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Learning Methods in Greek Kindergarten and Pre-kindergarten Schools: Traditional Method vs New Technology

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Abstract
In the early 2000's new technology methods were introduced in Greek kindergarten schools, which enriched the learning methods that were used before 2000, enabling teachers to embrace this technological era. Using new technologies and promoting them to students doesn't mean that the learning outcomes will be better. Will the students learn by using new technologies? Will the learning outcome be improved? These are some of the basic questions this article is about. This work compares the performance of the students on traditional learning methods to new technology learning methods in order to investigate which of the two methods has the best learning outcomes. Moreover, the intelligence of the pupils was evaluated by the use of Raven's Colour Progressive Matrix (CPM). The results of the current research in a sample of 1183 Greek pupils indicated that pupils tend to perform better by the use of new technologies. Furthermore, the level of intelligence for the majority of the sample ranged from normal to high intelligence and does not have a strong influence on pupils' performance.
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1. Introduction

For the last ten years digital and web applications have become an important aspect in the field of preschool education (Burris, 2019). Technology provides interesting activities for young children, keeping a playful atmosphere in the classroom, which contributes positively to the child's attention and concentration during the lesson (Lewin, 2000).

Researchers argue that kindergartens play a crucial role to the child's development and further school performance, as the activities at this age help children develop the necessary cognitive and spiritual skills, and cultivate a positive attitude towards school in general (Tymms, Merrell and Henderson, 1997; Vrinioti et al., 2008; Siraj-Blatchford et al., 2008; Yan and Yuejuan, 2008; Tymms et al., 2009). For this reason, the tools that are used by the kindergarten teachers are very important in the acquisition of knowledge by young children.

The new curriculum for kindergarten (DEPPS-IA, 2003: 4310) supports the integration of digital applications in daily actions, and intends to familiarize children with simple basic computer operations and come into initial contact with various uses. Researchers like Hertzog and Klein (2005) argue that technology, when is properly used, has the capacity to contribute significantly in children's learning. On the other hand, researchers, including Cordes and Miller (2000), point out that there is no reliable empirical evidence documenting the educational value of digital and Internet applications in preschool education, also drawing attention to several harmful effects on the child's health and learning.

1.1 Literature review

The teaching techniques used by the pedagogical team (kindergarten teachers) in kindergartens are very important, and should be associated with similar pedagogical theories of learning in order to document their validity and their educational value and practice. Three pedagogical learning theories will be presented below, that are directly connected with technological activities. Social constructivism is one of the most important pedagogical learning theories, which is connected and documented with digital and web applications in preschool education. This theory gives more emphasis on the development of socio-cultural process and combines social, historical, cultural and biological aspects (Alevriadou *et al.*, 2008: 15).

According to social constructivism children develop new cognitive abilities and capabilities through interaction with others. Vygotsky (1962) is one of the major supporters of this pedagogical theory, and suggests that imitation is the cornerstone of the development and cultivation of children's mental abilities. He argues that children learn new subjects by imitating adults and other children.

Some years later, Vygotsky (1978) indicated that the process of obtaining and understanding knowledge is

based on several stages. Based on the theory of atomic structuralism (Dewey, 1916; Piaget and Inhelder, 2000), Vygotsky (1978:57) suggests that every function in the child's development appears twice: at a social level and at the individual level, first among people and then within the child.

In kindergartens children interact with their teacher as well as with each other. Researchers, like Hujala (2002), argue that the process of learning in kindergartens requires the child's social interaction in order to be effective. A little later, Aubrey (2008: 9) agrees with Hujala (2002), featuring infants as active social factors.

Plowman and Stephen (2005) noted that preschoolers cooperate during technological activities, helping one another to correct any errors that may occur or decide what the right command is. They specify that preschoolers interact in three different ways during their technological activities. More specifically it is argued that children negotiate when they have to take turns in order to play on the computer decide which button to press, in order to have the desired results and share their joy, when carrying out an activity. Therefore, based on these arguments, the digital and web applications in early childhood education promote social interaction in children, which contribute positively to the acquisition of knowledge.

Another important pedagogical learning theory is the "zone of proximal development", which also connects and documents the technological activities in preschool. Vygotsky (1978), who tried to find the appropriate link between learning and the development of children, suggested that the things that children can succeed in with the help of an adult reflect to their cognitive abilities. There are things that children can learn on their own in their spare time or by just playing, without the help of an adult. When children enter the "zone of proximal development", they can learn only with the mediation of an adult or with the mediation of "a more capable" peer (capabilities that the children cannot learn alone without help in a pre-mature age).

The skills involved in the "zone of proximal development" depend on the age group of the child and their previous knowledge. Skills that are not within the child's capability are not possible to be gained at the "zone of proximal development", because the "zone of proximal development" has limits, which expand in time (Doliopoulou, 2001).

Children in the nursery school are old enough to discover and conquer all the skills that they will need in their later life. In that development, adults and more capable peers play an important role, as they can broaden the mental field of young children (DEPPS-IA, 2003).

"Zone of proximal development" is linked to digital and online applications in early childhood education, and documents their pedagogical value and practice. The new curriculum for kindergarten (DEPPS-IA, 2003: 4310) states that teachers enable children to play safely with the available digital devices and online applications.

Klein, Nir-Gar and Darom (2000) support this argument, documenting that children have better learning outcome in technological activities when aided by adults, unlike children who play totally free on their computer. Therefore, the role of educators and adults, which is the terminus in the "zone of proximal development", is very important in the process of the child conquesting knowledge and understanding in preschool age.

Another important pedagogical theory is behaviorism. Under this theory, students must conquer new knowledge through individual study (Mergel, 1998). Although this theory is neither directly related to technological activities in kindergarten nor to the teaching methodology in preschool, it generally reflects indirectly to the children's activities in their free time. Canning (2007) describes situations in which toddlers reproduce, experiences that they had with adults in their free play. Similarly, infants sometimes apply, in their free play, actions carried out earlier with adults on the computer or the internet. However, these activities are not encouraged by the adults in behavioural theory, as children engage in them voluntarily. More specifically, researchers including Comaskey, Savage and Abrami (2009), Klein, Nir-Gal and Darom (2000), Segers and Verhoeven (2005), and Lewin (2000), document the positive effects of digital applications in the learning development of preschool children.

1.1.1 Research Methodology

The target population of this research was children from kindergarten and pre-kindergarten full day schools, from the region of Eastern Macedonia and Thrace in Greece. For this academic year the students that were enrolled in kindergarten and pre-kindergarten were 6979, from which 3856 students attended full day schools. Furthermore, kindergartens that had two classes were chosen to participate in this research. The first group was control group (605 children), and the second was the experimental group (578 children). As control group it is called the group that uses traditional methods first and proceeds to new technology methods, whereas experimental groups are vice versa. In order to be able to apply this research, the researcher had to obtain the consent of the Ministry of Education, the children's parents and the principals of the kindergarten schools. The total number of children that participated in this research was 1183 (31% of the total population), from which 70.70% were from kindergartens whereas 39.30% from pre-kindergarten schools. The sample size that has been collected for this research represents fully the population in a marginal error of 2% (Saunders, Lewis and Thornhill, 2014). From the demographic data of the children, 52.50% were boys and 47.50% were girls. More

specifically, 55% were boys from kindergartens and 45% were girls, on the other hand 46.40% were boys from pre-kindergarten schools and 53.60% were girls. The research methodology was divided in two steps. In the first step the researcher supplemented Raven's Colour Progressive Matrix (CPM) to children. The CPM consists of 36 items, divided into three sets of 12 (set A, set Ab and set B). Within each set, items (which are brightly coloured to attract and maintain children's attention) are ordered in terms of increasing difficulty. Sets also vary in difficulty, with set B containing the most challenging items. The sets have been designed to distinguish between degrees of intellectual maturity by quantifying a child's ability to form comparisons and to reason by analogy (Raven, Court and Raven, 1990; Raven, Raven and Court, 1998).

More recently, CPM has been used in several brain imaging studies, searching for a neural locus of fluid intelligence (Prabhakaran *et al.*, 1997; Gray, Chabris and Braver, 2003). It has also been viewed as a culturally and ethnically fair measure of intellectual functioning for both children and adults (Anderson, Kern and Cook, 1968; Jensen, 1974; Carlson and Jensen, 1981; Valencia, 1984; Kaplan and Sacuzzo, 1997).

The researcher administrated the book form of the CPM to each child individually, following the standard administration procedure that was prescribed by Raven, Raven and Court (1998) without setting time limit (Raven, Court and Raven, 1990; Raven, Raven and Court, 1998). The children's personal data were kept anonymous by the researcher. Prior to administrating the book form of CPM, the kindergarten were asked to provide the researcher the names in alphabetic order, reversing the order of the code in order for no one to be able to know the personal characteristics of the children that participated in the research. The second step concerned kindergarten teachers and school units chosen by the researcher based on the curriculum of the kindergarten. The subject that was chosen and implemented in all the kindergartens was traffic education. Kindergarten teachers divided this subject in two subunits teaching, the first one using traditional methods and the second one using new technologies. Traditional methods based to Reiser (2001), is considered the teacher the use of the white board and the textbook. The duration of each subunit, which was determined by the researcher and the kindergarten teachers, was two weeks.

After the completion of the first week, the researcher gave the teachers a form that had three columns. The first column was the codes that the researcher had given to the students, the second was the grades that the teachers would give to the children based on their performance using the traditional teaching method. The rates were from 1 to 5 (where one was the lowest and 5 the highest). The children had to answer correctly to the five questions that he/she had been asked. The third column was the grades given to the children using new technology methods (the highest grade was 5). Every kindergarten teacher interviewed each student by asking him/her five questions, such as the functions of the red light, green light, orange light, the reason that the traffic lights have both colors and sound, and what a pedestrian is. After the kindergarten teachers had completed the interview, he/she gave the children a grade.

In the second week the teachers taught them by using new technology. The researcher had given the teachers a software created by the Ministry of Education, allowing all the teachers to download and use the web side that the Ministry had implemented in order to make their lesson more interesting. This software had all the signs, games that had to do with the type of clothing that a child should wear when riding a bicycle, the correct way to walk when a child is with an older person (inside or outside the pedestrian zone), the first thing that a child should do when he/she gets into the car and the correct way to sit when they are in the car. These were the five questions that the children should answer correctly in order for their teachers to grade them. After the completion of the second week, the kindergarten teachers returned the forms to the researcher.

1.1.2 Raven's CPM results

The taxonomy of IQ was based on Raven's Colour Progressive Matrix, where scores of IQ depends on the age (calculated in months) and the score that they (children) have gathered from the CPM. Thus, the first age group was pre-kindergarten children that consisted of children from 4 years and 9 months old to 5 years old. The second age group was named kindergarten 1 and consisted of children that were older than 5 years old to 5 years and 3 months. The third age group was named kindergarten 2 and consisted of children that were older than 5 years old and 3 months to 5 years and 9 months old, and the last age group was named kindergarten 3 and was composed of children that were more than 5 years and 9 months old to 6 years old. As far as the taxonomy is concerned, there are three different levels depending on the IQ score. The first level named "Low intelligence" consists of children with less than 85 IQ score. The second level named "Normal intelligence" from 85 to 115 IQ score, and the third level named "High intelligence" with more than 115 IQ score. This taxonomy was based on Diagnostic Statistical Manual (DSM), Inter Class Disorder -10 (ICD-10) and Motti-Stefanidi (2009). The data were analyzed by using SPSS.

The total sample size constituted by 14.10% children that had "Low intelligence", 63% of "Normal intelligence" and 22.90% of "High intelligence". The corresponding distribution for the three age groups are given in Table 1. Based to the literature there is a Gaussian carve where the corresponding parameters are from idiot to exceptional cleverness/ ingenuity. Our results confirm this theory.

Table 1 Distribution for the three age groups

	Age Group			
Intelligences' Level	Pre-kindergarten children	Kindergarten 1	Kindergarten 2	Kindergarten 3
Low intelligence	11.80%	14.50%	14.40%	16.10%
Normal intelligence	58.20%	68.10%	65.00%	64.20%
High intelligence	30.00%	17.40%	20.60%	19.70%
Total	100.00%	100.00%	100.00%	100.00%

In order to examine the relationship between the variables gender and intelligence groups, the chi square test has been performed. Between age and groups in the whole sample showed that 14.80% of the boys had "Low intelligence" where girls in the same category held 13.30%. In the second category "Normal intelligence" boys held 64.60% whereas girls held 61.20%, and finally in the third category "High intelligence" boys held 20.60% whereas girls held 25.40%. This is the value of Pearson's chi square test (3.989) is not statistically significant (sig. = 0.136 > 0.05), and he variables gender and groups of intelligence are independent (Table 2).

More specifically, in the first age group boys had 11.20% in the "Low intelligence", whereas girls had 12.40%. For the "Normal intelligence" boys were 60.20%, whereas girls held 56.50%, and the "High intelligence" category had 28.60% of boys and 31.20% of girls. In the case of Pre-kindergarten group Pearson's chi square test (0.513) in not statistically significant, because sig. = 0.774, and that means that the variables are not dependent. Pearson's chi square test is not statistically significantly in the other categories as well and that is because in all cases sig. is higher than 0.05 (Kindergarten 1 (0.499) Kindergarten 2 (2.557) and Kindergarten 3 (1.287)). The second age group had 16.30% of boys in "Low intelligence" category and 11.50% of girls. The second category of "Normal intelligence" had 65.10% of boys and 73.10% of girls, and the third category of "High intelligence" had boys with 18.60% and girls with 15.40%. The third age group had 15.70% of boys in the first category which is "Low intelligence", whereas girls held 12.80%, the second category "Normal intelligence" had 66.30% of boys and 63.30% of girls, and last "High intelligence" had 18.10% of boys and 23.90% of girls. The last age group had 16.70% of boys and 15.40% of girls in the "Low intelligence category", 66.10% of boys and 62.30% were girls in the "Normal intelligence" category and in the last category of "High intelligence" 17.30% were boys and 22.20% were girls (Table 2).

Table 2 Chi square tests

Gender and Level of Intelligence by age group			
	Chi square	d.f.	sig.
Whole sample	3.989	2	0.136
Pre-kindergarten children	0.513	2	0.774
Kindergarten 1	0.499	2	0.779
Kindergarten 2	2.557	2	0.278
Kindergarten 3	1.287	2	0.526

1.1.3 Results of Evaluation Methods

In order to examine if there is a relation between gender and their performance in traditional teaching and the use of new technologies, an Analysis of Variance (ANOVA) has been performed. The results showed that the children's performance in the use of new technologies is about the same between males and females (F = 0.029 and sig. = 0.865 > 0.05). On the other hand there is a statistical significance between males and females concerning their performance in the traditional way (F = 11.469 and sig. = 0.001 < 0.01). More specifically, girls perform better in the traditional way than boys (Table 3).

Table 3 Performance between boys and girls

		Mean
New Technologies	Boys	8.2995
	Girls	8.3149
	Total	8.3068
Traditional Method	Boys	7.9630
	Girls	8.3096
	Total	8.1276

Below it has been performed a correlation between each age group in comparison with the method that it was used and the gender (Table 4). The results showed that for the first, second and forth category, there were no statistical significant difference, whereas in the third category there was a significant difference. Girls seem to perform better with the traditional method than the boys (B = 8.11, G = 8.66).

Table 4 Gender and Teaching Method by age group

		F	sig.
Pre-kindergarten children	New Technologies	0.013	0.909
	Traditional Method	3.111	0.079
Kindergarten 1	New Technologies	0.162	0.689
	Traditional Method	1.279	0.262
Kindergarten 2	New Technologies	1.307	0.254
	Traditional Method	11.802	0.001**
Kindergarten 3	New Technologies	0.023	0.881
	Traditional Method	2.595	0.108

** Significant at the 0.01 level

In the Table 5 the four group categories were merged in two main categories. The first category is about pre-kindergarten children and the second is about kindergarten children. The results showed that there is a statistically significant difference between kindergarten and pre-kindergarten children.

Table 5 Whole sample (kindergarten and pre-kindergarten)

	F	sig.
New Technologies	35.564	0.000 ***
Traditional Method	50.378	0.000 ***

*** Significant at the 0.001 level

Kindergarten children seem to perform better than pre-kindergarten children in both methods (Table 6).

Table 6 Performance in New Technologies and Traditional Methods

		Mean
New Technologies	Kindergarten	8.4785
	Pre-Kindergarten	7.8934
	Total	8.3068
Traditional Method	Kindergarten	8.3577
	Pre-Kindergarten	7.5735
	Total	8.1276

In order to determine if the performance of the control group has improved, a paired t-test was performed using the grades of this group for a comparison between pre-test and post-test of the scores. As pre-test in the control group was defined traditional method, whereas post test was defined new technologies method. On the other hand, in the experimental group pre-test was new technology methods whereas post test was traditional methods. The results in the Table 7 showed that there is a significant (t = - 2.637 and sig. = 0.009) improvement from traditional methods (8.0269) towards new technology (8.1732) methods.

Table 7 Paired t-test (control group)

	Pre-test	Post-test	t	d.f.	sig.
Control Group (Traditional Method)	8.0269	8.1732	- 2.637	604	0.009 **

** Significant at the 0.01 level

Similarly, to determine if the performance of the experimental group is better in the use of new technologies than in traditional method, a paired t-test was performed using the grades of this group for a comparison between pre-test and post-test of the scores (Table 8).

Table 8 Paired t-test (experimental group)

	Pre-test	Post-test	t	d.f.	sig.
Experimental Group (New Technologies)	8.4568	8.2339	-3.276	577	0.001**

** Significant at the 0.01 level

There is a statistically significant difference in the total sample between the two methods (t = 4.198 and sig. = 0.000 < 0.001). Indicatively, students seem to perform better in the use of new technologies (8.3068) than in the traditional (8.1276) method (Table 9). Furthermore, between the variables "New Technologies" and "Traditional Methods" there is a sufficient correlation (0.616) that is also statistical significant (sig. = 0.000 < 0.001), which shows that students that perform well by the use of the traditional method tend to have about the same performance using new technologies.

Table 9 Paired t-test (total sample)

	Traditional Methods	New Technologies	t	d.f.	sig.
Total Sample	8.1276	8.3068	4.198	1182	0.000 ***

Significant at the 0.001 level

The same happens with the two kindergarten categories (kindergarten and pre-kindergarten). Both cases have statistical significant difference, and both of them perform better when the learning takes place using new technologies (Table 10).

Table 10 Paired t-test (kindergarten and pre-kindergarten)

		Mean	t	d.f.	sig.
Kindergarten	New Technology	8.4785	2.380	835	0.018 *
	Traditional Method	8.3577			
Pre-Kindergarten	New Technology	7.8934	4.076	346	0.000 ***
	Traditional Method	7.5735			

* Significant at the 0.05 level
*** Significant at the 0.001 level

1.1.4 Conclusions

A few years ago there has been discrimination between the two genders. Males tended to be better in maths and new technologies, while females tended to be better in reading comprehension (e.g., Hedges and Nowell, 1995; Nowell and Hedges, 1998; Lynn and Mikk, 2009). Nowadays, things have changed for two main reasons. The first one is the curriculum / syllabus of the schools that has new technologies from very early ages, and the second is the way that people live. New technologies are everywhere, so in this way both genders are getting familiar with them in early ages, and that has as a result to minimize this gap between boys and girls (Hyde *et al.*, 2008; Lindberg *et al.*, 2010). A study that was held by Sackes, Trundle and Bell (2011) indicated that girls had a higher developmental rate of computers than boys. The results of this study showed that there is no difference between males and females, and their performance towards the use on new technologies. It comes in accordance with the researches that were held by Sackes, Trundle and Bell (2011), and Wei and Hendrix (2009).

On the other hand, the findings of this research showed that girls seem to perform better in traditional method than boys. As Kiefer and Shih (2006) found, girls are better in traditional method because they devote more time than boys. Indicatively, both genders perform better in the use of new technologies method than in the traditional method. Furthermore, it is shown that students that perform well by the use of the traditional method tend to have the same performance using new technologies. The same happens with the two kindergarten categories (kindergarten and pre-kindergarten). Both cases have statistical significant difference, and both of them perform better when the learning takes place using new technologies. Kindergarten children seem to perform better than pre-kindergarten children in both methods. These results come in accordance with researches that were held by Andrews *et al.* (2003), Cviko, McKenney and Voogt (2012), and Korat and Shamir (2012).

Finally, the results of the paired t-test analysis that was performed, showed that new technology is a tool that helps students to perform better when the learning process starts with it (Papadakis et al., 2021). That is because new technology promotes motivation students learn faster in an interactive learning environment and allows students to learn in their own individual pace (Zarazanis and Oikonomidis, 2009).

As a future research it would be very interesting to carry out the same research after Covid-19 pandemic in order to examine the impact of Covid-19.

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