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Comparing the Effectiveness of Using Tablet Computers for Teaching Addition and Subtraction

Nicholas Zaranis
Associate Professor, University of Crete, Greece

ABSTRACT

The purpose of this study is to investigate if tablet computers help improve primary school students' mathematical achievements regarding addition and subtraction. This research compares the level of mathematical competence of the students taught using our tablet computers oriented learning method which specifically takes advantage of 'Realistic Mathematics Education' (RME) for the concept of addition and subtraction, as opposed to traditional teaching methodology. The designed software consisted of several activities with and without the use of computers for addition and subtraction. It was designed following the background of the RME theory. The present study was a pilot research of quasi-experimental design with one experimental and one control groups. The research results show that the students who were taught with educational intervention based on tablet computers and RME had a significant improvement on their total mathematical achievement, addition and subtraction in comparison to those taught using the traditional teaching method.

Keywords: Educational Intervention, Tablet Computers, Realistic Mathematics Education, Addition, Subtraction, First Grade Students, Information and Communications Technology, Mathematical Achievements

INTRODUCTION

The integration of ICT into primary education has become a high priority for everybody involved in the learning process (Chen, & Chang, 2006; Desoete, Ceulemans, De Weerdt, & Pieters, 2010; Zaranis, & Oikonomidis, 2009). A growing body of literature provides increasing evidence of the effectiveness of using computer technologies to facilitate instruction and learning across a variety of school subjects (Bayraktar, 2002; Bobis, et al., 2005; Clements, 2002; McKenney, & Voogt, 2009; Trundle, & R. L. Bell, 2010). Particularly, studies have demonstrated that computers have supported the development of the abilities in children's memory, problem-solving, literacy and math (Clements, & Sarama, 2003; Dodge, Colker, & Heroman, 2003; Ihmedieh, 2010; Judge, 2005; Kroesbergen, Van de Rijt, & H Van Luit, 2007; Morrow, L. Gambrell, & M. Pressley, 2003; Starkey, Klein, & Wakeley, 2004; Walcott, et al. 2009). These technologies can therefore play an essential role in achieving the objectives of the first grade curriculum in all sectors and subjects if supported by developmentally appropriate software applications (Brooker, & J. Siraj-Blatchford, 2002; Fischer, & C. W. Gillespie, 2003; Haugland, 1999; Lee, 2009) embedded in appropriate educational scenarios (Dimakos, & Zaranis, 2010; Fesakis, & Kafoussi, 2009; Zaranis, & Kalogiannakis, 2011). Many early-year practitioners and researchers state that the interactive environment created in a primary educational level by using tablets is stronger in maintaining children's

interest towards digital activities, and encourages them to become more closely and effectively involved in digital mathematical activities (Liu, 2013; Risconscente, 2012).
Today, the vast majority of children in the developed world, regardless of their ethnic or socioeconomic background, have access to a smart mobile device (Kyriakides, Meletiou-Mavrotheris, & Prodromou, 2016). Compared to other digital devices (e.g. laptops, mobile phones, and personal computers) the mobile devices with touch screens, are by far the most popular among young children and this trend is growing rapidly (Ofcom, 2014). The intuitive interface of a touch-screen tablet, the ease of installing new apps, the increased portability and autonomy are some of the features which may contribute to their growing popularity in among students (Falloon, 2014; Hirsh-Pasek, Zosh, Golinkoff, Gray, Robb, & Kaufman, 2015; Lynch & Redpath 2012; Neumann & Neumann, 2015).
There have been studies revealing that smart mobile devices, tablets in particular, may have a positive role on improving the teaching and learning of preschoolers (e.g. emerging literacy and mathematics skills) (Kyriakides et al., 2016; Neumann & Neumann, 2015). Unlike other forms of digital technology that are available in the classrooms (Fessakis, Lappas, & Mavroudi, 2015; Lynch & Redpath, 2012), the research on children's use of smartphones and tablets has shown that it presents very few technical challenges and, as a result, children quickly become enthusiastic users (Flewitt, Messer, & Kucirkova, 2015; Shifflet, Toledo, & Mattoon, 2012). As many students have not sufficiently developed the fine motor skills required to handle conventional computer peripherals such as mice and keyboards, tablets are an attractive tool to implement educational activities for this age group. International studies have shown that first level-age children can handle the applications for such devices relatively easily (Hirsh-Parsek et al., 2015). In light of these shifting views regarding general technology use in first level classroom, tablet computers have been described as particularly suitable for students (Blackwell, Lauricella, & Wartella, 2016).

BACKGROUND

ICT and teaching mathematics concepts in primary level

Mathematical operations in conjunction with the contribution of ICT not only facilitate the development of mathematical thinking in young children, but also encourage the creation of new teaching methods which are expected to radically change the way that the teaching of mathematical concepts takes place in early childhood (Pegrum, Oakley, & Faulkner, 2013). In the context of developing early mathematical thinking, even the use of "drill and practice" software can help children develop their mathematical skills in basic math concepts (Clements, 2002; Clements, & Sarama, 2007; Siraj-Blatchford & Whitebread, 2003). As McManis and Gunnewig (2012) describe, when young children use computers with adult support, their math skills increase for number recognition, counting, shape recognition and composition, and sorting. The most powerful benefits of using ICT are the enhancement of a higher level of thinking and the development of mathematical skills such as classification, counting and number recognition (Lieberman, Bates, & So, 2009; Sarama & Clements, 2009). Student-controlled ICT supports the development of knowledge about mathematics and its applications, and also provides authentic working methods (Nunes et al., 2009).
Although computers can be a valuable tool, there are disadvantages for the incorporation of them in a classroom. When computers and other technological tools used continuously, students can develop a dependency on these tools. Just as students who are never required to do math without a calculator lose their ability to solve math problems by hand, students who use computers for almost every activity experience a decrease in their ability to spell even write by hand. Students should practice these simple skills without technological tools regularly to ensure that their skills do not atrophy (Sáinz, and Eccles 2012).
Mathematics will attract students' interest when they realize that mathematics is a tool for solving real world problems. One way that primary teachers can achieve this is by utilizing problems from students' everyday life as a means of teaching mathematics. As a result, mathematical learning should not take

place in a neutral and abstract world in which students' experiences have no place. Mathematics attracts students when they can connect their mathematical knowledge to realistic meanings, through which they can understand why and how certain calculations are made for the solution of a problem (Nunes & Bryant, 1996). A modern primary mathematical education is not interested in imposing premade ideas and meaningless procedures in the minds of students. It is oriented towards a complete multifaceted development of students as persons enabling them to think and act in a mathematical way (Clements and Sarama, 2007, 2009; Locuniak & Jordan, 2008).

Advances in digital technologies and technological gadgets are dramatically altering the tools available to teachers and students, even in preschool education (Biancarosa & Griffiths, 2012). Although iPads and other similar tablets have not been extensively studied as teaching tools in the early childhood classroom, many educators are enthusiastic about using them; they rave about their versatility, connectivity, mobility, as well as the potential benefits of thousands of educational apps (Falloon, 2013; Mango, 2015). Usability studies with tablets find that students learn to use the devices quickly, independently, and confidently and explore freely (McManis & Gunnewig, 2012). For Kucirkova (2014) tablets have three novel features with the potential to make a positive difference in early education: iPads are portable and light-weight, they eliminate the need for separate input devices (such as mouse and keyboard) and thirdly, they are specifically designed to accommodate a number of apps, many of which have a child friendly intuitive design. Concerning the pedagogical use of tablets in primary education, recent studies have concluded that tablets may have the potential to act as a valuable tool for educational use, especially in learning mathematical concepts (Pitchford, 2014; Shuler, Levine, & Ree, 2012; Zaranis, Kalogiannakis, & Papadakis, 2013). The regular use of tablets brings about significant learning gains to students in areas mathematics if supported with proper educational software (Chiong & Shuler, 2010).

The software designed and the students' activities developed and examined for the purposes of the current study were inspired by the framework of Realistic Mathematics Education (RME). RME is an active and constantly evolving theory of teaching and learning mathematics (Van den Heuvel-Panhuizen, 2001). Indicative of this is the learning teaching trajectories with intermediate attainment targets which was first conducted for calculation with whole numbers in primary school and then extended to other subjects (Dimakos, Zaranis, & Tsikopoulou, 2009; Zaranis, 2012). In the whole trajectory of the RME teaching theory, three main characteristics of understanding mathematical concepts are involved:

- The first level, context-bound counting and calculating, implicates young students with problem situations, in which questions of comparisons or 'how many' questions are posed in a way to be meaningful for children, relative to their experiences and always inside a context.
- In the second level, object-bound counting and calculating, students should be able to face direct 'how many' questions and answer them. Attention is focused to quantification, where the involvement of numbers is immediate. As a result, questions should relate to distinctive objects or quantities such as 'how many candles are there' or 'which tin has the most sweets in it.' At this level students should be able to organize the way of counting objects using clear patterns, so as to avoid mistakes.
- In the third level, pure counting and calculating via symbolization, students do not need any more the natural presence of objects in order to count, but their "physical or mental representations", like numbers, fingers, dots, lines, etc. In this way, counting ceases to be object-bound and is, instead, transferred to physical or mental representations of the objects. These representations can occupy very different levels of abstraction, including that of 'pure' arithmetical numbers.

The present study

The purpose of the present study was to examine how the use of the mathematical software influences the development of students' mathematical ability. To our knowledge, this is the first study to test the relationship between computers and tablets and math acquisition. Following the theoretical framework that blends together Realistic Mathematics Education (RME) and the use of ICT in primary school, the researcher designed a new model referred to as the First Grade Tablet Addition Subtraction Model (FGTASM).

Our study was based on the above mentioned international literature; the researcher set out to investigate the following research question:

1. The first class students who will be taught mathematical concepts with educational intervention based on FGTASM will have a significant improvement on total mathematical knowledge in comparison to those taught using the traditional teaching method.
2. The first class students who will be taught addition with educational intervention based on FGTASM will have a significant improvement on addition in comparison to those taught using the traditional teaching method.
3. The first class students who will be taught subtraction with educational intervention based on FGTASM will have a significant improvement on subtraction in comparison to those taught using the traditional teaching method.
4. What is the mathematical level of the students who had the highest benefit from FGTASM on addition according to their general mathematical achievement?
5. What is the mathematical level of the students who had the highest benefit from FGTASM on subtraction according to their general mathematical achievement?

METHODOLOGY

The present pilot research was conducted in three phases. In the first and third phases, the pre-test and post-test were given to the students respectively. In the second phase, the teaching intervention was performed.

Subjects

The study was carried out during the 2016-17 school year in four public primary schools located in the city of Athens. It was an experimental research which compared the tablet computer teaching process to traditional teaching based on the first grade curriculum. The sample included 179 first graders consisting of 94 girls and 85 boys aged six to seven years old. There were two groups in the study, one control (n=93) and one experimental (n=86). In the control group there was not a computer available for the students to use. The classes in the experimental group had tablet computers available for daily use by children as part of the teaching procedure. For the uniformity of the survey, instructions were given to the teachers who taught in the experimental or control groups.

Educational Measures

In the first phase, the pre-test was given to the classes of the experimental and control groups at the end of February 2017 to isolate the effects of the treatment by looking for inherent inequities in the mathematical achievement potential of the two groups. The pre-test was a test based on the Test of Early Mathematics Ability third edition (TEMA-3) (Ginsburg, & Baroogy, 2003).

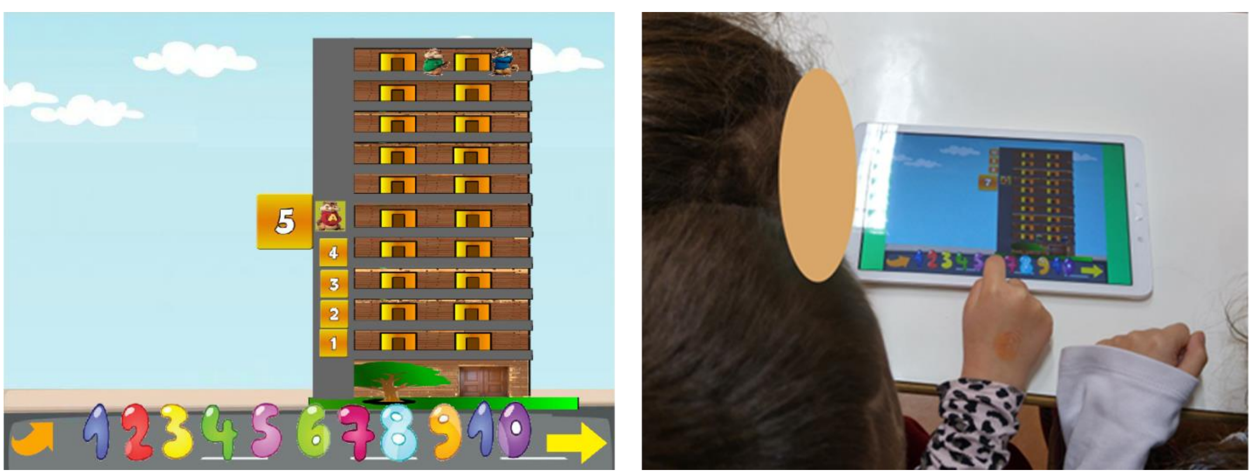
The TEMA-3 is a norm-referenced, reliable, and valid test of early mathematical ability that is appropriate for children of ages 3 years and 0 months through 8 years and 11 months. The form of TEMA-3 contains 72 items. The purposes of TEMA-3 are to: a) identify the children who are significantly behind or ahead of their peers in the development of mathematical thinking, b) identify specific strengths and weaknesses in mathematical thinking, c) suggest instructional practices appropriate for individual children, d) document children’s progress in learning arithmetic and e) serve as a measure in research projects. Also, one of the purposes for developing the TEMA-3 was to provide researchers with a statistical test that was based on current research and theories about mathematical thinking. In

particular, TEMA-3's availability would stimulate the study of mathematical thinking in young children (Song, & Ginsburg, 1987).
Due to the young age of the students, explicit details were given to the students by the teacher for the pre-test. These were pencil-and-paper tasks in which the students were asked to select numbers including: reading and writing numbers, verbal counting, enumeration, cardinality rule, produce sets, choosing the greater and the lesser number, addition and subtraction (Fig. 1).
Each task had a grade that was computed from the student's answers. Scores were computed for each of the individual mathematical tasks based on the TEMA-3. On average, students will be able to complete the relevant portion of the given test in 30 to 40 minutes.

Figure 1. Student does addition (left) and subtraction (right)

Instructional Intervention

In the second phase, the control group taught with traditional teaching according to the first grade curriculum. Group and individual activities were given to children every day. The experimental group covered the same material at roughly the same time according to the FGTASM procedure. The content of the four weeks syllabus of the FGTASM was divided into four levels.
At the beginning of the teaching intervention (zero level) has activities called 'Up and Down' which the students have to help 'Alvin' to go up or down with the elevator in order to find his friends apartments', as described in Figure 2 (a) and (b). For example, in Figure 2 (a) the student helps Alvin, who is on the ground floor, to go to the tenth floor where Theodore and Simon live by clicking on the appropriate numbers. It was presented with tablet computers in the classroom. Then the students painted some of their favorite characters of the activity.



(a) (b)

Figure 2. The student had to help 'Alvin' to go up (a) and down (b) with the elevator (zero level)

The first level started with an activity which the students identified the main objects of an addition and subtraction problems by counting objects. The teacher gave three candies to John. Then, Mary gave two candies to John and the teacher asked the children, “How many pieces of candy does John have now?” (Fig. 3). Finally, there was a computer activity with addition and subtraction problems (Figure 4a - b). For example, in Figure 4 (a) Alvin is in the supermarket and has five euros; the student helps him to buy a product, by dragging it into Alvin's basket. The student has to find out how much money he will get back if the product costs less than five euros (Fig. 4a) or how much money he still needs to buy if the product costs more than two euros (Fig. 4b), by clicking on the correct number.

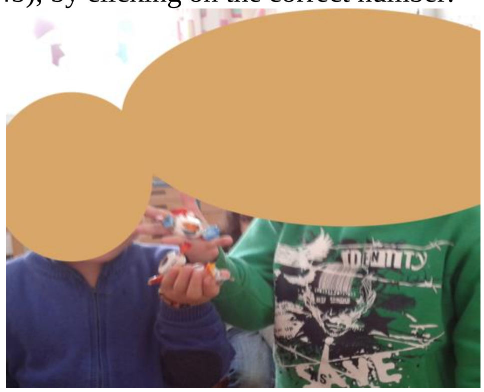
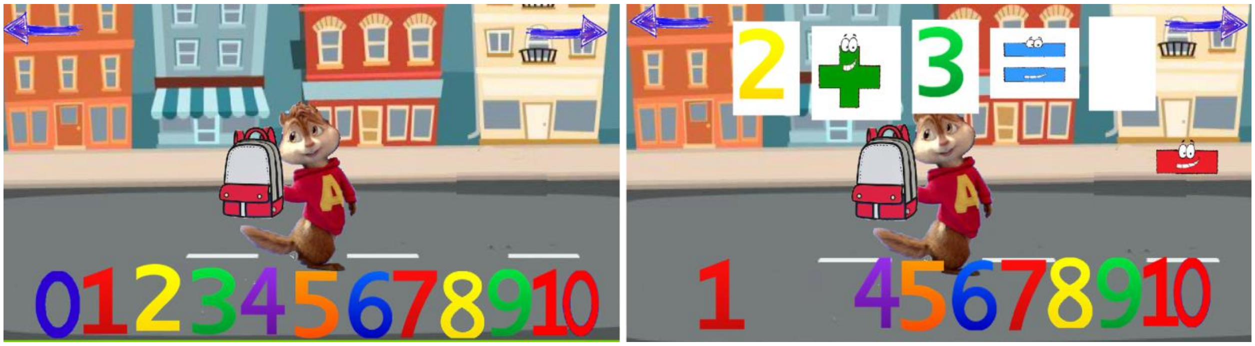


Figure 3. The students had to count John’s candies (first level)

(a) *(b)*

Figure 4. The students had to find out how much money Alvin has to pay (first level)

In the second level of the teaching procedure the objects were hidden. For instance, the teacher gave some coins to a student and hid them in his wallet. Then another student took some coins from the first student’s wallet. At the end the student had to construct mathematical problems of hidden objects. Finally, a software activity with hidden objects was followed, where the student had to construct addition or subtraction problems. For instance, in this activity Alvin took two apples from David and tree apples from Eleanor and put them in his bag. Then the student has to answer the question: "How many apples does Alvin have now? Click on the correct number (Figure 5a)." Also, the student has to construct the addition problem in mathematics (Figure 5b).

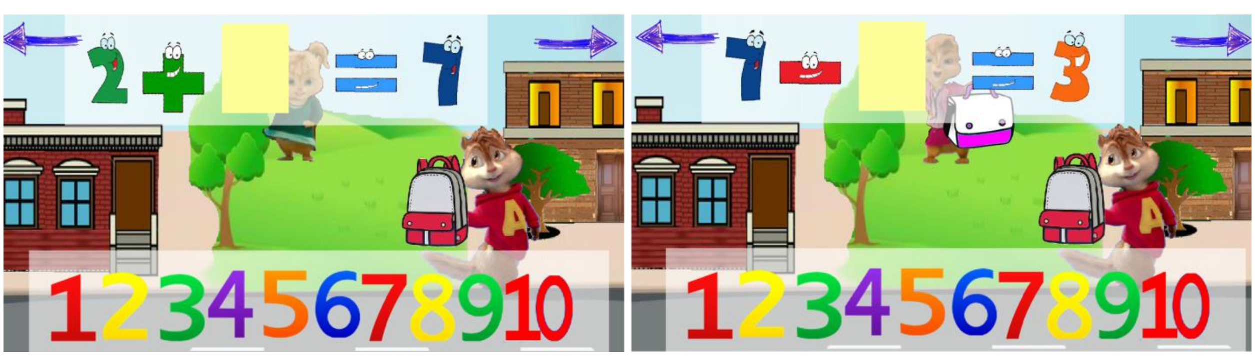


(a) *(b)*

Figure 5. The student had to do addition with hidden objects and construct the problem (second level)

In the last level of the teaching process, the students are separated into groups and played the game "Supermarket" (Fig. 6). One student was the buyer and the other was the employee of the super market. The buyer wanted to buy two things. The students knew how much money had the buyer and the cost of the first thing that he bought. The children had to find how much money the second product cost. Afterwards, there were similar computer activities where the student had to find the missing number of an addition and subtraction problems (Fig. 7a, b). For example, in an activity Alvin went for a walk and had seven apples; then Alvin met with Isidor and gave her some apples; at the end, Alvin went to David's house, measured the apples, and found that there were three apples in his bag. The student has to answer the question: "How many apples did Alvin give to Isidor? Drag the correct number to the yellow box (Fig. 7b)."

Figure 6. The children had to find how much money the second product cost (third level)



(a) *(b)*

Figure 7. The student had to find out the unknown number of addition (a) and subtraction (b) problems (third level)

The above computer activities were designed using Flash CS6 Professional Edition. This version of Flash provides a comprehensive authoring environment for the creation of interactive applications and applications using multimedia. Flash CS6 is widely used to create interesting projects that incorporate video, audio, graphics, and animations. Researchers can create original Flash content or import elements from other Adobe applications to integrate sophisticated interactivity (Chun, 2012). For example, implementation of second level activity has embedded the graphics of Alvin, David and Eleanor in the Flash CS6 library. These graphics were animated during the flow of this activity using the Flash CS6 tools. Numbers are buttons and action script commands used to create interaction with students (Fig. 8).

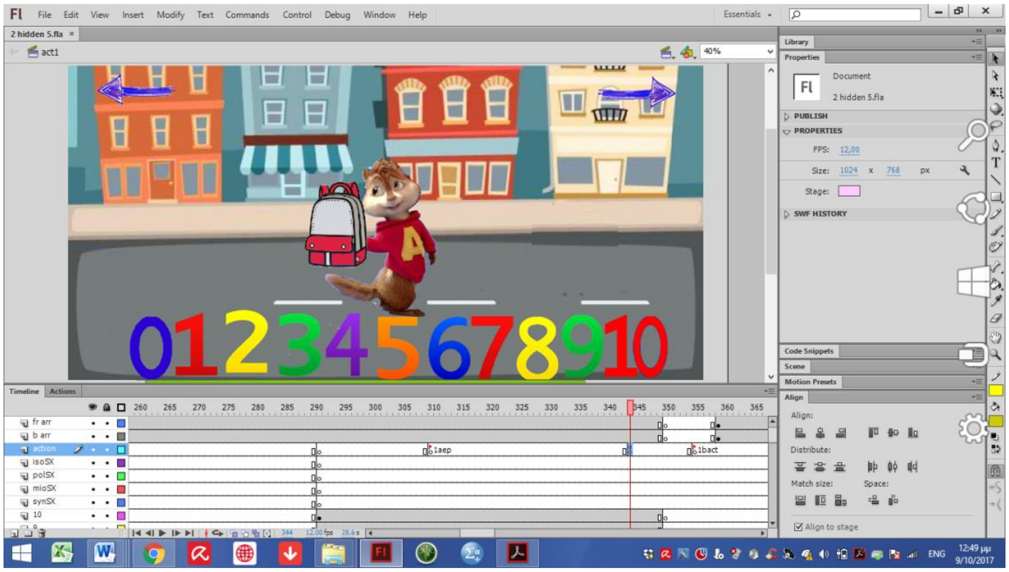


Figure 8. The implementation of the second level activity with Flash CS6

Similarly, during the third and final phase of the study, after the teaching intervention, the same test was given to all students in both the experimental and control groups as a post-test at the beginning of April 2017 to measure their improvement on general mathematical ability and addition.

RESULTS

Analysis of the data was carried out using the SPSS (ver. 19) statistical analysis computer program. An independent sample t-test was conducted. The independent variable had two levels: exposure to educational software with tablets (experimental group) and no exposure (control group).

Evaluate the total mathematical achievement

The dependent variable was the student's pre-test score. The t-test for equality of means was not significant ($t = .554$, $p = 0.581$), indicating non-significant differences initially, in mathematical achievement between the experimental and control groups. Though the control group had a mean score higher than the experimental group, the mean difference in the pre-test scores was 0.213. The results of this test are summarized in Table 1 and Table 2.

In order to determine if the performance of the experimental group is significant than the control group after the teaching intervention on total mathematical knowledge, the analysis of ANCOVA on the students' post-test scores was carried on (Howitt & Cramer, 2008). After adjusting the scores for mathematical achievements (TEMA-3) in the pre-test (covariate), the following results were obtained from the analysis of covariance (ANCOVA). A statistically significant main effect was found for type of intervention on the post-test scores for total mathematical achievements, $F(1, 176) = 22.197$, $p < .001$, $\eta 2$

= .112; thus, after the teaching intervention the experimental group performed significantly higher in the post-test than the control group, as summarized in Table 3.

Table 1. Group Statistics of pre-test on total mathematical knowledge

Group	N	Mean	Std. Dev.	Std. Error
Control	93	46.806	2.821	.292
Experimental	86	46.593	2.328	.251

Table 2. Independent Samples Test of pre-test on total mathematical knowledge

Pre-test	t	df	Mean difference	Sig. (2-tailed)
t-test	.554	174.789	.213	0.581

Table 3. Comparison of student scores in post-test on total mathematical knowledge: ANCOVA analysis

Sources	Type III Sum of Squares	df	Mean Squares	F	Sig.	Partial Eta Squared
Pre-test	8.764	1	8.764	.190	.663	.001
Group	1023.105	1	1023.105	22.197	.000	.112
Error	8112.087	176	46.091			

Evaluate the mathematical achievement for addition

Similarly, to determine if the performance of control group starred from the same level as the experimental group in addition, the researcher conducted an independent sample t-test between the pre-test of the two groups. The dependent variable was the student's pre-test score for addition. The t-test for equality of means was significant ($t = -5.787$, $p < 0.001$), indicating significant differences initially, in mathematical achievement for addition between the experimental and control groups. Though the experimental group had a mean score higher than the control group, the mean difference in the pre-test scores was 0.935. The results of this test are summarized in Table 4 and Table 5.

Table 4. Group Statistics of pre-test for addition

Group	N	Mean	Std. Dev.	Std. Error
Control	93	17.064	1.559	.161
Experimental	86	18.000	.000	.000

Table 5. Independent Samples Test of pre-test for addition

Pre-test	t	df	Mean difference	Sig. (2-tailed)
t-test	-5.787	92.000	-0.935	.000

In order to determine if the performance of the experimental group is significant than the control group after the teaching intervention the analysis of ANCOVA on the students' post-test scores of addition was carried on. After adjusting the scores for mathematical achievements of addition in the pre-test (covariate), the following results were obtained from the analysis of covariance (ANCOVA). A statistically significant main effect was found for type of intervention on the post-test scores for mathematical achievements, $F(1, 176) = 10.053$, $p = .002$, $\eta 2 = .054$; thus, after the teaching intervention the experimental group performed significantly higher in the post-test than the control group, as summarized in Table 6.

Table 6. Comparison of student scores in post-test for addition: ANCOVA analysis

Sources	Type III Sum of Squares	df	Mean Squares	F	Sig.	Partial Eta Squared
Pre-test	.161	1	.161	.020	.887	.000
Group	79.288	1	79.288	10.053	.002	.054
Error	1388.145	176	7.887			

Evaluate the mathematical achievement for subtraction

In order to determine if the performance of control group starred from the same level as the experimental group on subtraction, the researcher conducted an independent sample t-test between the pre-test of the two groups. The dependent variable was the student's pre-test score for subtraction. The t-test for equality of means was significant ($t = 18.329$, $p < 0.001$), indicating significant differences initially, in mathematical achievement for subtraction between the experimental and control groups. Though the control group had a mean score higher than the experimental group, the mean difference in the pre-test scores was 2.281. The results of this test are summarized in Table 7 and Table 8.

Table 7. Group Statistics of pre-test for subtraction

Group	N	Mean	Std. Dev.	Std. Error
Control	93	11.9677	1.097	.113
Experimental	86	9.6860	.466	.050

Table 8. Independent Samples Test of pre-test for subtraction

Pre-test	t	df	Mean difference	Sig. (2-tailed)
t-test	18.329	126.284	2.281	.000

In order to determine if the performance of the experimental group is significant than the control group after the teaching intervention the analysis of ANCOVA on the students' post-test scores of subtraction was carried on. After adjusting the scores for mathematical achievements of subtraction in the pre-test (covariate), the following results were obtained from the analysis of covariance (ANCOVA). A statistically significant main effect was found for type of intervention on the post-test scores for mathematical achievements, $F(1, 176) = 5.367$, $p = .022$, $\eta 2 = .030$; thus, after the teaching intervention the experimental group performed significantly higher in the post-test for subtraction than the control group, as summarized in Table 9.

Table 9. Comparison of student scores in post-test for subtraction: ANCOVA analysis

Sources	Type III Sum of Squares	df	Mean Squares	F	Sig.	Partial Eta Squared
Pre-test	2.221	1	2.221	.869	.353	.005
Group	13.720	1	13.720	5.367	.022	.030
Error	449.872	176	2.556			

Evaluating the stratification of students in addition according to their success in TEMA-3

Moreover, a stratification of experimental and control group according to their success in TEMA-3 was divided into three equal categories: less than 46.5 (33.33th percentile - low), 46.6 to 47,5 (33.33th to 66.66th percentile - medium), and more than 47,6 (66.66th percentile - high).

The statistical analysis shows that 58.1% of the students of the experimental group exhibited high grading, 22.1% exhibited medium grading, whereas 19.8% exhibited low grading. Likewise, 37.6% of the control group exhibited high grading, 12.9% medium and 49.5% low as summarized in Table 10.

A two-way ANOVA was conducted that examined the effect of group (experimental versus control) and the students' level of mathematical achievement (low versus medium versus high) on their improvement of TEMA-3 on addition (post-test minus pre-test score). The effect of mathematical level was significant ($F(2, 173) = 15.060$, $p < 0.001$, $\eta 2 = 0.148$). Also, the effect of group was significant ($F(1, 173) = 3.998$, $p= 0.047$, $\eta 2 = 0.023$).

Table 10. Frequencies of the two groups in the pre-test of mathematical achievement

Group	Level	Mean	Std. Deviation	N	f%
control	Low	6.057	2.448	35	37.6
	Medium	6.166	3.588	12	12.9
	High	4.434	2.971	46	49.5
	Total	5.268	2.960	93	100
Experimental	Low	6.176	3.225	17	19.8
	Medium	8.736	1.408	19	22.1
	High	4.560	2.666	50	58.1
	Total	5.802	3.055	86	100
Total	Low	6.096	2.695	52	29.1
	Medium	7.741	2.744	31	17.3
	High	4.500	2.802	96	53.6
	Total	5.525	3.009	179	100

The Bonferroni post hoc tests indicated that students' improvement in addition of the experimental group of the medium-level group differed significantly from students' improvement of the low-level ($p = 0.026$) and the high-level ($p < 0.001$) group (Fig. 8).

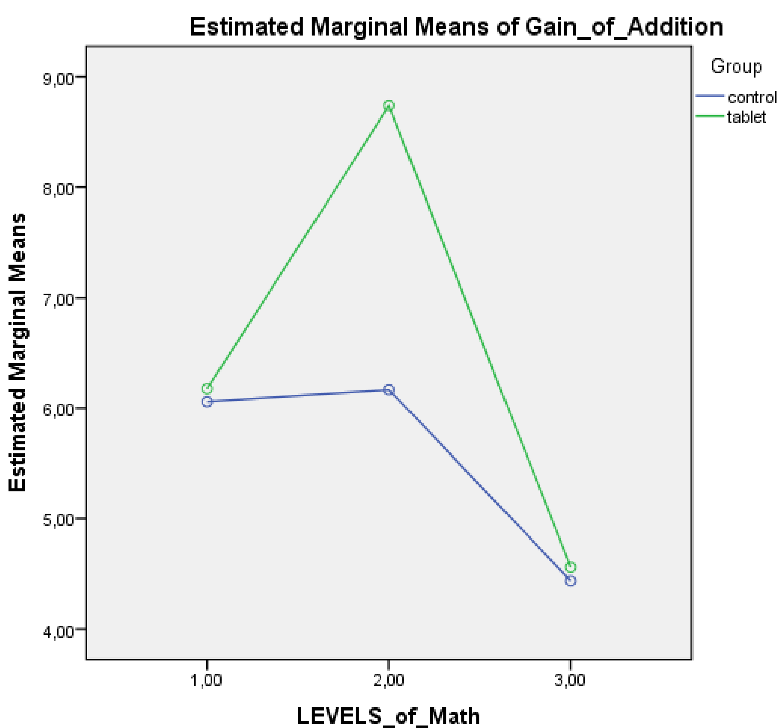


Figure 8. Mathematical improvement in addition after the teaching intervention according to the levels of total mathematical achievement

Evaluating the stratification of students in subtraction according to their success in TEMA-3

A two-way ANOVA was conducted that examined the effect of group (experimental versus control) and the students' level of mathematical achievement (low versus medium versus high) on their improvement of TEMA-3 on subtraction (post-test minus pre-test score). The effect of mathematical level was not significant ($F(2, 173) = 1.668$, $p = 0.192$, $\eta 2 = 0.019$). On the contrary, the effect of group was significant ($F(1, 173) = 6.969$, $p= 0.001$, $\eta 2 = 0.075$).
The Bonferroni post hoc tests indicated non-significant students' improvement in general mathematical achievement of the experimental group (Fig. 9).

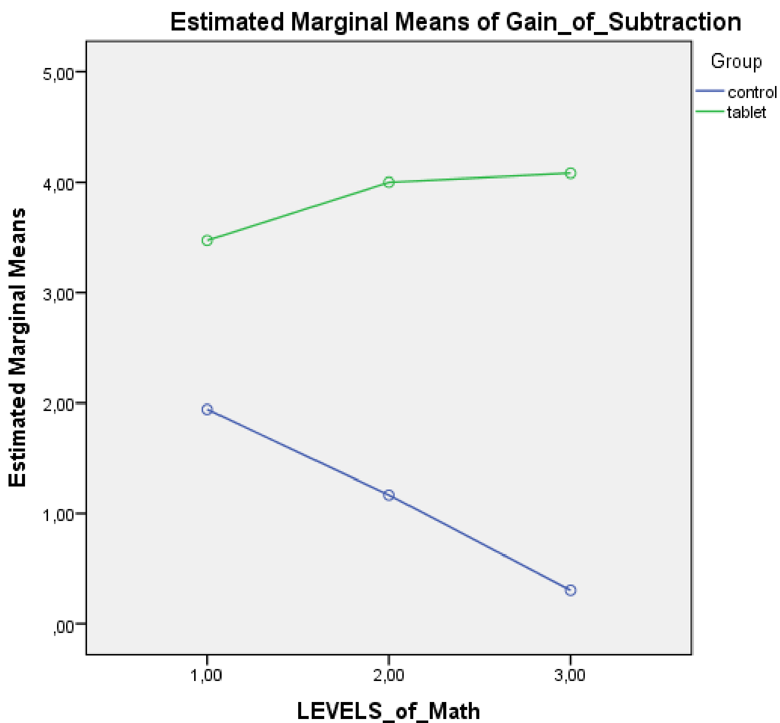


Figure 9. Mathematical improvement in subtraction after the teaching intervention according to the levels of general mathematical achievement

DISCUSSION

The purpose of the study was to investigate the impact of the 'First Grade Tablet Addition Subtraction Model' (FGTASM) intervention on the mathematical ability of first-class students; the entire research schedule summarized in Table 11.

Table 11. The research overview

	The purpose of the study	**First Phase** **February 2017**	**Second Phase** **Four weeks syllabus**	**Third Phase** **April 2017**	**Results**
		Pre-test	Teaching with tablets	Post-test	1. Significant

Experimental Group ***n=86***	To investigate the impact of the intervention of First Grade Tablet Addition Subtraction Model (FGTASM) in regards to the mathematical competence of the first grade students	TEMA-3	Four levels of First Grade Tablet Addition Subtraction Model (FGTASM), with computer and non-computer activities.	TEMA-3	improvement on total mathematical knowledge, addition and subtraction in comparison to those taught using the traditional teaching method. 2. Students with the lower mathematical level have the highest benefit from FGTASM on addition and subtraction.
Control Group ***n=93***		Pre-test TEMA-3	Traditional Teaching, with non-computer activities.	Post-test TEMA-3	

In this research, the researcher found that the students who were taught with educational intervention based on the 'First Grade Tablet Addition Subtraction Model' FGTASM had a significant improvement on their total mathematical achievement in comparison to those taught using the traditional teaching method according to the first grade curriculum. Our findings agree with similar researches (Desoete et al., 2010; Dimakos, & Zaranis, 2010; Papadakis, Kalogiannakis & Zaranis, 2016; Zaranis, Kalogiannakis, & Papadakis, 2013) which implied that ICT helps students to understand mathematical notions more effectively. As a result, the first research question answered positively.

Moreover, the researcher found that the students that taught with the educational intervention based on FGTASM had a significant improvement on addition in comparison to those taught using the traditional teaching method according to the first grade curriculum. Our results overlap with the results of other analogous studies which indicate the positive effects of a computer based-model of teaching math (Dimakos, Zaranis, Tsikopoulou, 2009; Zaranis, 2012; Zaranis, & Oikonomidis, 2009). Therefore, the second research question was confirmed.

Moreover, the researcher found that the students that taught with the educational intervention based on FGTASM had a significant improvement on subtraction in comparison to those taught using the traditional teaching method according to the first grade curriculum. Our results overlap with the results of other analogous studies which indicate the positive effects of a computer based-model of teaching math (Clements, & Sarama, 2003; 2007; Fessakis, Lappas, & Mavroudi, 2015; Zaranis, 2011). Therefore, the third research question was confirmed.

Also, our findings suggest that students with the medium level of general mathematical achievement, who were taught addition with educational intervention based on FGTASM had a significant improvement, compared to those with high and low level of general mathematical knowledge students who were taught with the same method. Our outcomes overlie with the results of other similar studies which indicate the positive effects of a computer based teaching model for mathematical notions (Fischer, & Gillespie, 2003; McManis, & Gunnewig, 2012; Keong, C. C., Horani, S. and Daniel, 2005; Zaranis, & Oikonomidis, 2009). Thus, the fourth research question was addressed.

Moreover, our findings suggest that there is not significant students' improvement in subtraction achievement of the experimental group among the students with the low, medium and high level mathematical achievement. Thus, the fifth research question was not addressed.

Results of this study expand the research on the effects of appropriate software embedded in a computerized environment as a tool for mathematical reasoning used alongside with specially designed activities (Dimakos, Zaranis, Tsikopoulou; 2009; Papadakis, Kalogiannakis & Zaranis, 2016; Zaranis, 2012). Also, the outcomes of the present study create a new teaching model with computer and non-computer activities based on the theoretical framework that blends together Realistic Mathematics Education in the first grade level.

CONCLUSION

Regarding the educational value of the present study, its findings should be taken into account by a range of stakeholders such as students, teachers, researchers, and curriculum designers. Specifically, our teaching approaches could be set up as a broad range study to examine to what extent they help children understand addition and subtraction. We, as instructors of educators, will certainly try to inform our students about these results which they will need to keep in mind when designing activities for students. Moreover, the learning method based on Realistic Mathematics Education (RME) using ICT can be used in various mathematical subjects as a research plan. The result of this research can be extended by developing various similar studies in geometry and mathematics (geometry shapes, multiplication, division etc.) in various classes of the primary education.
The above discussion should be referenced in light of some of the limitations of this study. The first limitation of the study is that the data collected was from the participants residing the city of Athens. The second limitation was the generalizability of the study which was limited to participants attending public schools. As a result, the outcomes from this research can be generalized only to similar groups of students. The results may not adequately describe students from other regions of Greece. However, as the study was in a specific context, any application of the findings should be carried out with caution.

The current findings add to a growing body of literature supporting the effective role of educational software in education and more specifically in mathematics (Dimakos, Zaranis, Tsikopoulou, 2009; Zaranis, 2011). Furthermore, the undertaken tablet computer assisted educational procedure revealed an extended interest for the tasks involved from the part of the students which transformed the whole procedure into a thorough, focused, independent learning environment.

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