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## Inspection Of Techno-Pedagogical Educational Qualifications Of Mathematics Teacher Candidates

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### Abstract

In this study, it is aimed to inspect qualifications and attitudes of mathematics teacher candidates regarding application of techno-pedagogical knowledge in mathematics lessons. 26 (21 Female and 5 Male) teacher candidates from Pedagogical Formation Group of Education Faculty of Aegean University in spring semester of 2012-2013 Educational –Training year have participated to the study. 9 hours of training in total was provided for 3 weeks, 3 hours per week was provided on using Geogebra Application software, which is one of the utility programs to enable mathematics teachers to integrate technology to the lessons. *Computer Aided Mathematics Teaching Questionnaire* was performed to the participants both before and after trainings consisted of 30 Clauses as five point Likert scale. The results of conducted survey are analysed using T-test. According to the data obtained, it is understood that participants who received computer training have a more positive attitudes towards applying techno-pedagogic knowledge in their lessons than those who did not received computer training. At the same time, it is observed that the participants who are more interested with computer use have a more positive attitude towards applying techno-pedagogic knowledge in their lessons than those who have less interested with using computer. The ideas of participants are obtained on the training provided by researchers and on Geogebra software by submitting an semi-structured interview form consisted of three questions prepared by researchers along with the survey. Reliability formulation developed by Miles and Huberman (1994) is used for the reliability of the analysis of qualitative data obtained from semi-structured interview form. Data gathered from semi structured interview form are interpreted by separating them into three subjects. It is concluded that provided training was enhanced techno-pedagogic qualifications of candidate mathematics teachers.

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## 1. Introduction

### 1.1. TPACK (Technological-Pedagogical Content Knowledge)

In the fast developing society of nowadays, it is possible to say that many fields have taken a share from technology. Applications of utilization of technology aimed at supporting education in order to improve quality of learning-instructing process are also becoming widespread as is in the other fields.

A teacher must have all necessary information on the content of lesson to be shared with students during lessons. The importance, necessity, points at forefront of the subject matter and examples of the subject are included. In the same manner, teacher should have sufficient qualification on how to present owned content knowledge to the students. He/she should be able to present current available information by organizing it according to features of readily availability. Content knowledge and pedagogical knowledge combines forming pedagogic content knowledge (Shulman, 1987).

It can be suggested that techno-pedagogical content is aroused by inclusion of technology in training-education process over this concept for which Shulman has laid the foundations. Pedagogical content knowledge which prescribes how to present the content to student and techno-pedagogical knowledge for the inclusion of technology to prepare information that suits to student combined with techno-content knowledge on using technology according to the content comprises techno-pedagogic content knowledge (Mishra& Koehler, 2006). According to Mishra and Koehler, technological pedagogical content knowledge (TPACK) targets to organize all stages according to technological pedagogical content knowledge generally in order to increase quality of educational processes.

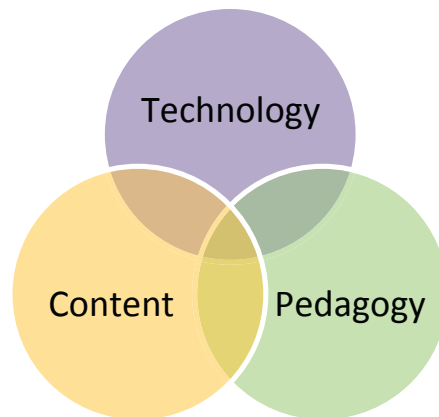


Figure 1. Mishra & Koehler, 2006

There are findings in the body of literature on techno-pedagogical content knowledge on positive approaches of teachers and candidate teachers for using technology in their courses (Albion, 2003; Gülbahar, 2008; Yurdakul, 2011).

### 1.2. GeoGebra Software

Geogebra is open source application software prepared by Markus Hohenwarter and his team for use of geometry, algebra and calculus application in mathematics courses ([http://wiki.geogebra.org/tr/Kullanım\\_kılavuzu:Ana\\_Sayfa](http://wiki.geogebra.org/tr/Kullanım_kılavuzu:Ana_Sayfa)).

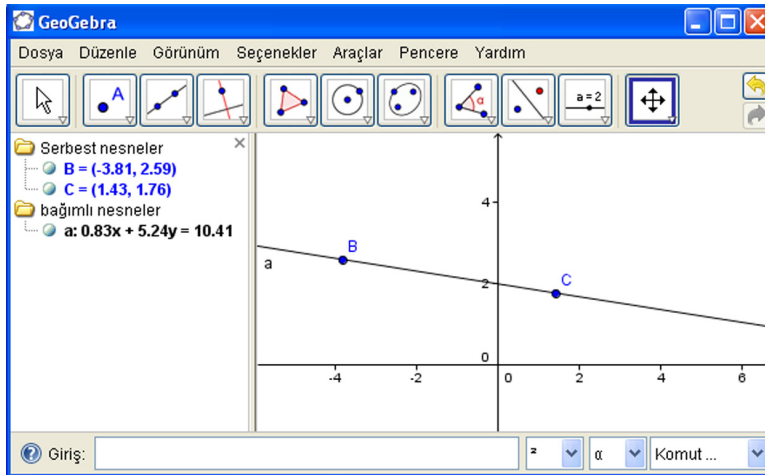


Figure 2. A view from interface of Geogebra software

In this study it is targeted to inspect the qualifications and attitudes of mathematics pedagogic formation students regarding application of techno-pedagogical knowledge in their courses. To this end, it can be asserted that this study is looking for the answers of these research questions:

### 1.3. Main Problem

Are pre-test-post-test grades of mathematics pedagogical formation students indicating a meaningful difference regarding application of techno-pedagogical knowledge in their courses?

### 1.4. Sub-Problems

Are the attitudes of mathematics pedagogical formation students indicating a meaningful difference regarding application of techno-pedagogical knowledge in their courses depending on their receiving computer training?

Are the attitudes of mathematics pedagogical formation students indicating a meaningful difference regarding application of techno-pedagogical knowledge in their courses depending on their interest to use computer?

## 2. Method

### 2.1. Participants

Totally 26 (21 Female and 5 Male) teacher candidates from Pedagogical Formation Group of Education Faculty of Aegean University in spring semester of 2012-2013 Educational –Training year have participated to the study. The details of participants are given on Table 1.

Table 1: Participant specifications

Gender	Academic success	Interest on Computer Use	Computer Training	Computer using level	I first met with Geogebra
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Female	Male	Mean	High	Low	Medium	High	Received	Not received	Sufficient	Insufficient	t	Yes	No
21	5	7	19	4	11	11	18	8	15	9		25	1

## 2.2. Data Gathering Instruments

A semi-structures interview form developed on the efficiency of the training along with *Computer Aided Mathematics Teaching Questionnaire* prepared by Yenilmez and Sarier (2007) was used in the study. Computer Aided Mathematics Teaching Questionnaire is prepared by alternatives Not agreed, Agreed a Little, I agree, Agreed a lot, Fully Agreed as 5 Point Likert Scale for totally 30 clauses. Positive options in the questionnaire are pointed as Fully Agreed: 5, Agreed A Lot: 4, Agreed: 3, Agreed A Little: 2 and Not Agreed: 1 while negative options are graded oppositely from 1 to 5.

Minimum points to be received from used Computer Aided Mathematics Teaching Questionnaire are 30 while maximum point can be 150. Internal consistency test is carried by Yenilmez and Karakuş (2007) for the reliability of questionnaire. Cronbach Alpha coefficient of questionnaire is found as 0,95. According to these results, accepting the questionnaire, no reliability study is carried under the scope of this study.

## 2.3. Application Process

In order to measure qualifications and attitudes of participants on applying techno-pedagogical knowledge in their mathematics courses, Computer Aided Mathematics Teaching Questionnaire was applied. Then 9 hours training is carried in three weeks as 3 hours per week on use of Geogebra application software which is one of utility programs to integrate technology to the course by a mathematics teacher. This training is carried in computer laboratory of Education Faculty of Aegean University allocating a computer to each participant (Figure 3). During training, guidance is provided for participants but abstained from information transfer. Opportunity is granted to participants to discover Geogebra.



Figure 3. A view from training

*First week;* toolbars and menus of GeoGebra software were introduced by means of geometry applications. Participants are asked to conduct these applications on their own computers. Furthermore, out of class studies on geometry applications were given to participants through mail group formed by researchers.

*Second week;* studies given to participants in first week were shown by the volunteer participants in practice in the laboratory (Figure 4). Then studies were proceeded by examples on use of Geogebra software in advanced geometry applications. In line with the first week, new out of class studies were given to the participants.



Figure 4. A view from training

Third week; studies given during second week was shown in practice by the participants selected randomly. Application cannot be performed by participants were completed with the guidance of researchers.

#### 2.4. Data Analysis

Computer Aided Mathematics Teaching Questionnaire was applied to participants both before and after training. In addition to this questionnaire, semi structures interview form consisted of three questions was applied to the participants and data on training were gathered.

Table 2: T-test results of points of pre-test and post-test attitudes of mathematics pedagogical formation students regarding application of techno-pedagogical knowledge in their courses

	N	$\bar{X}$	S	sd	t	p
Pretest	26	124.19	2.77	10.47	.094	.000
Posttest	26	123.85	3.34			

As seen on table 2, t-test carried to inspect whether pre-test and post-test attitude points of participants display a meaningful difference or not regarding application of techno-pedagogic knowledge in their lessons has shown statistically meaningful difference at 0,05 significance level ( $p < .05$ ). I.e. Attitude points of mathematics pedagogical formation students on application of techno-pedagogical knowledge in their lessons indicate significance at post-test level. In other words, 3 weeks of Geogebra training provided to participants have increased attitude points of the participants.

A semi-structured interview form was given to participants at the end of training along with Computer Aided Mathematics Teaching Questionnaire; their opinions on training and Geogebra software were collected. This form was consisted of three questions. The questions on semi-structures interview form are as follows:

1- What do you think about GeoGebra training you have received? (Please explain in terms of sufficiency of content, contribution for you, examples and applications)

2- How do you think to use GeoGebra software in your lessons to describe which subjects? (Please explain with examples)

3- Which advantages do you think GeoGebra software may provide to your teaching activities? (Such as time saving, teacher-student interaction, directing students, etc.)

For the reliability of qualitative data obtained from semi-structured interview form, reliability formulation (Reliability: Agreements / (Agreements+ Disagreements)) developed by Miles and Huberman (1994) was used. According to Miles and Huberman formulation specialists from different fields are analysing the data by coding them according to predetermined subjects. In consequence of such coding, sub-subjects are formed. In this way, sub-subjects agreed or disagreed among specialists are established and consistence rate between reliability formula and specialists ideas are determined (Yanpar Yelken, 2009). Researchers have determined 3 subjects for this section of researched problem. The values of Miles-Huberman reliability formula were given in Table 3 for three subjects. Subjects ate;

1. Ideas regarding provided training
2. Lessons and subjects for which GeoGebra software can be used
3. Advantages of GeoGebra software

Table 3. MH reliability Formula Values on the subject matter

Subjects	M.H. Reliability Formula Values
Ideas regarding provided training	MH:22/(22+4)=0,85
Lessons and subjects for which GeoGebra software can be used	MH:25/(25+1)=0,96
Advantages of GeoGebra software	MH:24/(24+2)=0,92

When Table 3 is inspected, it is determined that Miles-Huberman reliability formula values are over 0,70 for each data in consequence of the analysis carried to determine reliability of the data analysis. This indicates that coding of researchers is reliable.

### 3. Findings and Comments

One of the problems of the research is expressed as *Are the attitudes of mathematics pedagogical formation students indicate a meaningful difference regarding application of techno-pedagogical knowledge in their courses depending on their receiving computer training?* The results of t-test performed to test this problem are presented on Table 4 long with relevant data.

Table 4: T-test results of points of attitudes of mathematics formation students on application of techno-pedagogical knowledge in their lessons depending on their computer training

Computer training	N	$\bar{X}$	S	sd	t	p
Received	19	118.6	18	17.5	31	.000
Not received	7	124.8	6	15.4	20.4	.000

As seen on Table 4, t-test performed to test whether attitudes of participants on using techno-pedagogical knowledge to their lessons vary significantly depending on their computer trainings indicates a statistically meaningful difference with 0,05 significance level ( $p < .05$ ). I.e. the points of attitudes of mathematics formation students regarding application of techno-pedagogical knowledge in their lessons varies depending on their computer training status. According to gathered data, it is understood that participants who have received computer training have a more positive approach to applying techno-pedagogical knowledge in their lessons than the participants who did not received any computer training.

Another question of the research was expressed as *Are the attitudes of mathematics pedagogical formation students indicate a meaningful difference regarding application of techno-pedagogical knowledge in their courses depending on their interest to use computer?* In order to test this issue, normality test was performed on distribution

first and it is seen that distribution is normal ( $p(.310)>.05$ ). The results of conducted t-test analysis are given on Table 5.

Table 5: t-test results of attitude points of mathematics pedagogical formation students on application of techno-pedagogical knowledge in their lessons depending on their interest to computer use

Interest to Computer Use	N	$\bar{X}$	S	sd	t	p
Low	4	90.75	7.54			
Medium	11	125.09	7.84	16.5	37.59	.000
High	11	129.27	9.81			

As seen on Table 5, t-test performed to see whether attitude points of participants on application of techno-pedagogical knowledge in their lessons vary significantly depending on their interests to use computer has shown a statistically meaningful difference at 0,05 significance level ( $p<.05$ ). This means that attitudes of mathematics pedagogical formation students regarding application of techno-pedagogical knowledge in their lessons are indicating a meaningful difference depending on their interest to computer use. According to the obtained data, the participants interested highly with computer use have a more positive attitude towards application of techno-pedagogical knowledge in their lessons compared to the participants who are less interested in computer use.

Based on the responses of participants to the question *What do you think about GeoGebra training you have received?*, it is determined that 3 weeks (9 hours) of GeoGebra Training is effective, enjoyable, efficient and sufficient. According to participants, the examples given by the researchers during training are interesting, current and have a nature developing different perspectives. However some participants ( $n=11$ ) emphasized that duration of training is insufficient. Participant14 expressed his/her opinions on GeoGebra training as follows:

*“... content was well fixed. Its contribution to me has ensured inclusion of GeoGebra into my lessons as far as possible. If we consider examples, applications and duration of instruction, it was sufficient. The purpose was to guide us. Directing us to seek for more examples was also very positive.”*

According to the data gathered based on the responses of participants to the question: *How do you think to use GeoGebra software in your lessons to describe which subjects?*; participants specified that GeoGebra software may be used for all Geometry and Mathematics subjects primarily for Circles, Functions, Parabola, Integral and Trigonometry subjects. Participant25 responded as follows: *“I am planning to use for all subjects as far as I can use.”*

Participants responded to the question *Which advantages do you think GeoGebra software may provide to your teaching activities?* Positively as: time saving, attracting attention, materialization of subjects, provide ease on class management, motivation, enjoyable subject explanation. Participant11 replied as follows:

*“First and foremost thing is that knowledge provided to students visually is more permanent. In addition, to show on GeoGebra instead of drawing figures on the blackboard save time. It enhances concentration since it addresses eyes of students; it provides ease on control of class. I.e. use of GeoGebra also facilitates class management”.*

#### 4. Conclusion and Discussions

The followings are the concluded results in the view of statistical findings of research problems.

26 mathematics teacher candidates, including 21 girls and 5 boys have participated to the study. 19 of the participants have high academic success while 7 have lower success. The number of participants interested highly in computer use is 11, while medium level interested ones are 11 and 4 are less interested. 18 participants have received computer training while 8 participants did not. Computer using abilities of 15 participants is sufficient while 9 participants are insufficient. While the number of participants hearing about GeoGebra for the first time is 25, only one participant has heard about GeoGebra software previously.

Attitudes of participants towards use of computer support in their mathematics lessons are also positive. Findings are supportive to the studies given in the literature in this subject (Albion, 2003; Gülbahar, 2008; Yurdakul, 2011).

In conclusion, it can be asserted that GeoGebra software may be employed as a supportive and complementary activity for education.

## 5. Suggestions

Applied courses may be planned at graduate level on how to integrate technology into their lessons targeting to enhance techno-pedagogical qualifications of mathematics teacher candidates. In the same manner on the job trainings may be organized enhance techno-pedagogical qualifications of mathematics teachers. In this way, mathematics teachers and teacher candidates may be encouraged to employ technology in their lessons.

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