

# The Other Side of the Moon: Content-Specific Learning in CLIL in Core and Non-Core Subjects

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**Abstract** With respect to the development of language skills, in CLIL the acquisition of content has so far received less attention. The paper investigates the learning of content-specific competence in Italian high school students of Chemistry and Physics in CLIL and in traditional education. Both subjects are science-oriented but differ in their status in the two schools: Chemistry is a core subject in a science-oriented school, whereas Physics is a non-core one in a humanities-oriented school. Findings point out that students' attitude and motivation toward the core and non-core subject plays a complex and unexpected role in the learning of content in CLIL.

**Keywords** CLIL. Content-specific learning. Motivation. Argumentative skills. Core and non-core subjects.

**Summary** 1 Introduction. – 2 Content-Specific Learning Perspective in CLIL. – 3 The Study. – 3.1 Research Questions. – 3.2 Participants. – 3.3 The CLIL Teaching Units. – 3.4 Data Collection. – 4 Analysis. – 5 Discussion. – 6 Conclusions.

## 1 Introduction

Content and Language Integrated Learning (CLIL) is one of the educational approaches which has received more attention in recent language learning literature. It has been investigated from numerous perspectives in many different contexts and regarding several languages and non-linguistic disciplines, and it has achieved a

strong consensus from policymakers, teachers, and families (Santipolo 2021). Theoretical and applied interest for CLIL is particularly lively in Europe: thanks to its peculiar integration of foreign, or additional, language and disciplinary content (Marsh, Langé 1999), CLIL can fulfil the European Commission and Council of Europe requirements to educate multicultural and multilingual citizens in all member countries (Eurydice 2006).

In Italy, the first studies on CLIL were by Coonan (1998; 2000; 2002) and Serragiotto (2003), which defined the topic and pointed out its relevant features, such as language for specific purposes, interaction between language and content, evaluation, and teacher training. In subsequent years, several studies focused on these factors in CLIL applied to the Italian education system (Coonan 2006; 2008; Di Sabato, Cordisco 2006; Menegale 2006; Ricci Garotti 2006; Serragiotto 2007; Mazzotta 2009). Starting from the first surveys on CLIL, studies on Italian schools mainly examined the acquisition of language, while only a few studies (Infante 2010; Ricci Garotti 2017; Rosi 2018) considered the acquisition of content, which remains a sort of 'the other side of the moon' in CLIL. Content-specific learning was far less explored than language-specific learning in CLIL, not only in Italy, although both components are crucial to a good understanding of the CLIL educational approach. There are several reasons for this scarce attention to the content-specific perspective. Unlike the validated standard for language testing, no international standard evaluation was developed for non-linguistic disciplines (Dalton-Puffer 2011). Moreover, a focus on content requires an interdisciplinary research team with expertise on language teaching and one, or more, non-linguistic discipline(s).

The paper aims to add another piece of the puzzle regarding the acquisition of content by comparing CLIL effects on content-specific learning in two subjects with two different statuses in students' school careers: a core discipline (Chemistry in a science-oriented high school) and a non-core one (Physics in a humanities-oriented high school). To the best of our knowledge, no studies to date have carried out a comparison among CLIL effects on core vs. non-core subjects, neither in Italy nor in other countries, neither regarding language nor content. Nevertheless, the different statuses of the subjects account for different student motivation toward the disciplines in question and, consequently, toward the CLIL experience overall, thus emphasising that motivation is crucial for learning achievements in CLIL contexts (for studies on motivation in CLIL see Seikkula-Leino 2007; Lasagabaster 2011; Doiz, Lasagabaster, Sierra 2014). Moreover, a better understanding of CLIL benefits on core or non-core subjects is relevant for decisions regarding the selection of disciplines to be performed through CLIL. In Italy, the appointment of teachers and disciplines for CLIL is the responsibility of the headmaster of

each school. The headmaster, in accordance with the board of teachers of the single classes, identifies the instructors to be trained as CLIL teachers in the official methodological training course<sup>1</sup> and to be appointed to give CLIL lessons. When more than one teacher has the required language proficiency level (C1) and asks to be trained, the headmasters usually tend to give priority to a teacher of a core subject for the specific high-school orientation. Thus, results of the present study may have both theoretical and applied implications.

## 2 Content-Specific Learning Perspective in CLIL

While the beneficial effects of CLIL have been empirically proved regarding the acquisition of language and rise in motivation in language learning (Dalton-Puffer 2011; Dalton-Puffer, Nikula 2015; Roquet, Pérez-Vidal 2017), the debate about the impact of CLIL on content-specific learning is still open.

The positive effects of CLIL on the acquisition of disciplinary competence are documented by Van de Craen, Ceuleers, Mondt (2007), Serra (2007), Gregorczyk (2012), Canlas (2016), and Surmont et al. (2016). These studies mainly reveal that CLIL students outperform their traditionally-educated peers in written tests in L1 on disciplinary topics taught in CLIL. By contrast, CLIL students turn out to underperform non-CLIL students according to Lim Falk (2008), Dallinger et al. (2016), Piesche et al. (2016), Fernández-Sanjurjo, Fernández-Costales, Arias Blanco (2019), Virdia (2022). Finally, other studies note no significant differences between CLIL and non-CLIL students (Seikkula-Leino 2007; Haagen-Schützenhöfer, Hopf 2014; Ricci Garotti 2017). The surveys examine students of primary, middle and high school, from different foreign languages in several countries and various disciplines. With specific regard to the subjects tested in the present research, for Chemistry, CLIL positive effects on disciplinary competence tested in L1 emerge in Polish middle-school CLIL students compared to their peers instructed in L1 (Gregorczyk 2012); for Physics, Canlas (2016) underscores that CLIL can foster conceptual understanding of disciplinary topics in Kazakh year 9 high-school students tested in EFL, while Haagen-Schützenhöfer, Hopf (2014) document no significant differences among CLIL and non-CLIL students of Austrian year 11 high-school classes, tested in L1 German.

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**1** The Italian official prerequisites for a CLIL teacher are to work as an in-service non-linguistic discipline teacher, to hold a certification of C1 competence in the language involved in CLIL and to pass the methodological training course (Aiello, Di Martino, Di Sabato 2017). The recruitment of teachers for the training course is organised by regional scholastic institutions on the basis of headmasters' indications.

Haagen-Schützenhöfer and Hopf (2014) underline CLIL's beneficial effects on students' motivation. Students are more motivated after a 4-month CLIL experience than before. It is worth noting that the increase of motivation occurs not only in students with a great interest in English and Physics, but also in students with medium to low motivation toward Physics and with low scores in the subject. CLIL can encourage students with low motivation and low competence in the non-linguistic discipline to strive harder to participate in lessons and to study at home. Indeed, Coonan (2007; 2012) and subsequent studies (Dalton-Puffer et al. 2009; Lasagabaster, Sierra 2009; Ricci Garotti 2017) point out that CLIL entails environmental features which foster students' motivation, such as authentic and stimulating learning material, learner-centred approach, strong sensitivity of the teacher toward students' needs. Furthermore, CLIL enhances intrinsic and instrumental motivation, thanks to the linguistic improvement students perceive they gain and the high relevance of foreign language proficiency for future careers according to the opinion of pupils and their families (Seikkula-Leino 2007; Marsh, Zajac, Gozdawa-Gołębiowska 2008).

Just as the acquisition of language was investigated more often than content-specific learning, CLIL effects on student motivation toward language (Lasagabaster 2011; De Smet et al. 2018) were also analysed more often than CLIL's impact on student motivation toward the non-linguistic subject. The longitudinal survey by Lasagabaster and Doiz (2015), monitoring more than 300 high-school students over 2 or 3 years, shows that CLIL students are more motivated toward content than non-CLIL pupils, and that motivation toward the discipline remains constant in CLIL students over time.

### 3 The Study

#### 3.1 Research Questions

The study aims to answer to the following research questions:

RQ1: Does CLIL foster the acquisition of disciplinary content?

RQ2: Does CLIL have different effects upon students' receptive disciplinary knowledge and productive argumentative skills in L1?

RQ3: Does CLIL have different effects if applied to core or non-core subjects?

#### 3.2 Participants

The students who took part in data collection were 89, but only 64 were present in all the 3 elicitation sessions and were included in the final sample. There were 31 CLIL students (10 F, 21 M; mean age

= 16.6) and 33 non-CLIL students (23 F, 10 M; mean age = 16.5). The students belonged to 4 third-year high-school classes (Year 11) in two different schools located in the area of Salerno, in the South of Italy: an industrial technical high school and a humanities high school (*Liceo delle scienze umane*). In each school, a CLIL class and a non-CLIL class, as a control group, were involved in the research. The CLIL and non-CLIL student groups were examined in Chemistry in the former school and in Physics in the latter. Chemistry constitutes a core subject since it is a foundation discipline for a student's career in the science-oriented school, while Physics is considered a non-core subject since students are focused mainly on Pedagogy and Psychology in the humanities-oriented school.

The students were all Italian-native speakers with an active knowledge of the local dialect. In the CLIL core class, one student is an Italian-Belarusian bilingual speaker; in the CLIL non-core class, one student is an Italian-Ukrainian bilingual speaker; in the non-CLIL non-core class one student is an Italian-German bilingual speaker. When the research began, all students had studied English as a Foreign Language (EFL) for 10 years and reached the A2 or B1 level of CEFR (Council of Europe 2001). The disciplinary competence in the two examined subjects was similar between CLIL and non-CLIL classes, as emerged from the pre-test.

### 3.3 The CLIL Teaching Units

The two teaching units (TUs) examined for core and non-core subjects constituted the first experience with CLIL for students. The TUs were carried out in EFL by the teacher in charge of the discipline, during the regular school timetable and dealt with topics included in the regular syllabus for a third-year high-school class (Year 11): UV-Vis spectrophotometer for Chemistry and Newton's laws of dynamics for Physics. The two TUs were run from March to April and each lasted 5 weeks. In the two experimental classes, the only difference between CLIL and previous traditional lessons occurred with respect to the language of instruction, namely EFL instead of Italian. In fact, in the CLIL TUs both the core and non-core teacher employed the teaching techniques students were already familiar with from previous instruction: teacher frontal explanations, experiments in a laboratory, and interactive classroom activities, such as cooperative content review and exercises.

The CLIL TUs were prepared by teachers who had passed the C1 Cambridge Advanced English Examination and the official methodological training course for CLIL teachers just before the research started. Both teachers are women, aged between 55 and 60, with comparable teaching experience at school. Both used to share teach-

ing techniques, activities and materials with the teachers of the control classes, so that in CLIL and non-CLIL classes the two monitored TUs differed only in terms of the language of instruction: EFL in the CLIL class vs Italian in the non-CLIL class.

### 3.4 Data Collection

Data were collected in 3 elicitation sessions: a pre-test right before the TUs (T1), a post-test just after the TUs (T2), and a delayed post-test 5 weeks later (T3). CLIL and non-CLIL students filled in the same questionnaires concerning disciplinary topics in Chemistry or Physics in Italian in order to collect comparable data. At T1, the questionnaire dealt with background on content-specific concepts, at T2 and T3 two identical questionnaires about the TU topic were administered to test short-term and long-term retention of constructs taught in the TUs.<sup>2</sup>

The questionnaires consisted of 10 multiple-choice questions (M1) and 10 requests for a short written explanation of the chosen answer in the previous multiple-choice questions (M2). The former measurement gauges the receptive disciplinary competence needed to individuate the correct answer, while the latter focuses on the productive argumentative skill necessary to justify the given answer. The former competence is based on a deep understanding of disciplinary concepts. The latter competence entails both deep understanding of disciplinary concepts and proficiency of technical language, as students were required to explain, with their own words, the connection between concepts in M1 and related factors they had to identify and discuss. Both M1 and M2 answers were scored as 1 if correct or 0 if incorrect, incomplete or missing. The questionnaires were prepared by the teachers who designed and carried out the TUs. Students' answers were blindly assessed by two external teachers, one for Chemistry and one for Physics, who did not know which students were from CLIL or non-CLIL classes.<sup>3</sup>

At T1, CLIL students filled out a background questionnaire about their own linguistic repertoire, previous study of EFL and a self-evaluation of EFL competence, attitude toward EFL and toward the monitored subject (Chemistry or Physics). At T2, CLIL students completed a feedback questionnaire on the experienced CLIL TU.

<sup>2</sup> The echo effect at T3 with respect to T2, if any, was analogous for CLIL and non-CLIL students in both the subjects.

<sup>3</sup> The author would like to thank Gioacchino Amato for support in collecting and transcribing data, Tullia Aquila, Carmine Licerti, Rosa Labadia, and Maria Buonocore for preparing the TUs and questionnaires, Alessio De Giorgi and Francesco Amato for scoring students' answers.

## 4 Analysis

For the two sets of CLIL and the non-CLIL classes, mean score and coefficient of variation are calculated for each elicitation: mean score profiles the learning trend; coefficient of variation gauges data dispersion within the class. Both values are calculated for M1 and for M2, then are summed up to have a comprehensive measurement of students' disciplinary competence. The differences between the mean of the two classes, based on the sum scores of the students' tests, were analysed with a T-test when  $p < 0.05$  and  $p < 0.01$ , in order to verify the reliability of comparisons between means. A between-groups analysis and a within-group analysis were performed using a T-test to validate comparison of results between the two classes in each test, as well as comparison of a single class's scores among the three elicitations.

Figure 1 shows mean scores for M1 and M2 summed up, within the maximum score of 20 (10 M1 questions + 10 M2 questions).

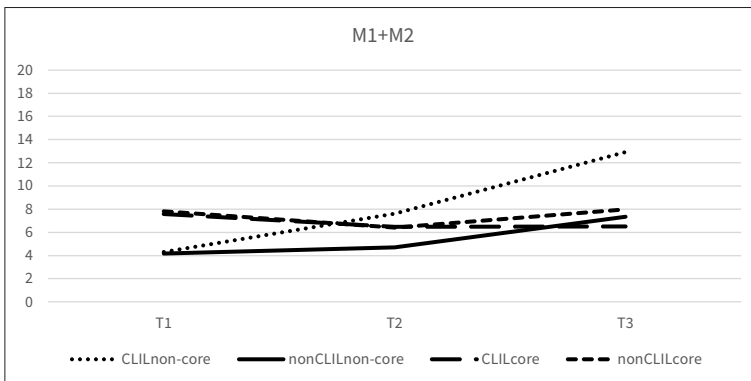


Figure 1 Mean scores at T1, T2 and T3 for the 4 groups (M1+M2)

The mean scores of M1+M2 are very similar to T1 in the two sets of CLIL and non-CLIL classes and no statistical significance arises. This result underlines that CLIL and non-CLIL classes are aligned before CLIL, both for Chemistry and Physics. After the TU, CLIL students of Physics improve their disciplinary competence (4.31 mean score at T1 vs 7.62 mean score at T2) and improve still more at T3 (12.93 mean score). The non-CLIL non-core class does not show relevant differences between T1 and T2 (4.16 mean score at T1 and 4.31 mean score at T2), with an improvement only at T3 (7.33 mean score) but to a lesser extent than CLIL-students (12.93 mean score). In turn, in CLIL students of Chemistry, disciplinary competence slightly decreases after the CLIL TU (7.59 mean score at T1 vs 6.46 at T2, 6.52 at T3). A similar negative trend oc-

curs for non-CLIL students of Chemistry from T1 and T2 (7.80 at T1 vs 6.40 at T2). At T3 the mean score (7.97) is comparable with T1 (7.80), whereas in CLIL core students the mean score at T3 is lower than in T1.

Figure 2 shows the mean scores for M1 and for M2 separately, within the maximum score of 10.

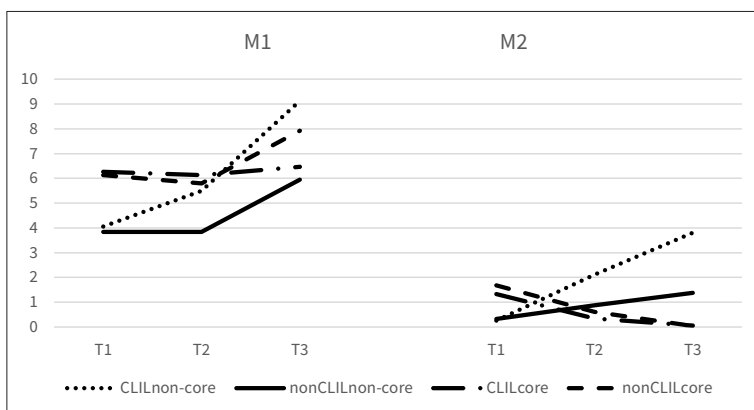


Figure 2 Mean scores at T1, T2 and T3 for the 4 groups in M1 and in M2

The comparison between the two disentangled measurements reveals that M1 mean scores are generally higher than M2 scores, confirming that receptive disciplinary competence is easier than productive argumentative skill. So, it is particularly remarkable that CLIL students of Physics improve in both the measurements and in M2 even more than in M1 (M1: 4.06 mean score at T1, 5.50 at T2, 9.12 at T3; M2: 0.25 at T1, 2.12 at T2, 3.81 at T3). Non-CLIL students of Physics show a positive trend for both M1 and M2 (M1: 3.83 mean score at T1, 3.83 at T2, 5.95 at T3; M2: 0.33 at T1, 0.88 at T2, 1.38 at T3), but with much lower improvement with respect to CLIL non-core students. On the other hand, CLIL students of Chemistry do not increase their competence in M1 (6.26 mean score at T1, 6.13 at T2, 6.46 at T3) and greatly diminish their competence in M2 (1.33 mean score at T1, 0.33 at T2, 0.06 at T3). Non-CLIL students of Chemistry reduce both M1 and M2 mean scores after the TU (M1: 6.13 at T1 vs 5.80 at T2; M2: 1.67 at T1 vs 0.60 at T2).

As for the coefficient of variation, data for each measurement and for the two measurements added together are reported in table 1.



**Table 1** Coefficient of variation at T1, T2, T3 for the 4 groups in M1, M2, and M1+M2

	T1			T2			T3		
	M1	M2	M1+M2	M1	M2	M1+M2	M1	M2	M1+M2
CLIL non-core	0.39	4.00	4.39	0.29	0.98	1.27	0.14	0.58	0.72
Non-CLIL non-core	0.41	2.30	2.71	0.40	1.15	1.55	0.29	0.99	1.28
CLIL core	1.71	1.43	3.14	1.45	2.47	3.92	2.58	2.61	5.19
Non-CLIL core	2.50	1.14	3.64	1.89	1.65	3.54	2.15	1.94	4.09

In CLIL non-core class of Physics, the coefficient of variation decreases consistently from T1 to T2 to T3 (4.39 vs 1.27 vs 0.72), in particular for M2: productive argumentative skill is 4 before the CLIL module and 0.98 after it. This outcome shows that CLIL can reduce the difference among students' competence levels within the class. A comparison of trends in the mean scores (fig. 1) and in the coefficient of variation (tab. 1) suggests that CLIL students of the non-core discipline become more homogeneous since pupils with an initially low level improve their competence after CLIL and approach the results of their peers with an initially high level. The reduction of differences among students of the CLIL non-core class is determined by the improvement of students with initially low competence, both for M1 and M2. On the contrary, in the CLIL core class of Chemistry, the coefficient of variation increases after the CLIL module. At T1 it is 3.14 (it is lower than in CLIL non-core class before CLIL), at T2 increases (3.92), at T3 rises still more (5.19). In the non-CLIL non-core class it declines but to a lesser extent than in the CLIL non-core class (2.71 at T1, 2.55 at T2, 1.28 at T3), in non-CLIL core class it raises (3.64 at T1, 3.54 at T2, 4.09 at T3).

## 5 Discussion

RQ1 addresses whether CLIL has an effect upon the acquisition of disciplinary content. The comparison among CLIL and non-CLIL students shows that an effect occurs since at T1 the mean score is similar in both the experimental and control groups, while, after CLIL TU, the value differs among the classes. This effect turns out to be divergent in CLIL non-core and core classes. The analysis of CLIL and non-CLIL students' outcomes in the two separate measurements (RQ2) confirms the difference between non-core and core classes and underlines that all students have lower competence in productive argumentative skills (M2) than in receptive disciplinary knowledge (M1). The former is, indeed, more difficult than the latter as it poses high cognitive and linguistic demands on learners (Pallotti 2019).

RQ3 focuses on the CLIL effect upon content-specific learning in core and non-core subjects. The analysis points out that CLIL has a positive effect in the non-core subject and a negative effect in the core subject. CLIL students of the non-core discipline (Physics) outperform non-CLIL students after the TU and improve their disciplinary competence in both the measurements, especially in productive argumentative skills. Moreover, the CLIL non-core class becomes more homogeneous after the TU since students with low competence perform better on the topics taught through CLIL than on topics traditionally taught before the TU, so that variance among students in the class is reduced. Conversely, CLIL students of the core discipline (Chemistry) do not outperform non-CLIL students and show lower outcomes after the TU than before it. In addition, differences among students increase in the CLIL core class.

Thus, the diverse CLIL effect in non-core and core disciplines occurs in an unexpected way. CLIL is supposed to be more beneficial in a subject that students appreciate, such as a core subject (Chemistry) of the specific high-school orientation they choose. Consequently, the headmasters tend to appoint teachers of core subjects as CLIL teachers. In turn, findings of the study suggest that the high motivation toward the subject does not guarantee positive results in acquisition of content in CLIL. The interest toward the discipline can lead students to have a high learning expectancy and to possibly perceive CLIL as an obstacle to a complete understanding of disciplinary concepts. As a matter of fact, such perception emerges from students' statements collected through the feedback questionnaires about the experienced CLIL TU. Students of Chemistry put emphasis on the difficulties they encounter in studying through EFL, in particular for the understanding of disciplinary concepts and technical lexicon; this finding is in keeping with other surveys (Coonan 2009). Students of Physics, instead, focus on the advantage of learning two subjects at once (Physics and EFL) and on the innovative teaching methodology, which makes the lessons more alluring, challenging, and engaging. CLIL applied to a non-core subject can enhance learners' curiosity and commitment toward a discipline that students are not much interested in, without the fear of not perfectly comprehending the disciplinary content. In Rosi, Amato and Zappoli (forthcoming), a cluster analysis among different motivational profiles of students underscores that motivation toward the subject is the trigger factor for CLIL effectiveness and that it arises in an inverse way: students who learn the most from CLIL are learners with a low interest toward the discipline and a low anxiety toward CLIL.

## 6 Conclusions

Findings of the present study provide evidence for different CLIL effects on content-specific learning in non-core and core disciplines on the basis of the analysis of mean score and coefficient of variation. For both the values, CLIL appears to have beneficial influence on the non-core discipline and a negative impact on the core discipline for both types of disciplinary competence investigated in L1 Italian, i.e. receptive disciplinary knowledge and productive argumentative skills.

The results call attention to the role of the status of the disciplines involved in CLIL within a high-school study orientation (core or non-core) and the consequent motivation students show toward the discipline (high or low) for the effectiveness of CLIL. Despite the assumption that CLIL is more advantageous for a core discipline, which is the rationale that leads Italian educational system to appoint more instructors of core subjects than teachers of non-core subjects as CLIL teachers, the high motivation toward the core discipline turns out to weaken the acquisition of content, as students are anxious about not fully mastering topics which are important for their career. In turn, CLIL applied to non-core subjects can arouse learners' curiosity, interest and commitment, with a low fear of undermining comprehension and learning of disciplinary concepts and technical lexicon since the subject is one that students do not see as particularly crucial for their education. It is no coincidence that, in feedback questionnaires, students of the non-core subject (Physics) evaluate the CLIL experience and their own achievements on topics taught through CLIL more positively than students of the core discipline.

The outcomes of the study, which need to be confirmed through further research on larger samples of students and disciplines, display relevant implications for language policy in the Italian educational system regarding the selection of subjects to be taught through CLIL, pointing to the need to rethink the usual priority given to core disciplines for CLIL.

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