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Views of Mathematics Teacher Candidates about the Technological Tools That Can Be Used in Mathematics Lessons

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Abstract: In this research, it was aimed to determine the views of mathematics teacher candidates about the technological tools that can be used in mathematics lessons. The research was conducted through qualitative research methodology. 120 teacher candidates who were educated in the mathematics teacher education program in Dicle University Ziya Gokalp Education Faculty took part to the research. The data of the study were collected through semi-structured interviews. The data collection tool used in the study is an interview form developed by the researcher, and it consists of open-ended questions. In the analysis of the data, descriptive analyses were used. As a result of the data analysis obtained from the research, it was determined that teacher candidates responded as "computer/computer software" at most for the questions about what technological tools could be used in mathematics lessons, what technological tools they would use when they were teachers, and which technological tools would be beneficial. In addition, teacher candidates stated that there were computers at most as technological tools in their faculties and the technological tools in their faculties were mostly used for visualization/concretization the subject.

Keywords: *Mathematics, technology, technological tools, mathematics teacher candidates.*

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Introduction

Rapid developments in science and technology have brought countries into an inevitable race. Due to this race, the development of existing technological opportunities has become necessities more than privilege. Technology is a process in which tools, structures or systems are developed to supply people's needs (Roztocki &Weistroffer, 2015).

Today, technology is effective and active in the all areas of the life (Dogan & Akbarov, 2016; Durukan, Hacioglu & Donmez-Usta, 2016; Buyukbaykal, 2015). Education is one of these areas. It is unavoidable that technological developments affect the process of learning-teaching as well as all areas of the life. The use of technology in education is one of the issues that should be emphasized in education. By the process of learning with technology, it's become possible to use new methods and techniques and thus innovations and regulations have been made in the arrangement of learning environments. The innovations and developments in technology have caused changes in the comprehension of learning. Accordingly, this situation has brought the use of new methods and techniques (Sein-Echaluce, Fidalgo-Blanco & Alves, 2017; Dogan & Akbarov, 2016; Sonmez, 2014). Along with these innovations and developments, many technologies such as interactive whiteboards, computers, tablets, projection devices have become a part of education (Volk, Cotic, Zajc & Starcic, 2017; Isik, 2015; Kayak & Kir, 2015; Liu, Wang, Liang, Chan & Yang, 2003). One of the most used areas of these technologies is undoubtedly mathematics. Mathematics is a system composed of structures and relations that are changed as sequential abstraction and generalization processes (Alakoc, 2003). Since technological tools have an effective role in embodying abstract mathematical terms, especially if students at the age of primary school are taught using appropriate technologies, they can better understand their mathematics (Kuslu, 2015; Holmes, 2009). In many researches, it has been found that there are positive effects of using technology in mathematics (Brown, 2017; Volk et al., 2017).

In recent years, many scientific studies have been made on the use of technology in education in Turkey. When the literature is examined, it is determined that there are many studies on the use of computers and technology in mathematics teaching, but most of them are about academic achievement and attitude. However, the dizzying developments experienced in technology cause significant changes in the education sector as well as in all areas of life

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(Sein-Echaluce et al., 2017). Educational institutions are faced with a group of students who use technological tools such as computers, tablets, internet, and smart phones every day. Therefore, teacher candidates are faced with a student segment that lives together with technology when they start to work.

By appreciating the education process of teacher candidates who prepare for teaching profession, if an education environment can be made to use the technology in the most accurate and effective way, a very useful work will be done for both themselves and future generations. In order for teachers to be able to successfully carry out these new roles, they must first acquire sufficient knowledge of the technology and continue their education in such an environment. In the lessons, it has become a necessity to carry out the educational activities by rendering the contents through computer and internet and making them visual and audible so that they can address the students with different learning styles in teaching the subjects. The most important task to actualize and apply all of these is teachers'. Akkoyunlu (2002) emphasizes it is quite important that teacher candidates get an education about this subject to be able to use effectively in the learning environment.

Purpose of the Research

In order for teachers to develop positive attitudes towards the benefit and use of technology in education, faculties of education, where they are educating, have very important tasks. From this point, the candidates of mathematics teachers' views should be determined about the technological tools to be utilized in mathematics lessons. In light of all these explanations, it is aimed to reveal the views of mathematics teacher candidates regarding the technological tools that can be used in mathematics courses in this research.

Methodology

Model of the Study

This research is a qualitative study that aims to reveal the perceptions of mathematics teacher candidates about the technological tools that can be used in mathematics lessons. Qualitative research is an approach to discover and understand the meanings of individuals or groups that refer to a social or human problem (Creswell, 2013). In the research, phenomenological design which is a qualitative research design was used. Phenomenological design is a research design that provides an opportunity for in-depth investigation about facts which we cannot produce clear discourses based on scientific discoveries although we know them and it allows us to interpret those facts by making rich speeches (Creswell, 2013).

Sample and Data Collection

The sample of the research is composed of 120 mathematics teacher candidates who are studying in the mathematics teacher program. The participants were randomly selected from the Dicle University Ziya Gokalp Faculty of Education in Diyarbakir, Turkey, in the fall semester of the 2016-2017 academic years. Therefore, simple random sampling method was utilized to constitute the sample of the present study.

An interview form formed by researcher was used as data collection tool in the study. The interview form consists of five open-ended questions. The relevant literature has been used while preparing the questions on the interview form. After the questions were formed, expert views were consulted to ensure their validity, and questions were formulated in accordance with the views received and then the interview form was finalized. The questions in the interview form are as follows:

1. What are the technological tools can be used in mathematics lessons?
2. What technological tools do you intend to use when you become a teacher? Why?
3. Which technological tools do you have in your faculty and which of these tools are used frequently in your courses?
4. For what contribution are the technological tools in your faculty used?
5. Which technological tools do you think will benefit you?

Data Analysis

Descriptive analysis was used in the analysis of the data. In descriptive analysis, the aim is to present the findings to the reader in an organized and interpreted way. Direct quotations are frequently given to reflect the views of the interviewed or observed individuals in a striking way. The data summarized and interpreted in the descriptive analysis are processed in a deeper way, and the concepts and themes that cannot be recognized by the descriptive approach in descriptive analysis can be discovered at the result of this analysis (Yildirim & Simsek, 2011).

When the data are coded, the number of frequencies in the theme is higher than the total number of participants since the replies of the mathematics teacher candidates include expressions more than one theme to enter. Participants in the survey were coded as "C_1, C_2, C_3...". In the coding, C indicates the mathematics teacher candidate and numbers indicate the sequence number. These codes are used when direct quotations are given from mathematics teacher candidates.

Findings / Results

In this part of the research, findings obtained from the answers given by mathematics teacher candidates to open-ended questions have been presented below with a direct citation from the views of some teacher candidates in the light of the thematic coding that was generated.

What are the technological tools can be used in mathematics lesson?

Mathematics teacher candidates were firstly asked "*What are the technological tools can be used in mathematics lessons?*" Teacher candidates' replies to this question are given in Table 1.

Table 1. The Technological Tools Can Be Used in Mathematics Lesson

Technological Tools Can Be Used in Mathematics Lesson	**f**
Computer / Computer Software	103
Projection Device	69
Interactive Whiteboards	54
Overhead Tool	39
Calculator	31
Concrete Materials	22
Internet	5
Total	**323**

When Table 1 is examined, the reply given by teacher candidates to the question "*What are the technological tools can be used in mathematics lessons?*" is computer/computer software (f=103) at most. This reply is respectively followed by projector device (f=69) and interactive whiteboard (f=54). Besides, 39 teacher candidates stated that overhead projector could be used. The frequencies of other technological tools that can be used in mathematics lessons are presented in Table 1.

Some examples of mathematics teacher candidates who responded to the question "*What technological tools can be used in mathematics lessons?*" as computer/computer software are given below:

> C_{62}: *"As a necessity of our age, practical tools, especially computers and overhead projectors, should be recommended for further consolidation.*"
>
> C_{88}: "*computer applications in the game type that will teach small operations …*"
>
> C_{107}: "*The computer which is indispensable in today's conditions …*"
>
> C_{108}: "*The use of computers is comfortable and effective in terms of students and teachers.*"
>
> C_{119}: "*Computers which are today's technological tools can be used*"

There were also teacher candidates who preferred to use traditional teaching methods and classical boards instead of using technology in mathematics lessons, as opposed to the themes given in the table for the question of what technological tools can be used in mathematics lessons. The views of these teacher candidates are as follows:

> C_{20}: "*Mathematics is not a lesson that can be explained with technology. More, it is related with expression and practice. Therefore I prefer practical expression to using technology.*"
>
> C_{84}: "*I would spend time for using ordinary board and practice as technology.*"
>
> C_{99}: "*Since mathematics lesson is more theoretical, the tools can be used are limited.*"

What technological tools do you intend to use when you become a teacher? Why?

In the research, secondly the question "*What technological tools do you intend to use when you become a teacher? Why?*" was asked to mathematics teacher candidates. Teacher candidates' replies to this question are given in Table 2.

Table 2. Technological Tools That Teacher Candidates Think to Use

Technological Tools That Teacher Candidates Think to Use	**f**
Computer / Computer Software	78
Projection Device	47
Interactive Whiteboard	35
Overhead Projector	12
Calculator	9
Concrete Materials	8
Internet	5
Total	**184**

When Table 2 is examined, mathematics teacher candidates indicated that they think to use mostly computer/computer software (f=78), projection devices (f=47) and interactive whiteboards (f=35) when they are teachers. The number of teacher candidates who consider using overhead projector (f=12), calculator (f=9), concrete materials (compass, ruler, abacus, geometric objects ...) (f =8) and internet (f=5) is less.

Figure 1 is occurred by the opinions illustrated in Table 2:

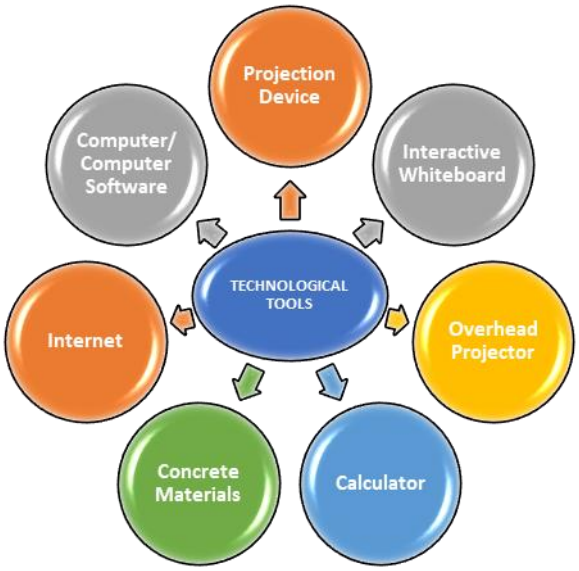

Figure 1. The Model of Technological Tools That Teacher Candidates Think to Use

When the answers about why mathematics teacher candidates want to use these technological tools are examined, the reasons such as "*visualizing and concretizing the subject more*", "*saving time*", "*better comprehension of the subject by the students*", "*persistence*", "*attracting attention of the students*" have come to the forefront.

Some direct quotes from some of the mathematics teacher candidates who gave computer/computer software, projection device and interactive whiteboard answers for the second question of the research are given below:

> C_6: "*When I am teacher, I want to use both computer, projection device and interactive whiteboard.* Because *student can learn better by concreting abstract subjects in this way.*"
>
> C_{33}: "*Projection, computer and interactive whiteboard provide student to understand better.*"
>
> C_{43}: *"I want to use computer because information will be more permanent in student's memory."*
>
> C_{46}: "*Computer, projection device and interactive whiteboard save time. More questions can be solved*. So the subj*ect is better understood.*"
>
> C_{71}: "*Computer, projection device and interactive whiteboard. For concreting the abstract inform*ation *to be permanent in student's mind.*"
>
> C_{87}: "*Information will be permanent because computer takes the attention of students.*"

C_{100}: "*With computer aided tools, it is possible to transmit information more clearly in a short time. Also visualizing the information provides it to be kept in the memory.*"

When they start to teaching profession, the candidates stated the following reasons for the use of the tools different from computers/computer software, projection device and interactive whiteboards:

C_1: "*I prefer overhead projector to computer. Because there are many e*lements on the computer that *can distract the students. Overhead projector, projection devices focus o*n student subjects."

C_{51}: "*I use the model of geometric objects. Because visual learning is more permanent*."

C_{99}: "*I provide them to solve more problems and learn more information on internet*."

C_{109}: "*I will use compasses and a ruler, thus I can draw shapes that are beautiful on the board*."

C_{111}: *"To solve long operations in a short time, I would use calculator."*

On the other hand, some mathematics teacher candidates stated that instead of specifying any technological means, they would like to use all the technological tools according to their place. Some views of these mathematics teacher candidates are below.

C_8: "*I would use all of them in the possibilities. Because technology means convenience. And mathematics, which is an abstract science, is learned better with technology.*"

C_{18}: "*I would use all within my opportunities; because they all can make students understand better*. *They can concrete abstract lessons.*"

C_{21}: "*If it is possible, it is better to take advantage of all. Because it allows us to describe with a simpler, more concrete and more understandable language.*"

C_{22}: "*I would like to take advantage of all the technological developments if all the opportunities are provided. Because I can use different technologies according to the course content.*"

C_{76}: "*I think that each technological tool facilitates daily life. Especially in teaching profession, I think that it is possible to comprehend the lesson to the students by lecturing in different ways.*"

Which technological tools do you have in your faculty and which of these tools are used frequently in your courses?

The third question of the research is "*Which technological tools do you have in your faculty and which of these tools are used frequently in your courses?*". The replies of teacher candidates are in Table 3.

Table 3. The Technological Tools Provided by the Faculty

Technological Tools Provided by the Faculty	**f**
Computer	92
Projection Device	60
Overhead Projector	6
Interactive Whiteboard	5
Total	**163**

When Table 3 is examined, mathematics teacher candidates generally stated that their faculty had computers (f=92) and projection device (f=60). A small number of teacher candidates stated that there were overhead projectors (f=6) and interactive whiteboard (f=5). When the answers about the frequent use of these technological tools were examined, it is seen that most of the students emphasize that the computer and projection device are used more frequently than the other tools, but these tools are not used frequently and adequately. In addition, some of the teacher candidates stated that although there were computers in the faculty, there was no internet access.

Some replies of mathematics teacher candidates are below:

C_5: "*Computers are used, but it is not a tool that we use frequently.*"

C_{21}: "*There are computer and projection device but we benefit from just projection device from time to time.*"

C_{32}: "*Computers are used only in the lessons which are related to the computers. For now there are not technological tools which are used frequently.*"

C_{35}: "*Computers are used more or less. Technology isn't used so much.*"

C_{41}: "*There are computers and projection devices. Recently interactive whiteboards have been brought, however we haven't been able to benefit from it. Also it is an important deficiency that we can't access internet although we have computers.*"

C_{75}: "*We have computers as technological tool, but we don't use it.*"

C_{76}: "*Computer is used just in computer lesson.*"

C_{99}: "*I can't say that we have used technological tools in our lessons.*"

C_{107}: "*Unfortunately, there aren't many technological tools. There should have been computers with internet access, interactive whiteboards, overhead projectors, videos etc. that students could benefit from in the science age.*"

C_{119}: "*There are computers, but we don't benefit from them adequately.*"

For what purpose are the technological tools in your faculty used?

The third question of the research is "*For what contribution are the technological tools in your faculty used?*" The replies of teacher candidates are in Table 4.

Table 4. The Contribution of the Use of Technological Tools

Contribution of the Use of Technological Tools	**f**
Visualization / Concretization	46
Permanency	29
Time Saving	23
Easy Access	16
Active Learning	15
More Effective and Understandable Access	15
Attracting Attraction to the Topic	14
Easy Learning	9
Practice	8
Total	**175**

When Table 4 is examined, it is seen mathematics teacher candidates stated that the technological tools in the faculties were mostly used for visualization/concretization (f=46). This reply is respectively followed by permanency (f=29) and time saving (f=23).

The reply of some of the mathematics teacher candidates who expressed that the technological tools in their faculties were used for visualization/concretization was given below.

C_{18}: "*It is used for purposes such as comprehending the subjects better, visual expression, concreting the abstract.*"

C_{23}: "*Since mathematics lesson is an abstract lesson, these tools concretize the lesson.*"

C_{27}: "*I think visualization is very important for learning information.*"

C_{68}: "*To access better in terms of visualization…*"

C_{86}: "*The projection system we use in the training course gives us a visual advantage.*"

C_{116}: "*They are used to concretize the abstract information. Students learn lessons more visually through these technological tools.*"

The views of some mathematics teacher candidates who say that the technological tools in their faculties are used to ensure the permanence are as follows:

C_{26}: "*It is used to ensure that the information about the subject is permanent. By teaching practically, it becomes more permanent, and visuality makes it permanent.*"

C_{52}: "*In terms of practice, visuality makes it more permanent in the mind.*"

C_{53}: "*To make the comprehension permanent.*"

C_{71}: "*To strengthen the memory of the learner in order to make it permanent.*"

C_{83}: "*These tools are used to increase permanence.*"

C_{88}: "*To teach students in the shortest and permanent way.*"

Some examples from the views of the mathematics teacher candidates who say that the technological tools in their faculties are used to save time are as follows:

C_{46}: "*Time saving… Subject scanning gets easy, different sample solutions can be seen, it can also be used in distance learning.*"

C_{74}: "*Technological tools are used to save time.*"

C_{105}: "*To quicken and facilitate teaching activity.*"

C_{115}: "*They are used to concretize information and make time more economical.*"

Figure 2 is occurred by the opinions illustrated in Table 4:

Figure 2. The Model of the Contribution of the Use of Technological Tools

Which technological tools do you think will benefit you?

The last question for mathematics teacher candidates is the question, "*Which technological tools do you think will benefit you?*" The replies of the teacher candidates to the question are given in Table 5.

Table 5. Technological Tools Which Are Thought That Will Be Useful

Technological Tools Which Are Thought That Will Be Useful	**f**
Computer/Computer Software	78
Projection Device	35
Interactive Whiteboards	23
All Technological tools	20
Internet	14
Calculator	5
Overhead Projector	3
Unnecessary use of technology	5
Total	**183**

When the replies of mathematics teacher candidates to the question "*Which technological tools do you think will benefit you?*" are examined, it is seen that the replies computer/computer software (f=78), projection device (f=35) and interactive whiteboards (f=23) are at most. At other side, it is noteworthy that 14 teacher candidates give "internet" answer.

Direct quotes from the answers given by the mathematics teacher candidates to the fifth question are given below.

> C_{19}: "*I think especially computers, interactive whiteboards and projection devices will benefit.*"
>
> C_{75}: "*The use of interactive whiteboards will save time and energy.*"
>
> C_{81}: "*I think the intended information can be accessed very quickly and easily via the internet.*"
>
> C_{97}: "*If there were computers internet connection, it would be more beneficial to the students for some researches.*"
>
> C_{101}: "*By means of interactive whiteboards, learning is faster because students have the opportunity to review the problems again and again which we solve in classroom.*"
>
> C_{103}: "*The computer is in everywhere now and be used in every field. We should know using computer well.*"

Some mathematics teacher candidates (f=20) think that all technological tools should be had conditionally. The views of some of these teacher candidates are as follows:

> C_{2}: "*The world is already highly developed in terms of technology. All technological tools can benefit people. Because there are various kinds of topics, a different technological tool can be used for each subject.*"
>
> C_{36}: "*By the development of technology, it is necessary to make use of all technological tools.*"
>
> C_{45}: "*It may not be right to separate tools. Technological tools have many benefits. It should be noted that the tools are used correctly in the right place.*"
>
> C_{113}: "*It would be good for me to have all the technological tools that would benefit my education or general culture.*"
>
> C_{115}: "*The more technological tools, the better the teaching takes place.*"

A small number of mathematics teacher candidates (f=5) stated that it is not necessary to use technology or it is more important that teachers are equipped. Direct quotes from these teacher candidates are as follows:

> C_{8}: "*Teachers should be the latest technology, that is, they should be well-equipped and self-developed. As long as good teachers exist, qualified education will be provided whether or not technological tools are available.*"
>
> C_{20}: "*I think there should be none, the teacher must do something by his own effort. In the past there were no technological tools, but the students were more eager, had more effort to read and the reading rate was more.*"
>
> C_{38}: "*I think especially the department of mathematics does not need technological tools much. Perhaps because of that have been trained with traditional teaching technology until this day, I think we do not need the technological tools. For now there is no technological tool that I think it will benefit us.*"
>
> C_{69}: "*I do not think that the use of technological tools in mathematics will benefit students. More consideration should be given to thinking.*"
>
> C_{99}: "*To tell the truth, rather than technological tools, teachers should be more equipped. If teachers have the highest level of knowledge and can access it to us, then there will be no need for technological tools.*"

Discussion and Conclusion

This research was carried out in order to reveal the perceptions of mathematics teacher candidates about the technological tools that can be used in mathematics lessons. There are discussions and suggestions which were reached with the help of the findings obtained in this part of the research.

Mathematics teacher candidates responded as computer/computer software at most to the first question of the research, "*What are the technological tools can be used in mathematics lessons?*" and the second question, "*What technological tools do you intend to use when you become a teacher? Why?*".

The replies of the last question of the research "*Which technological tools do you think will benefit you?*" are similar with the replies of the first two questions. Computers can be shown as the most important tools of the technological tools used in the educational environment (Catlioglu & Kutluca, 2008; Akkoyunlu, 2002). Cagiltay, Cakiroglu, Cagiltay and Cakiroglu (2001) state that many teachers believe that the use of computer is very important in education. On the other hand, the answer of "interactive whiteboard" that mathematics teacher candidates give to this question is far fewer than computer and projection device. However, computers and projection devices leave their places to interactive whiteboards fast. In recent years, interactive whiteboards have been used in many educational institutions, including private educational institutions (Kocak, 2013). Moreover they are offered to schools by many governments such as Australia, the UK and the USA under the national education policies (Lai, 2010; Holmes, 2009). Classrooms have been equipped with interactive whiteboards by FATIH project announced in 2010 in Turkey. In addition, the researches related to interactive whiteboards indicate by use of interactive whiteboards in classrooms the success of the students has increased (Volk et al., 2017; Kayak & Kir, 2015).

Mathematics teacher candidates often pointed out that there were computers and projection devices in their faculties, while a small number of teacher candidates stated that they have overhead projector and interactive whiteboard. When the replies to "the frequent use of these technological tools" are examined, it was found that the majority of the students emphasized that the computer and the projection device have been used more frequently than the other tools, however these tools are also not used frequently and adequately. The role of technology in education and teaching is related to the knowledge and ability of teacher candidates to use technology. In order for teachers to be able to use technology effectively in their professional lives, teacher candidates should be equipped with the knowledge and ability to use technology in university years. For this reason, it is important to use the technological tools compatible to the course contents widely in education faculties. Because of the fact that the lessons in higher education are based on technology, the teacher candidates will be equipped with the skills to use technology (Erdemir, Bakirci & Eyduran, 2009). Besides that, some teacher candidates stated that despite the existence of computers in the office, there is no internet access, it is a deficiency, and that internet access will be beneficial to them. Catlioglu and Kutluca (2008) indicate that the mathematics teacher candidates have a very low frequency of internet use in the school and therefore, it will be very useful to provide learning environments where they can reach and benefit from internet in education faculties where they learn. However internet, which has become a part of our lives, opens the door to a whole new world and offers new possibilities and experiences to individuals. Today, the internet has become an indispensable technology in all educational institutions, in especially universities, and continues to take more space in human life every day. By the use of the Internet, information can be accessed at any time without limitation of time and space, and people can freely share their knowledge and ideas. Mathematics teacher candidates stated that most of the technological tools are used to visualize and concretize the subject, to provide permanency and to save time. Kuslu (2015) also notes that technological tools have an effective role in concretizing the abstract mathematical terms and therefore teaching mathematics to students using appropriate technologies can provide them to understand mathematics better. In addition, Yavuz and Coskun (2008) also found that technology is important in terms of visuality and saves time in the study that they made to determine classroom teachers' attitudes and views about the use of technology in education.

The opinions of teacher candidates regarding the technological tools used in mathematics lessons in this study are limited to the education faculty students of Dicle University in Turkey in 2016-2017 education years. The ability of the mathematics teacher candidates to use the technological tools as much as possible in their lessons firstly depends on the fact that the instructors make this interaction environment with their students in their lessons. Indeed, there are technological tools such as software (Mathematica, Derive, Cabri, Logo, Spreadsheets, Geometry Sketchpad, Geogebra etc.) and graphic calculators that can be used in teaching mathematics. In addition, the number of compulsory courses such as computer and technology-supported mathematics education at the higher education level should be increased and integrated into the mathematics curriculum.

In spite of some limitations, it is hoped that the results will provide some insights especially to the mathematics teacher education programs to revise the course requirements and to plan future remedial programs related to the technology.

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