

# A Web-based Framework for CLIL in Primary School: Design, Implementation, Pilot Experimentation and Results

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**Abstract.** Content and Language Integrated Learning (CLIL) is an immersive pedagogical approach where the learners' foreign language represents the medium of classroom instruction. In this paper we will discuss its applicability to primary school, addressing children aged approximately between 5–7. Such an approach, relatively novel due to the young age of students, requires ad hoc pedagogical methods, learning resources and multimedia interactive interfaces in order to foster bi-lingualism and – potentially – even multi-lingualism. This work will cover all development stages, starting from an overview of the state of the art, defining the research questions, describing the design and implementation of a suitable Web framework, showing a pilot experimentation, and finally discussing the obtained results.

## 1 Introduction

An emerging trend in pedagogy is to propose rich educational environments based on integrated approaches, including traditional lessons, manipulative activities, and multimedia. The goal is to enhance that educational cross-component able to influence key aspects of children's growth such as expressiveness, autonomy and sociality, in accordance with the fundamental concepts of *pedagogical activism* [Dewey, 2005].

In this sense, technology can profitably support pedagogy. Ad-hoc methodologies, techniques and devices can be designed to make children learn how to interact, listen, watch, discriminate, transpose concepts, develop their cognitive and social skills in meaningful learning contexts. Multimedia and technology can be coupled to create multi-layer learning environments aiming at the integration of skills and abilities. As stated in [Gonzalez et al., 2000], multimedia is more than just a collection of sound, images, video and animations; rather, it is a vital, dynamic field offering new challenges, interesting problems, exciting results,

and imaginative applications. The educational impact of multimedia – already addressed by a huge number of theoretical analyses, scientific works and projects – requires an explicit design effort geared to kids [Druin and Solomon, 1996].

Integration among heterogeneous skills is also the basis of *Content and Language Integrated Learning* (CLIL), a methodology adopted in teaching situations where a foreign language is used as a medium for teaching non-language content [Mehisto et al., 2008]. CLIL encourages a cross fusion of didactic subjects – currently considered as a relevant educational trend [Coyle et al., 2010] – by approaching content through the target language. In this sense, CLIL acts as a bridge able to connect multiple learning aspects into a coherent whole where interdisciplinary elements prevail [Agolli, 2013].

The goal of this work is to discuss a novel approach to CLIL which takes into account and joins commonly-accepted pedagogical theories, current trends in education, multimedia, computing devices, and information systems, in order to make CLIL profitably applicable to primary school students.

This paper is an extension of XXX, a work presented at the CSEDU 2016 conference. After the discussion of the paper, we were able to set up a pilot experimentation in two classes of an Italian primary school. This experience will be described in Section 6.

## 2 A Short Overview of CLIL

The label *CLIL* stands for classrooms where a foreign language is used as a medium of instruction in content subjects [Dalton-Puffer, 2007]. This initiative was launched in 1994 in conjunction with the European Commission, since multilingualism was – and it is still – considered at the heart of European identity, and in this sense languages are seen as a fundamental cultural aspect of European citizenship [Directorate-General for Education and Culture, 2006]. The idea was originated by a discussion among experts, above all in Finland and the Netherlands, on how to bring the language-learning excellence typical of a restricted number of institutes into mainstream government-funded schools and colleges.

CLIL aims to develop in children both *lower* and *higher order thinking skills*, according to Bloom’s taxonomy of cognitive objectives [Bloom, 1956]. CLIL is mainly focused on the latter skills, even if these are dependent on an earlier acquisition of the former abilities. Consequently, such a methodological approach is more cognitively engaging for both students and teachers. On one side, this fact may increase the demands and difficulty of CLIL, but on the other it also leads to increasing engagement and motivation [Pinner, 2013].

Another aspect to underline is the difference between *Basic Interpersonal Communicative Skills* (BICS) and *Cognitive Academic Language Proficiency* (CALP). The acronym BICS refers to conversational fluency in a language, whereas CALP refers to student’s ability to understand and express, in both oral and written modes, concepts and ideas that are relevant to success in school [Cummins, 2008]. In CLIL, teachers have to address CALP rather than BICS,

and students have to know content-specific vocabulary for the topic they are learning (e.g., technical terms), as well as a suitable language to carry out activities during the lesson (e.g., sentence starters).

One of the key aspects in CLIL lessons is the identification of the input [Krashen, 1985]. A foreign language should provide learners with a substantial amount of comprehensible input. From this point of view, content is conveyed by the teacher as a way of facilitating understanding, and the input is represented by the language to which learners are exposed [Costa and Coleman, 2010].<sup>3</sup>

All constructivist comprehension theories underline the importance of the input in the construction process. However, the input as such is not important for successful processing, rather the significance it has for the comprehender is fundamental. Cognitive psychologists argue that a comprehender can only process input successfully if he/she can relate it to what is already part of his/her body of knowledge. Social constructivists carry their argument even further: in their opinion, only input in which the comprehender can get engaged – or involved in – can be processed and will finally lead to a construction which he/she can make use of [Wolff, 2003]. These considerations are behind the design of the Web framework described below.

In order to provide an effective input, educators need to know what CLIL exactly is, mastering both the methodology and a specific language for contents. Consequently, specific professional training is required for teachers. Among a number of initiatives, it is worth citing *CLIL4U*<sup>4</sup> and the *British Council's CLIL project*.<sup>5</sup>

### 3 State of the Art

In this section we will focus on two key aspects of this proposal: i) CLIL in primary school education, and ii) the use of multimedia technology as a means to convey content in a foreign language.

In most educational systems that encourage an early study of a foreign language, curricular approaches are rather similar, usually consisting of general lessons that include foreign culture, art and craft activities. A great importance is given to the development of phonemic awareness and vocabulary, and these goals are traditionally achieved through reading and writing assignments.

In the educational systems open to CLIL experimentation, this methodology is usually applied to secondary (see e.g. [Llinares and Whittaker, 2006], [Whittaker et al., 2011], [Costa and Coleman, 2013]) or tertiary education (see e.g. [Dafouz et al., 2007], [Aguilar and Rodríguez, 2012], [Strotmann et al., 2014]).

Conversely, the application of CLIL to very young students attending primary school is a quite novel idea. In this sense it is worth citing a pilot project in

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<sup>3</sup> In the following, we will extend the concept of input to other aspects of our proposal, such as multimedia and digital skills.

<sup>4</sup> <http://languages.dk/cli14u/index.html>

<sup>5</sup> <http://www.britishcouncil.org/europe/our-work-in-europe/content-and-language-integrated-learning-clil>

Spanish curricular infant education described in [Esteban, 2015]. An interesting study about CLIL across multiple educational stages, ranging from primary to tertiary level, is provided in [Dafouz, 2009]. Another relevant initiative aiming to examine the effects of foreign language exposure vs. specific language exposure was carried out in a school located in Lleida, offering preschool, primary and secondary schooling [Saladrigues and Llanes, 2014].

Some researches go even further, exploring the methodologies and tools to teach a foreign language to preschool children. For example, [Tabors, 1997] addresses preschool teachers and administrators, suggesting how to develop effective programs to create the linguistic background for early second-language learning. Learning in an early stage of life is facilitated, so the acquisition of a foreign language can be easily integrated into basic curricular topics such as numbers, colors, animals, etc. [Fernández López, 2014], also using unconventional teaching methodologies such as nursery rhymes [Haces Tamés, 2015].

Didactic experiences expressively designed for children aged between 5 and 7 can encompass engaging classroom tasks, motivating games and other activities aiming to improve their listening and speaking skills. The development of reading and writing abilities will occur later, but it will be possible to encourage such skills through a suitable evolution of the CLIL environment, thus creating a continuous educational path. In all the mentioned activities, CLIL is considered effective not only to teach curricular contents together with a foreign language, but also to foster cognitive development, communication abilities and cultural awareness, as stated in [Sakurai, 2015] and [Sokół, 2015].

## 4 Research Questions

This work raises research issues that are rooted into different fields, in particular pedagogy, multimedia and information technology. Consequently, the research questions we want to answer are complex, heterogeneous and trans-disciplinary.

We do not aim to prove the pros neither discuss the cons presented by CLIL; in this sense, the state of the art reported in Section 3 should provide some interesting food for thought. Rather, our proposal makes an assumption: the possibility to effectively employ CLIL in primary school education, as demonstrated by some pilot studies cited above. Starting from this ground truth, our research moves along 3 dimensions: i) the educational dimension, ii) the technological dimension, and iii) the teaching environment setting.

As it regards the educational dimension, [Q1] *how can we rethink traditional teaching tools in order to encourage CLIL-based learning?* [Q2] *Can multimedia and transmediality be integrated in order to enhance the CLIL experience?*

Concerning technological aspects, [Q3] *to what extent can the use of technological devices encourage the adoption of CLIL in primary school?* And [Q4] *how does a combined use of CLIL and multimedia technologies improve students' skills in the administered school subjects, foreign language, and digital competences?* Please note that [Q4] actually refers to this dimension as far as the focus is on technology; but if the aim is to “demix” the integration of school subjects,

foreign language and multimedia technologies in order to test the acquisition of skills in each single area, this research question will better fit the educational dimension.

Moreover, we want to discover if the current proposal could/should affect the teaching environment, including the way lessons are organized and conducted, and the relationship between school and the outer world. For instance, [Q5] *what is the impact of the proposed CLIL enhancement on teaching activities (seen here from a practical rather than a theoretical point of view)?* In other words, are teachers ready and trained to accept this innovation? Are classroom settings fit for this goal, and – if not – can they be easily rearranged? Is the available equipment adequate?

Besides, we want to test if the integrated vision typical of CLIL, promoted here to a 2.0 version, can help bridge different learning spheres. In particular, [Q6] *may this proposal encourage the integration of classroom lessons and external activities?* Finally, more general research questions may arise. For example, [Q7] *to what extent can a playful environment foster creativity, collaboration and the aptitude to a learn-it-yourself approach?*

In the following we will try to answer all these questions in order to validate our proposal, from both a theoretical and an experimental point of view. In particular, Section 6 will present the results of a pilot study conducted in an Italian primary school.

In general terms, there are two types of data that can shape research questions: quantitative and qualitative data. While the former type of data focuses on the numerical measurement and analysis between variables, the latter examines the social processes that give rise to the relationships, interactions, and constraints of the inquiry. In this work, quantitative data will be retrieved from both measurable aspects of classroom situations and the analysis of assessment tests administered to young students after CLIL lessons, whereas qualitative data will be mainly inferred from an interview to the teacher who adopted the proposed methodology during the pilot study.

## 5 A Web-based CLIL Environment

As stated in [Glušac, 2012], CLIL exists in different guises on a continuum where content-based education is at the softer end and bilingual education is at the harder one. As a consequence, we can recognize *Hard (Strong) CLIL*, where teaching and learning are primarily content-driven, and *Soft (Weak) CLIL*, which is mainly language-driven. The version of CLIL we are going to adopt stands in the middle, consequently it is sometimes called *Mid (Comfortable) CLIL*: learning occurs as a combination of both language and content, thus its aims can be considered dual-focused. Mid-CLIL requirements imply a mixed use of graphical and audio-visual elements (i.e. multimedia in its multiple forms), necessarily predominant if compared to texts due to the young age of students. A key role is played by audio, that mainly allows listening activities in the native as well

in the foreign language. Moreover, audio can be used to introduce additional sounds that can reinforce learning, as in the examples below.

Computer-based solutions and technological devices can respond to the mentioned needs, since they provide those audio-visual aids required to involve young learners and to overcome the typical problems caused by an unknown language in young students. In addition to traditional resources already in use at schools (blackboards, textbooks, etc.), technological resources such as interactive whiteboards and the Internet can foster the acquisition of linguistic competence in an entertaining and motivating way.

Narrowing the field to the Web, the new possibilities offered by HTML5 – and specifically by its built-in support of audio and video – allow the creation of playful environments specifically oriented to CLIL in primary school. JavaScript, another W3C-compliant standard, can add the interactivity required to enrich the interface from both a graphical and a functional point of view.

Needless to say, a Web application in opposition to “traditional” software presents a number of advantages, such as: multi-platform portability, availability on a wide range of devices,<sup>6</sup> natural continuation of classroom activities at students’ homes, and so on. Besides, the adoption of purely client-side technologies allows teachers to distribute materials through physical media (CD-ROMs, USB pens, etc.), and users to work off-line, namely without network availability.

In order to test the efficacy of our approach, we have designed, implemented and tested a basic Web environment dealing with typical primary-school subjects, like farm animals and musical instruments. The idea was to equip teachers with a flexible tool, easily adaptable to students’ age, skill levels and didactic goals. Needless to say, a single class is composed by many different children, each one presenting his/her own way to learn. In accordance with the theory of multiple intelligences [Gardner, 2011], we aimed to provide multiple inputs, multiple interaction modes and multiple ways to employ the same Web environment, so that the resulting learning experience can be really “student-tailored”.

Consequently, we embedded *different kinds of content* into each single *learning resource*: multiple graphical representations, pronunciation of terms in the native and foreign language(s),<sup>7</sup> other contextualized audio content (animal sounds, music excerpts, etc.) and a text transcription of foreign words.

The resulting interface, shown in Figure 1, lets teachers choose among scenarios that present a gradually increasing number of learning resources as well as a gradually increasing graphical complexity. At the moment of writing, two sample lessons – dealing with farm animals and musical instruments respectively – are available at <http://clil.lim.di.unimi.it>.

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<sup>6</sup> A W3C-compliant application can be virtually run on desktop computers, tablets, interactive whiteboards, smartphones, and – in general – any network-connected device equipped with an HTML5 browser.

<sup>7</sup> Please note that a strict interpretation of CLIL completely excludes the use of students’ mother tongue during lessons.



Fig. 1. A Web framework for CLIL written in HTML5 and JavaScript.

## 6 Pilot Experimentation

An early experimentation of the framework described in Section 5 took place at the *Istituto comprensivo Mahatma Gandhi* located in Trezzano Rosa, Italy. Two first-year classes of the primary school, made of 13 (Class A) and 15 (Class B) students, were involved in the experimentation.

Two CLIL sessions were organized during the hours of Music and Sciences, dealing with musical instruments and farm animals respectively. The two tests were administered to students approximately of the same age, between 5 and 7. For practical and organizational reasons – the pilot study was conducted at the end of the school year – Class A participated in both sessions, whereas Class B was administered only the lesson about farm animals.

CLIL sessions were coordinated by a non-linguistic subjects' teacher, having expertise on the topics to treat, a basic ability to speak a foreign language, and prior knowledge on the vocabulary known to students.

Each CLIL session consisted of two parts: *learning* and *assessment*. During the former phase, taking approximatively 40 minutes, students were free to independently explore the Web interface, working alone or in small groups, possibly under the supervision of the teacher, as explained in Section 6.1. After the conclusion of the learning phase, students were required to undergo an anonymous assessment test that lasted about 20 minutes. The goals were manifold: the teacher had to check the actual learning of school subjects and foreign lexicon; the CLIL expert had to test the achievement of high order thinking skills and the development of further abilities (e.g., digital competences, scaffolding, peer collaboration, etc.); and the authors of the research wanted a measurable feedback about the effectiveness of their methodology. The results of the assessment phase are reported in Section 6.2.

### 6.1 The Learning Phase

The learning phase was conducted by following a strict interpretation of CLIL: the teacher spoke exclusively the foreign language – in this case English – adopting necessarily a simplified lexicon and grammar. Since children could remain surprised or even confused because of the foreign language, the educator characterized the context by placing an English pennant on the teaching desk.

Due to the constraints imposed by classroom equipment, the teacher decided to concentrate the activity of each class on a single device. When in front of the computer, students had to work alone or in small groups, exploring different scenarios and finding their own way to learn (see Figure 2). In fact, one of the current trends of pedagogy is to turn the student into the protagonist of his/her educational process within a self-regulated learning approach [Zimmerman, 2008]. In the meanwhile, idle children were invited by the supervising teacher to observe the interface and to participate by repeating the words chosen by their classmates. The teacher acted as a *coach* by coordinating students activities, providing inputs and encouraging cooperation.

While students were engaged with learning and the teacher was supervising them, an expert with a pedagogical background conducted the observation phase.

As a first result, this lesson model proved to be effective in encouraging interaction among classmates, thus reaching the goals of peer seeking, peer reviewing and cooperative learning. Due to the limited linguistic knowledge of young students, interaction necessarily occurred in their native language. Figure 3 shows a moment of dialog among classmates.

Simultaneously, another type of relationship emerged in the class: the presence of the teacher was not seen by students as a constraint but rather as a guide, in the context of a supervised didactic activity.

Besides, the observation revealed some unforeseen ways to use the interface, originally designed for personal fruition in a self-regulated context. The observed experience conversely showed a number of collaborative applications: for example, a game where a child choose an animal sound, and the classmates have to say the corresponding foreign word. This kind of activities created an atmosphere of playful involvement, motivation, and peer-to-peer incitement.





**Fig. 2.** Students exploring different scenarios.

One aspect that could affect the experiment was the need to provide young students with technology skills, for instance to explain in a foreign language how to navigate the Web interface. However, being *digital natives*, students showed a good mastery of technological tools, and the interfaced proved to be intuitive enough.



**Fig. 3.** Cooperation and dialog among students in front of the interface.

## 6.2 The Assessment Phase

In order to verify the effectiveness of the proposed method, at the end of the CLIL-based learning session a test was administrated to children in a paper-delivered format. The test was anonymous, in order to reduce stress conditions and let the learning outcomes emerge.

The skill to investigate was mainly listening comprehension, since reading and writing abilities should be developed later. Consequently the document contained a very limited amount of text, it required no written answer, and contents were mainly graphical. However, pictures were significantly different from the representations shown to students in the learning scenarios. In fact, the goal of the CLIL experience was not to teach the relationship occurring between a given graphical representation and its phonetic counterpart, but rather the one occurring between a concept – which can be graphically represented in different forms – and the corresponding foreign word.

The assessment was conceived to check the acquisition of different skills and test multiple intelligences. It consisted of three sections – *Listen & Choose*, *Listen & Color*, and *Listen & Draw* respectively – and the task to carry out in each section was orally explained by the teacher.

During the *Listen & Choose* assignment, the teacher indicated through a simplified language a subject (i.e. an animal or a musical instrument) to be recognized among three alternatives. An example of sentence was: “Number 1: choose the pig”. Students had to go to line 1, select one of the pictures – in this case a bear, a pig and an elephant – and mark the right answer. This activity included a total of four multiple-choice questions. As shown in Figure 4, answers

could contain also animals not present in the scenarios, and – in any case – the graphical representation of the known animals was different from the ones previously presented to children. In this way, we tested not only the acquisition of specific lexicon, but also the development of understanding and abstracting abilities.

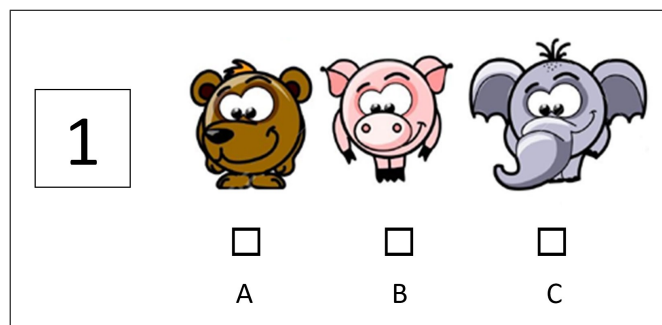
Concerning students’ performances, children demonstrated a very good level of listening comprehension and lexicon acquisition. As it regards the recognition of animals, in Class A the wrong answers were 3 out of 52, with an error rate less than 6%, and in Class B they were 6 out of 60, with an error rate of 10%. The recognition of musical instruments was proposed only to Class A, and this task was carried out with only 1 error, which means an error rate of 2% approximatively.

During the *Listen & Color* assignment, the teacher indicated through a simplified language which subject (i.e. which animal or musical instrument) had to be colored with a specific crayon. An example of sentence was: “Take your blue pencil and color the rooster”. Figure 5 shows the coloring page for the test on farm animals. The associations were: blue rooster, green cow, yellow pig, brown horse, white goat, red sheep for animals; orange violin, pink trombone, black flute, blue xylophone, green oboe, yellow double bass for musical instruments.

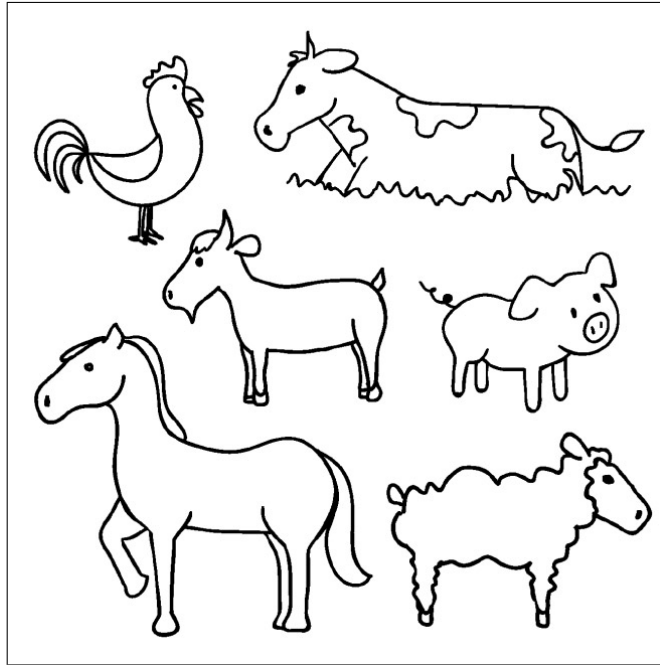
One of the difficulties of this task was the discrepancy between the color a subject usually presents in the real world and the one requested by the teacher. Another potential obstacle was the need to recall prior knowledge, such as the name of colors in English. Reasoning skills were also stimulated by the request to use the color white, which did not correspond to any crayon. These aspects were intentionally introduced in order to foster students’ higher-order thinking skills and transversality among school subjects.

Students’ performances on animals were impressive: both in Class A and B the assignment was completed without any error. The case of musical instruments proved to be more difficult, however the error rate remained below 8% (6 errors out of 78 answers).

Finally, during the *Listen & Draw* assignment, the teacher suggested which entities (i.e., which animals or musical instruments) had to be drawn. An ex-



**Fig. 4.** An excerpt from the *Listen & Choose* assignment.

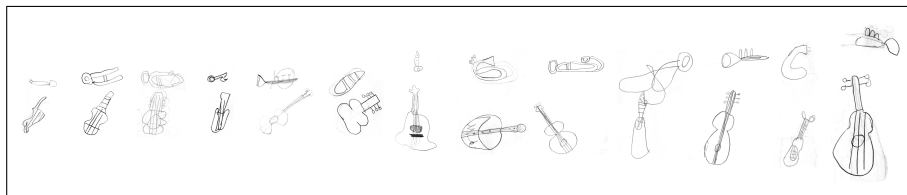


**Fig. 5.** The picture to fill during the *Listen & Color* assignment.

ample of sentence was: “Number 1: draw a dog”. Please note that the sentence challenged students not only through the use of a contextual lexicon in a foreign language, that is a basic requirement of CLIL, but also through the prior knowledge of numbers and the need for a personal reworking of graphic content, thus bridging different school subjects and competences. The sequence of animals was: 1. dog, 2. pig, 3. sheep, 4. rooster, 5. horse; the sequence of musical instruments was: 1. piano, 2. trumpet, 3. guitar, 4. flute, 5. drum.

All students from Class A and Class B completed the task. The outcomes of this section, partially shown in Figure 6, were interesting from different perspectives: they pointed out not only which words were harder to understand, but also which subjects were more difficult to represent. Needless to say, these results cannot be evaluated ignoring the prior knowledge of the domain (e.g., the availability of a given musical instrument at home), the drawing skills and the level of creativity of each student.

In order to improve listening comprehension, during the assessment phase some reinforcement techniques were adopted by the teacher. First, the instructions to follow – provided using a simplified language – were uttered clearly and repeated several times. Besides, when previous knowledge had to be recalled, the teacher employed additional tools: for example, the number of the current exercise was pronounced and simultaneously written on the blackboard. Finally,



**Fig. 6.** The pictures of guitars and trumpets produced during the *Listen & Draw* assignment.

ad-hoc body language and explanatory gestures proved to be particularly effective, for instance to mimic the movements of instrument players.

### 6.3 Interview with the Teacher

The interview with the teacher who conducted the classroom experimentation allowed us to catch those qualitative aspects of student-teacher interaction which could not have been inferred from the test.

In addition to confirming a number of issues that had emerged from the observation, such as the good level of involvement and interaction, she reported some sentences uttered by students that unveiled interesting aspects.

First, in reference to the use of the web platform, a little girl asked in Italian: «Teacher, can I do it at home, too?», thus revealing the will to spontaneously bridge school education and home activities.

Another interesting aspect noticed by the teacher during her coaching activity is a mixed use of the native and foreign language in children’s interactions. For example, she heard the sentence: «Guarda, ecco il *dog!*», which can be translated as: «Look, here is the dog!».

One last point that is worth remarking is the aptitude shown by some students to anglicize unknown terms by an autonomous mental process of rule inference. For example, the Italian word “nero” – corresponding to the English word “black”, unknown to students – was transformed into “ner”, thus creating the same relationship that exists between “violino” and “violin”. Despite this naive approach generally produces incorrect results, this case demonstrated CLIL’s potential to stimulate higher order thinking skills.

## 7 Towards a Multi-layer Pedagogical Approach

With respect to the approach described in Section 5, a more advanced goal is to realize a multi-layer pedagogical environment based on the role of multimedia not only as a privileged means to convey content, but also as a way to create a complex network of correlated and synchronized information. Foreign language, multimedia and technologies are the entities to integrate in order to foster a stratification of skills, in accordance with the theory of “four Cs” [Coyle, 2002]: Communication (i.e. improving overall target language competence), Content

(i.e. learning the knowledge and skills of the subject), Culture (i.e. building intercultural knowledge and understanding), and Cognition (i.e. developing thinking skills).

We can define this new proposal as “multi-layered” because it embraces different media types and media instances – each one with its own features, granularity and level of abstraction – and keeps them together in an interconnected information network. This approach was already present in the Web environment described in Section 5, but we would like to extend it by establishing a dense network of interconnections among the various facets of learning resources, including synchronization among timed materials.

A multi-layer structuring of information can be conferred to a Web environment through a suitable representation format. To this end, we are exploring the possibilities offered by IEEE 1599, an international standard promulgated by the Institute of Electrical and Electronics Engineers (IEEE). Originally conceived for music information, IEEE 1599 adopts XML (eXtensible Markup Language) in order to describe a music piece in all its aspects, ranging from notation to audio, aiming to provide potentially the most comprehensive description for it [Baggi and Haus, 2013].

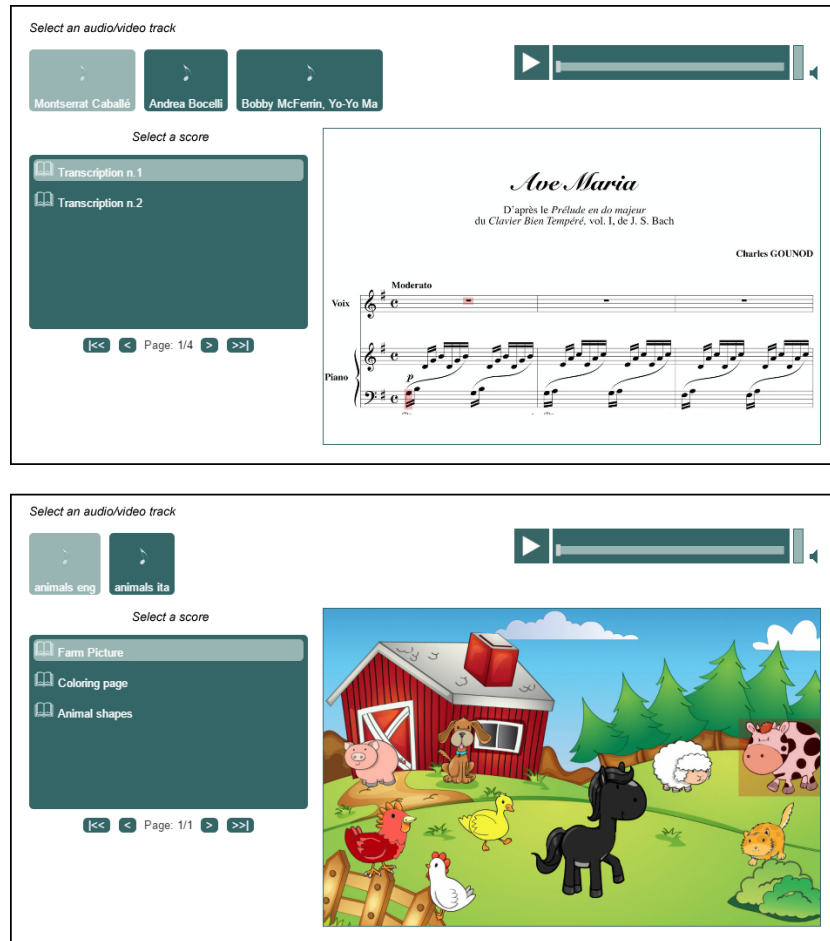
The design of a CLIL framework based on IEEE 1599 requires a paradigm shift, but it may support important improvements with respect to the proposal in Section 5, such as the possibility to include multiple timed contents and to experience them in a synchronized environment. While the previous interface required specific user actions to trigger events, now it is possible to use a tale, a rhyme or a song to drive event occurrences. Besides, thanks to the characteristics of IEEE 1599 designed for music, the user is allowed to switch current materials in real time: graphic backgrounds can be changed to increase or decrease the difficulty level without pausing the narration, the sequence of events can be altered by choosing a different kind of timed content, multiple audio tracks can be employed to illustrate different pronunciations, the language itself can be switched in the context of a multilingual lesson, and so on.

An IEEE 1599 example of CLIL lessons has been uploaded to the “Music Box” section of the *EMPIU* framework,<sup>8</sup> a repository of music pieces encoded in IEEE 1599 format. The comparison between a standard music case and CLIL learning material is illustrated in Figure 7.

Another field to explore is the integrated use of CLIL and music, which could be easily implemented in IEEE 1599 without any paradigm shift. Pedagogical research demonstrated that songs and rhymes can be used to teach new words, increase vocabulary, introduce a specific lexicon, and improve pronunciation [Atta-Alla, 2012]. Moreover, songs are memorable for a long time: a recent study confirmed the long-held belief that singing in a foreign tongue can facilitate language learning [Ludke et al., 2014]. Music quite naturally provides opportunities to practice patterns, math concepts, and symbolic thinking skills, all in the context of a joyful noise, which makes it attractive and engaging even for very young children. There are multiple and heterogeneous ways

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<sup>8</sup> URL: <http://emipiu.di.unimi.it>



**Fig. 7.** A Web interface for advanced music fruition and its CLIL reinterpretation.

to participate in music activities, and such experiences can be easily adapted for a range of developmental levels and skills depending on the learner's age [Parlakian and Lerner, 2010].

Recalling the concept of *input* introduced in Section 2, music-based lessons offer three distinct sources of language input [Willis and Paterson, 2008]: i) the language used to manage classroom activities and to set up music experiences; ii) the process itself that leads to a performance; and iii) the actual words and phonological features of songs, rhymes, musical stories, etc. (performed by the audience or already available as media content).

Some pilot studies about the integration of music in CLIL experiences have been already published – see e.g. [Kuncířová and Vojtková, 2013] – but mainly as an alternative to traditional music lessons and addressing secondary-school

students. As it regards future work, one of our research goals will be to transform CLIL into CLMIL – standing for content, language and music integrated learning – and to test the efficacy of this approach in primary school.

## 8 Conclusions

In this work we have described an educational proposal for primary school based on the integration of three domains: computer technologies, multimedia, and foreign language. Let us go back to the research questions listed in Section 4.

[Q1] *How can we rethink traditional teaching tools in order to encourage CLIL-based learning?*

[A1] We propose two web frameworks presenting features and technical requirements that make them suitable for use by primary-school children both in class and at home, in a supervised context as well as autonomously. These tools were not designed to completely replace traditional teaching methodologies, but to improve their efficacy thanks to computer support and multimedia.

[Q2] *Can multimedia and transmediality be integrated in order to enhance the CLIL experience?*

[A2] CLIL methodologies encourage the use of additional content and reinforcement elements coming from different fields. Also in a traditional setting, the teacher is suggested to go beyond a standard lesson administrated in a foreign language. In this case, digital pictures and sounds have been integrated in a framework that could recall real life scenes, like a window open on a courtyard full of animals or a theater box above the orchestra on the stage. A number of scenarios have been provided, in order to challenge self-regulated children without causing frustration if the scenario was too demanding. As a result, the level of interactivity and engagement was undoubtedly higher with respect to a standard CLIL lesson.

[Q3] *To what extent can the use of technological devices encourage the adoption of CLIL in primary school?*

[A3] Despite their young age – or perhaps thanks to this aspect – digital natives have shown great familiarity with technology. During the experimentation, there was no need to explain how to use the web interface, since children were perfectly able to navigate it and enjoy its learning resources. Far from representing a limit or a constraint, the use of technological devices has emphasized the playful aspect of CLIL learning.

[Q4] *How does a combined use of CLIL and multimedia technologies improve students' skills in the administered school subjects, foreign language, and digital competences?*

[A4] The assessment results were very encouraging and demonstrated the acquisition both of the school subject under discussion and of the related foreign lexicon. In other words, the basic goals of any CLIL experience have been completely achieved. Moreover, these computer activities improved the familiarity



with technological tools, and less-skilled children were helped and encouraged by their classmates in the context of a joyful peer-to-peer cooperation.

[Q5] *What is the impact of the proposed CLIL enhancement on teaching activities? Are teachers ready and trained to accept this innovation? Are classroom settings fit for this goal, and – if not – can they be easily rearranged? Is the available equipment adequate?*

[A5] Thanks to the training and open-mindedness of the teaching staff of the school where the experimentation was conducted, our experience was really positive. Nevertheless, answering these questions in general terms is hard: CLIL requires a specific training for educators, and materials and learning resources should be the result of a cooperative work involving domain experts, linguistic subjects' teachers, pedagogues and computer developers. These aspects may clearly have an impact on the activities of a traditional school. Conversely, as it regards the classroom equipment our framework is not too demanding: it requires a personal computer, possibly attached to a video projector or an interactive board, and – despite the use of web technologies – no network connection.

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## References

- [Agolli, 2013] Agolli, R. (2013). A penetrating content and language integrated learning (CLIL) praxis in Italian mainstream education: Stemming novelties and visions. *Research Papers in Language Teaching and Learning*, 4(1):138.
- [Aguilar and Rodríguez, 2012] Aguilar, M. and Rodríguez, R. (2012). Lecturer and student perceptions on clil at a spanish university. *International Journal of Bilingual Education and Bilingualism*, 15(2):183–197.
- [Atta-Alla, 2012] Atta-Alla, M. N. (2012). Developing adult english language learners' vocabulary skills through children's rhymes and songs. *English Language Teaching*, 5(11):79.
- [Baggi and Haus, 2013] Baggi, D. L. and Haus, G. M. (2013). *Music Navigation with Symbols and Layers: Toward Content Browsing with IEEE 1599 XML Encoding*. John Wiley & Sons.
- [Bloom, 1956] Bloom, B. S. (1956). Taxonomy of educational objectives. *New York: David McKay*, 356:1998–1999.
- [Coonan, 2007] Coonan, C. M. (2007). Insider views of the CLIL class through teacher self-observation–introspection. *International Journal of Bilingual Education and Bilingualism*, 10(5):625–646.
- [Costa and Coleman, 2010] Costa, F. and Coleman, J. (2010). Integrating content and language in higher education in Italy. Ongoing research. *International CLIL Research Journal*, 2010(3):19–29.

- [Costa and Coleman, 2013] Costa, F. and Coleman, J. A. (2013). A survey of English-medium instruction in Italian higher education. *International Journal of Bilingual Education and Bilingualism*, 16(1):3–19.
- [Coyle, 2002] Coyle, D. (2002). Relevance of CLIL to the European Commission’s language learning objectives. 2002). *CLIL/EMILE the European Dimension. Finland: UniCOM*.
- [Coyle et al., 2010] Coyle, D., Hood, P., and Marsh, D. (2010). *Content and language integrated learning*. Ernst Klett Sprachen.
- [Cummins, 2008] Cummins, J. (2008). BICS and CALP: Empirical and theoretical status of the distinction. In *Encyclopedia of language and education*, pages 487–499. Springer.
- [Dafouz, 2009] Dafouz, E. (2009). *CLIL across educational levels: Experiences from primary, secondary and tertiary contexts*. Richmond Publ.
- [Dafouz et al., 2007] Dafouz, E., Núñez, B., Sancho, C., and Foran, D. (2007). Integrating cil at the tertiary level: teachers and students reactions. *Diverse Contexts-converging goals. CLIL in Europe. Frankfurt: Peter Lang*, pages 91–101.
- [Dalton-Puffer, 2007] Dalton-Puffer, C. (2007). *Discourse in content and language integrated learning (CLIL) classrooms*, volume 20. John Benjamins Publishing.
- [Dewey, 2005] Dewey, J. (2005). *Art as experience*. Penguin.
- [Directorate-General for Education and Culture, 2006] Directorate-General for Education and Culture (2006). *Content and Language Integrated Learning (CLIL) at School in Europe*. Eurydice, European Commission.
- [Druin and Solomon, 1996] Druin, A. and Solomon, C. (1996). *Designing Multimedia Environments for Children: Computers, Creativity, and Kids*. ERIC.
- [Esteban, 2015] Esteban, S. G. (2015). Soft CLIL in infant education bilingual contexts in Spain. *International Journal of Language and Applied Linguistics*, 1:30–36.
- [Fernández López, 2014] Fernández López, P. (2014). The use of audiovisual stories in the preschool CLIL environment.
- [Gardner, 2011] Gardner, H. (2011). *Frames of mind: The theory of multiple intelligences*. Basic books.
- [Glušac, 2012] Glušac, T. (2012). CLIL and one-to-one classes. *Content and Language Integrated Learning (CLIL) in Teaching English to Young Learners*, page 63.
- [Gonzalez et al., 2000] Gonzalez, R., Cranitch, G., and Jo, J. (2000). Academic directions of multimedia education. *Communications of the ACM*, 43(1):89–95.
- [Haces Tamés, 2015] Haces Tamés, B. (2015). Nursery rhymes for content and language integrated learning in preschool education. Master’s thesis, Facultad de Formación del Profesorado y Educación, Universidad de Oviedo.
- [Krashen, 1985] Krashen, S. D. (1985). *The input hypothesis: Issues and implications*. Addison-Wesley Longman Ltd.
- [Kuncířová and Vojtková, 2013] Kuncířová, J. and Vojtková, N. (2013). CLIL in music for secondary schools. Master’s thesis, Department of English Language and Literature, Faculty of Education, Masaryk University.
- [Llinares and Whittaker, 2006] Llinares, A. and Whittaker, R. (2006). Linguistic analysis of secondary school students’ oral and written production in CLIL contexts: Studying social science in english. *Current Research on CLIL*, page 28.
- [Ludke et al., 2014] Ludke, K. M., Ferreira, F., and Overy, K. (2014). Singing can facilitate foreign language learning. *Memory & cognition*, 42(1):41–52.
- [Mehisto et al., 2008] Mehisto, P., Marsh, D., and Frigols, M. J. (2008). Uncovering CLIL. *China: Macmillan Publishers Limited*.
- [Parlakian and Lerner, 2010] Parlakian, R. and Lerner, C. (2010). Beyond Twinkle, Twinkle: Using music with infants and toddlers. *YC Young Children*, 65(2):14–19.

- [Pinner, 2013] Pinner, R. (2013). Authenticity of purpose: CLIL as a way to bring meaning and motivation into EFL contexts. *Asian EFL Journal*, 15(4):137–158.
- [Sakurai, 2015] Sakurai, S. (2015). Bilingual education in primary school: aspects of immersion, CLIL, and bilingual modules. *Language and Education*, 29(1):83–85.
- [Saladrigues and Llanes, 2014] Saladrigues, G. and Llanes, À. (2014). Examining the impact of amount of exposure on L2 development with CLIL and non-CLIL teenage students. *Sintagma: revista de lingüística*, (26):133–147.
- [Sokół, 2015] Sokół, M. (2015). Helping preschool and primary school children to develop phonemic awareness and bilingual literacy skills in the light of SLA theories. Master’s thesis, Institute of Iberian and Ibero-American Studies and College of English Language Teacher Education, Warsaw University.
- [Strotmann et al., 2014] Strotmann, B., Bamond, V., Lopez-Lago, J. M., Bailen, M., Bonilla, S., and Montesinos, F. (2014). Improving bilingual higher education: Training university professors in content and language integrated learning. *Higher Learning Research Communications*, 4(1):91–97.
- [Tabors, 1997] Tabors, P. O. (1997). *One child, two languages: A guide for preschool educators of children learning English as a second language*. ERIC.
- [Whittaker et al., 2011] Whittaker, R., Llinares, A., and McCabe, A. (2011). Written discourse development in CLIL at secondary school. *Language Teaching Research*, 15(3):343–362.
- [Willis and Paterson, 2008] Willis, J. and Paterson, A. (2008). English through music: effective CLIL lessons for young learners.
- [Wolff, 2003] Wolff, D. (2003). Integrating language and content in the language classroom: Are transfer of knowledge and of language ensured? *ASp la revue du GERAS*, (41-42):35–46.
- [Zimmerman, 2008] Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1):166–183.