



THE USE OF AUGMENTED REALITY IN TEACHING GEOGRAPHY AT PRIMARY LEVEL

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Abstract:

The present paper focuses on the contribution of CLIL and Augmented Reality (AR) while teaching Geography to the students of the 4th grade of a Primary School. Towards this goal, two different teaching interventions have been carried out to two groups of school students (46 students in total), at an Experimental Primary School in Piraeus, Greece. The first group was taught Geography in English, through the CLIL approach (teaching a foreign language through content), making use of Augmented Reality applications, while the second group was taught Geography the traditional way, without the use of Technology. Data analysis showed a significant improvement regarding the learning outcomes of the first group, while students' positive attitude towards using digital applications was also examined.

Keywords: CLIL, augmented reality, Geography, English, technology

1. Introduction

The process of teaching and learning at a primary level is of uttermost importance. At the ages 5 – 11 years old, students need to get more attention in order to increase their motivation and class satisfaction (Perez-Lopez & Contero, 2013). Learning, thus, should be turned into a multisensory procedure, involving all three senses of sight, hear/sound and touch in the daily educational practices. Teaching different school subjects based on the CLIL approach contributes to a deeper understanding of the target language (that is, English, in our context) and the school subject to be taught, improving students' social and critical thinking skills, as well as their digital literacy through the use of technology.

Moreover, in the past decade, new applications which allow blending the digital world with the real one, widely known as Augmented Reality (Pengcheng et al., 2011), seem to highly contribute to the learning process, both increasing student motivation and participation (Bidin & Ziden, 2013) and improving their critical thinking development, as well as their creativity (Mang & Wardley, 2013). Augmented Reality has been proposed as a rather promising tool to enhance students' motivation and interest (Verdugo &

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Belmonte, 2007), as well as support teaching and learning processes of the educational context, at a primary level.

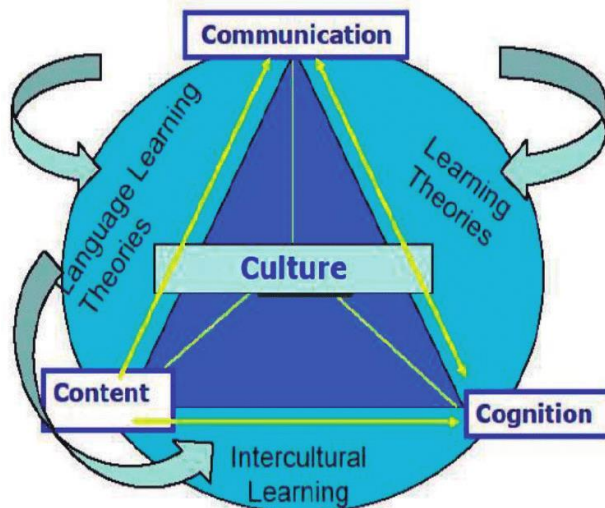
2. Using digital technology in foreign language teaching and learning

2.1 The CLIL approach

Within the past decades, digital technology has become a significant factor in the process of language learning. According to a recent study (Senad Bećirović et al, 2021), students' experience with technology-based language learning (TBL) is rather positive. Teachers have an important role to play in technology-based foreign language learning, guiding students towards the effective exploitation of digital learning resources and, ultimately, towards a self-directed use of technology for out-of-school learning (Lai, 2015). Thus, teachers contribute to the creation of a rather positive atmosphere in class (Yaman & Bećirović 2016).

Nowadays, schools all over the world try to integrate different subjects into the school curriculum. Regarding foreign language learning, students use the English language to study school subjects like Geography which are usually taught in their native language – in our case, in Greek. This teaching approach is widely known as CLIL (Content and Language Integrated Learning), involving teaching a school subject through the medium of a foreign language (Klimova, 2012).

Image 1: The 4Cs Framework of CLIL



Source: https://www.researchgate.net/figure/The-4Cs-Framework-of-CLIL-Coyle-et-al-2010-Coyle-2011-As-illustrated-in-Figure-1_fig1_343917211)

It is rather conducive to recall Coyle's theory of the 4 Cs (Coyle, 1999), involved in lesson-planning while teaching Geography at primary level – in our case, an ARETE Geography project on the five continents:

- Content, related to the question "What is the Geography topic to be taught?". Possible answers might include the continents or the flora and fauna of different places around the world.

- Communication, related to the question “*What kind of Geography terms and language in general will be communicated through each lesson?*”. Possible answers might include vocabulary items and expressions related to the flora and fauna of a continent, the weather or important landmarks.
- Cognition, related to the question “*What are the skills that students should have or develop during a Geography lesson?*”. Possible answers might include continent identification and their location on the world map or weather/time changes, depending on which hemisphere each continent is situated.
- Culture, related to the question “*Does the lesson involve any cultural elements? If yes, what are they?*”. For example, students could study Geography features that are similar or different when learning about different continents (e.g. customs, language, habits, landmarks).

Therefore, when planning our CLIL Geography lessons related to the continents of the world, activating students’ prior knowledge is rather significant, finding out what students already know about different continents in their mother tongue and brainstorming ideas that can be then transferred/translated into the foreign language (i.e. English). Moreover, the teacher has to plan the information that is being presented during the CLIL class: how the activities are performed (written/orally, whole class/group/pair/individual work) and what is accepted as successful for the students. Students should be given ample wait time, especially during the first teaching sessions, between listening to a question and answering it in a foreign language. Collaborative tasks are highly desirable, including activities that support the processing of new Geography content and language (e.g. a presentation of the flora and fauna of Africa). The material used is always cognitively challenging, providing effective scaffolding and students should always be encouraged to answer questions that demand higher-order thinking skills (“why” and “how” questions) at every stage of learning (Teaching Geography Through English – A CLIL Approach, 2011).

2.2 Augmented Reality (AR)

Augmented Reality (AR) is considered to be an innovative form of technology (Al-Azawi and Shakkah, 2018), applied in many fields of research, including that of education. Integrating the use of mobile Augmented Reality (AR) applications in students' learning experiences both engages them in the 21st-century skills acquisition and provides educators with opportunities to diversify their teaching.

When talking about Augmented Reality, we refer to technologies that are specifically characterized by an ability to present reality through a process of transferring existing dynamic elements into more dynamic ones (Shuaili et al, 2020). Through AR, direct as well as indirect realistic environments are brought in the classroom through the use of digital devices: students work on them, interact and manipulate the content presented to them (Chang et al., 2013). In our teaching context (i.e. Geography), abstract topics in the printed Geography booklets related to the five world continents are **augmented**, through the use of multimedia and three-dimensional objects (e.g. interactive continent maps) which highly improve the students’ learning experience;

thus, a deeper understanding is achieved on their behalf. The real world is literally brought into the classroom, while possible difficulties related to the traditional teaching of Geography are eliminated. The learning process turns into a fascinating experience and information retention is elongated (Alhumaidan et al., 2018).

Image 2: Interactive world map, used in the AR learning sessions



Source: ARETE Geography Interactive World Map (accompanying the Augmented Reality GEOGRAPHY Workbook)

3. Material and Methods

3.1 Aims

The aim of the proposed teaching intervention was double. On the one hand, students were expected to acquire the specific Geography vocabulary in the target language (i.e. English) through a variety of playful digital activities; on the other hand, students were enabled to learn Geography through content (through the CLIL approach) and interact with a digital application (ARETE Geography app), so that vocabulary teaching and learning became more effective and efficient.

3.2 Participants and Project Duration

The teaching proposal to be described was applied at primary level, in a public experimental primary school of an urban area, during the English class. The duration of the intervention was 20 teaching hours, which took place over a period of 4 months. Two groups of students participated in it: the experimental group consisted of 22 students (11 girls and 11 boys), while the control group consisted of 23 students (10 girls and 12 boys).

3.3 Material Used – Teaching Process

For the experimental group, the main target was the use of digital material that responds satisfactorily to children's curiosity and imagination, as well as their mood to play, so that a range of different multimodal activities could be achieved.

In the present teaching proposal, the ARETE Geography application was used in class by the experimental group of students. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 856533. This application features 3D models of continents and countries, including information on geographical peculiarities, political structures, animals, plants and heritage sites. Teamwork and collaboration are highly supported. The pilot project investigates the impact of Augmented Reality (AR) technologies on STEM skills learning and retention, focusing on learning Geography through visualization and interaction. Students develop both their spatial and visual cognition by learning the foundations of Geography through critical thinking, by engagement with and understanding of abstract objects (<https://www.areteproject.eu/trainingplatform/pilot2>).

Image 3: ARETE Geography Clever Book



Source: <https://apkpure.com/arete-geography/eu.cleverbooks.arete.geography>

CleverBooks is an application that can be launched on a tablet or mobile phone, accompanied by a workbook and a world map. Through this application, students are expected to develop their critical thinking, creativity, visualisation skills and improve their cognitive development by viewing plants, animals, cultural heritage, seasons of the year, water world and more. They can also listen to voiceover for all the 3D objects and interactions.

Before the beginning of the intervention, both groups of students were given an initial questionnaire to fill out in class, to identify their prior knowledge regarding Geography and Environmental Studies. Next, each activity, one for every continent, was

carried out in three stages both for the experimental and the control group - namely the pre-, the while- and the post-stage.

More specifically, during the pre-stage, the experimental group watched on the class interactive whiteboard a video (in English) related to the continent that they would be taught. A digital mind map was then completed in class, including information from the video (for example, main cities, landform or places of interest). The control group was introduced to the same topic through a printed, ordinary map and some pictures, followed by a class discussion so as to elicit prior knowledge. In the while-stage, students were taught about each continent using the CLIL approach. For the students of the experimental group, the teacher of English created a PowerPoint presentation related to each continent, with photos and important pieces of information about it. Students watched the presentation, discussed difficult points and, finally, completed a relevant Live Worksheet on their tablet. The control group studied the same material through a printed Geography book, then filled out a relevant printed worksheet. Finally, in the post-stage, the students were divided into teams of three. In the experimental group, each team had an i-pad at its disposal, for the continuous recognition of the pattern, with which the Augmented Reality element (a map of the continent to be studied) was activated. With the help of their teacher, students were asked to process the visual stimulus, name it and refer to related words and expressions, reviewing the vocabulary they had been acquainted with during previous stages. They explored the continent and completed some activities (e.g., word searches, matching exercises, gap-filling tasks) included in their ARETE Geography Clever Book. The experimental group carried out the activities using the AR application on their i-pads, scanning their Clever Book and the interactive world map and finding the information necessary to complete the tasks. Thus, the children of the experimental group had the opportunity to interact digitally with the help of an AR application.

Respectively, the students in the control group were asked to divide into three groups and carry out the same activities in their Geography Clever Book, the traditional way: they searched for answers in their Geography book, with the help of their teacher, describing their findings in the target language (i.e. English).



Images 4-5: Students of the experimental group, working on the Australian continent

3.4 Data collection tools

The following tools were used to collect the research data:

- A post-test, completed by the students of both the experimental and the control group, provided by the ARETE pilot program. The test included the same questions as the initial questionnaire, to check out how students' knowledge had improved after the completion of the teaching sessions. The same post-test was filled out again, one month after the completion of the ARETE pilot program, to detect students' retention of what they had learnt.
- A diary/journal, for a more complete evaluation regarding the results of the intervention (Richards & Lockhart, 1994)

Image 6: ARETE Geography material



Source: <https://apkpure.com/arete-geography/eu.cleverbooks.arete.geography#eu.cleverbooks.arete.geography-16>

- Interviews, which took place after the end of the pilot teaching intervention with the students of the experimental group, in order to investigate their attitude towards the activities, the possible difficulties and the degree of their satisfaction. This stage was necessary as the experimental group had used digital applications for learning the taught material in the foreign language, which were not used by the control group.

4. Results

4.1 Post-Test Results

The students of both the experimental and the control group answered 13 questions, the same as in the pre-test questionnaire, regarding environmental matters they were taught during the intervention. The questions were related to object shadows, the position of the Earth in the solar system, the history of the Earth as well as its physical structure and characteristics, ecosystems, organisms and their interactions with the environment. It was

observed that there were higher percentages of correct answers to all questions from both groups in comparison to the results of the initial questionnaire; the students of the experimental group scored even higher compared to those of the control group.

4.2 Journal Entries

The journal entries provided significant data on a) the role of digital applications, in particular of Augmented Reality, in the learning process (i.e. while learning Geography), b) the students' reactions to the ARETE Geography application and c) the overall evaluation of the intervention. More specifically, the learning environment which was created allowed the young students to come into contact with the digital technologies through active participation and led to the cultivation of their cognitive and language skills.

4.3 Student Interviews

The students were asked the following questions:

- 1) "Which activity did you enjoy the most? Would you like to repeat it in the future?"
- 2) "What was the most difficult part for you?"
- 3) "What was the most interesting thing you learnt?"

The majority of the students mentioned that they liked all tasks in which Augmented Reality was implemented, in particular activities in which wild animals came to life, as they commented. They noted that they learnt and retained new knowledge more easily with the use of technology, which turned the lesson into a very pleasant and interesting experience, compared to a traditional Geography lesson. Regarding difficulties, most students commented on connectivity issues related to the slow internet speed at school; some of them also mentioned difficulties understanding and remembering the names of rare animals and plants in different continents when completing tasks in their Geography Clever Book.

5. Conclusion

The use of educational technology in the implementation of CLIL, as well the ARETE Geography application and the use of Augmented Reality in the classroom, greatly facilitated the creation of a multimodal learning environment. Therefore, we come to the conclusion that the above-mentioned technologies can support the teaching and learning of Geography at the primary level. The intervention objectives were satisfactorily achieved. The students of the experimental group reacted in a very positive way to the use of videos, interactive presentations, digital books, tablets and 3D models used during the pilot intervention: the learning material allowed the acquisition of clearly differentiated learning experiences in relation to the control group, regarding effectiveness in language learning. Vocabulary learning, recall and retention were highly facilitated and it was observed that the application of digital technologies allowed students to complete the relevant activities in less time since students were enthusiastic and willing to participate in all the activities involved.

Image 7: 3D models of famous landmarks in Africa



Source: <https://apkpure.com/arete-geography/eu.cleverbooks.arete.geography#eu.cleverbooks.arete.geography-13>

It is pointed out that these are some of the first conclusions which demonstrate the positive effect of the ARETE pilot intervention. It is proposed to implement the intervention for a longer time period as well as on a larger scale, by enriching the Geography material, so that it relates to more thematic units such as our country, Greece or Environmental Studies material (change of the seasons, day-time and night-time, Earth in the solar system, Earth's structure and characteristics). Moreover, the pilot intervention could be implemented on other school subjects as well like Mythology or Geometry/Mathematics. This will lead to the extraction of more valid conclusions regarding the use of Augmented Reality at the primary level.

Conflict of Interest Statement

The author declares no conflicts of interest.

About the Author

Maria Rellia is a teacher of English (MEd. Hellenic Open University) at Ralleia Experimental Primary Schools of Piraeus Greece, as well as a sub-headmistress at the same school. She is also an eTwinning Ambassador for Greece and an Educational Technology Trainer. Her research interests include the implementation of technology in the EFL classroom, in particular, CLIL and Augmented Reality applications. She has written several books on the teaching of English as a Foreign Language to Young Learners, as well as on STEAM for the first grades of Primary School.

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