Ανοικτή Εκπαίδευση: το περιοδικό για την Ανοικτή και εξ Αποστάσεως Εκπαίδευση και την Εκπαιδευτική Τεχνολογία

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Teaching mathematical concepts using web-based collaborative enviroments. An eTwinning case study

Λαμπρινή (Labrini) Νικόλαος Αλεξίου (Alexiou)

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Διδάσκοντας μαθηματικές έννοιες σε συνεργατικά διαδικτυακά περιβάλλοντα. Μελέτη περίπτωσης μιας eTwinning δράσης

Λαμπρινή Ν. Αλεξίου
university of nicosia
labrinale@gmail.com

Abstract
eTwinning is an innovative European program that strengthens lifelong learning and the main purpose of which is the networking of schools with the help of new technologies. It is an initiative of the European Commission to strengthen the collaborative distance learning and the implementation of new innovative instructional methods. Through literature review, this article explores the contribution of the eTwinning project to the cultivation of basic skills, which the European Parliament identifies as keys to an individual's lifelong learning. Mathematics are included in these skills. It is an attempt to show the schools' potential to cultivate the students' European identity and European skills, such as cooperation and respect for the perceptions and culture of other people. It is also a case study aimed at exploring the cognitive, creative, cooperative and technological dimensions of an eTwinning action, as well as the attitude of 18 students towards the distance learning action, which they participated in. The subject of the eTwinning practice combines mathematical concepts applied in real context.

Keywords
eTwinning, Twinspace, European programs, distance learning, online learning

Abstract in Greek
Ένα καινοτόμο Ευρωπαϊκό πρόγραμμα που ενισχύει τη δια βίου μάθηση και έχει ως βασικό σκοπό τη δικτύωση των σχολικών μονάδων με τη βοήθεια των νέων τεχνολογιών, είναι το eTwinning. Αποτελεί πρωτοβουλία της ευρωπαϊκής επιτροπής για να ενισχύσει τη συνεργατική εξ αποστάσεως μάθηση και την εφαρμογή νέων καινοτόμων μεθόδων διδασκαλίας. Το παρόν άρθρο διερευνά μέσω της βιβλιογραφικής ανασκόπησης την προσφορά των έργων eTwinning στην καλλιέργεια βασικών δεξιοτήτων, τις οποίες το ευρωπαϊκό κοινοβούλιο χαρακτηρίζει κλειδιά για τη δια βίου μάθηση του ατόμου. Ανάμεσα σε αυτές τις δεξιότητες συγκαταλέγονται και οι μαθηματικές. Αποτελεί προσπάθεια ανάδειξης της δυναμικής των σχολείων να καλλιεργήσει στους μαθητές τις ευρωπαϊκές δεξιότητες, όπως τη συνεργασία και το σεβασμό στις αντιλήψεις των άλλων λαών. Επίσης αποτελεί μελέτη περίπτωσης που έχει σα σκοπό να ερευνήσει τις γνωστικές, δημιουργικές, συνεργατικές, τεχνολογικές διαστάσεις μιας δράσης eTwinning, καθώς και τη στάση 18 μαθητών απέναντι στην εξ αποστάσεως δράση στην οποία συμμετείχαν, το θέμα της οποίας συνδυάζει μαθηματικές έννοιες εφαρμοσμένες σε πραγματικό πλαίσιο.

Introduction

Education is a continuous process of knowledge and skills enrichment, which provides the person with the necessary capabilities to respond to the needs of modern society and harmonize with the new data. It is a key instrument that contributes to the personal development as well as the establishment of collaborative relationships between individuals, groups and nations (International Commission on Education for the Twenty-First Century & Delors, 1996). The European Parliament demonstrates key skills that it identifies as keys to lifelong learning (Europea, 2006). We will focus on some of them, such as linguistic and social skills, initiatives-undertaking, mathematical and programming skills.

Language is a basic prerequisite for understanding cultural values, recognizing the differences and similarities of cultural systems and cultural norms and rules of other people (Galvin et al., 2007). It contributes to the externalization of opinions, beliefs and thinking processes that will be the subject of negotiation for a group's members (Slavin, 2017). Individuals will need to evaluate claims, reconsider their perceptions, and lay the foundations for peer learning (Galvin et al., 2007). Interaction with the social environment will contribute to the inner speech, which contributes to shaping and organizing their thinking (Vygotsky, 1978). Thought control, self-awareness and self-regulation are cognitive processes and features of metacognitive skills. Their absence deprives pupils of applying knowledge in practice (Schoenfeld, 1987).

Mathematical skills relate to the applicability of mathematical thinking to solving problems of everyday life. The individual needs to be able to monitor, analyze, synthesize and evaluate the inductive and deductive reasonings and arguments presented (Steyn & Du Plessis, 2007). He can also get involved in searching for the mathematical truth, making and investigating his initial assumptions, coming to conclusions and checking the validity of his claims (National Research Council, 2006, Europea, 2006; National Council of Teachers of Mathematics, 2000). The connection and interaction of mathematics with other subjects and their application in a variety of contexts helps pupils perceive their usefulness and the mathematical concepts become meaningful to them (National Council of Teachers of Mathematics, 2000). The positive attitude towards the subject and the continuous effort result in the improvement of the mathematical skills and the achievement of the objectives pursued. (National Mathematics Advisory Panel, 2008, Schoenfeld, 1987).

Additionally, the cultivation of technological skills is important for the European Parliament. New technologies support distance learning and offer new innovative capabilities to lifelong learning. Students can access and interact with multimedia educational material, participate in collaborative activities, communicate with pupils and teachers outside the classroom, get feedback on their actions (US National Research Council, 2006; Feweks & Macabe, 2012; Hazari, North & Moreland, 2009). The student possessing technological skills can draw on and produce material , as well as share it with care. He is also given the opportunity to collaborate and participate in online learning communities wisely and responsibly, thus expanding his spiritual horizons (Europea, 2006). Through ICT, a student has the potential to engage in activities that goad him into making decisions, reasoning and problem solving, which contribute to the deep understanding of the mathematical terms and concepts (National Council of Teachers of Mathematics, 2000).

The European Commission proposes programs that enable schools to open their gates to Europe, offering experiences that enhance social interaction between nations and the cultivation of skills necessary for an individual's continuous development and

lifelong learning. The role of new technologies in supporting synergy between schools in different countries is crucial. The eTwinning networking platform is an example of a major technological tool that offers experiences of collaborative distance learning (Kampylis et al., 2012).

This paper will analyze the pedagogical offer of eTwinning actions through bibliographic review. Also, this article is a case study aimed at exploring the cognitive, creative, cooperative,and technological dimensions of the action, as well as the attitude of 18 students towards the distance program, the subject of which combines mathematical concepts applied in a real context.

Theoretical Background

eTwinning is an innovative European project which fosters lifelong learning and whose main purpose is the networking of schools with the help of new technologies (Galvin et al., 2007). eTwinning actions enable students to cultivate basic skills that the European Commission indicates as keys to lifelong learning (Manfredini, 2007). It is an initiative of the European Committee to enhance cooperative distance learning, investigation and application of new innovative teaching methods (Barorova et al., 2007; Vlada et al., 2009). According to Galvin et al. (2007), students and teachers are given the opportunity to travel virtually by making digital trips to other countries, gaining intercultural cooperative experiences. They acquire experiences of formal and non-formal education (Galvin et al., 2007; Vlada et al., 2009).

By participating in eTwinning programs, students have the opportunity to exchange experiences and jointly decide which the steps towards a common goal will be. They gain experiences of international co-operation in original learning environments (Galvin et al., 2006) that are necessary for their future professional career. In authentic activities, knowledge is interconnected with action. The context in which authentic activities are applied leads to knowledge. Activities are an integral part of the learning process (Brown, Collins, & Duguid, 1989). In eTwinning programs, students are asked to solve real-world problems through social interaction with pupils from other countries and different cultural backgrounds. Students communicate with a real audience and enchance their skills regarding the use of foreign languages as recorded by various scholars (e.g. Cachia & Punie, 2012; Galvin et al., 2006; Manfredini, 2007, Vlada et al., 2009; Kampylis, 2013). They are given the opportunity to learn a foreign language in depth because they get aware of their interlocutors' culture (Galvin et al., 2007). They will need to manage unpredictable situations encountered in real life, such as misunderstandings due to different linguistic backgrounds and the use of unknown idioms (Barorova et al., 2007). They acquire authentic intercultural experiences and enrich the ones that school textbooks provide (Galvin et al., 2006).

In addition, by participating in eTwinning actions, pupils become members of a digital online learning community (Cachia & Punie, 2012; Song et al., 2011). Members of a community participate actively, exchange views, experiences and strategies for completing a project. They build relationships, acquire a sense of responsibility for the tasks they will undertake and invest in the community (Cardet, 2012; Collins et al., 1991). In eTwinning, students learn through the trial-and-error process. They formulate and produce ideas, judge and evaluate the thoughts and actions of their classmates (Galvin et al., 2007) by giving feedback on their actions. The above actions, as Schoenfeld (1987) characteristically mentions, are attributes of the self-regulation skill and it is difficult to imagine a learning environment other than a learning community in which this skill can be developed in a more natural way.

Participation in eTwinning programs contributes to independent self-regulating learning (Barvor et al., 2007; Galvin et al., 2006), which takes place in a pleasant and creative manner, increasing learning motives (Galvin et al., 2006; Manfredini, 2007). Students are prompted to participate actively, because they deal with real problems, collaborate and demonstrate their results to a wide audience. Collaboration is a difficult process especially when it must take place between students from different countries. However, it is considered to be exciting in eTwinning actions (Barorova et al., 2007). Students overcome their fear of making mistakes, developing their confidence and self-esteem (Galvin et al., 2006; Galvin et al., 2007; Kampylis, 2012; Kampylis, 2013).

eTwinning programs provide school units with the opportunity to enrich the program. Projects that support cross-curricular approach, interdisciplinarity, mathematics and physical sciences can be implemented and fully harmonized with school subjects (Manfredini, 2007; Kampylis et al., 2012). Language will be a tool for students to negotiate mathematical terms and concepts and seek new knowledge, which extends to expanded environments. They can participate in projects that give them the opportunity realize the application of mathematics to life in a pleasant way (Arkadiusz, 2009). For example, they can engage in a statistical survey that involves collecting real data, presenting them with statistical diagrams and drawing conclusions (Barorova, 2007; Manfredini, 2007). They can also interact with mathematical software, such as GeoGebra, enabling them to explore the relationships that regulate the objects of a shape. By altering the values of the parameters and observing the changes they make to the algebraic and the geometric representations of the shape, which are dynamically linked to each other, they get helped to approach mathematical concepts from different points of view, thus cultivating their abstract thinking (Criscuolo & Gnudi, 2013 Zengin et al., 2012). The GeoGebra mathematical software has been used in eTwinning projects and can be considered as a laboratory environment whose dynamic handling contributes to the understanding (Cataldo, 2007). Participation in the eTwinning community strengthens learning through the use of new technologies. Students and teachers experience innovative teaching methods and innovative teaching practices (Vlada et al., 2009).

The professional development of teachers is highlighted by various surveys (e.g Holmes & Sim, 2012; Kampylis, 2012; Vuorikari et al., 2011). Professional development includes the enrichment of knowledge, skills and experiences acquired in formal or non-formal learning environments, in school environment, in online communities, through school units partnerships (OECD, 2009). Vuorikari et al. (2011) report that many teachers -despite the fact that their initial goal was not their professional development- realized later the skills they gained by participating in eTwinning actions. Events, development workshops, training seminars in the eTwinning platform, the cooperation for the creation of a project and the exchange of good practices contribute to the cultivation of their creativity, enhancing their educational work (Kampylis, 2012). The eTwinning community and the playful approach that is often followed, contribute to the cultivation of technological skills (Galvin et al., 2006).Teachers feel more confident and determined to implement technological tools into their teaching (Holmes & Sim, 2012). They improve their pedagogical and instructional strategies (Barorova, 2007), as well as their managing skills (Galvin et al., 2006). They gain flexibility in thinking by observing a matter from different perspectives, broadening their horizons (Kamplylis, 2013). The relationship between pupils and teachers becomes stronger (Kamplylis, 2013) and that facilitates the work of the latter ones.

However, it should be noted that in order for eTwinning actions to deliver positive results, basic requirements must be met. As stated by Kamplylis et al., (2013) the goal setting of a project should be accurate, the results sought must be clear and the schedules must be harmonized with the requirements of each activity. As Cataldo (2007) characteristically says, the learning process takes place in a pleasant way when the objectives and the results are well-defined, and when there are activities that require a combination of knowledge and practice. However, many teachers are not trained in exploratory and problem-centered teaching methods (Kampylis et al., 2013). They have no experience in developing and implementing constructivist and socio-constructivist activities necessary for the implementation of a quality eTwinning project (Papadakis, 2015). Velea (2011) reports that the reason why the teacher's development is often not visible, although he may have participated in many eTwinning actions, is his inadequate pedagogical training. It is also important to mention the problems encountered in the implementation of a project due to lack of time. Curricula are not flexible for the implementation of such practices. Finally, the inadequate technological infrastructure as well as the the feeling of absence or inadequacy of teachers' digital skills are an obstacle to their implementation (Kampylis et al., 2013).

Methodology

Project description

The practice was implemented into the school timetable of two European schools of I.E.S. Izpisúa Belmonte, Spain and the 3rd General High School of Rethymno. Two classrooms of 15 to 16-year-old students, who could also engage in the activities outside the classroom without space-time constraints, took part in the action. The program lasted 8 months from October 2017 to May 2018 and is titled "Golden number where are you?" Mrs. Inmaculada Illan, professor at I.E.S. Izpisúa Belmonte, Spain, is the inspirer and one of the two founders of this project. Mrs. Inmaculada Illan was also one of the two coordinators of the project.

The students collaborated on the online platform that eTwinning offers, which is named "Twinspace". The project was organized and structured on this platform. The goals and the timetables were formulated and the results from the two coordinating teachers of the project were presented. Collaborative digital tools, such as padlet, Google excel and Geogebra web worksheets, as well as several web 2.0 tools that contributed to the organization and presentation the students' effort were incorporated. The aim of the project was to explore the mathematical concept of the golden section in the human body, in nature, in everyday life objects ,with the help of collaborative digital tools. Using concepts of geometric construction, the pupils of the two countries created in the digital cooperative environment of Geogebra Groups, golden spirals, golden rectangles, shapes similar to those that they found to exist in life. They chatted synchronously and asynchronously using the chat room and the forum of the Twinspace platform, collaborated in all activities, highlighting the excellence and effectiveness of collaborative learning. In detail, the project timetable was as follows:

1st Activity. October - November. Students get to know each other with the help of a pleasant game called Chinese portrait. In order for the acquaintance game to take place, the students interacted asynchronously through the forum of the Twinspace platform.

2nd Activity. December-January. Data collection on the dimensions of the human body and statistical data processing. The students gathered data from 74 people aged 9-90 years. They shared the tasks, sorted the tables by sex, age, ethnicity, created

charts and calculated means. Statistical conclusions on how much the bodies in the different groups studied approached the harmonic dimensions were drawn. The teams worked together on the Google Excel online worksheets embedded on the Twinspace platform. The results of their research were recorded in the collaborative digital book Story jumber by the students who had undertaken this task.

3rd Activity. February-March. The pupils of both countries have noticed the nature and, more generally, the world that surrounds them. They studied the golden ratio in the pets, their garden plants, objects they often use, such as doors, on the computer mouse, on their parents' credit cards. They uploaded real photos on the padlets of the teams, justifying the way that the concept of the golden section in these photos is distinguished (Fibonacci sequence, distance ratio φ = 1,1618) and expressing their opinion on what they consider to be the most interesting. There was a final vote among all the groups, on the best photo which contains the concept of the golden ratio in the world that surrounds us through a web 2.0 tool embedded on the Twinspace platform.

4th Activity. April -May. Students created their own constructions while applying the proportions of the golden section. They co-produced gold spirals, golden rectangles, shapes similar to those they discovered to exist in life in Geogebra's virtual classroom. They incorporated the winning photo from the competition vote of the previous activity into their constructions. The virtual class of GeoGebra groups enabled the sharing of material, communication and feedback. Teachers completely supervised the collaborative effort of the students with the potential of support when necessary. The interactive worksheets of GeoGebra groups were integrated into the Twinspace platform.

The synchronous communication that the students had twice in the chat room, one of which took place in the middle of the project and the next one just before the end of it, as well as the exchange of friendship gifts, enhanced the communication and the relationships among the students. All activities were accompanied by the completion of open and closed Google forms questionnaires in Twinspace. Students' views were a feedback on the effort of the two teachers who coordinated the program. The two teachers exchanged their impressions via synchronous communication in the chat room, as well as through a live event on the Twinspace platform and asynchronously via email.

Data collection

At the end of the program, a sample of 18 pupils from the two transnational classes, namely 9 from the Greek and 9 from the Spanish class, completed a questionnaire with open and closed-ended questions on the overall evaluation of the project. The questions were categorized into four dimensions, which related to the content, the pedagogical and technological characteristics and the students attitudes towards the program. These four dimensions also support the research questions of this work. Each dimension consists of factors on which the 5-point Likert scale was used. Table 1 analytically includes 26 factors with their encoding. Our specific purpose is to study students' views on whether:

1. their knowledge of the issue negotiated was enriched by this action,
2. their creative, cooperative and technological skills were enhanced,
3. they cultivated a positive attitude towards the project

Table1. The four dimensions and the factors of the questionnaire

	Factors	Dimensions
C1	The project helped me enrich my knowledge, regarding the implementation of the golden section concept into the human body	Project Content
C2	The project helped me enrich my knowledge regarding the implementation of the golden section concept into the nature	
C3	Combining mathematical concepts with elements of the real world was interesting for us	
	A. Creative features	Pedagogical features of the project
P1	The project helped me work gradually independently	
P2	The project helped me develop my imagination	
P3	The project helped me develop my creativity	
P4	The project provided me with new experiences	
P5	The lesson became more interesting with the incorporation of the eTwinning action	
	B. Cooperative features	
P6	The experience of sharing my obligations with students from another country was helpful	
P7	The experience of sharing my obligations with students from another country was interesting	
P8	I would like more opportunities for real-time chat	
P9	The gift exchange experience was pleasant	
P10	Communicating with the use of English was easy	
T1	The project offered me the opportunity to work with new digital tools	Technological features
T2	The project helped improve my technological skills	
T3	The use of the padlet in the project was helpful	
T4	The use of the Google excel's web worksheets was helpful	
T5	The use of Geogebra websheets in Geogebra groups' virtual class was helpful	
T6	The use of the padlet was easy	
T7	The use of Google Excel's web worksheets was easy	
T8	The use of Geogebra's webpages was easy	
T9	The use of Twinspace was easy	
A1	I initially found the idea to participate interesting	Attitudes
A2	The twinning project has met my expectations	
A3	I would like to have eTwinnng experiences in other subjects as well	
A4	I would like to participate in eTwinning projects in the future	

A questionnaire with closed and open questions was completed by both teachers who implemented this action, and provided information on the experience they gained.
Then the data from the questionnaire completed by the students at the end of the action and the two teachers-action coordinators' impressions from the cooperative distance experience will be presented.

Results

Project content: Table 2 deals with students' views on the content of the project regarding its contribution to broadening their knowledge. As shown in Table 2, the majority of students agree or absolutely agree with the fact that the project helped them enrich their knowledge regarding the mathematical concept of the golden section in the human body (72.2%) and in nature (94.4%). The mean of the question whether the combination of mathematical concepts with real world data was interesting, is quite high ($\bar{x}$=4.28, S.D= 0.57). The mean of the three factors belonging to this dimension is quite high as well (4.18).

Table 2: The content of the eTwinning project

Factor	Absolutely disagree	Disagree	Neutral	Agree	Absolutely agree	$\bar{x}$	S.D.
C1	0.0%(0)	0.0%(0)	27,8%(5)	**44,4%(8)**	27,8%(5)	4.00	0.77
C2	0.0%(0)	0.0%(0)	5.6%(1)	**61.1%(11)**	33,3%(6)	4.28	0.57
C3	0.0%(0)	0.0%(0)	5,6% (1)	**61,1%(11)**	33,3%(6)	4.28	0.57

Cronbach α=0.843; 3 items; five-point Likert scale (1-5); mean=4.18

Pedagogical features of the project: Table 3 relates to the perceived cultivation of skills , the motivation and student interaction. 10 out the 18 students believe that they developed features of self-regulating their learning. 50% of them are of the opinion that the cultivation of their imagination was fostered, while more than 50% disagreed or had neutral stance on the claim that their creativity was enhanced. The mean of the claims that the students lived new experiences and that the lesson became more interesting are quite high ($\bar{x}$ =4.17, S.D=0.62, $\bar{x}$ =4.11, S.D=0.90, respectively).
Also, the positive valuation of the project is indicated by the cooperation. The students agree or totally agree with the view that the cooperation process was useful (82.3%) and interesting (88.9), for the completion of the project. Among the 18 students, 17 stated their intention for additional synchronous communication, although the use of the English language is difficult for two pupils and a possible problem for 5 other of them, as their stance on the ease of its use is neutral.

Table 3: Pedagogical features of the eTwinning project

Factor	Absolutely disagree	Disagree	Neutral	Agree	Absolutely agree	$\bar{x}$	S.D
A. Creative features							
P1	0.0%(0)	5.6%(1)	38.9%(7)	**55.6%(10)**	0%(0)	3.50	0.62
P2	0.0%(0)	11.1%(2)	33,3%(6)	**50%(9)**	5,6(1)	3.50	0.78
P3	0.0%(0)	11.1%(2)	**44.4% (8)**	38.9%(7)	5.6(1)	3.39	0.78
P4	0.0%(0)	0.0%(0)	11.1%(2)	**61,1(11)**	27.8(5)	4.17	0.62
P5	0.0%(0)	0.0%(0)	33.3%(6)	22.2(4)	**44.4%(8)**	4.11	0.90
B. Collaborative features							
P6	0%	5.6%(1)	22.2(4)	**55,6%(10)**	16.7%(3)	3.83	0.78
P7	0%	0%	11.1(2)	**50(9)**	38.9(7)	4.28	0.67
P8	0%	0%	5.6%(1)	**55.6%(10)**	38.9(7)	4.33	0.59
P9	0%	0%	22.2%(4)	**50(9)**	27.8(5)	4.05	0.72
P10	5.6%(1)	11.1%(2)	16.7%(3)	22.2%(4)	**44.4%(8)**	3.89	1.28

A. Cronbach α=0.77; 5 items; five-point Likert scale (1-5); mean=3.73
B. Cronbach α=0.68; 5 items; five-point Likert scale (1-5); mean=4.08

Project Technological Features: Table 4 provides information on pupils' views on the contribution of digital tools used to cultivate technological skills and achieve project goals. It also provides information on ease of use. The overwhelming majority of respondents (94.5%) believe that they were given the opportunity to learn new technological tools and improve technological skills through the eTwinning project(83.3%). Over 50% of students recognize the usefulness of collaborative digital tools. Particularly 61.1% recognized the importance of padlets, 72.3% of Geogebra online worksheets and 72.2% of Google excel worksheets.
However, they have second thoughts about using these tools as a significant percentage disagrees or has a neutral view on the claim that they are easy to use. More specifically, 61.1% and 44.4% maintain a neutral attitude regarding the ease of padlet and google excel worksheets use, with only 38.9% agreeing or fully agreeing that geogebra online worksheets are easy to use. Regarding the ease of using the Twinspace, 61.1% of respondents do not feel that their environment is difficult, while 16.7% are experiencing difficulties and 16.7% have neutral view.

Table 4: Technological features of the eTwinning project

Factor	Absolutely disagree	Disagree	Neutral	Agree	Absolutely agree	$\bar{x}$	S.D
T1	0.0%(0)	0.0%(0)	5.6%(1)	**55.6%(10)**	38.9(7)	4.33	0.59
T2	0.0%(0)	0.0%(0)	16.7%(3)	**61.1%(11)**	22.2(4)	4.05	0.64
T3	0%(0)	5.6%(1)	33.3% (6)	**50%(9)**	11.1(2)	3.67	0.77
T4	0.0%(0)	0.0%(0)	27.8(5)	**72.2%(13)**	0%(0)	3.72	0.46
T5	0.0% (0)	5.6%(1)	22.2%(4)	**66.7%(12)**	5.6%(1)	3.72	0.67
T6	0.0% (0)	0.0%(0)	**61.1%(11)**	22.2%(4)	16.7%(3)	3.55	0.78
T7	0.0% (0)	0.0%(0)	**44.4%(8)**	38.9%(7)	16.7%(3)	3.72	0.75
T8	5.6(1)	22.2(4)	**33.3(6)**	27.8(5)	11.1(2)	3.16	1.09
T9	5.6(1)	16.7(3)	16.7(3)	**44.4(8)**	16.7(3)	3.5	1.15

Cronbach α=0.80; 9 items; five-point Likert scale (1-5); mean=3.71

Attitudes behaviors: Table 5 contains the factors describing student attitudes towards the eTwinning action and their behavior in a future engagement. From Table 5 we conclude that although 66.7% of the students found the idea of participating in the eTwinning program initially interesting, the project satisfied 50% of the students. However, a high of 77.8% would like eTwinning programs to be integrated into other courses. Only a small percentage (5.6%) would not want to participate in the future and a significant percentage of 22.2% maintains a neutral attitude.

Table 5: Attitudes-Behaviors

Factor	Absolutely disagree	Disagree	Neutral	Agree	Absolute-ly agree	$\bar{x}$	S.D
A1	0.0%(0)	5.6%(1)	27.8%(5)	**38.9%(7)**	27.8(5)	3.89	0.90
A2	0.0%(0)	5.6%(1)	**44.4%(8)**	33.3%(6)	16.7(3)	3.61	0.85
A3	0.0%(0)	5.6%(1)	16.7% (3)	**66.7%(12)**	11.1%(2)	3.83	0.71
A4	0.0%(0)	5.6%(1)	22.2%(4)	**55.6 (10)**	16.7%(3)	3.83	0.78

Cronbach α=0.86; 4 items; five-point Likert scale (1-5); mean=3.79

From answers to the open-ended question of the questionnaire, which concerned the students' suggestions for improving the project, it appears that they seek activities that combine mathematical concepts with real-world elements. Some of the answers that indicate this desire are:
«Lets calculate the importance of the golden ratio in Olympic sprinters»
«Lets have an activity about sports»
«An activity to investigate how many daily actions we should make use of mathematics»
The students' positive intent for further sychronous communication is illustrated by the following answers:
«would like to communicate with the others students more »
«More interaction between us»
«More communication»
«Talk more with greek guys»
"To talk more between us because we could work with more confidence"
«Talk more with those of the other country»
«We need more communication»
«It would be fun to chat again with the transnational students, because it would help to get to know her other better»
«We could plan a school trip»
«More communication with the Greek students»
«I would like to have a web cam with the child»
«I would like a communication through Skype»
«More countries to participate»
Their responses also show their desire for more time to additional activities to be devoted:
«I think the activities were very funny and we have to repeat more activities»«Do more things»
«More hours»
«We have not done much in geogebra»
«More mathematics about golden number»
Time particularly troubled one of the two teachers ,who only had one instructional hour according to the timetable, to meet with the students. Perhaps the limited time, which was orally reported by many students in the discussions with the group's teacher, was a key factor in the initial expectations of some students from the program not being met. It should be noted that a lot of the teachers' personal time for the selection of the material, the structure, the organization and the coordination of the students was required. However, their impressions were very positive. They gained experience of collaborative digital tools, improving their technological skills. In addition, they gained knowledge of creating a quality eTwinning project according to the instructions of the national eTwinning service. The contemporary pedagogical learning theories, the harmonization with the curriculum, the collaboration between the teachers and the use of new technologies are elements that quality eTwinning projects (National quality labels, n.d.) must feature and I believe that they should characterize our teaching. Through the eTwinning action, dynamic relationships of appreciation and trust which will form the basis for future collaborations have been established between the two teachers. The positive feelings they had, led them to recommend to other teachers to participate in eTwinning actions.

Discussion

Through literature review, the potential that eTwinning projects offer to engage in exploratory cross-thematic activities that combine mathematical concepts with real-world elements is revealed (eg Arkadiusz, 2009; Barorova, 2007; Cataldo, 2007; Manfredini , 2007). This particular case study confirms this potential. The students shared the project's obligations, gathered, processed and presented the statistical data in graphs, created their own constructions with GeoGebra software and the majority of them enriched their knowledge. The students who participated in the project gradually took more initiatives and were independent from the teacher, a conclusion that has also been recorded in the literature (eg Barorova et al., 2007; Galvin et al., 2006).

It is important to note that the participants benefited from the cooperation, as they understood its usefulness in completing the tasks and in the fact that the obligations can be carried out in a pleasant way, offering them new experiences. The fact that eTwinning projects are a learning community, enhancing cooperative skills is also demonstrated by several researchers (Cachia & Punie, 2012; Galvin et al., 2007; Song et al., 2011). Although many surveys show improved skills in using the foreign language, this claim can't be confirmed by this study because it is not the subject of it. The English language was a means of externalizing the thinking processes and supporting collaborative learning, as well as a means of taking initiatives, recording conclusions, making statements and exchanging views. The majority of students did not have difficulty using the English language, but the stance of a significant number of pupils was neutral.

It is worth mentioning that eTwinning projects offer the experience of innovative teaching methods (Barorova et al., 2007; Vlada et al., 2009). In this eTwinning project, the majority of students agree with the view that they have been given the opportunity to get in touch with new digital tools, enhancing their technological skills. Although the majority of students recognize their usefulness in achieving the desired goals, a significant number of them experienced difficulties or had neutral attitude as far as the ease of use of the collaborative digital tools used is concerned. The Twinspace platform does not belong to the digital tools that their use complicated or troubled the majority of students.

In addition, as reported by several researchers (Barorova et al., 2007; Galvin et al., 2006; Manfredini, 2007), learning through participation in eTwinning actions takes place in a pleasant and creative way, increasing motivation for learning. This study shows that the pupils agree with this view. The lesson became more interesting, the combination of mathematical concepts with real-context elements attracted pupils to the degree that the majority wanted eTwinning projects to be integrated into other subjects. The majority also want to participate in such programs in the future, although, in a significant degree, they did not improve their initial neutral attitude towards the action or their initial expectations were not satisfied.

Students' answers to open-ended questions demonstrate their desire for deeper understanding of the concepts and more interaction, as well as lack of available time. Time as well as the inadequacy or even the age of technological equipment are factors that made the teachers' tries more difficult. The above negative factors for the implementation of an eTwinning project are also recorded in the study by Kampylis et al. (2013). However, despite the difficulties, the two teachers who participated in this project confirm the conclusions of several studies (eg Barorova, 2007; Holmes & Sim, 2012; Kampylis, 2012; kamplylis, 2013; Vuorikari et al., 2011) for professional development. I believe that the fact that many teachers, do not have the appropriate

pedagogical training to create activities that support the new pedagogical learning theories, as reported by Velea (2011) and Papadakis (2015), may be dealt with through the support of the national eTwinning service, as well as the many events, which are about creating a quality project and are organized by ambassadors. However, although many events on the topic of acquaintance and integration of many web 2.0 tools are organized, I agree with the opinion of Kampylis et al. (2013), who argue that teachers with no basic technological skills will have difficulty in actively supporting eTwinning projects. Possession of technological skills is a key factor in the success of a remote program (Vrasidas, & Glass, 2002).

In conclusion, I would like to express the view that distance eTwinning projects can cultivate the basic skills that the European Parliament lays out as keys to lifelong learning (Europea, 2006) and which were mentioned in the introduction. I also believe that it contains the four basic elements that the International Committee for Education in the 21th Century considers to be the foundation for the lifelong learning of the individual. The students "learn how to learn", cultivating the skill of taking initiatives with judgment and prudence, "learn how to act" in different situations and "learn to exist" and "coexist". According to the International Commitee, participation in cooperative activities can help cultivate respect for the perceptions and the values of the cultural characteristics of other members. Autonomous, responsible ,dynamic personalities are developed, highlighting key aspects of the human character such as power of speech, communication skills, creativity, sense of beauty and solidarity (International Commission on Education for the Twenty-first Century & Delors, 1996). The school environment can be considered a suitable place to prepare pupils to live and work in multicultural Europe. It can act as a catalyst for students to cultivate European identity, European skills such as cooperation, respect for the perceptions and cultures of other people, reducing the distance between nations due to socio-cultural differences (Galvin et al., 2007). I think that the participation of schools in distance eTwinning projects can contribute to this. Of course, it is advisable that surveys for a larger number of students are carried out.

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