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Increase Students' Understanding of Mathematics Learning Using the Technology-Based Learning

Nurul Aini Jaafar[1,*], Siti Rohani Mohd Nor[1], Siti Mariam Norrulashikin[1], Nur Arina Bazilah Kamisan[1], Ahmad Qushairi Mohamad[1]

[1] Department of Mathematical Sciences, Faculty of Science, Universiti Teknologi Malaysia, 81310, Skudai, Johor Bahru, Malaysia

ABSTRACT

Recently, a digital technology becomes important in learning to enhance students' understanding, knowledge and visualization. Technology can give benefits in learning mathematics to motivate and excite the students. In this study, the effectiveness of implementation technology and applications in students' understanding and visualization in mathematics learning among university students is analyzed. Learners have more opportunity to see and interact with mathematical concepts by using technology. Students can use games, application, simulations, and digital tools to explore and discover new things. This research will do an analysis on the students' understanding and interest on learning mathematics with and without technology-based. The data has been collected by observation on students' performance and survey from university students. The survey focuses on various aspects such as students' acceptance, interest and skills. Data analysis on students' engagement, performance, acceptance, interest and skills has been obtained. These findings are expected to benefit school, universities and educators that looking for the innovation and future ready learning and education.

Keywords:
online learning, technology-based learning, visual learning, visual thinking, applications

1. Introduction

Learning mathematics using technology is important nowadays to attract the students' attention. Over the last two decades, researchers have focused on the use of technology in mathematics education[1]. In addition, the presence of the COVID-19 pandemic led to the implementation of the online teaching and learning using digital technology widely [2]. This situation forced the educators to adapt and master with the technology to deliver the lecture during COVID-19. Learning mathematics using technology is one of the effective methods to increase students' understanding, participation and interaction. Many applications and website technology such as Geogebra[3], [4], Wolframalpha [5], Symbolab, Desmos, graphic calculator [6] and so on are useful in learning mathematics. These applications including the mathematics problem solver such as plotting the graphs 2D and 3D, integration, differentiation, series, sequence, limit, domain and range, and many other mathematics problems. Besides, the applications and website technology for active learning such as E-learning, Edpuzzle, Padlet, Whiteboard.fi and Liveworksheet also very interesting

* *Corresponding author.*
E-mail address: nurulaini.jaafar@utm.my

technology platforms that provide mathematics expressions and help the educators to interact with students. These technology webs help to attract the students' participation and enhance students' knowledge. The advantages of using technology are the educator can save times and observe the students' performance easily especially in a large quantity of students.

The aim of this study is to analyze the effectiveness of implementation technology and applications in university students' understanding and visualization in mathematics learning. The effect of technology to the students' engagement, performance, acceptance, interest and skills have been analyzed.

1.1 Research Question

This research aims to investigate the importance and the effect of using technology in learning mathematics towards the students' engagement, performance, acceptance, interest and skills. Specifically, this study aims to answer the following research questions:
(a) What are the students' views on the use of technology in learning mathematics?
(b) What are the students' views towards students' engagement, performance, acceptance, interest and skills when technology is used in learning mathematics?

1.2 Research Objectives

The objectives of the study are as follows:
1. To analyze the students' views on the use of technology in learning mathematics.
2. To analyze the students' views towards students' engagement, performance, acceptance, interest and skills when technology is used in learning mathematics.

2. Methodology

2.1 Research design

This research identifies the problems such as the students' engagement, interest and skills on learning mathematics by designing research questionnaire among students. The data has been collected by observation on students' performance and survey from university students. The questionnaire focuses on various aspects such as the importance of technology in learning mathematics, the effect of technology on the students' attitude, interest and skills in learning mathematics.

2.2 Sample

The participations for this study are from undergraduate students who taking Mathematical Methods 1 subject from Faculty of Science. The sample size for this study is 90 participants, regardless of the gender. These students are selected to get their feedback and survey on the importance of technology in mathematics class.

2.3 Instrumentation

In this research, the students' feedbacks have been collected from students to observe the effectiveness of technology and effect on students' engagement, performance, acceptance, interest and skills when technology is used in learning mathematics.

3. Results and Discussion

This section discusses the results obtained from the surveys among the 90 undergraduate students from Universiti Teknologi Malaysia who taking Mathematical Methods 1 subject.

3.1 The importance of technology in mathematics class

Table 1
The feedback on the importance of technology in mathematics class

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Technology is an important tool in learning mathematics	0	0	6	39	45
More mathematics problem can be solved when students can access the technology	0	0	9	36	45
Technology can help students in solving the mathematics problems easier	0	0	4	38	48
Technology such as Geogebra, Desmos, Symbolab, WolframAlpa and so on makes the mathematics learning more fun	0	1	6	30	53
Technology enables us to learn or achieve results quicker and saves time	0	1	3	33	53
Technology should only be used to check work once the mathematics problem has been solved on paper.	1	4	20	32	33
Using a technology in learning mathematics will remove some learning opportunities for students.	5	22	36	17	10
Smart search engines make it easier to find information than poring over reference books in a library.	0	2	12	39	37
Using a technology can improve the learning and teaching method	0	0	7	44	39
By using a technology, students can visualize the mathematics concepts and make out your own meaning	0	1	8	48	33
Using technology in class makes you feel comfortable	0	1	14	43	32
Using technology in class will make you learn independently	1	1	22	40	26

Tables 1 and 2 show the feedback on the importance of technology in mathematics class and the percentage of the feedback on the importance of technology in mathematics class, respectively. From the Tables 1 and 2, it is observed that majority students agree that the technology is very important tools in learning mathematics. More mathematics can be solved when the students can access the technology such as Geogebra, Desmos, Symbolab and WolframAlpa. From the solution provided by these technologies, the students can observe and learn the steps on solving the mathematics problems. Students agreed that these technology makes the mathematics learning more fun, achieve results quicker and saves time. From the results, although the students use the technology in learning mathematics, majority agreed that they should solved the problem on the paper first and once done, they can compare and check their working using technology.

Table 2
The percentage on the feedback of the importance of technology in mathematics class

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Technology is an important tool in learning mathematics	0	0	6.6667	43.333	50
More mathematics problem can be solved when students can access the technology	0	0	10	40	50
Technology can help students in solving the mathematics problems easier	0	0	4.4444	42.222	53.333
Technology such as Geogebra, Desmos, Symbolab, WolframAlpa and so on makes the mathematics learning more fun	0	1.1111	6.6667	33.333	58.889
Technology enables us to learn or achieve results quicker and saves time	0	1.1111	3.3333	36.667	58.889
Technology should only be used to check work once the mathematics problem has been solved on paper.	1.1111	4.4444	22.222	35.556	36.667
Using a technology in learning mathematics will remove some learning opportunities for students.	5.5556	24.444	40	18.889	11.111
Smart search engines make it easier to find information than poring over reference books in a library.	0	2.2222	13.333	43.333	41.111
Using a technology can improve the learning and teaching method	0	0	7.7778	48.889	43.333
By using a technology, students can visualize the mathematics concepts and make out your own meaning	0	1.1111	8.8889	53.333	36.667
Using technology in class makes you feel comfortable	0	1.1111	15.556	47.778	35.556
Using technology in class will make you learn independently	1.1111	1.1111	24.444	44.444	28.889

Students also did not agree that the using technology in learning mathematics will remove some learning opportunities. It is can be observed that, by using the technology, students can learn better the mathematics' skills. Majority of the students agreed that the smart search engines make it easier to find information than poring over reference books in a library. Using a technology can improve the learning and teaching method, students can visualize the mathematics concepts and make out your own meaning, makes students feel comfortable and learn independently in order to build the lifelong learning generic skills among the students. Visual learning has an important role in learning, applied in the form of audiovisual media [7].

3.2 The effect of technology on the students' attitude and achievement

Tables 3 and 4 exhibit the feedback on the effect of technology on the students' attitude and achievement, and the percentage of the feedback on the effect of technology on the students' attitude and achievement, respectively. From the Tables 3 and 4, it is observed that majority students agree that by using technology in learning mathematics will improve students' mathematics' skills and disagree that by using technology in learning mathematics will cause students to lose their mathematics' skills. Students can understand mathematics better if they could use technology in learning mathematics. From the observation, majority students chose neutral to the feedback of the students can understand mathematics better if they used pen/pencil and paper compared to

ipad/laptop/handphone/digital platform. From the results, the effect of using technology improves the students' positive attitude such as increase their motivation, be more confidence, interest, collaboration and interaction with the educators and their peer. From the observation, majority students chose neutrally if they usage of technology can make the students become lazy.

Table 3
The feedback on the effect of technology on the students' attitude and achievement

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Using technology in learning mathematics will improve students' mathematics' skills	0	2	23	39	26
Using technology in learning mathematics will cause students to lose their mathematics' skills	8	34	25	16	7
Students can understand mathematics better if they could use technology in learning mathematics	0	1	22	44	23
Students can understand mathematics better if they used pen/pencil and paper compared to ipad/laptop/handphone/digital platform	6	5	33	24	22
Students will be more motivated in learning mathematics when they use technology	0	4	29	35	22
Students will be more confidence in learning mathematics when they use technology	0	0	26	37	27
Students rely on technology too much when solving problems.	3	9	34	26	18
Using technology in learning mathematics will increase students' interest in learning mathematics	1	1	16	38	34
Technology can increase students' collaboration	0	3	34	31	22
Technology can increase students' collaboration with educators/lecturers and peer in the learning process.	0	2	29	34	25
The advancement of technology is making the student lazy	9	22	34	13	12
Technology can increase students' interaction with educators/lecturers and peer in the learning process.	1	3	28	35	23

Table 4
The percentage of the feedback on the effect of technology on the students' attitude and achievement

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Using technology in learning mathematics will improve students' mathematics' skills	0	2.2222	25.556	43.333	28.889
Using technology in learning mathematics will cause students to lose their mathematics' skills	8.8889	37.778	27.778	17.778	7.7778
Students can understand mathematics better if they could use technology in learning mathematics	0	1.1111	24.444	48.889	25.556
Students can understand mathematics better if they used pen/pencil and paper compared to ipad/laptop/handphone/digital platform	6.6667	5.5556	36.667	26.667	24.444
Students will be more motivated in learning mathematics when they use technology	0	4.4444	32.222	38.889	24.444
Students will be more confidence in learning mathematics when they use technology	0	0	28.889	41.111	30
Students rely on technology too much when solving problems.	3.3333	10	37.778	28.889	20

Using technology in learning mathematics will increase students' interest in learning mathematics	1.1111	1.1111	17.778	42.222	37.778
Technology can increase students' collaboration	0	3.3333	37.778	34.444	24.444
Technology can increase students' collaboration with educators/lecturers and peer in the learning process.	0	2.2222	32.222	37.778	27.778
The advancement of technology is making the student lazy	10	24.444	37.778	14.444	13.333
Technology can increase students' interaction with educators/lecturers and peer in the learning process.	1.1111	3.3333	31.111	38.889	25.556

4. Conclusions

In general, technology makes the teaching and learning easier and more comfortable with easy to access information and provide fun opportunities. In addition, the technology can improve educators' instruction, teaching method, productivity and efficiency of teaching. Majority students agreed that the technology is very important in learning mathematics to make them more fun, motivated, confidences and learn independently. In general, the development of our country is strongly connected with the growth of the development in technology. Nowadays, there are so many applications and websites that has been developed to make easier for student to learn mathematics. However, the students agreed that they still will use paper to work out the problem and use the technology to compare and check their answer. Thus, it is concluded that the usage of technology in learning mathematics can be applied in class to develop the innovation and future ready learning and education. It also enforces students to develop essential 21st-century skills.

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