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Abstract

As a member of digital age, individuals are surrounded by Information and Communication Technologies (ICTs), so their daily life is directly or indirectly influenced. Teachers are one of the most influenced members of society because of the inclusion of ICT into education and the changes in new generation students. The goal of this study is to specify the effect of DIMLE (Dynamic Interactive Mathematics Learning Environment) on pre-service mathematic teachers' computer literacy. The sample group (n=233) consists of 4th grade students who are given education in Elementary Mathematics Education Department of Hasan Ali Yücel Faculty of Education at Istanbul University, in 2011-2014. The research model is one-group pretest-posttest design. With that model, it is possible to determine whether hypotheses proposed are right or not. Collected data was evaluated by paired sample t-test with SPSS 21.0. The results show that GeoGebra, one the famous DIMLE, has positive effect on improvement of pre-service teachers' computer literacy level.

Keywords: DIMLE, GeoGebra, Computer Literacy, Mathematics Education, Digital Natives

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Introduction

Information and Communication Technologies (ICTs) have important potential for improving quality of education from well documenting and tracking of learning process to develop new learning environments and methods (Tinio, 2003; Toki, 2012; Liu et al., 2014). In order to use efficiently and effectively that potential, teachers should have positive attitude, good computer literacy level and willing to discover educational technology. But there is a "push and pull" situation for teachers. For example, feeling less confident about improving ICT usage level, lack of much more practicing in pre-service training (Markauskaite, 2007), weakness in awareness of improving educational technology literacy and low level of theoretical knowledge of educational technology (Liu, et al., 2010) push the teachers. On the other hand, rapid changes in ICTs, popularity and necessity of educational technologies, and distinctive changes in the generation pull teachers into the digital world.

DIMLE (Dynamics Interactive Mathematics Learning Environment) is one of the ICTs-based new teaching and learning environments. It provides to both learners and teachers special opportunities to increase mathematics knowledge and deepening in the understanding levels (Martinovic & Karadag, 2012; Özdemir & Ayvaz Reis, 2013). Because of the core idea of DIMLE, it supports new learning and teaching processes such as active learning, cyber learning, explorative learning, and etc. It also develops learners' visualizing skill (Ayvaz Reis & Özdemir, 2011; Velichova, 2011; Yuyucu & Ayvaz Reis, 2010; Özdemir & Ayvaz Reis, 2013).

The general responsibilities of teachers are not only related to learn and teach using the right instruments. They also should know the students, their characteristics and expectations. Thus they can build a bridge between the students and the essential information. Nowadays teachers are face to face a new generation, -called digital natives, millennials, net generations, and etc. Digital natives are the new model students for teachers, who struggle with ICTs. Digital technologies are general part and tools of this generation's daily life (Palfrey & Gasser, 2010; Tapscott, 2009; Prensky, 2004, 2001). They feel very comfortable while using new technologies and they have immediate adaption to those technologies without feeling fear for misuse failure (Rikhye, Cook & Berge, 2009; Bennet, Maton & Kervin, 2008; Günther, 2007). They speak digitally and prefer online materials and platforms in order to learn and/or research something instead of printed materials. Even though they are different from their precedence, they still have the same problem with dealing mathematics.

Methodology

In the core of research, a project -Computer Supported Mathematics Education Project- was conducted between 2010 and 2014. The main research question of this study is "How can DIMLE affect pre-service teachers'

computer literacy level?" In order to answer to that question, some hypotheses were proposed.

- H0: There is no statistically difference between pre and post-tests that applied in study group's results
- H1: There is no statistically difference between pre and post-tests that applied in study group's female members' results.
- H2: There is no statistically difference between pre and post-tests that applied in study group's male members' results.

The research model is one-group pretest-posttest design. With that model, it is possible to determine whether hypotheses are right or not. Collected data was analyzed with paired sample t-test by using SPSS 21.0. Table 1 illustrates the research model.

Table 1. *Research Model of the Study.*

Group	Pre-test	Training	Post-test
G1	O1.1	X	O1.2

The universe of this study is the 4th grade students of Elementary Mathematics Education in Turkey. The study group (n=233) contains of 4th grade students of Elementary Mathematics Education, Hasan Ali Yücel Faculty of Education, İstanbul University, between the years 2010-2014. Table 2 illustrates the range of study group.

Table 2. *The Range of Study Group*

Gender	N	%
Female	122	52
Male	111	48

Because they are close to candidate for being teacher, the study group is chosen as 4th grade. Their specified features are to be successful in Computer I and II courses and have no experience DIMLE before.

Data Collection Tools and Analysis

Firstly the DIMLEs were literately evaluated and one of them, GeoGebra, was selected. The distinctive features of GeoGebra are to be a free software, easy to access structure (with online, offline version, iOS and android applications) and no necessity to learn any programming language or coding.

GeoGebra was started as a master thesis in 2001, at the University of Salzburg by Markus Hohenwarter. Now it is a MERLOT Classics Award 2013 winner program. There are 156 GeoGebra Institutes all over the world (http://www.geogebra.org/cms/institutes).

In order to specify the effect of GeoGebra, a fourteen-week training program was designed. Table 3 illustrates the contents of that program.

After selection of DIMLE and design of training program, a multicriteria questionnaire "Computer Literacy Test", which contains 28 questions, was prepared in order to collect data. That test was applied before and after the training program. Collected data was analyzed with paired sample t-test by using SPSS 21.0

Table 3. *Contents of the Training Program*

Weeks	Main Topics
1	The fundamental concepts of computer supported education
2	The tools of computer supported education
3	The tools of computer supported education
4	Information Communication Tools (ICT) for Mathematics Education: DIMLEs
5	Introduction to Geogebra
6	Interfaces and Menus of Geogebra
7	Interfaces and Menus of Geogebra
8	Logic operators and mathematical equations for dynamic structure
9	Designing a simple concept with Geogebra
10	Designing a dynamic and interactive concept/question/problem with Geogebra
11	Designing an original material with Geogebra
12	Designing an original material with Geogebra
13	Presenting the designed materials
14	Evaluating presented materials

Findings

H0: There is No Statistically Difference between Pre and Post-tests that Applied in Study Group's Results.

Table 4 illustrates the evaluated data of pre and post-test results of study group.

Table 4. *Evaluated Data of Pre and Post Test Results of Study Group*

		Paired Differences			t	df	Sig. (2-tailed)
		Std. Deviation	95% Confidence Interval of the Difference				
			Lower	Upper			
Pair 1	pretest - posttest	3,28483	-9,70725	-8,85927	-43,139	232	,000

As it seen in Table 4, the arithmetic mean of pre-test and post-test success points was compared by paired sample t-test. Consequently, there is statistically significant ($p<0.05$) difference; H0 is refused.

H1: There is No Statistically Difference between Pre and Post-tests that Applied in Study Group's Female Members' Results.

Table 5 illustrates the evaluated data of pre and post-test results of female participants.

Table 5. *Evaluated Data of Pre and Post Test Results of Female Participants*

		Paired Differences					
		Std. Deviation	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
			Lower	Upper			
Pair 1	pretest - posttest	3,45679	-9,82451	-8,58533	-29,412	121	,000

As it seen in Table 5, the arithmetic mean of pre-test and post-test success points was compared by paired sample t-test. Consequently, there is statistically significant ($p<0.05$) difference in female participants' results; H1 is refused.

H2: There is No Statistically Difference between Pre and Post-tests that Applied in Study Group's Male Members' Results.

Table 6 illustrates the evaluated data of pre and post-test results of male participants.

Table 6. *Evaluated Data of Pre and Post Test Results of Male Participants*

		Paired Differences					
		Std. Deviation	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
			Lower	Upper			
Pair 1	pretest - posttest	3,09818	-9,95214	-8,78660	-31,861	110	,000

As it seen in Table 6, the arithmetic mean of pre-test and post-test success points was compared by paired sample t-test. Consequently, there is statistically significant ($p<0.05$) difference in male participants' results; H2 is refused.

All hypotheses of the research were refused, so it can be said that GeoGebra course has positive effect on computer literacy level. Besides the improvement in their computer literacy level, pre-service teachers developed materials, which meet with new generation's demands and also support mathematics learning.

Figure 1. *A Screenshot from* One of the *Designed Materials about Coordinate System by a Pre-service Teacher in 2011*

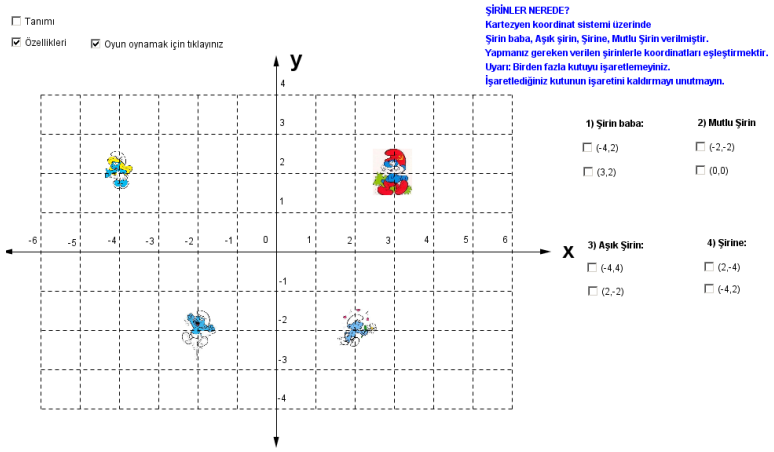

Figure 2. *A Screenshot from* One of the *Designed Materials about Operations by a Pre-service Teacher in 2013*

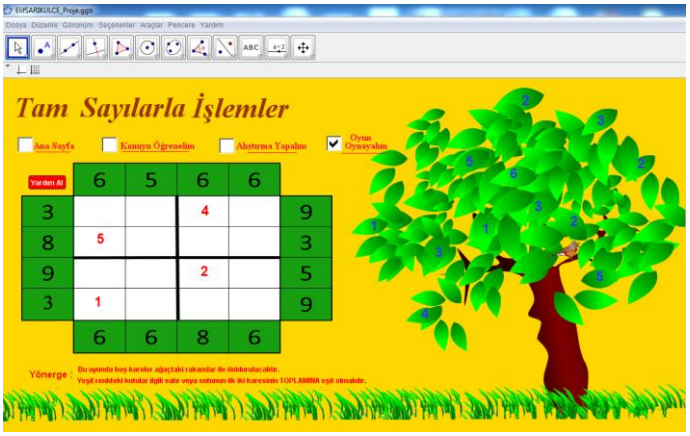

Figure 3. *A Screenshot from One of the Designed Materials about Percentages and Fractional Numbers by a Pre-service Teacher in 2014*

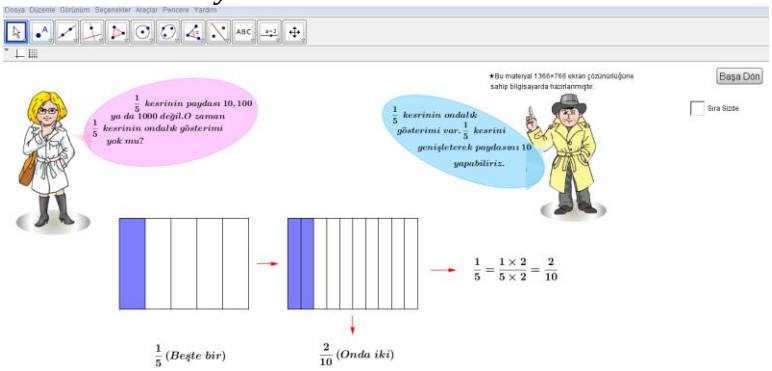

Figure 1, 2 and 3 were chosen from among more than 233 materials, designed by pre-service teachers during the project.

Conclusion

The important aim of education is to provide the most appropriate education to the individuals and transform them as beneficial individuals to the society.

When considered from this point of view, teachers should carefully analyze the digital age, its characteristics and right tools/instruments for new generation.

In the digital age, teachers have a natural obligation for using ICTs in their courses because of changes in both the generation and the expectations. With the usage of DIMLE, GeoGebra, there can be important opportunities for mathematics teachers, such as

- improving their computer literacy level,
- designing materials, for which related to an abstract concept of mathematics,
- re-organizing content of the mathematics lessons for new generation, who prefers visuals for learning.

The fundamental problem for future of education probably will be about quality and effectiveness of future teachers. DIMLEs can help in order to improve quality of education as motivating to learn, facilitating the acquisition of basic skills and enhancing teacher training.

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