THE DEVELOPMENT OF SOFT SKILLS AND ENGLISH THROUGH ICLHE: LITERATURE REVIEW AND PEDAGOGICAL PROPOSAL FOR ENGINEERING STUDENTS

EL DESARROLLO DE HABILIDADES BLANDAS Y EL INGLÉS A TRAVÉS DE ICLES: REVISIÓN DE LA LITERATURA Y PROPUESTA PEDAGÓGICA PARA ESTUDIANTES DE INGENIERÍA

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Abstract
Mastering English is a must for all engineers in the current globalized world where English is the language of science, communication and business. In an engineering syllabus, however, in addition to technical skills and English proficiency, the development of other competences also needs to be considered. To adequately equip engineering students for their careers, we also have to promote the development of soft skills such as communication, problem-solving, teamwork, time-management or leadership, among others. ICLHE (Integrating Content and Language in Higher Education), which is itself evocative of CLIL (Content and Language Integrated Learning) approach extensively used in other educational levels, appears as an alternative to integrate language learning in non-language subject curriculums in higher education and to develop soft skills. This paper makes a literature review to find out the main aspects that engineering instructors should consider to properly implement ICLHE to enhance learners’ development of soft-skills through the active methodologies of Project-Based Learning and Flipped Classroom. In the last part of the study, a 10-step guideline is proposed, which will help teachers to integrate these active methodologies in an ICLHE engineering subject.

Key Words: Integrating Content and Language in Higher Education; engineering studies; project-based learning; flipped classroom; soft skills

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Resumen
Tener una buena competencia en inglés es una necesidad para los ingenieros en un mundo globalizado donde el inglés es la lengua de la ciencia, la comunicación y los negocios. Sin embargo, en el plan de estudios de una ingeniería se debe tener en cuenta otras competencias además de las habilidades técnicas y el inglés. Para preparar adecuadamente a los estudiantes de ingeniería para sus carreras profesionales, debemos fomentar también el desarrollo de sus habilidades blandas tales como la comunicación, la resolución de problemas, el trabajo en equipo, la gestión del tiempo o el liderazgo, entre otras. ICLES (Integración de Contenido y Lengua en Educación Superior), el cual es si mismo evoca el enfoque AÍCLE (Aprendizaje Integrado de Contenido y Lengua) ampliamente utilizado en otros niveles educativos, aparece como una alternativa para integrar el aprendizaje de lenguas en currículos de asignaturas donde no se enseña lengua en la universidad y desarrollar las habilidades blandas. Este artículo hace una revisión de la literatura con el objetivo de encontrar los aspectos más importantes que los docentes de ingeniería deberían considerar para, de forma adecuada, implementar ICLES para mejorar el desarrollo de las habilidades blandas mediante las metodologías activas del aprendizaje basado en proyectos y la clase invertida. En la última parte del trabajo, se propone una guía de 10 pasos que ayudará a los docentes a integrar estas metodologías activas en una asignatura ICLES de ingeniería.

Palabras clave: Integración de Contenido y Lengua en Educación Superior; estudios de ingeniería; aprendizaje basado en proyectos; clase invertida; habilidades blandas
1. INTRODUCTION

English is the current international language of science. Not only most of the research is published in English, but also English dominates international communication and business. Therefore, mastering English is a requirement for most engineers in the world, and its study is particularly significant in countries where English is a foreign language. Moreover, some engineering education programmes lack the experiential component that could equip students for their professional development, giving them opportunities to put into practice their learning. This detachment from real-world projects during their training process could lead to a lack of teamwork and communication skills needed for their professional development (Mills & Treagust, 2003).

Studies in engineering education have highlighted the importance of soft skills in students’ lives and how these can complement technical/hard skills (Schulz, 2008). Evidence has shown that soft skills predict and produce success in life; thus, programmes that enhance them should be important in an effective portfolio of public policies (Heckman & Kautz, 2012). As a matter of fact, “(t)hese soft skills are also known as people skills, life skills, interpersonal skills, employability skills, and emotional intelligence” (Rao, 2014: 43). The need for explicit and embedding teaching of soft skills to engineering students (Pulko & Parikh, 2003) is underpinned by engineering education literature, which shares a consensual vision of the importance of soft skills for every workplace. In this vein, all the stakeholders involved in engineering education, and mainly students, must be aware of the importance of soft skills for their future employment and professional development. Direito, Pereira, and de Oliveira Duarte (2012) call for curriculum development focused on using appropriate pedagogic techniques that enhance learning and develop soft skills. They conclude that “specific training could be designed and delivered to respond to major skills’ gaps, using learning styles-based methodologies. For example, enhancing teamwork skills using active and visual learning strategies, and work organization skills using sequential learning strategies” (Direito et al., 2012: 849). However, the question is if it is possible to enhance soft skills in some hours of training. Here is where pedagogic techniques play a crucial role since educators have a major influence on the development of engineering students’ soft skills during their university time. Schulz (2008: 146) affirms that “(e)embedding the training of soft skills into hard skills courses is a very effective and efficient method of achieving both an attractive way of teaching a particular content and an enhancement of soft skills.”

One of the features of soft skills is communication, the capacity to interact with others effectively. It is out of discussion that nowadays having good communicative skills in English opens the door for engineers to enter the workforce of the industry of the 21st century. Universities must evolve to respond to new realities such as internationalization, which is driven by two main trends: online education and English-medium instruction (Querol-Julían & Crawford Camiciottoli, 2019). Nowadays, most universities offer a wide variety of programmes implemented to teach (in or through) English. However, the
integration of English in higher education is not an easy task, although the English-medium paradigm applied in higher education shows different possibilities (Schmidt-Utterberguer, 2018). Because of this reality, CLIL (Content and Language Integrated Learning) appears to be a solution to integrate content and language learning in the curriculum (Coyle, 2007). The term CLIL has been widely used to refer to this bilingual education practice mainly in lower education levels, but also at university. In higher education, this integrative approach is referred to as ICLHE (Integrating Content and Language in Higher Education) or, more recently, EMEMUS (English-Medium Education in Multilingual University Settings). As regards the latter, ROAD-MAPPING (Dafouz & Smit, 2020) is one innovative and holistic framework to conduct contextualised research and to engage in EMEMUS management.

Yet, the Englishisation of the university has received considerable attention from the most prominent approach used: English-Medium Instruction (EMI) (Macaro, 2018), where English is the vehicular language but there is not an attempt to integrate content and language learning, as it is in the other approaches mentioned above. However, there is still a lack of research in this context on CLIL/ ICLHE/ EMEMUS (Fortanet-Gómez, 2013; Komori-Glatz, 2017; Valcke & Wilkinson, 2017) and the impact of its application on learning content and language. Additionally, some of this literature is not clear about the phenomenon studied, showing an ill-use of the term CLIL. Some authors, as it mentioned in more detailed in the next section, refer to CLIL, when it is not clear where teachers are actually trying to integrate content and language learning or only using English as a vehicular language, i.e., doing EMI. Aguilar’s (2017) study put in the foreground the differences between the two approaches. This author analysed engineering lecturers’ views on CLIL and EMI, who reported that they only employed EMI and did not contemplate CLIL because they declined “teaching English” (Airey, 2012) or assessing it since they do not perceive language issues as one of their duties. Nonetheless, it seems that an increasing interest in EMI towards language is present nowadays (see for example the special issue on the role of languages in English-Medium Instruction (EMI) at university, edited by Doiz and Lasagabaster (2020)). Hopefully, we are witnessing a final twist of the screw on EMI teachers’ awareness of the importance of language, and a step forwards towards the popularisation of ICLHE.

The general aim of this study is to make a literature review of the main aspects that engineering educators should take into account to develop ICLHE to adapt CLIL core features, which are fully developed in other educational levels, to the university setting. These core features are related to, and thus enhance, the development of the soft skills needed in the engineering world. The specific objectives that will help us to attain the general aim of the study are:

- Place ICLHE in the English-medium education paradigm.
- Examine the concept of CLIL and know the benefits and drawbacks of its implementation at the university level.
- Know the benefits and challenges of introducing project-based learning and flipped classroom in engineering programmes, as well as the recommendations for its use.
• Provide a set of guidelines to implement an ICLHE lesson plan in an Engineering subject to develop soft skills while integrating content and language learning.

2. THE ENGLISH-MEDIUM PARADIGM AND ICLHE

The English-medium paradigm is a framework featured by different types of programmes or courses found in English-medium contexts. Schmidt-Unterberger (2018) has classified it into five distinct categories and defined their potential opportunities and implications for language learning: i) Pre-sessional ESP/EAP (English for Specific Purposes/ English for Academic Purposes): They are language courses, which are implemented before a particular content course, to work in its linguistic demands, and that “equip students with the essential discipline-specific language (ESP) and/ or academic communication and study skills (EAP)” (Schmidt-Unterberger, 2018: 531). Their main drawback is their disconnection from the rest of the programme. ii) Embedded ESP/EAP: These courses are part of the regular curriculum, and their objective is to “develop discipline-specific and general academic language skills students need in the English-medium programmes” (Schmidt-Unterberger, 2018: 533). iii) Adjunct ESP: It is also carried out while a content subject is taught. Its objective is to help students understand the language needed in the subject and the genres most used in the content class. This type is utterly challenging because collaboration between content and language teachers is required to create two curriculums of two different subjects that complement each other (Brinton, Snow, & Wesche, 1989). iv) EMI: English-Medium Instruction for a particular course/ programme is the approach most used in higher education. Language learning goals are not taken into account (Järvinen, 2008). Due to this vision of English, EMI can lead to difficulties with concepts comprehension, absence of learning about the subject and low participation due to a lack of English proficiency (Kocaman, 2000). v) ICLHE: As mentioned above, it is the direct counterpart for tertiary education of CLIL, which is an umbrella term that has become increasingly popular in school programmes across Europe (Coyle, 2007). CLIL is defined by Coyle, Hood, and Marsh (2010: 3), as “an educational approach in which various language-supportive methodologies are used which deal with a dual-focused form of instruction where attention is given to both language and content”.

One of the first attempts to understand CLIL in higher education was made by Räsänen (2010), who identified five main ways in which CLIL was integrated into the curriculum: i) Partial CLIL LSP (Language for Specific Purposes) or pre-CLIL (discipline-based language teaching, explicit L2 learning aims). ii) Partial CLIL-language (Language for Academic Purposes focus tailored for future content learning, explicit L2 learning aims). iii) Partial CLIL-content (content mastery, incidental L2 learning, implicit L2 learning aims). iv) Adjunct CLIL (content mastery and L2 learning, tailored adjunct L2 instruction to support content learning). And v) CLIL (full dual integration of language through subject teaching, content mastery and L2 learning, specified aims for both). One can see a parallelism between Räsänen’s classification and Schmidt-Unterberger’s
English-medium paradigm since Partial CLIL LSP seems to refer to embedded ESP, Partial CLIL-language to Pre-sessional EAP, Partial CLIL-content to embedded EAP, and CLIL to ICLHE.

Schmidt-Unterberger (2018) argued that a marriage between EMI courses and ESP/EAP programmes is a more realistic combination than adopting ICLHE. However, this partnership seems to be used to counterbalance the lack of a language-conscious approach in EMI courses. In line with this, research on the impact of ESP courses on the preparation for EMI courses has inquired into teachers’ perception (Jiang and Zhang, 2017), and engineering students’ perception (Arnó-Macià, Aguilar-Pérez, & Tatzl, 2020) with positive results. Furthermore, research has revealed that academic success in the EMI context is connected to ESP (Rose et al., 2019). Therefore, it is evident that there is a need to pay more attention to academic language proficiency in EMI. Furthermore, the development of academic English language proficiency is a crucial component of ICLHE (Crossman, 2018) since the main principle of this approach is balancing content and language learning through their integration.

3. **CLIL CURRICULUM DEVELOPMENT AT UNIVERSITY LEVEL**

As Alimi (2018: 2) pointed out “CLIL needs contextualization and personalization to answer the needs of the institution”. To facilitate the transition between theory and classroom practice, Coyle (2008) developed the well-known 4Cs framework that aims to plan an effective integration of content and language in a specific context, also at the university level. The 4Cs are: Content, Communication, Cognition, and Culture.

i) Content is understood from a broad perspective since it is not only for students to gain knowledge and skills, but also to create their own knowledge, skills and understanding following a specific learning path. CLIL adopts a constructivist perspective, being the students the centre of the learning process and taking responsibility. This perspective cements critical and creative thinking, which is the first step towards the development of soft skills in engineering students.

ii) Communication, particularly language, requires a reconceptualization which is defined by six main features: (1) Language is a medium for learning and an objective. Thus, meaningful and contextualised learning can be promoted in the university classroom, avoiding detachment from reality. (2) A journey takes place from the development of Basic Interpersonal Conversational Skills (BICS) to the development of Cognitive Academic Language Proficiency (CALP) (Cummins, 2008), which can provide engineering students with the linguistic tools needed for the countless and unpredictable communicative situations they will find at work. (3) Special attention is paid to fluency rather than to accuracy. This can make feel some lecturers more comfortable with what is expected from them as regards language. (4) Nonetheless, there is a need for comprehensible input (Krashen, 1998), which requires scaffolding strategies to ensure understanding. (5) The language triptych (language of learning, language for learning, and language through learning) (Coyle et al., 2010) should also be considered when planning CLIL lessons at university. The language of learning is the “language learners
will need to access new knowledge and understanding when dealing with concepts” (Coyle et al., 2010: 61), i.e., topic-related key vocabulary and phrases. The language for learning “is linked to the language students will need during the lessons to carry out the planned activities effectively” (Coyle et al., 2010: 62); for example, the language to present a project, discuss, write a report, etc. The language through learning refers to unprepared language that emerge through learning.

iii) Cognition is approached from Bloom’s revised taxonomy (Anderson & Krathwohl, 2001) to design educational objectives. Thus, tasks must be created following a progression from Lower Order Thinking Skills (LOTS) to Higher Order Thinking Skills (HOTS). The development of critical and creative thinking skills is at the core of the approach. As Hanesová (2014: 33) pointed out students “are intellectually challenged to transform information, to solve problems, to discover meaning using creative thinking”; that is, to develop soft skills.

iv) Culture is related to the self and other awareness, identity and progression towards intercultural understanding. This term has been disambiguated over the years due to technology and its implication in the globalized world. Community and Connection are added to this dimension to identify learning and collaborative networks that are accessible to everyone. Thus, the connection between the conceptual and methodological features of CLIL and soft skills development is conspicuous. As regards culture, engineering students will benefit from their personal and professional development when evoking the feeling of being part of a specialised community.

Although CLIL is known in tertiary education as ICLHE, most of the literature we have found uses CLIL to refer to its development at the university level. Research has revealed some benefits and drawbacks of its implementation, which are summarized in Table 1.

Table 1

Benefits and drawbacks of CLIL implementation at university level.

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Drawbacks</th>
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<tr>
<td>Larger lexicon, with a higher use of it and vocabulary richness (Jexenflicker &amp; Dalton-Puffer, 2010; Vázquez, 2007; Várkuti, 2010).</td>
<td>Lack of faculty collaboration to integrate content and language teaching (Airey, 2016; Arnó-Macià &amp; Mancho-Barés, 2015; Weinberg &amp; Symon, 2017; Woźniak, 2017).</td>
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<tr>
<td>Increase of motivation for language learning (Schmidt-Unterberger, 2018) and for the topic studied (García-Fernández, Moreno de Diezmas, &amp; Ruiz-Gallardo, 2017).</td>
<td>It is “time-consuming in joint lesson planning, team teaching and collaborative assessment” (Schmidt-Unterberger, 2018, p. 535).</td>
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<tr>
<td>Increase of student’s spontaneity in their oral communications (Lasagabaster, 2008)</td>
<td>Losses in students: decreasing participation because of low English proficiency, failure to show the best performance, decrease in</td>
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Development of multilingual interests and attitudes (Carrió & Gimeno, 2007)  

| Improvement of receptive skills (Aguilar & Rodríguez, 2012). |
| Knowledge becomes stronger and more orderly (Godzhaeva, Logunov, Lokteva, & Tochilina, 2018). |
| Facilitation of higher order thinking skill, better English competence and moral development (Alimi, 2018). |
| Preparation for professional life, providing more job opportunities (Carrió & Gimeno, 2007). |

| student’s overall learning results or increase in study load (Aguilar & Rodríguez, 2012). |
| Losses for teachers: some content knowledge is sacrificed (Airey, 2004), a slower delivery rate (Hincks, 2010; Thørgersen & Airey, 2011). |

It is surprising the variety of benefits that ICLHE implementation has, not only related to English skills, but also personal development, such as motivation or spontaneity increase, and the broad spectrum of possibilities opened thanks to English proficiency. However, some drawbacks also need to be considered when implementing ICLHE in the best possible way because some could be overcome. We cannot avoid investing much time in the process; however, we could work on faculty collaboration and lecturers’ profiles which should be completed with an academic background in the given field, proficiency level of English and training in ICLHE methodology (Aguilar & Rodríguez, 2012). Thus, these professionals will be able to easily integrate language and content learning and cover the curriculum with fluency and using scaffolding strategies. When these basic conditions converge, it has been observed students’ and teachers’ positive perceptions (Aguilar & Rodríguez, 2012) and that neither the content nor the academic performance is sacrificed (Toledo et al., 2012).

4. **ACTIVE METHODOLOGIES TO DEVELOP CLIL CORE FEATURES AND SOFT SKILLS**

According to Mehisto, Marsh, and Frigols (2008), the main core features of CLIL are:

i) Multiple focus approach: a high degree of integration between content and language and among different subjects is required.

ii) Safe and enriching learning environment: authentic materials and learning environments.

iii) Authenticity: connect students’ lives, motivations and feelings with learning. Real materials are brought into class using media, technology and other sources.

iv) Active learning: students are the centre of the teaching-learning process. Students talk time should be higher than teacher talk time. Activities must foster cooperation to achieve common goals.
v) Scaffolding: teachers act as facilitators; they must support students’ language needs and be ready to work with different learning styles.

vi) Cooperation, which is seen in students’ activities and between content and language specialists.

In general, a change is needed in the way we teach at university to integrate these features. Traditional lecture, known as teacher-centred, is still the most common way of teaching in the engineering setting (Rodríguez et al., 2019). This kind of instruction leads to some limitations because it treats all the students in the same manner, without taking into account the different learning styles and needs, students also come to class without previous preparation, and formative feedback is usually not given immediately but delayed (Tormey & Henchy, 2008). Research on learning and teaching styles in engineering education revealed mismatches between students’ learning styles and teacher’s teaching styles that lead “to poor student performance, professorial frustration, and a loss to society of many potentially excellent engineers” (Felder & Silverman, 1988: 680). These mismatches have been confirmed by more recent studies, claiming the need for further research “to determine how willing faculty members are to teach outside their comfort level to match the students’ preferred learning styles” (Katsioloudis & Fantz, 2012:67).

These limitations can be mitigated by shifting classroom activity from teachers to students, for example, with the help of the flipped classroom (Munir et al., 2018). Student-centric approaches are needed to make learning more meaningful and dynamic. Moreover, not only content is important, but the development of some soft skills, such as communication, leadership, creativity, teamwork, decision making, problem-solving, initiative, negotiation or goal setting, is also needed in this competitive and globalize world (Barros & Bittencourt, 2019). These can be fostered by engaging students in project-based learning and by flipping the classroom.

4.1. Project-based Learning

Project-based learning (PjBL) is a pedagogical approach where students acquire knowledge and skills working in real-world projects and research. In these projects, students work in groups to create a common end product. As it was stated by Larson et al. (2018: 500), “Project-based learning is often confused with problem-based learning (PBL)”, which is centred on a problem to be solved. In project-based learning and problem-based learning, students work cooperatively to increase individual and group learning (Aranzabal, Epelde, & Artetxe, 2019). The model problem-oriented and project-based learning (POPBL) attempts to integrate both (Li & Faghri, 2016). Furthermore, the importance of teamwork and the close collaboration with the real environment has led this pedagogical approach to be also named Team Project-Based Learning (TPBL) (Raycheva, Angelova, & Vodenova, 2017).

Project-based learning has been used in many engineering programmes in the last years due to its benefits (Ballesteros, Daza, Valdés, Ratkovich, & Reyes, 2019; Moreno-Ruiz et al., 2019; Villalobos-Abarca, Herrera-Acuña, Ramírez, & Cruz, 2018; Zancul,
Sousa-Zomer, & Cauchick-Miguel, 2017). Table 2 provides a review of these benefits, as well as some challenges and recommendations to apply the approach.

**Table 2**

*Project-based learning in engineering programmes: benefits, challenges and recommendations*

<table>
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<tr>
<th>Benefits</th>
<th>Challenges</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td><em>Project-based learning:</em></td>
<td>It is difficult to create a stimulating approach that engages students.</td>
<td>Instructors must be trained to possess strong skill sets for implementing PjBL.</td>
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<tr>
<td>Increases students’ participation in the learning process</td>
<td>(Nwokeji, Aqlan, Olagunju, Holmes, &amp; Okolie, 2018)</td>
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<tr>
<td>Encourages students to assume responsibility for their learning experience and to shift from passive to more active learning patterns.</td>
<td>Students have little experience in PjBL.</td>
<td>Provide some training sessions on teamwork: jigsaw session.</td>
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<tr>
<td>Enhances communication skills and teamwork.</td>
<td>(Aranzabal et al., 2019)</td>
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<tr>
<td>Takes into account different learning styles.</td>
<td>A well-balanced group.</td>
<td>“Use an instructional and reflective session of Belbin roles (Belbin, 2012). Each student writes a report justifying the reasons and facts why he/she chose that role” (Aranzabal et al., 2019: 60).</td>
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<tr>
<td>Promotes critical and proactive thinking.</td>
<td>How to assess students.</td>
<td>Using rubrics, responsible sharing marks, certification of votes or peer assessment.</td>
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<tr>
<td>Allows that knowledge and skills are transferred from academic learning environment to more real contexts.</td>
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Based on the benefits found of project-based learning, this methodology could be useful for engineering students to bring more real-life experiences into class and to develop soft skills such as:

- professionalism; reliability; the ability to cope with uncertainty; the ability to work under pressure; the ability to plan and think strategically; the capability to communicate and interact with others, either in teams or through networking; good written and verbal communication skills; information and communication technology skills; creativity and self-confidence; good self-management and time-management skills; a willingness to learn and accept responsibility. (Andrews & Higson, 2008: 413)
However, its implementation may not be easy because not all teachers have the skills needed to create stimulating environments to apply it. Moreover, as Mitchell and Rogers (2019) reported, the teacher context and aspirations have led to a softly different interpretation of project-based learning. In line with this, teacher’s roles are essential in project-based learning. Walsh (2005) defined them as follows:

- Climate setting: they create certain learning conditions that foster autonomous learning.
- Planning: they are responsible for organizing and structuring the project and tutorials.
- Clarifying learning needs: they set goals and learning aims.
- Designing a learning plan: they help learners to develop strategies to achieve their goals.
- Engaging in learning activities: they give direction and scaffold to guarantee that learners are following their learning path.
- Assessing learning outcomes: they use formative feedback and summative assessment.

Furthermore, to boost a learning-by-doing scheme, it is necessary to devote more time to deal with theory at home. To do so, we can use strategies like the flipped classroom (San-Valero et al., 2019).

4.2. Flipped Classroom

The flipped classroom is a pedagogical approach that consists in changing the class structure. Activities carried out in class like theoretical explanations are now performed outside the classroom, whereas practical problem resolution is worked inside the classroom (Valero et al., 2019). The effective flipped classroom has been related to Bloom’s Taxonomy. Before coming to class, students are individually involved in activities that require lower levels cognitive processes of understanding and remembering; while in class, activities entail developing higher-order thinking skills (Nihlawi et al., 2018).

One way to implement this approach is through the recording of educational videos that aim to complement traditional materials such as slides or texts (Rodríguez et al., 2019). Pre-recorded videos are shared online and are available until the end of the term. Regarding the length of the videos used to promote autonomous learning, Guo, Kim, and Rubin’s (2014) comprehensive study on the effects of video production on students’ engagement revealed an optimal length of about 6 minutes. The use of flipped classroom and the best advantages of face-to-face learning in class is one of the formats of blended learning (Bonk & Graham, 2006) that we have at our disposal. Table 3 shows the main benefits, drawbacks or challenges and recommendations of the flipped classroom implementation in engineering programmes.

As in other methodologies, flipped classrooms need time to prepare videos and explain students what the fundamentals and structure of the new autonomous learning they have to perform are. As it reported by Salcines-Talledo, Cifrián, González-
Fernández, and Viguri (2020), students’ engagement does not happen spontaneously, an adaptation time is necessary. This adaptation period finishes when students are aware of the benefits of this active learning methodology.

Table 3

Flipped Classroom in engineering programmes: benefits, challenges and recommendations

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Challenges</th>
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<td>(Chiquito, Castedo, Santos, López, &amp; Alarcón, 2020; Khan &amp; Thayniath, 2020; Rodríguez-Chueca, Molina-García, García-Aranda, Pérez, &amp; Rodríguez, 2020; Valero et al., 2019)</td>
<td>More time dedicated to practical application of learned concepts in class. Students show further comprehension of the content, a higher amount of thinking and stronger capacities to deal with down-to-earth problems. A change in student’s learning habits that promotes independent learning. More time to address students with special needs. The use of Project-based learning and cooperative learning activities in class are promoted.</td>
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<td>(Rodríguez et al., 2019) Although most of the material is reused, it should be convenient “to have a shared platform on the internet where teachers from over the world share chunks of knowledge that others can reuse and take advantage of” (Rodríguez et al., 2019: 12).</td>
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<td>Students observe an increase in the amount of effort needed. (Valero et al., 2019) “It is due to a poor presentation of the methodology. Students need to know exactly how this process is going to develop from the very beginning”. (Valero et al., 2019: 77).</td>
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<td></td>
<td>Limited and delayed feedback. Collect student’s performance once they watch the videos using quizzes. Use the outcomes to adapt the content to the next lecture. (Kakosimos, 2015)</td>
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Flipped classroom has been used in many engineering programmes (Chiquito et al., 2020; Gren, 2020; Khan & Thayniath, 2020; Martínez-Carrascal, Márquez Cebrían, Sancho-Vinuesa, & Valderrama, 2020; Salcines-Talledo et al., 2020). Interestingly, Gren (2020) stated how vital is the help of pedagogical experts during the development of active lectures to success in the implementation of active learning activities. Moreover, Khan and Thayniath (2020) showed how engineering students’ English oral skills improved through flipped classroom.
Flipped classroom merges with other active learning methodologies such as project-based learning (Moreno-Ruiz et al., 2019) because it allows students to have more time for hands-on work in class. The integration of these approaches may foster cooperation, authentic and active learning and the rest of the core CLIL features, that is, the soft skills needed to be developed in ILCHE to shape the students’ professional competences profile.

5. FROM THEORY TO PRACTICE

This section proposes how these approaches, project-based learning and flipped classroom, could merge in the design of an ICLHE subject to develop English proficiency and soft skills. The aim is to provide some guidelines for university teachers involved in English-medium instruction to move from content focus and teacher-centred methodologies to a more integrative perspective, placing students engagement at the core of their practices (Carini, Kuh, & Klein, 2006). The two main objectives of the approach, apart from facilitating the development of hard skills, are: (i) to improve students’ English proficiency level, and (ii) to foster the development of soft skills that are necessary in the engineering world: communication, leadership, creativity, teamwork, decision making, problem-solving, initiative or negotiation. In Table 4, we propose 10 interdependent steps to design a lesson plan for an engineering ICLHE subject.

Table 4

Guidelines to implement ICLHE, Project-Based Learning and Flipped Classroom in an engineering subject

<table>
<thead>
<tr>
<th>Tips</th>
<th>Examples</th>
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<tbody>
<tr>
<td><strong>Step 1. Choose the topic of the project</strong></td>
<td></td>
</tr>
<tr>
<td>• Align the topic with the students’ real needs to be part of the labour market.</td>
<td>The chemical industry. Students can work on reactants, materials, energy sources, chemical reactions, thermodynamics, etc.</td>
</tr>
<tr>
<td>• Consider all the contents of the subject.</td>
<td></td>
</tr>
<tr>
<td>• Show a clear connection between its parts and the contents of the subject.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2. Define the final goal</strong></td>
<td>Create your own chemical industry.</td>
</tr>
<tr>
<td>• Design an integrative goal, comprising content and language.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3. Organise the project in parts</strong></td>
<td>Classification of basic operations. Variables of the processes. The chemical processes.</td>
</tr>
<tr>
<td>• Relate each part to one of the topics/units of the subject or comprise some topics in one part.</td>
<td></td>
</tr>
<tr>
<td>• Order the parts following a progression.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4. Integrate content and language learning</strong></td>
<td>Follow the 4Cs framework (content, cognition, communication, and culture).</td>
</tr>
</tbody>
</table>
• Design objectives related to the 4Cs.
• Design objectives for each task. Some tasks can share some objectives.

Design content-related objectives.

| Identify the energetic needs of an industrial plant. | Identify the energetic needs of an industrial plant. |
| Differentiate between the different types of energies. | Differentiate between the different types of energies. |
| Plan how to reduce contamination using renewable energies. | Plan how to reduce contamination using renewable energies. |
| Create an environmentally friendly plant. | Create an environmentally friendly plant. |

Design language-related objectives.

| Understand the lexicon related to energies (Language OF). | Understand the lexicon related to energies (Language OF). |
| Use language for debating about energies advantages and disadvantages (Language FOR). | Use language for debating about energies advantages and disadvantages (Language FOR). |
| Look for news in your L1 related to energy and share them in English with your classmates (Language THROUGH). | Look for news in your L1 related to energy and share them in English with your classmates (Language THROUGH). |

Foster the development of the cultural dimension.

| Science literacy can be spread out on the Internet through some videos made by the students. | Science literacy can be spread out on the Internet through some videos made by the students. |
| Interculturality can be enhanced if students have the opportunity to interact with peers from other universities working on similar projects. | Interculturality can be enhanced if students have the opportunity to interact with peers from other universities working on similar projects. |

Step 5. Design tasks

• Identify the learning situations needed to achieve the learning objectives of each task.
• Design one task for each part of the project.
• Decide how long each task or part of the project will last.

An outdoor activity to visit a chemical industrial plant.

Step 6. Plan the development of soft skills

• Foster the development of soft skills during the tasks.
• Cooperative learning is central to develop and enhance soft skills.

Communication: teamwork, debates, interviews.
Self-motivation: project related to the students’ future job.
Leadership: teamwork, the visit of a leader from a recognised enterprise who talks about what is necessary to be a leader.
Responsibility and Time management: teamwork, tasks deadlines.
Negotiation and conflict resolution: teamwork, emotional dimension awareness.

Step 7. Foster cooperative learning
• Form small groups of heterogeneous abilities.
• Ensure positive interdependence and individual accountability.
• Use pedagogical translanguaging during teamwork. Allow learners to use their complete linguistic repertoire.

Positive interdependence: assign roles to the students, which can be changed throughout the project.
Individual accountability: ask students to make an individual public performance (e.g., report, presentation, etc.)
Pedagogical translanguaging: allow the use of sources published in the students’ L1 and small talks in other languages, establish what has to be done in English, e.g., group discussion and outputs.

Step 8. Create videos to flip the classroom
• Include the essential concepts and explanations of the subject necessary to develop the different activities proposed throughout the project.
• Create several short 6-minute videos for each part of the project.

A video to introduce the different types of energies or to explain how to calculate the carbon footprint.

Step 9. Design assessment
• Include a wide range of assessment instruments.
• Assess the whole process: individual work during the flipped classroom and cooperative work throughout the project-based learning.
• Engage students in the assessment process through self-assessment and peer-assessment.
• Assess hard skills and soft skills, that is, communicative skills, group management, problems resolution, analysis and reflection, negotiation and conflict resolution, flexibility, team working, etc.

Individual tests about the videos. Post edit the videos and insert questions making watching videos more interactive (e.g., with Edpuzzle or Zaption) or create short quizzes after watching them (e.g., Mentimeter, Canvas, Quizalize, Google Form), and automatically collect answers.
Class observation
Oral presentations
Written reports
Blueprints

Step 10. Plan content and language scaffolding
• Create multimodal (e.g., visual and/or oral) support to scaffold content learning.
• Create multimodal support to scaffold language learning.

A working wall where some photographs show different engineering materials or units with their names.
A video with examples of good presentations or common mistakes made by students.
A list of expressions used for debating.

After following these ten steps, the project will be ready to be applied. Projects are dynamic and can be modified during the process or after the first results are obtained. Evaluating the design and the accomplishment of the learning goals is essential to identify any adaptation or improvement needed. An example of a unit design is shown in Table 5.
Table 5

Unit example following the guidelines to implement ICLHE, Project-Based Learning and Flipped Classroom in an engineering subject

<table>
<thead>
<tr>
<th>UNIT EXAMPLE</th>
<th>ENERGIES AND POLLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>3 hours</td>
</tr>
</tbody>
</table>

**Content goals**

- Identify energetic needs in an industrial plant.
- Differentiate between the different types of energies.
- Plan how to reduce contamination using renewable energies.
- Create an environmentally friendly industry.

**Language goals**

<table>
<thead>
<tr>
<th>Language of</th>
<th>Language for</th>
<th>Language through</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand the lexicon related to environmental applications.</td>
<td>Use language for debating about the different types of energy.</td>
<td>Add terms to the English-native language glossary.</td>
</tr>
<tr>
<td>Watch and listen to the video prepared for this unit.</td>
<td>Answer teacher’s questions using evidence.</td>
<td>Search for news in your country about environmental problems and share them in English with your classmates.</td>
</tr>
<tr>
<td>Use reason and consequence clauses to talk about energy and contamination.</td>
<td>Use language for proposing new ideas for the industry.</td>
<td></td>
</tr>
</tbody>
</table>

**Scaffolding instruments**

- Video of the unit.
- List of the most used vocabulary about Energies and Pollution.

**Tasks**

- Search on the internet the different types of energies and how electric energy is produced.
- Design a schema with the information found.
- Debate with your group the advantages and disadvantages of the different energies.
- Calculate the footprint of the different energies.
- Search for news in your country about environmental problems and share them with your group.
- Create a map where the most typical renewable energies used in a higher percentage in each country appear.
- Create a video explaining what type of energy you can implement in your industry: explain the possible implementation and the pollution sources.

**Assessment**

- Class observation of students’ work.
- Peer-assessment to know if all students have worked in the group.
- Rubric of the video produced in the last task where content and communication skills are considered.

**Soft skills developed**

- Communication skills in the debate and in the video production
- Teamwork skills working in groups.
6. CONCLUSIONS

The literature review conducted in this study has revealed a lack of research on the application of ICLHE. Although this approach seems to have gained relevance in the bilingual/multilingual higher education construct, it seems there is still an inaccurate use of the concept of content and language integrated learning in this setting. Some publications refer to CLIL when the approach adopted is EMI (or a combination of EMI with ESP or EAP courses/programmes), or the characteristics of the approach are not clearly stated, and one cannot be sure about having the integration of content and language learning at the core of the teaching practice.

The study has shown the benefits and challenges of applying project-based learning and flipped classroom in engineering studies. It has been revealed how these and CLIL principles are aligned and can perfectly combine to foster the development of technical/hard skills and English proficiency, and the soft skills that are central in the engineering students’ profile.

Based on the results found in the literature review, the paper proposes some guidelines to design an engineering ICLHE subject that embodies project-based learning and flipped classroom, while integrating content and English language learning. Project-based learning has been demonstrated that increases students’ participation, enhances communication skills and teamwork, takes into account different learning styles and promotes critical thinking. On the other hand, when flipping the classroom, the time needed to develop the project in class will be available. This strategy has also been shown to increase students’ comprehension, time management and responsibility.

REFERENCES


Alimi, M. Y. (2018). The use of content and language integrated learning (CLIL) as conservation education methodology: An experience from State University of


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