students develop their listening skills with authentic texts and help them understand the content through the combination of audio, image and written text.

Likewise, the "essay" type of question page offered by *Moodle* has been used to create activities where students need to write their own answer. Learners are asked to relate key ideas to what they know about the world and process them in a different way instead of simply memorising and repeating them. This allows them to demonstrate that they really understand the information that they have learned. Some example

sentences containing useful language structures can be provided as a way of scaffolding (see Figure 6).

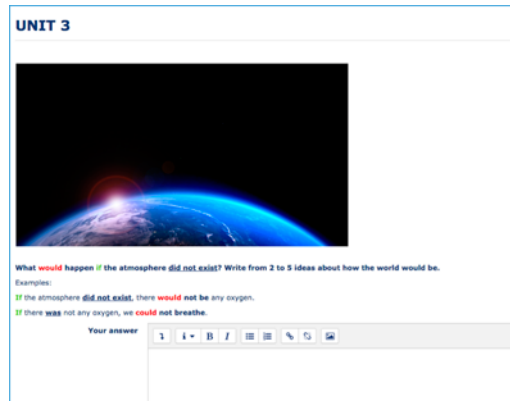


Figure 6. Essay Activity from Unit 2

#### 4.1.4. Resources to create collaborative tasks

Different collaborative activities have been designed in order to help students work on their HOTS and develop their divergent thinking while learning from their classmates' contributions. For instance, the platform *Tricider* (<https://www.tricider.com>) has been used to create an activity that allows students to express and share their suggestions to solve an environmental problem in written form. Then, they can evaluate the ideas proposed by their classmates by commenting on their advantages and disadvantages and voting on the ones they find more useful (see Figure 7).

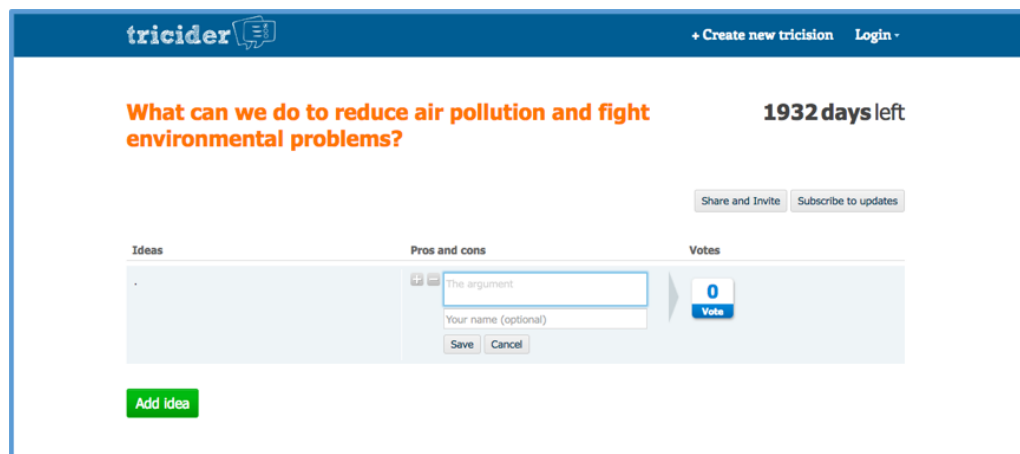


Figure 7. Tricider Site from Unit 3

*Padlet* (<https://www.padlet.com>) has been selected to design a collaborative activity where each student can contribute by sharing their discoveries about a specific mineral (see Figure 8). It allows learners to add links and upload images, audio and video files, as well as to comment on each other's posts and give "likes" to their favourite ones.

*Canva* (<https://www.canva.com>) has been used to create a collaborative infographic for students to contribute with their own tips to save water in their everyday life (see Figure 9). The resulting composition could then be uploaded to the website of the school and shared in social networks by the learners.

*Bubbl.us* (<https://www.bubbl.us>) has been proposed as a platform for students to create a collaborative virtual mind map which provides them with a recap tool where



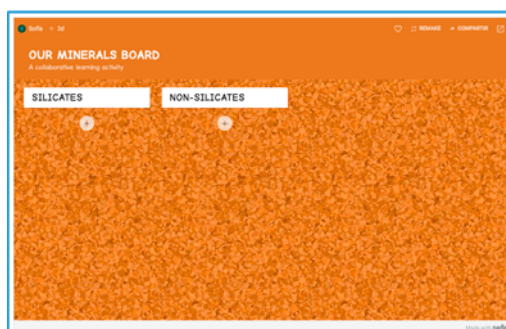


Figure 8. Padlet from Unit 2

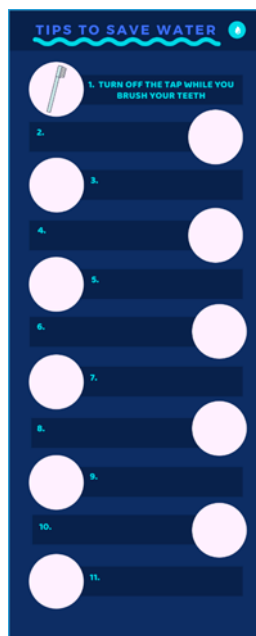


Figure 9. Collaborative Infographic from Unit 4

they can review at a glance what they have learned throughout a unit (see Figure 10). Each learner can be asked to choose a type of invertebrate, locate it and write its name in the corresponding box, and then look for and select relevant features, an example and a picture, as well as any other resources they may want to include in it (e.g. links to videos or to interesting webpages). It needs to be noted that for real-time collaboration to be possible, it is necessary to subscribe to a premium plan.

#### 4.1.5. Other resources

In addition to these, other resources have allowed us to incorporate different types of activities. *Google Forms* has been used to create questionnaires where students have to answer questions related to their learning process, which aim to raise their awareness about their own needs and goals, and help them reflect on their progress and establish new objectives and ways to achieve them. Some visible thinking routines have been adapted and integrated, as is the case of the Compass Points proposed by [Project-Zero \(2015\)](#). Through these exercises, students will be able to work on their metacognitive skills and develop their key competence of learning to learn. Moreover, these questionnaires include an additional section in which students can evaluate qualitatively the usefulness of the activities of this proposal and add any suggestions for improvement.

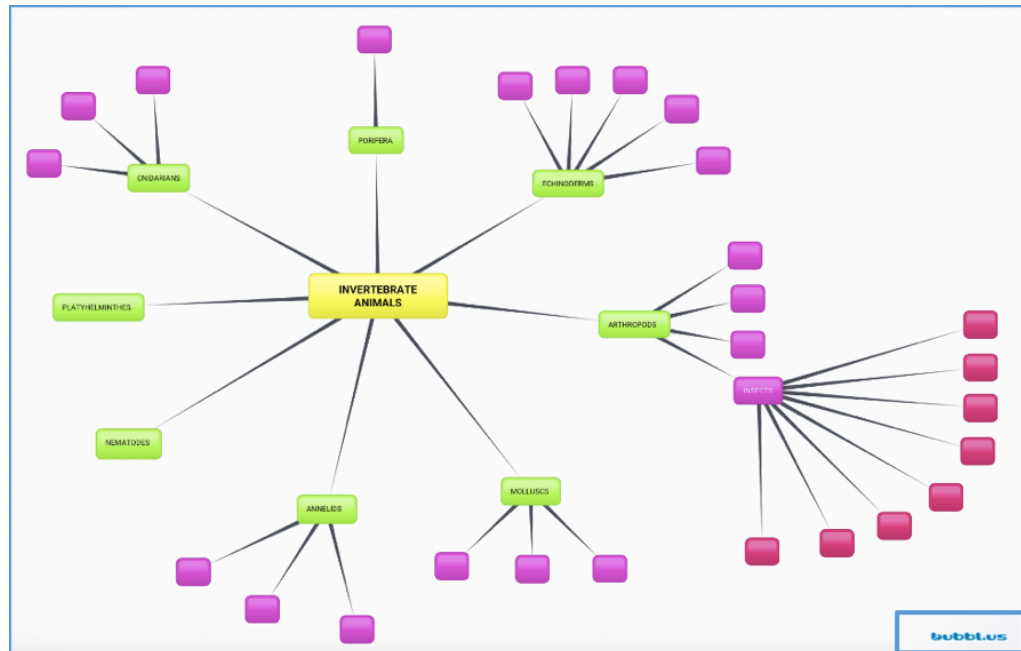


Figure 10. Collaborative Mind Map from Unit 7

*Google Forms* has also been used to create guided lab reports for students to complete after working in virtual labs, which are digital environments available online where they can experiment, hypothesise, and apply the scientific method to discover new aspects about the topic and learn through trial and error. Guided reports help students reflect on what they have learned from the experiments and draw some conclusions in an orderly way. Similarly, questionnaires may easily be used to check the students' understanding of specific topics in a quick way.

Likewise, interactive maps can be useful to encourage students to learn about other cultures and consider different perspectives from which to study a specific aspect. For instance, learners can explore time and seasons differences among countries as a result of rotation and revolution by clicking on different locations, and reflect on the fact that, depending on the area where people are, they tend to do different things at a specific moment of the day or of the year.

## 5. CONCLUSION

This proposal for the ICT-enrichment of a CLIL course tries to address the challenges that this type of subjects can pose for teachers and students. It takes into consideration relevant theoretical conceptualisations of CLIL and intends to work on the four paramount areas proposed by [Coyle \(1999\)](#), namely content, communication, cognition and culture. In fact, it aims to help students learn and review content of the discipline, improve their communication in a foreign language both receptively and productively, develop their different cognitive skills, and become aware of the existence of other cultures and perspectives from which to approach certain concepts of the subject. All this can be sought through the inclusion of a variety of activities and resources using Moodle tools, as well as other digital platforms, making an informed use of the affordances offered by different technological elements.

The proposal is characterised by several aspects. First, it suggests that supplementary materials can include explanations of relevant concepts that are supported with different digital resources, taking advantage of hyperlinking and multimodality. At the same time, these resources need to offer a great exposure to key vocabulary

items, asking students to work with them in a wide range of activities. Likewise, verbal scaffolding can be provided for students to learn the language that they need in order to convey their ideas in a variety of meaningful tasks. Moreover, the proposal argues for the creation of activities that foster the development of cognitive, divergent and metacognitive thinking, and require learners to use both their LOTS and HOTS. Furthermore, it recommends integrating differentiation in the students' levels, their learning styles and their interests, and incorporating potentially motivating elements which may not be found in an ordinary printed textbook.

This proposal has been implemented in a CLIL course on Biology and Geology, and a natural progression of this work is to evaluate the effectiveness of the materials in the context for which they have been designed. This could be done by carrying out a study in which the learning achievement results of an experimental group to whom these resources were made available were compared with those of a control group. Subsequent interviews with the teacher would also be useful to identify improvable aspects and make any necessary modifications accordingly.

To conclude, despite its exploratory nature, this paper has explained and exemplified how ICT can be used to design a set of supplementary materials for a CLIL course with the aim of better meeting the students' needs. It has examined existing resources and platforms available on the Internet which could be useful to support the learning process and which either are free or offer a free version, with the option of subscribing for extra features. The systematic selection, design and curation of extra digital materials from a principle-based approach could lead to a more personalised type of teaching and may help bridge some gaps related to both language and content difficulties by offering activities which each student can do at their own pace. In this way, the enriching practices used for this course could be adapted to other CLIL courses, according to the particular needs of each group of students, to maximise learning opportunities and meet the demands of these double-aimed subjects.

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