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Students' content learning in Science in CLIL vs non-CLIL classes in Greece

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Abstract

The recent introduction of CLIL instruction in some Greek state schools has given rise to concerns voiced by parents – and sometimes educators as well – regarding students' ability to learn content in or through an L2. The fear is that students' low proficiency in L2 will inhibit full understanding of the content and eventually will impact negatively on subject competence. Although there are several studies in the impact of various types of bilingual education programs on students' L2 development, research in their impact on content learning is scarce (see Murphy et al., 2020). Our study aims to contribute to this research by examining 3rd grade students' performance in Science when this is taught through English as L2. The main objective is to assess if students learning Science through the L2 (English) will outperform their peers studying the same content in Greek (L1) as regards content acquision. The participants of this study are 90 pupils in grade 3 – 46 CLIL students and 44 non CLIL students. Two Science tests are used to assess students' performance and the two cohorts are compared on the basis of their scores in those tests. The main finding is quite encouraging for parents and educators alike, as the two cohorts' performance is very similar in both tests; this indicates that CLIL instruction does not impact negatively on students' content acquisition and that CLIL programs can support not only L2 instruction but also content knowledge.

Keywords

CLIL, Greece, primary education, science, content knowledge

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1. Introduction

Content and Language Integrated Learning (CLIL) has been used to refer to any type of educational provision in which a language other than the language of the curriculum is used to teach school subjects other than the foreign/second language (L2) lessons themselves (Eurydice 2006, Coyle et al., 2010). This covers cases of foreign, regional or minority languages. The teaching of a foreign language through content is definitely not new in the field of language teaching. CLIL is in fact the European version of content-based instruction (CBI), usually associated with the Canadian immersion programmes which started in 1965 (Cenoz, 2015). The integration of content and language is based on the idea that languages are not learned first and then used, but that they are learned by being used (see Genesee and Lindholm-Leary, 2013). CLIL has been welcomed by schools and policy makers in Europe as a convenient solution to the problem of achieving the best possible learning outcomes within the constraints of the school curriculum. Today CLIL is considered to be the main strategy for creating a multilingual population in Europe (Merino & Lasagabaster, 2018). The EU has officially recognized its potential in promoting multilingualism and this is obvious in important policy documents issued over the past 20 years. Also, several CLIL projects have been funded by the Council of Europe aiming to support teacher training, materials development, research in CLIL and dissemination[1].

Studies carried out in the Canadian educational contexts suggest that the integration of L2 with content matter is more effective than L2 instruction in isolation (Genesee 1994, as cited in Pérez-Cañado, 2012). A recent Rapid Evidence Assessment (REA) carried out by Murphy et al. (2020) examined previous research to understand what is known from the research literature concerning foreign language education. Two of the issues addressed were (a) the influence of learning an L2 on other aspects of attainment, and (b) the impact of using an L2 as the medium of instruction on students' academic achievement. Unfortunately, their review indicated that relevant research is very limited. Although they did find some evidence regarding the positive impact of learning an L2 in school on other academic areas, they stressed the urgent need for more systematic research in this area. Research in content learning in CLIL, in particular, is much more limited compared to

[1] Information on CLIL projects funded by the Council of Europe as well as their outcomes is available at the site of The European Centre for Modern Languages: http://www.ecml.at

research in language learning outcomes (Pérez Cañado, 2018a; Hughes & Madrid, 2020) but also more contradictory. Our study aims to address this gap by examining the effect of CLIL instruction on learners' content learning.

2. Literature review

According to Coyle et al. (2010), CLIL is a dual-focused educational approach which focuses on the teaching and learning of both academic, non-linguistic content (e.g., math, history, civics, etc.), and of the foreign or second language in which the academic content is taught. This means that when studying the impact of CLIL on students' learning outcomes, researchers need to examine skills and knowledge related to both academic content and L2. To date, several studies have highlighted the positive impact of CLIL on students' L2 development and especially on their communicative competence (Korosidou & Griva, 2016; Nieto Moreno de Diezmas, 2016 and 2018; Pérez Cañado, 2018b, Pérez Cañado & Lancaster, 2017; Ruiz de Zarobe, 2015, among others).

More particularly, researchers have investigated the language outcomes of CLIL students by comparing them to those of English as a Foreign Language (EFL) learners. These studies aimed to examine the effectiveness of CLIL instruction, as CLIL had been proposed by the European Union as an effective method for the improvement of European learners' foreign language skills (Mattheoudakis et al., 2018). Overall, the results of these studies highlighted the positive effect of CLIL instruction on students' L2 development (Hughes & Madrid, 2020). Researchers reported better overall language ability for CLIL learners (Jexenflicker & Dalton-Puffer, 2010; Lorenzo & Moore, 2010), superior academic language and language complexity (Maillat, 2010), improved writing skills (Gené-Gil, Juan-Garau & Joana Salazar-Noguera, 2015; Jexenflicker & Dalton-Puffer, 2010), listening comprehension (Dallinger et al., 2016; Nieto Moreno de Diezmas, 2018), reading skills (Pérez-Vidal & Roquet, 2015), as well as greater oral fluency and creativity in speaking skills and interaction (Admiraal et al., 2006; Nieto Moreno de Diezmas, 2016). Vocabulary seems to be the linguistic component that benefits the most in CLIL settings. In particular, research suggests that learners who receive CLIL instruction are exposed to massive input including technical vocabulary, academic discourse, and lexical chunks that are not usually encountered in non-CLIL foreign language classes and, as a result, vocabulary and especially,

receptive vocabulary is positively affected by CLIL (Jiménez Catalán & Ruiz de Zarobe, 2009; Merikivi & Pietilä, 2014, among others). Overall, research comparing CLIL and EFL learners concludes that CLIL learners attain higher levels of linguistic and communicative competence when compared to foreign language learners who receive L2 instruction only for a few hours a week (Bialystok, 2016).

As regards the impact of bilingual types of education like CLIL on the academic content, research is much more limited and less conclusive (Murphy et al., 2020). In Spain, Madrid (2011) compared primary and secondary school CLIL and non-CLIL students' performance in social science classes and found that CLIL and non-CLIL learners' scores in this subject showed no significant differences. According to the author, this may be due to CLIL learners' low level of language proficiency, as primary school learners have not had the time to develop their linguistic skills sufficiently in order to function in content subjects in a foreign language.

Similarly, Brindusa et al. (2015) carried out research in primary education in Spain aiming to evaluate the impact of CLIL on content learning. Their results indicated that CLIL education had a negative impact on content learning for children whose parents have a low educational background. Sanjurjo et al. (2019) compared primary school CLIL and non-CLIL students' scores in science and found that CLIL students performed slightly worse than non-CLIL students. Also, in Germany, Dallinger et al. (2016) conducted a study aiming to compare high school CLIL and non-CLIL students' skill development in English and history. Their findings indicated that the number of CLIL instruction hours needs to be greater for CLIL students to attain comparable performance levels in history with their non-CLIL peers.

On the other hand, there is research on the impact of CLIL instruction on content learning suggesting that this is either positive or at least non-detrimental (Admiraal et al., 2006; Jäppinen, 2006). For example, Lamsfuß-Schenk (2008) found that CLIL learners outperformed their non-CLIL peers in history and Ouazizi's study (2016) suggested that CLIL students outperformed non-CLIL learners in both L2 and mathematical competence. He believed that this is because of enhanced student motivation and the fact that the teaching approaches employed in CLIL classes seem to be more effective than those used in traditional non-CLIL classes. Jäppinen's (2005) study in Finland found differences between younger and older students. While younger ones found it difficult to cope with abstract scientific topics, over time, CLIL was found to have a beneficial

effect on their cognitive development. In this particular study, Jäppinen (2005) compared the conceptual structures developed by CLIL and non-CLIL learners and found that CLIL instruction guides learners to construct complex concepts and cognitive schemata which eventually help them to outperform their non CLIL peers. In a more recent study by Mattheoudakis et al. (2018) in Greece, results indicated that CLIL 6th grade students performed significantly better in two tests in Geography than their non-CLIL peers. An interesting finding of this study is that learners' proficiency level in English seems to have an effect on students' performance at the beginning of the school year but differences in students' performance in the CLIL subject fade out as the year progresses.

So, regarding the effect of CLIL instruction on students' academic achievement, results seem to be contradictory and thus point to the need for more systematic research. The fact that CLIL education by default involves the use of L2 for the teaching of content seems to create issues for parents who often express concerns about their children's ability, especially in primary education, to learn content in a language which is not their native one and which is not adequately developed (Hajer, 2000). It is feared that learners' low level of proficiency in L2 will inhibit comprehension of the content and eventually will have a negative effect on subject competence. It is true that teachers may need to simplify the content in order to facilitate student comprehension and this is expected to lead to incomplete or inaccurate understanding (see Hajer, 2000). Another concern shared by parents regards students' ability to transfer content knowledge acquired in L2 to their mother tongue. However, Cummin's interdependence theory (1991) suggests that cognitive academic proficiency in the L1 and L2 are interdependent. When the capacity for cognitive activity increases in one language, it also boosts the same capacity in the other language. In other words, this means that concepts students develop in one language do not need to be re-learned in the other language and therefore, time spent in acquiring content knowledge in one language is not time lost to educational achievement in the other. Based on Cummin's theory, CLIL students are expected to be able to transfer knowledge acquired in L2, during CLIL instruction, to their L1.

3. The study

Taking into consideration the limited number of studies into the impact of CLIL on content learning, the present study aims to provide more evidence regarding its effect on subject knowledge and to

this end it will measure third grade primary school students' academic achievement in CLIL Science[2] as well as their learning growth in this subject over a school year – between October 2022 and March 2023. To this aim, the following research questions are addressed:

(1) Does CLIL instruction impact negatively on CLIL learners' content learning? In other words, are there significant differences between third grade CLIL and non-CLIL students' academic achievement in Science?
(2) What is CLIL students' learning growth in this subject over a school year?
(3) Can CLIL students transfer the academic content acquired in L2 English to their native language?

3.1 The teaching contexts

The present study took place in two public primary schools located in the western part of Thessaloniki, northern Greece: the 12th primary school of Evosmos and the 3rd Experimental Primary School of Evosmos (EPSE). Families of both schools belong to very similar socio-economic and educational levels; overall, the population in the western part of Thessaloniki includes mostly working and middle-class families and is of low to medium socio-economic background. Just like all experimental primary schools in Greece, the 3rd EPSE is supervised by a university department, namely the Department of English Language and Literature, Aristotle University of Thessaloniki, and it follows a lottery-based admission policy. In 2010, the 3rd EPSE was the first public primary school to introduce CLIL in Greece; this was an initiative taken by the Department of English Language and Literature in order to promote CLIL instruction in Greece and carry out studies on the effectiveness of this method.

For the last 13 years, the school's CLIL programme has expanded to all grades (1-6) and covers a variety of subjects, including Arts, Physical Education, History, Science, and Technology. However, these are not available every year to all grades as the CLIL programme is designed depending on teacher availability and scheduling requirements. This may mean that some students are introduced to CLIL instruction in grade 1 while others in grade 3. However, all students graduating from the 3rd EPSE have attended at least one CLIL class during their primary schooling; attendance of CLIL classes is compulsory for all students and families cannot opt out. For reasons

[2] The subject in the Greek curriculum is known as Environmental Studies.

related to Greece's educational policy, to date the 3rd EPSE has been the only state primary school in Greece that provides a structured CLIL programme. Over the last decade, interest in CLIL instruction in Greece has increased and several primary and secondary schools have implemented it, albeit mostly as short-term projects initiated by teachers. As CLIL does not yet have an official status in the Greek state educational system, its implementation continues to depend on individual teachers' initiatives (Varis, 2023).

The implementation of CLIL instruction in the 3rd EPSE integrates fully the teaching and learning of English as a foreign language and that of the subject content, and this is reflected on both the instructional and assessment aims of the programme (see Massler et al., 2014). CLIL classes are taught exclusively in English (students' L2) and all assignments and assessments - formative as well as summative ones - are in English. The content taught in CLIL classes is not taught or repeated in learners' L1, and therefore, the CLIL teacher is fully responsible for covering the syllabus of the subject taught in English. At the same time, as the aim of these CLIL classes is to integrate content and language, CLIL teachers are required to provide scaffolding and language support in L2 so as to make input comprehensible. As CLIL programmes have been accused of being elitist (see Paran, 2013), it needs to be stressed that the particular school does not implement CLIL selectively and it does not exclude any of its students from attending CLIL classes. Besides, as students are admitted through lottery, there is no possibility to select students on the basis of their academic skills. This means that CLIL classes at the 3rd EPSE include students of various achievement levels in both English (L2) and the subject taught; inclusivity and diversity are thus promoted.

Parallel to the CLIL instruction, the school implements a robust EFL programme in grades 1 to 6: this includes five EFL sessions per week in grades 1 and 2, seven EFL sessions in grades 3 and 4, and eight sessions in grades 5 and 6. EFL instruction promotes an implicit rather than an explicit approach to language teaching and aims to provide extensive input in English so as to boost learners' L2 development. The EFL curriculum does not follow a prescribed textbook but it is theme-based, including short stories and children's literature targeting native speakers of English; teachers' aim is to create a language-rich environment so as to immerse students in the L2.

CLIL subjects in the 3rd EPSE are commonly assigned to EFL teachers; these are all qualified EFL instructors with relevant postgraduate studies – usually an MA degree in Applied Linguistics or TEFL. All of them are required to attend in-service training for teaching school subjects other than English prior to being assigned a CLIL subject. Finally, with respect to the CLIL materials, these are basically designed by the CLIL instructors and based on the standards prescribed by the Greek state. Such materials include, for instance, authentic reading texts, audiovisual material, worksheets, and projects.

The 12th primary school of Evosmos implements the EFL programme prescribed by the Greek Ministry of Education: two EFL sessions per week in grades 1 and 2 and three EFL sessions in grades 3-6. For the teaching of English (L2), the teacher employs EFL textbooks prescribed by the Ministry of Education. The school does not implement CLIL instruction and thus all school subjects, except for the foreign language classes, are taught in Greek – students' native language – by the mainstream teacher.

3.2 Participants

A total of 60 third grade students (8-9 years old) took part in the study. Of them, 45 were students of the 3rd EPSE (experimental group) and 15 were students of the 12th primary school (control group). This numerical difference between the two schools is due to the fact that the 3rd EPSE has two classes of students in each grade (23 to 24 students each), whereas the 12th primary school only one (16 to 20 students). Three students in the experimental cohort and one student in the control cohort have been diagnosed with a special learning difficulty; they all participated in the study and their results were included in the data examined. Additionally, one more student of the control cohort attend a pull-out programme[3] because he is an immigrant and is learning Greek as a second language. The specific student has been excluded from the experiment; although he attended the Science class and took the summative test, his test was not taken into consideration in the analysis of the results as his language skills in Greek are still quite low. Students in both schools attend a Science class for two sessions per week and the syllabus covered by both cohorts is the same; the only difference concerns the language of instruction: the experimental cohort receives the content in English, whereas the control group receives it in Greek.

[3] Pull-out is a programme in which students with limited Greek proficiency are "pulled out" of regular, mainstream classrooms for special instruction in Greek as a second language.

3.3 Materials and assessment tools

The Science syllabus in grade 3 covers the following modules: (a) planet Earth, (b) continents and oceans, (c) landforms, (d) map of Greece, (e) types of maps; how to read a map, (f) traveling safely; means of transportation; road signs (g) mammals; life cycle, (h) farm animals, forest animals, and sea animals, (i) amphibians, (j) life cycle of a plant, (k) evergreen and deciduous plants. Both the CLIL teacher of the 3rd EPSE and the mainstream teacher of the 12th primary school covered the same modules, as these are prescribed by the national curriculum.

The research tools of the study were two tests, both written in Greek. The first one was given to both cohorts – control and experimental – in March; although we could have given the test earlier in the year, we chose to wait a bit longer so as to give CLIL students more time to familiarize themselves with the method and further develop their L2 skills, as lexical support in L1 was not provided This was a summative test aiming to revise the module on means of transportation and road signs, as both cohorts had just completed the particular module. The tests were graded by the respective mainstream teacher of each class. The test included four sections: (a) labeling the means of transportation illustrated, (b) classifying them according to the means by which they travel, (c) identifying five different road signs and explaining what they mean, and (d) a true/false section on safety regulations. The maximum score on the test is 32. Students of both cohorts were given 30 minutes to complete the test in class.

The second test was given only to the experimental group (3rd EPSE), in October as a pre-test and at the end of April as a post-test. The test included seven sections and covered nearly all modules of the syllabus. The activities were appropriate for children's age and required them to match words with definitions, label pictures, identify and classify, fill in gaps, answer multiple choice and true/false questions, and finally, provide more extended answers to two open-ended questions. The maximum score on the test is 45. This test aimed to examine students' academic growth over the school year with respect to the particular school subject. As the subject was taught exclusively in English, we aimed to examine (a) whether students were able to acquire the content taught in English (L2), and (b) whether they would be able to transfer this knowledge from English (the language of instruction) to Greek, which is their native language. Both tests were graded by students' mainstream teachers as the test was in Greek. The test was completed within 40 minutes in class.

In order to answer the first research question, i.e., whether the instruction of Science in English impacts CLIL learners' content learning, we compared the two cohorts' performance in the summative test (on the module 'means of transportation and road signs'). In order to address the second research question regarding CLIL students' learning growth in the specific subject, we compared their scores in the pre-test taken in October with those in the post-test taken in April. CLIL students' scores in the post-test and their academic growth, reflecting the differences between the pre and post-test scores, will also help us answer the third research question, i.e., whether CLIL students can transfer knowledge about the academic content acquired in English to their native language, Greek.

As already mentioned, the second test (pre and post-test) was given only to the CLIL group. Our initial aim was to give the same test to the control group as well so as to compare the two groups' learning growth over the year in science content. This kind of data would have provided us with more robust evidence regarding the impact of CLIL on students' content knowledge. Unfortunately, due to administrative complications, the permission needed for access to the non-CLIL school was delayed and consequently we decided to exclude the control group from this measurement.

4. Results

With respect to the first research question, below we are presenting descriptive and inferential analyses of the data from the summative test taken by CLIL and non-CLIL learners.

	Experimental cohort (CLIL)	**Control cohort (non-CLIL)**
Mean	28.55	22.00
SD	4.59	3.16

Table 1: CLIL and non-CLIL students' mean scores in the summative test

We carried out an independent t-test in order to examine whether there is a significant difference between the scores achieved by the two cohorts. Levene's $p > .05$, and therefore there is equality of variance. As illustrated in Table 1, the experimental cohort outperformed the control one (mean score 28.55 vs. 22.00) in the summative test taken in March and the difference between the conditions is significant ($t = 5.14$, $df = 60$, $p < .001$). Having said that, we should also note

that the standard deviation is higher in the experimental group than in the control one (4.59 vs. 3.16), which indicates that CLIL students' scores are more spread out whereas non-CLIL students' scores are clustered around the mean, and therefore their performance is more homogeneous.

For each cohort, we classified students' scores in 4 bands (0-7, 8-15, 16-23, and 24-32) in order to compare the two cohorts' distribution of scores. Figures 1 and 2 show the distribution of scores for each cohort separately. In particular, Figure 1 illustrates non-CLIL learners' distribution of scores and Figure 2 those of CLIL learners':

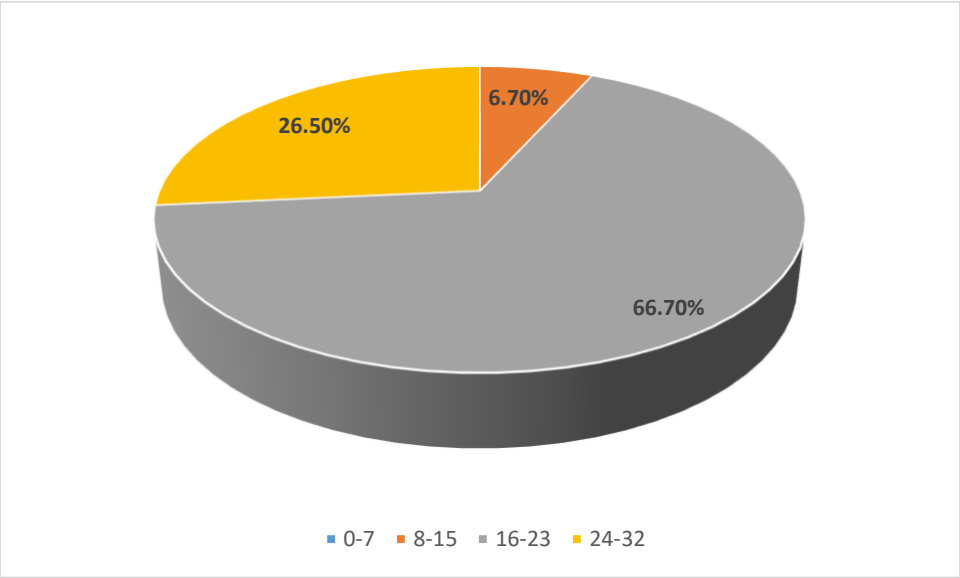

Figure 1: Non-CLIL learners' distribution of scores

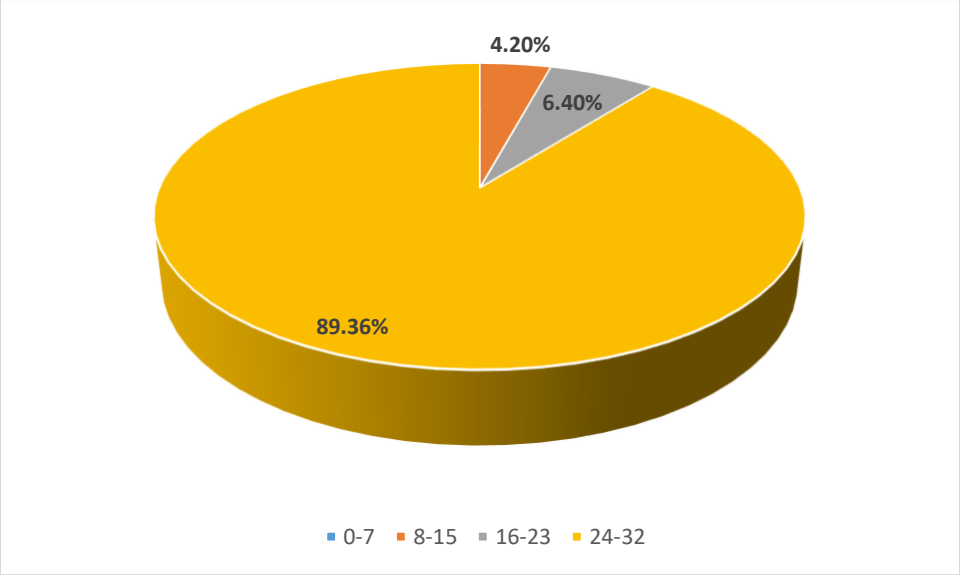

Figure 2: CLIL learners' distribution of scores

The main difference between the two cohorts as regards the distribution of their scores lies in the percentage of students in the top two bands. In particular, the majority of non-CLIL learners (66.7%) received scores between 16 and 23 (Figure 1), while the vast majority of CLIL learners (89.36%) received scores between 24-32 (Figure 2).

In order to answer the second research question, that is, whether or not there is significant learning growth in the CLIL subject over a school year, we carried out a paired samples t-test and compared CLIL students' scores in the pre-test (taken in October) and the post-test (taken in April). Table 2 presents the descriptive and inferential statistics of the data:

	Pre-test	**Post-test**
Mean	20.64	34.58
SD	7.631	7.200

Table 2: CLIL students' performance in the pre- and post-test

Results indicated that CLIL students scored significantly higher in the post-test (mean score 34.58) than in the pre-test (20.64) (t = -15.16, df = 44, p < .001, two-tailed). The standard deviation is quite similar in both tests, but slightly lower in the post-test (7.63 vs. 7.20). These results also provide an answer to the third research question of our study; students' significantly higher scores in the post-test provide robust evidence regarding their ability to transfer the academic content acquired exclusively through English (L2) to their L1. As the test was written in Greek, this required students both to comprehend the questions but also provide answers by using Greek irrespective of the fact that the subject was taught entirely in English.

5. Discussion

The implementation of CLIL instruction in Greece is very limited as it is not yet supported by a central educational policy (Varis, 2023). Although CLIL was first introduced in 2010 at the 3rd EPSE, this is still the only Greek state school to systematically implement CLIL instruction (Mattheoudakis et al., 2018). Given the limited implementation of CLIL in this country, which is mainly due to the 'institutional rigidity' of Greek state education (Varis, 2023: 4), it is important to collect data about its effectiveness. We hope that disseminating information about the impact of CLIL

instruction on students' language and academic development will provide all stakeholders with robust evidence about the method's potential and facilitate decisions regarding its adoption in mainstream schools.

Our study aimed to explore the impact of CLIL instruction on learners' content learning by comparing two cohorts of 3rd graders in two neighbouring state primary schools in Thessaloniki, northern Greece. The experimental cohort attended a CLIL class in Science with English as a medium of instruction, while the control cohort attended the same class in Greek (L1). The comparison was based on students' performance in a summative test taken in March and results indicated that CLIL learners performed significantly better than their non-CLIL peers. These results suggest that CLIL instruction and the use of English (L2) as a medium of instruction for the teaching of Science in grade 3 do not impact negatively on CLIL learners' content knowledge. With the exception of three CLIL students who achieved low scores in the summative test, the rest of the CLIL cohort achieved scores higher than 21 with the vast majority of them (89.36%) scoring between 24 and 32. As regards the non-CLIL students' performance, the majority of them scored between 16-23 and only a quarter of this class achieved scores in the top band. Taking into consideration CLIL students' diverse academic skills and learning profiles, as CLIL instruction addresses all 3rd graders, such results indicate that irrespective of their academic competence, nearly all CLIL students demonstrate academic gains.

Our findings do not agree with those of Madrid's (2011) and Sanjurjo et al.'s (2019), whose studies also examined the impact of CLIL instruction in a primary school context. Having said that, we should point out that such comparisons may not always be valid, as variables such as students' L2 proficiency, teachers' instructional strategies and training or even the CLIL material used in each context may interfere with the results and impact on students' academic performance in the subject content. On the other hand, our results corroborate previous findings such as those by Lamsfuß-Schenk (2008) in a CLIL history class and those by Ouazizi (2016) in a CLIL math class. A major difference between our context and Ouazizi's research context is that his CLIL group received Math content both in English (L2) and Dutch (L1), which obviously is expected to have had a positive impact on their academic performance. According to the author, the positive results may also be explained by the CLIL environment which promotes a pedagogical context very similar

to the L1 acquisition environment. Finally, our results also sit well with those of a previous study by Mattheoudakis et al. (2018) in the same school which examined the impact of CLIL instruction on 6th grade students.

Both parents and teachers of students who receive bilingual education and are required to attend content classes in an L2 are often concerned about learners' ability to acquire subject content in a language in which they are less than proficient (Hajer, 2000) Similar concerns are quite expected, since in bilingual education settings students often face challenges in their effort to comprehend the academic content in a language other than their L1 and to engage meaningfully with it (see Dalton-Puffer, 2008; Hajer, 2000; Jäppinen, 2005). Our study aimed to examine CLIL students' ability to acquire the academic content taught in English (L2) by measuring their learning growth over a school year. As the test used was delivered in Greek, students' results would also indicate whether they are able to transfer knowledge acquired in L2 English to their native language, viz. Greek. The results obtained clearly suggest that, despite the challenges encountered in these settings, CLIL learners manage not only to acquire the subject content when this is taught in English (L2), but also to demonstrate this knowledge in a test written in Greek (L1). This finding also suggests that the capacity for cognitive activity in one language enhances the same capacity in the other and therefore, cognitive academic proficiency in the L1 and L2 are interdependent (Cummins, 1991). Two recent studies, one by Evnitskaya and Dalton-Puffer (2023) on CLIL students' use of the cognitive discourse function (CDF) 'categorize' and that by Nashaat-Sobhy and Llinares (2023) on CLIL students' definitions have also found that students are able to perform similarly when expressing content in L1 and L2; such findings provide further evidence regarding transferability of learning from one language to another.

Taking into consideration (a) that this was the first CLIL experience for the experimental cohort of our study, and (b) that their proficiency in L2 English is quite low (pre-A1), those results are very good news but also quite astonishing and therefore, call for further discussion. Vollmer et al. (2006) argued that students in CLIL contexts often face challenges due to the difficulty of the new concepts presented but also due to the medium of instruction; thus, they are required to be continuously focused and work hard in class. They need to be alert, form assumptions and check for understanding (se also Mendez, 2014). This seems to boost their resilience as they learn to tolerate frustration, which also leads them to develop a higher degree of procedural competence in

the subject taught. In other words, it is suggested that far from being a hindrance, linguistic challenges in CLIL settings may help students intensify their mental activity, which eventually allows them to comprehend the curricular concepts taught. Jäppinen (2005) carried out a study in Finland aiming to compare the conceptual structures developed by CLIL (experimental group) and non-CLIL learners (control group). Her findings revealed significant differences between the two cohorts in favour of the experimental one. According to Jäppinen, CLIL learners, in their effort to process and understand subject content in a foreign language, construct complex concepts and cognitive schemata. Mattheoudakis et al. (2018) similarly argued that CLIL contexts can become highly demanding for learners because they require them to attribute meaning to concepts for which they do not yet know the equivalent terminology in their mother tongue and this possibly helps them develop critical thinking and problem-solving skills.

Of course, apart from looking into the learning process from students' perspective, we should also examine teachers' instructional and linguistic practices in CLIL classes. In other words, outperformance of CLIL learners may also be attributed to the demands CLIL places on teachers. CLIL educators are very well aware of the difficulties learners may encounter in their efforts to process the content in a language other than their mother tongue. Such difficulties are often due to a new or difficult concept or even to the use of another language and to the academic vocabulary. The difference between CLIL and non-CLIL educators is the fact that the former are 'more sensitive' to the linguistic and academic challenges experienced by CLIL learners; academic vocabulary is frequently very hard even in L1. However, similar difficulties may be ignored in mainstream classes, not because of mainstream teachers' indifference, but because knowledge of the L1 is a given and very often this is overestimated; teachers are not always aware that L1 vocabulary may be unknown at times and therefore needs to be explicitly taught. For CLIL teachers, this is a default situation. When learners are quite young, as is the case with our CLIL 3rd grade students in the present study, their limited world knowledge and academic language in L1 are expected to further challenge their curricular comprehension. The role of CLIL instructors is particularly crucial in such contexts; they are constantly aware of the need to paraphrase, explain, modify, simplify and repeat the content in order to make it comprehensible to all (Mattheoudakis and Alexiou, 2017). It

is possible that such practices are not as common in non-CLIL classes where content is delivered in students' L1 and educators may falsely assume that similar modifications of input are not always necessary.

The selection of CLIL subjects and their impact on students' academic achievement has not been adequately researched in the literature. Based on the results of our study, we suggest that Science seems to be linguistically and cognitively accessible to CLIL primary school students and therefore, highly appropriate for CLIL instruction. Although scientific concepts can be quite abstract and conceptually challenging in higher grades (see Jäppinen, 2005), the syllabus of the specific subject in grade 3 covers concepts that are concrete and imageable: landforms, animals, plants and trees, maps, road signs, etc.; this feature allows CLIL instructors to support the instruction of the academic content with visuals – pictures, videos, maps, all sorts of realia – and thus enhance content comprehensibility. We suggest that this is one of the major reasons that might account for CLIL learners' high scores in both the summative test taken in March and in the post-test taken in April.

Another possible reason for learners' high performance in those tests is the fact that most activities required limited language production; only a couple of questions in the pre/post-test required more extended written production. Of course, it is true that most tests taken by young learners in the lower grades of primary school (grades 1 to 3) have a similar format and require minimal language production on the part of the students as their L1 writing skills have just started developing and are still quite limited. The positive results of our study may also be due to the fact that the material taught in the specific subject (Environmental Studies) is neither abstract nor particularly complex since 3rd grade students are quite young. However, as students get older, both language and content become more abstract and challenging and therefore it would be interesting to carry out similar research with high school students to explore the impact of CLIL on older students' academic performance.

Finally, a factor that may impact on CLIL students' academic gains is their families' support. We remind the reader that admission to the 3rd EPSE is lottery-based and parents/guardians cannot opt out of the CLIL programme, which is compulsory for all students. Although we have not examined families' beliefs and attitudes regarding CLIL instruction, we might assume that they are quite positive towards it and willing to support it since they choose to register their children in

the specific school which systematically follows a CLIL instructional programme. Family support is expected to impact positively on students' attitudes towards CLIL instruction and also on their academic performance in CLIL subjects.

A significant limitation of this study is the limited data available; ideally, we would like to have had data from more CLIL and non-CLIL learners, but due to the limited implementation of CLIL programmes in Greece, this is not possible. Additionally, as already stated, we aimed to collect control students' scores in the pre- and post-tests so as to compare them with those of the experimental cohort's but due to unforeseen circumstances, this plan did not materialize.

6. Conclusion

Studies into the impact of CLIL on content outcomes are quite limited compared to those examining the impact of CLIL on students' L2 proficiency (Murphy et al., 2020). Llinares (2015) attributes this to the fact that CLIL has mainly attracted Applied Linguists' and language educators' interest, while content is an issue that requires collaboration between language and content experts. However, the issue of whether CLIL students are able to understand and learn content that is taught in a foreign language is a continuous concern for educators and parents (Dalton-Puffer, 2008). As the language of instruction is not learners' mother tongue, it is feared that CLIL learners may not be able to understand the content as well or as accurately as they would have understood it if the language of instruction was their L1.

The present study aimed to contribute to research in this area and examined the impact of CLIL instruction on students' content learning. The participants of our study included a group of 3rd graders (8-9 years old), native speakers of Greek who attended a CLIL class on Science, and a group of non-CLIL learners of the same age who attended the same class in L1 Greek. Our results, though limited, are quite encouraging for the implementation of CLIL instruction in primary schools as they indicate that the use of English as a medium of instruction, far from impeding content understanding, has a positive impact on students' content learning, as this was reflected on CLIL students' performance in the summative test and in the post-test taken at the end of the year.

This study's participants included young learners with a very low English language proficiency. Although several studies in CLIL have involved primary school learners, these are usually older than 8 years of age. The fact that CLIL instruction was shown to have a positive impact on those

young learners' content learning is both encouraging and highly promising for parents, educators and policy designers; it suggests that CLIL instruction can be introduced systematically from the very early grades of primary school and thus intensify foreign language instruction, since it adds further input to that provided in the regular foreign language classes, without overloading the school timetable and without risking students' academic achievement.

As bilingual education expands on a global level, we need to carry out systematic and coordinated studies into the impact of learning foreign languages and of learning content in a foreign language on academic outcomes. Access to reliable data will allow language policy designers to make informed choices regarding the provision and intensity of bilingual education. Similar studies are urgently needed, especially in Greece where CLIL is still at an embryonic stage.

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