CLILing environmentally to develop students' productive skills

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Abstract

Content and Language Integrated Learning (CLIL) and interdisciplinarity go hand in hand in foreign language classrooms because language becomes the tool of communication, collaboration, expression and creativity in diverse contexts, addressing numerous topics and learners' interests. By using a foreign language, learners are able to learn about current issues, act as global citizens and participate in real or simulated social, cultural or political events. To that end, the paper focuses on CLIL lessons about environmental issues, and esp. the issue of energy, through the collaboration of language and subject teachers. More specifically, it describes the practices implemented at the 2nd Model Senior High School of Thessaloniki during the school year 2021-2022 by the teachers of English language, Modern Greek Language, Chemistry and Math. By being exposed to a lot of relevant authentic material, and by using digital content and tools and alternative assessment practices, learners simulate real-life events, presenting, analyzing, discussing and writing about the issue of energy and climate change. By doing so, they develop a lot of language and soft skills, and perform as active citizens.

Keywords

Content and Language Integrated Learning (CLIL), environmental issues, digital tools, alternative assessment

Introduction: Why CLIL?

"CLIL is defined as an approach in which a foreign language is used as a tool in the learning of a non-language subject, in which both the language and the subject have a joint role" (Marsh, 2002). In literature (Coyle, 2013; Coyle et al., 2010; Gierlinger, 2015; Marsh, 2002, 2008; Pérez-Cañado, 2012; Soler et al., 2016), CLIL is described as an umbrella term, a dual-focused educational approach, in which an additional language is used as a medium in the teaching and learning of non-language content, with emphasis on both content and language, and it is underpinned by a set of flexible but theoretically robust principles that support teacher practices across a range of different contexts (Cross, 2013).

Content and Language Integrated Learning (CLIL) is thus a teaching and learning approach, which offers a motivating and authentic communicative framework of learning that improves foreign language competence (Mattheoudakis, Alexiou & Laskaridou, 2011), fosters communication and collaboration, supports interdisciplinary practices (Kofou & Tzortzis, 2021), and promotes innovation and research in the classroom (Craen et al., 2007). As Gabillon

(2020) aptly sets it, CLIL is not only about using an additional language in order to teach any subject content; on the contrary, it aims "to build and reinforce learners' knowledge of other disciplines while using the language to solve problems and develop critical thinking". Learners' confidence and self-esteem are enhanced (Mattheoudakis & Alexiou, 2017) while dealing with several topics not necessarily strictly-based on the Curriculum, whereas language and subject teachers employ innovative methods and alternative resources and develop professionally (Calviño, 2012; Lasagabaster, 2008; Smit in Dalton-Puffer, 2007).

A variety of models, approaches, and methods of CLIL, such as collaborative and experiential learning, have been implemented all over Europe, while in Greece CLIL is rather limited to a few schools, mainly experimental or model schools (see Kofou & Philippides, 2017; Kofou, Philippides & Gavriilidou, 2016; Kofou & Tzortzis, 2021). In that view, CLIL serves the educational and linguistic objectives not only of a country but of a particular school (Eurydice, 2006). Therefore, CLIL needs to be adapted each time to the local context, needs, and objectives, depending on the stakeholders, goals, and methods. So teachers need to think about three major stages: planning, implementation, and assessment. This means that they have to take into account the class they are going to teach, the subject matter they are going to focus on, and the objectives they are going to set. Then they have to select the content, plan the tasks, according to the emphasis they want to place on the language skills, and finally select the assessment forms, i.e. traditional tests or alternative assessment forms, or both (Kofou & Tzortzis, 2021).

Based on the content, methodology and practices of the present study, we define and apply CLIL as an interdisciplinary, cross-curricular approach, in which the foreign language becomes the medium to respond to lifelike situations in written and oral form, and deal with current issues of general interest.

All the above reveal a demand for effective teachers, able to collaborate (Mattheoudakis & Alexiou, 2017), plan lessons accordingly, use the foreign language proficiently, and integrate technology and alternative assessment forms.

Why deal with environmental issues and climate change?

The UK hosted the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow in 2021, aiming at bringing climate change under control and at reaching an agreement, the Glasgow Climate Pact.

The problem is that extreme weather events linked to climate are intensifying (Semerjian, El-Fadel, Zurayk & Nuwayhid, 2004). On the other hand, the world is warming because of emissions from fossil fuels used by humans, like coal, oil and gas. So, 200 countries were asked for their plans to cut emissions by 2030. Under the Paris Agreement of 2015, countries were also asked to make changes to keep global warming "well below" 2^{o}C -and to try to aim for 1.5^{o}C- in order to prevent a climate catastrophe. This is a target world leaders agreed to work towards in 2015 in order to avoid the worst climate impacts. The goal is to keep cutting emissions until they reach net zero in 2050, a rather ambitious goal, esp. after the war in Ukraine, which also intensifies the problem of energy across Europe. As regards methane, a scheme to cut 30% of current methane emissions by 2030 has been agreed by more than 100 countries. This is really important because methane is one of the most potent greenhouse gases, and is currently responsible for one third of human-generated warming. The majority comes from a range of activities, such as cattle production and waste disposal (European Commission, 2021).

The above goals -related to Sustainable Development Goals- and generally any issues related to the environment could not be overlooked in any educational context (UNESCO, 2011), since today's students are tomorrow's citizens who will have to cope with energy shortages and natural disasters, develop environmental awareness and adopt a more environmentally-friendly lifestyle.

Materials and Methods

Taking all the above into account and aiming to raise students' awareness of the environment and its sustainability, 3 CLIL practices were developed at the 2nd Model Senior High School of Thessaloniki during the school year 2021-2022 regarding methane emissions and energy issues. In particular, in the 1st CLIL practice, related to methane emissions and climate change, implemented by the EFL and the Chemistry teachers, the participating students of the experimental group had to propose a policy about how methane emissions can be reduced. The 2nd CLIL practice, implemented by the EFL and the Greek Language teachers, related to the issue of energy in the European Union. The students participated in a De Bono's 6-thinking-hats debate and in a simulation of the European Youth Parliament. Finally, the 3rd CLIL practice, implemented by the EFL and Mathematics teachers, involved Statistics and simulated the IELTS 1st writing task by using figures related to energy consumption and reduction in the EU.

The research hypothesis was if EFL learners are benefited regarding their learning, cognitive and cultural development and to what extent CLIL practices can develop their productive and soft skills, e.g. higher-order thinking skills, critical thinking, digital literacy, creativity, motivation and commitment to the task, active participation, communication and collaboration in a non-competitive learning environment.

To that end, the learning theories applied were:

- The theory of social constructivism (Vygotsky, 1978)
- Group Work with students' active participation, collaboration and experiential learning (Dewey, 1916).
- Problem-solving, in which students formulate hypotheses, do research, collect and analyze findings (Dewey, 1916).
- Exploratory teaching and learning, linked to the students' daily experience, and thus having positive effects on the teaching-learning process (Friesen & Scott, 2013; Pathway, 2012).

The data of the methane emissions practice were analyzed by using the statistical programs Excel and SPSS, whereas those of the other two practices, which concerned a writing product, were cross-referenced to the assessment criteria of writing of well-established EFL examinations, such as Cambridge and IELTS. The writings were also marked by two assessors in order to achieve interrater reliability, a common practice in formal language exams.

Methane emissions

The present teaching practice, concerning methane emissions, which is the second-largest cause of global warming, according to the European Commission, was carried out in December 2021 for 4 teaching hours in English, using the e-me educational platform, in Chemistry and English language courses, to 26 2nd graders of the 2nd Model Senior High School of Thessaloniki, acting as an experimental group, while the other 2nd Grade class acted as a control group.

The areas of knowledge involved studying methane (history, physical properties, chemical reactions, information about atmospheric methane, uses), the importance of Chemistry in scientific research, technology and society with thematic units and subsections of Energy and Climate Change, and the role of society in shaping energy policies.

The teaching material included: (1) course presentations with interactive exercises, with reference to the history, chemical structure, physical and chemical properties and uses of methane and information on methane emissions into the atmosphere and their impact on global warming, compared to those of carbon dioxide, (2) a worksheet concerning "Methane emissions vocabulary", (3) a worksheet entitled "Problem-solving presentation" in which students had to propose a policy about how methane emissions can be reduced, which was evaluated by both the students and teachers, (4) videos. The material used touched not only

the scientific point of view but also the political one. First, the students watched an interactive course presentation on the e-me platform including the speeches delivered by the President of the European Commission and by the President of the U.S.A. on the 26th UN Climate Change Conference of the Parties (COP26), and 9 dual-choice questions (fig. 1). Another interactive course presentation about methane included 6 multiple-choice questions (fig. 2). The students were given a text about the human activities that produce methane and its impact on the environment, humans and livestock, as well as a gap-filling activity on the e-me platform and a matching activity on learning apps (fig. 3).

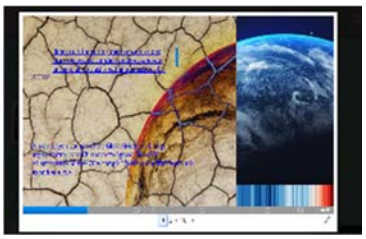


Figure 1. Interactive language course presentation

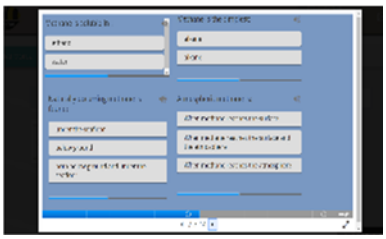


Figure 2. Interactive Chemistry course presentation

Figure 3. Matching activity

All the aforementioned activities gave the learners the opportunity to acquaint themselves with the policy and theory about methane, participate, be active and get instant feedback through this self-assessment method (Griva & Kofou, 2017). Finally, the participating students were given a mind map with the main issues to be discussed, a plan and useful phrases, and worked in groups to participate in a problem-solving activity and take part in a panel discussion about climate change and methane emissions. They had to use the information given to them and deliver a short speech proposing a policy about how methane emissions can be reduced. Voting would follow and the best policy would be selected to be put in action.

EU energy issues

This CLIL practice, related to energy, was implemented to a class of 26 2nd graders (the control group of the previous CLIL practice) and simulated in a way the European Youth Parliament (E.Y.P.) procedure.

First, the learners watched a video about the key issues of a debate, then they were introduced to De Bono's 6 Thinking hats and the questions to be answered, and finally to the way a resolution is written.

Afterwards they were divided in 6 groups, each one assigned with a different hat and a short text from the European Union about energy in order to discuss and keep notes according to the attitude each hat represented. The debate, following De Bono's pattern (fig. 4 & 5), took place in class, with each group represented by a spokesperson, and then the whole class, representing the Committee of Industry, Research and Energy (ITRE), used their notes and wrote a resolution which was voted at the end.

The whole practice was to a great extent a simulation of the European Youth Parliament aiming to discuss a current European issue, and help the participants discover and develop their skills, understand the principles of dialogue, co-operation and respect as well as prepare them to take charge of Europe's future.

Figure 4. Class discussion

Figure 5. Class discussion

Writing about environmental issues by using Statistics

This CLIL practice simulated one of the IELTS writings and aimed to acquaint students with statistics reading and writing.

It was implemented to 3rd graders by the teachers of Mathematics and English. The students were provided with a lot of relevant material, including the structure of the IELTS Academic Writing Task 1, Model IELTS Academic Writing, a model essay, a sample writing with a gap-filling activity of statistics expressions, useful vocabulary and the criteria of assessment: Task Achievement, Coherence and Cohesion, Lexical Resource, Grammatical Range and Accuracy. IELTS is trusted by individuals and organizations worldwide for its fairness, reliability and high-quality standards (https://www.ielts.org/-/media/pdfs/writing-band-descriptors-task-1.ashx).

They were also given figures and short texts about the European Union and a corresponding True/False/Not Mentioned activity to help them understand numbers, proportions, fractions, rates and relations. Finally, they produced a writing in groups, based on a figure about environmental issues, specifically about energy, and assessed it upon the criteria mentioned above.

Results

Regarding the CLIL practice in Chemistry and English, the results are the following.

The experimental group scored 100% in the course presentations (15/15 correct answers), and almost all managed to do the vocabulary gap-filling activity to 100%. Only two students scored 70% and 90%. As for the control group (the other 2nd year class), which was not taught but only asked to do the activities, the scores were lower both in the course presentations and the vocabulary quiz, and in a wider range (fig. 6 & 7).

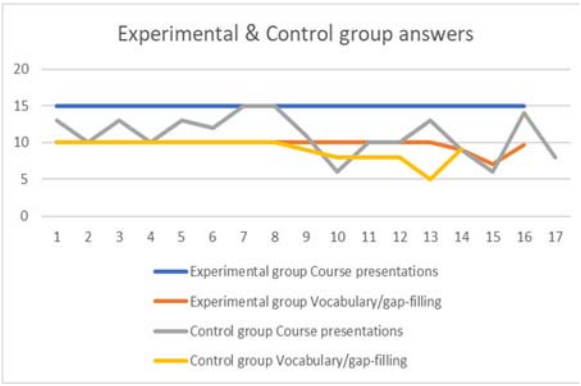


Figure 6. Comparison of the 2 groups answers

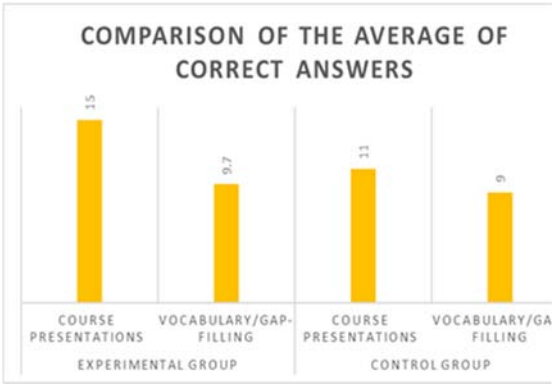


Figure 7. Comparison of the correct answers' averages

The statistical analysis indicated statistically significant difference between the experimental and the control group for the course presentation activities. The Mann Whitney test compares two conditions when different participants take part in each condition and the resulting data violate an assumption of the independent t-test (sig. .000) (Field, 2005). On the

other hand, the participants in the experimental group didn't seem to differ in vocabulary activities from the members of the control group (sig. .254).

As for the speeches delivered by the experimental group, students were assessed by the other groups and by the teachers upon the following criteria: Content analysis, Originality of ideas and suggestions, Presentation skills & pronunciation, Cohesion & linking words, Vocabulary & structure from 1 to 4 (1=weak; 2=quite good; 3-very good; 4=excellent). All the scores were added and compared to the teachers', and feedback was provided. It is interesting to mention that the students were stricter assessors than the teachers (Table 1).

Table 1. Assessment of the experimental group speeches

	TOTAL SCORE				STUDENTS' AVERAGE	T1	T2	TEACHERS' AVERAGE
GROUP 1	13	12	8	13	**11.5**	13	17	**15**
GROUP 2	15	11	16	13	**13.75**	18	18	**18**
GROUP 3	16	15	18	17	**16.5**	19	19	**19**
GROUP 4	17	15	16	15	**15.75**	17	18	**17.5**

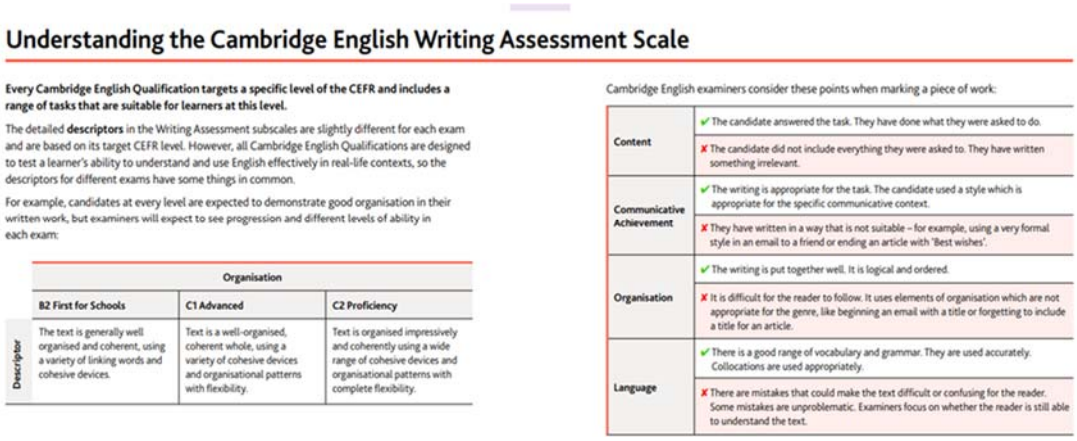
As regards the discussion about the energy issue, by using De Bono's 6 Thinking Hats, the participating students managed to collaborate successfully, have an active role in the debate and develop their thinking and communicative skills. Each group represented their hat effectively, since they presented the facts they had kept notes about, talked about the strengths and weaknesses, expressed their feelings and innovative ideas in an immaculately coordinated discussion.

The final product, i.e. the resolution by the Committee of Industry, Research and Energy (ITRE), was rated by both teachers upon the criteria of Task achievement/Impact, Content, Coherence/Cohesion, Lexical resource, Grammatical range/accuracy, each one from 1 to 4, in an attempt to achieve inter-rater reliability, which is very high (Table 2), but also to provide feedback to the class.

Table 2. Assessment of the learners' resolution

EARNERS' RESOLUTION	Task achievement	Content	Coherence/ cohesion	Lexical resource	Grammatical range	Total score
TEACHER 1	4	3	4	4	4	**19**
TEACHER 2	4	4	4	4	4	**20**

The criteria correspond to the points that assessors consider when marking a piece of writing in proficiency testing, such a Cambridge and IELTS examinations (https://www.cambridgeenglish.org/Images/600977-teacher-guide-for-writing-c2-proficiency.pdf) (fig. 8).



Understanding the Cambridge English Writing Assessment Scale

Every Cambridge English Qualification targets a specific level of the CEFR and includes a range of tasks that are suitable for learners at this level.

The detailed **descriptors** in the Writing Assessment subscales are slightly different for each exam and are based on its target CEFR level. However, all Cambridge English Qualifications are designed to test a learner's ability to understand and use English effectively in real-life contexts, so the descriptors for different exams have some things in common.

For example, candidates at every level are expected to demonstrate good organisation in their written work, but examiners will expect to see progression and different levels of ability in each exam:

	Organisation		
	B2 First for Schools	C1 Advanced	C2 Proficiency
Descriptor	The text is generally well organised and coherent, using a variety of linking words and cohesive devices.	Text is a well-organised, coherent whole, using a variety of cohesive devices and organisational patterns with flexibility.	Text is organised impressively and coherently using a wide range of cohesive devices and organisational patterns with complete flexibility.

Cambridge English examiners consider these points when marking a piece of work:

Content	✔ The candidate answered the task. They have done what they were asked to do.
	✘ The candidate did not include everything they were asked to. They have written something irrelevant.
Communicative Achievement	✔ The writing is appropriate for the task. The candidate used a style which is appropriate for the specific communicative context.
	✘ They have written in a way that is not suitable – for example, using a very formal style in an email to a friend or ending an article with 'Best wishes'.
Organisation	✔ The writing is put together well. It is logical and ordered.
	✘ It is difficult for the reader to follow. It uses elements of organisation which are not appropriate for the genre, like beginning an email with a title or forgetting to include a title for an article.
Language	✔ There is a good range of vocabulary and grammar. They are used accurately. Collocations are used appropriately.
	✘ There are mistakes that could make the text difficult or confusing for the reader. Some mistakes are unproblematic. Examiners focus on whether the reader is still able to understand the text.

Figure 8. Cambridge writing marking criteria

Hence, the resolution the students wrote is C2 level, according to the Cambridge examination scale (https://www.cambridgeenglish.org/exams-and-tests/cambridge-english-scale/) and band 9 according to the IELTS scale (fig. 9).

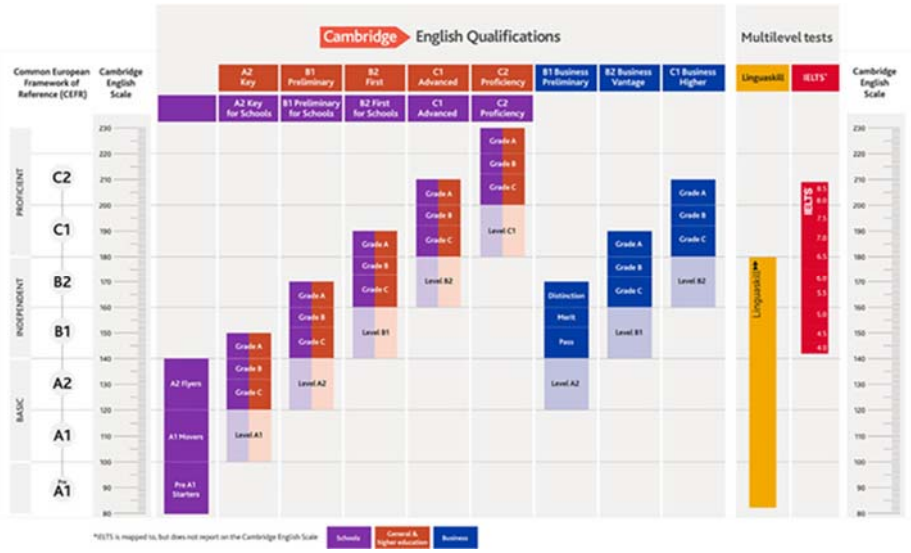


Figure 9. Cambridge examination scale

As far as the writing task simulating the IELTS writing task 1 is concerned, both teachers graded the group writings using the rubric of the IELTS band descriptors (Table 3). Using a rating scale like this, as a form of alternative assessment, gives a clearer picture of what a student can do with the language and describes their performance more accurately (Griva & Kofou, 2017). In the table below, we can see the marks allocated by the teachers to each group writing for each criterion and their average. It is quite interesting that the marks allocated by the Math teacher are a bit higher in many cases than those allocated by the English teacher, probably because the emphasis given by the English teacher is more on language, while by the Math teacher is more on the completion of the task and the successful description of the figure.

Table 3. Assessment of the IELTS writings

	ENGLISH TEACHER					MATH TEACHER				
LEARNERS' WRITINGS	Task achievement	Coherence & cohesion	Lexical resource	Grammatical range & accuracy	Average score	Task achievement	Coherence & cohesion	Lexical resource	Grammatical range & accuracy	Average score
Group 1	7	7	7	6	**6.75**	8	7	7	7	**7.3**
Group 2	6	7	7	7	**6.75**	9	8	7	9	**8.3**
Group 3	5	5	6	6	**5.5**	6	6	7	8	**6.8**
Group 4	9	8	9	8	**8.5**	9	9	9	9	**9**
Group 5	8	8	7	8	**7.75**	8	8	9	9	**8.5**

According to IELTS test statistics published in 2016, the average IELTS writing band score worldwide is 6.0. This average is taken from a 2016 sample of 3 million test-takers in over 140 countries (https://blog.e2language.com/why-do-test-takers-keep-on-failing-ielts-writing/). In our case, we can see (Table 4) that the means of all groups' writings are over 6, and most of them are between 8 and 9 in the IELTS band.

Table 4. Means of the IELTS writings

GROUPS	English Teacher	Math Teacher	MEANS
1	6.75	7.3	7.0
2	6.75	8.3	7.5
3	5.5	6.8	6.1
4	8.5	9	8.5
5	7.75	8.5	8.1

Discussion

The discussion should be twofold, i.e. revolve around the teachers' collaboration and professional development, and the students' learning and soft skills.

Throughout the stages of the CLIL practices, the teachers' collaboration was excellent as they shared a similar mindset, they discussed the idea and the process, and they worked together in shared documents and tools, in order to plan the lessons, prepare the material and assess the students in a non-competitive way for the benefit of their students. Each one contributed to the practices by transferring their motivating techniques, knowledge and discipline, which made the practices more scientifically robust. Their collaboration led to shared expertise and empowered them professionally. It is of great importance to mention that teachers had to alter their teaching methodology and find ways to help students learn in different and exciting ways.

As for the students and the research hypothesis which concerns them, it is obvious from the results that the students had multiple benefits regarding their language learning,

cognitive, and cultural development. Specifically, they developed team spirit, received the practices enthusiastically, and developed a number of skills. Their digital literacy was enhanced, esp. in the methane practice (CLIL and Chemistry), since they had to deal with digital content and do a variety of carefully assessed digital tasks. Furthermore, they familiarized themselves with chemical terminology, which is of great importance in their academic studies. More specifically, they were able to identify fossil fuels as important sources of energy, be aware of the natural causes and anthropogenic activities that cause methane emissions, enumerate the effects of the greenhouse effect on the climate, report on the impacts of climate change on the natural environment, ecosystems and society, propose a policy about reducing methane emissions, and raise their ecological awareness. The results confirm other similar research and studies on CLIL teaching practices, according to which, "ClIL programmes may offer the necessary conditions for effective learning" (Naves & Victori, 2010), language proficiency is developed through content learning (Ruiz de Zarobe & Jimenez-Catalan, 2009), and significant differences were detected in spoken production and interaction, writing, reading and "global comprehension" and "identification of details" in listening (Dalton-Puffer, 2011; Moreno de Diezmas, 2016; Ruiz de Zarobe, 2011). On the other hand, there are CLIL studies that "showed greater increases in English listening comprehension but not general English skills" (Dallinger, Jonkmann, Hollm &;Fiege, 2016), or studies in classes in which teachers failed to consider the three dimensions of this approach (content, language, and procedures) simultaneously (Argudo, Abad, Fajardo-Dack, & Cabrera, 2018), therefore students did not develop them.

However, in the present CLIL practices all students approached the topics and tasks critically and creatively, were highly motivated and engaged to participate actively, work together and achieve a common goal, and they developed their writing and speaking skills in non-competitive, real-life scenarios. Finally, they acquired positive attitudes towards the English language and improved their self-image.

The whole experience was thus positive and rewarding for both the teachers and the students, and confirms our assumption that CLIL can be successfully implemented in interdisciplinary, cross-curricular contexts, if it is planned, implemented and assessed accordingly. Moreover, the results contribute to adding a 5th 'C' to the 4 Cs of CLIL, that of active citizenship, an indisputable skill for 21st century students.

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