Advances in Social Science, Education and Humanities Research, volume 513
4th Sriwijaya University Learning and Education International Conference (SULE-IC 2020)

Mathematics Teachers in Using Technology: Is It as Expected?

Febrian Febrian*, Puji Astuti

Mathematics Education Department, Universitas Maritim Raja Ali Haji
*Corresponding author Email: febrian@umrah.ac.id

ABSTRACT
This research was conducted to find information about the use of technology by Mathematics teachers in learning and how the didactic form of technology applied by the teachers. Teachers who are in group of the Musyawarah Guru Mata Pelajaran (MGMP) of mathematics at the senior high school in Bintan Regency were the research subjects. To be able to find this information, data was collected by using questionnaires and interviews in the form of a Focus Group Discussion (FGD). The data collected were analyzed descriptively and qualitatively with data reduction techniques, data presentation, and drawing conclusions. Triangulation was then carried out to obtain a holistic picture of the information found. Through this research, it was found that the use of technology in mathematics learning is still very limited due to the consideration of its selection and limited forms of use as well. Furthermore, the consideration of choosing the right software in learning in relation to mathematics content is still very limited. Some limitations in understanding math skills makes teacher hard to distinguish the differences between mathematical work and math skills. Meanwhile, in didactic use of technology, almost all teachers do not understand the third didactic aspect due to a weakness in understanding the definition of mathematical concepts, providing examples of software and how the software is able to accommodate concept development. Some of these things occur because between one and the other are still problems so that teachers cannot build a didactic understanding of the third technology.

Keywords: *Technology, Mathematics Learning, Didactic Use of Technology.*

1. INTRODUCTION

The industrial revolution 4.0 which is marked by the development of digitalization and automation technology has brought many changes in various aspects of human life, especially in the field of education [1]. The existence of these technological developments is able to touch the thoughts of a number of education administrators so that a number of efforts to integrate technology in the learning process to achieve certain instructional goals have begun to be implemented. This is becoming increasingly real considering the practicality and attractiveness aspects that the developing technology product can offer.

A number of attempts in the form of using certain technological tools have been initiated by teachers in teaching certain topics such as Mathematics. Among them is through the use of Android-based software and applications that are easily accessible by a number of educational administrators such as teachers to the use of an online learning environment or what is often known as e-learning which is able to bring teachers and students in interactive and interesting non-spatial learning without space limitations and time.

To be able to keep up with the flow of technological developments and how their existence can affect education and the learning process, each educational organizer must be able to have a good understanding of existing technology, how to use and integrate it in the learning process for specific purposes. This is in line with the demands of the government where teachers are able to create technology-based learning in the era of the industrial revolution 4.0.

However, in relation to mathematics subjects, the use of technology in the learning process should begin with an understanding of mathematics as a field of science that has abstract and coherent and structured objects [2]. A teacher must understand mathematics material and be able to break it down into four basic objects such as facts, concepts, procedures, and principles [2] which are related to one another which,

when fully understood by the teacher, can make them think about how to do it, to teach mathematics itself to students well. Mastery of these four abstract mathematical objects is a determining factor in the success of understanding mathematics and its structure [3].

However, if this ability is followed by an understanding of technology and how to integrate it in the mathematics learning process, then an effective and meaningful mathematics learning process can be achieved by students and teachers [4]. This is reinforced by a number of studies that have been studied by [5] where technology that is integrated in the learning process is able to provide good results so that the use of technology in the learning process is widely recognized and globally.

In addition, a mathematics teacher should be able to see the didactic function of technology in the learning process. There are three didactic functions of technology according to [6]. First, technology for doing mathematics, where technology can play a role as a medium that enables students to do mathematical activities. The technology function can be a user assistant in carrying out calculation activities like calculators and the like. Second, technology for practicing skills, where technology is able to play a role in honing certain mathematical skills of students. Third, technology for developing conceptual understanding, where technology is able to facilitate the development of students' mathematical concepts.

With regard to technology issues in learning as an effort to balance technological advances in the era of the industrial revolution 4.0 and considering the theoretical aspects of the use of technology in mathematics learning, it is necessary to investigate the real situation that occurs among Mathematics teachers. Teachers who are in group of the Musyawarah Guru Mata Pelajaran (MGMP) at the high school level of Bintan Regency, Kepulauan Riau are research subjects that are studied in relation to technology and its integration in mathematics learning. Until now, there has been no study involving the teacher from Bintan in relation to technology issues and their use.

The search will be carried out in two domains. First, how do they use the technology? Second, the teacher's didactic understanding of technology when using technology in mathematics learning. It is hoped that with this search, information can be generated regarding educational understanding of technology and its didactic function.

2. METHOD

2.1. Research design

This study is a descriptive qualitative research. This research consists of several stages as follows: determination of research focus, determining research settings and subjects, data collection, data processing, data analysis, and drawing conclusions.

2.2. Subject

The research was conducted in Bintan Regency in August 2020 which involved a number of 8 Mathematics teachers who are in group of the Musyawarah Guru Mata Pelajaran (MGMP) in the senior high school (SMA) including those from SMA Negeri 1 Bintan Pesisir, SMA Negeri 1 Toapaya, SMA Negeri 1 Bintan Timur, SMA Negeri 1 Bintan Utara, SMA Negeri 1 Teluk Bintan, and MAN Tanjungpinang. Due to the COVID-19 pandemic, data collection was carried out face-to-face online.

2.3. Data Collection and Instrument

The data collected was qualitative in the form of arguments or explanations about teacher responses regarding technological developments in relation to Mathematics learning and how teachers use current technology in Mathematics learning; and the types of didactic uses of the technology they undertake. To collect this information, two data collection techniques were used. First, data was collected using a questionnaire technique. The instrument used was in the form of an online questionnaire on the Google Form platform which contains questions about technology and its integration in the learning process. This technique was carried out at the beginning of the activity.

Second, data was collected using direct interview techniques in the form of Focus Group Discussion (FGD) which was conducted online using Zoom. FGD is defined as a systematic data collection technique which is interpreted simply as a discussion which is organized systematically and directed on a particular issue or problem [7], [8]. As a data collection technique, FGD relies on obtaining information from informants through a series of interactions in a group that focuses on carrying out specific discussions [9], [10]. This technique was carried out with the help of a Zoom video recorder to obtain a more holistic data that can be accessed continuously to increase the authenticity of the data.

2.4. Analysis

Data from both techniques were collected for analysis. Qualitative descriptive data analysis techniques were used with the following steps: data reduction, data presentation, and drawing conclusions. The results of the analysis of the two data were

triangulated to obtain more in-depth/ representative results regarding the existing conditions. Furthermore, descriptions were presented descriptively in order to answer research questions.

3. RESULTS AND DISCUSSION

Two introductory questions were asked during the research regarding the meaning of integrating technology and why using it helps mathematics learning. In general, through two data collection techniques, almost all teachers provided a definition by conveying the sentence "integrating technology in mathematics learning" in other ways such as "using / applying / involving technology in mathematics learning". From this statement, without teachers giving further explanation, it appears that there was a sense where the understanding of technology integration in learning seems superficial.

The following explanation is about the perception of why technology can help learning mathematics. As many as 62.5% of teachers responded by highlighting the convenience aspects offered by technology in the learning process but with general explanations. From the statements conveyed, it is still clear that the teacher's understanding was still on surface and cliche. Meanwhile, 37.5% considered that the use of technology could help students understand abstract mathematical objects without giving specific examples.

The two introductory questions provided an initial description of how the teacher will respond to the two core research questions. The first question is related to how the technology they choose is used in mathematics learning. In order to be able to collect information in an effort to answer this question, a number of assistive questions were derived such as the experience of using technology in teaching, what software or applications they use, and concrete examples of its use.

The results showed that 100% of teachers stated that they had used technology in the learning process. This is quite encouraging considering that using technology is a form of professionalism for a teacher in teaching, especially in the midst of the COVID-19 pandemic, which forces teachers to make adjustments to the concept of distance learning which really requires the ability or mastery of technology.

Regarding the software or application used, information is obtained that Geogebra was the dominant software used by teachers with a percentage of appearance in a response of 62.5% with the argument that the software is able to help display the visualization of mathematical objects and help in creating them. Meanwhile, other software or applications include Calibri 3D, Microsoft Excel, and Microsoft Powerpoint without a significant selection explanation.

In this regard, a number of forms of using the software and applications are described as follows. A total of 32.5% of teachers did not provide clear examples of the use of this technology in learning, making it difficult to conclude even with the triangulation of techniques and data on interviews. The explanation was simple but not well elaborated, for example, such as the use of videos to teach material on three dimensional objects, the use of Geogebra to teach transformation geometry. Other response was using Microsoft Powerpoint to present presentation materials in a more effective and less boring by using video in it. It can be concluded that the examples given are more towards the aspect of interest than the learning process which is the main point of search in this study. There was only one teacher whose response was clear and could be assessed, namely the use of Geogebra to make graphs.

These three derivative questions can provide an overview of how teachers use technology in mathematics learning. First, even though all teachers have been involved in integrating technology in learning, its use was still very limited due to its limited selection and form of use. It appears in this case that almost every teacher provided no more than two common examples of applications or software used in Mathematics learning. This was further supported by the dominance of a software such as Geogebra in learning mathematics.

Furthermore, the consideration of choosing the right software in learning in relation to mathematics content was still very limited. In general, with commonly known software such as Geogebra and Calibri 3D where the mathematical domain of Geometry dominates the usage examples, only a few were able to provide a precise and clear explanation of how the software is able to help mathematics learning. Assumptions then develop about how the teacher will respond to further research questions.

The second question emphasizes the search for teachers' understanding of the didactic aspects of technology in mathematics learning which includes understanding of the use of technology to help mathematical work, mathematical skills, and assist in concept development. In order to obtain actual information, questions were addressed to the teachers involved using questionnaire techniques and interviews through FGD. The question was related to providing examples of each didactic aspect of technology.

Regarding the first didactic aspect, helping mathematical work or doing mathematics, as many as 37.5% of teachers gave irrelevant responses from research reviews, one of which was by providing the use of technology as a technology-based evaluation tool to conduct learning assessments which did not meet the desired criteria to be a correct answer. There are 37.5%

of other teachers who stated that the use of technology can facilitate calculations using a calculator and make it easier for students to see the graphical form of a function with Geogebra software. Meanwhile, 25% of them stated that they did mathematics such as determining the area for solving a system of two-variable linear equations and also in drawing graphs of functions.

Meanwhile, the second didactic aspect is helping to train math skills. There are 12.5% teachers who couldnot provide examples of usage. Meanwhile, 25% of them did not provide answers that met the correct criteria because they were not relevant to the questions given. There are 62.5% of other teachers who gave examples of using Geogebra to draw geometric shapes.

The third didactic aspect is to help develop mathematical concepts. There were 12.5% of teachers who did not provide answers. Meanwhile, 62.5% of them gave responses that did not meet the criteria for arguments that were correct, some examples were a just a simply-written Geogebra and students' understanding of the three dimensional objects. It was said not true, because it did not provide answers that are relevant to the questions given. Only one or about 12.5% of teachers provided examples on the quadratic function graph where the use of software can provide a variety of graphical positions on a flat plane that can provoke discussion on several concepts such as open up and down characters of a graph, intersection at two same or different points, etc seen from the coefficient and its square function constant.

From the description of the results related to the two research questions above, a discussion was carried out. In the first didactic aspect of technology where technology can help mathematical work, only 37.5% responded correctly where the teacher gave examples of tools and their use correctly. First, a calculator was a common example where students can use it to find the result of a calculation without having to understand the calculation process. Likewise, with the use of Geogebra software which can directly provide visuals of a function on a flat plane without having to understand why the graphic form is just like that. This is in line with the example described by [11] where Microsoft Excel can perform calculations without having to know how the calculations are obtained. Thus this shows that a small proportion of teachers have understood the first didactic aspects of technology as a tool in supporting mathematical activities [4]. Meanwhile, 25% gave examples that led to the use of technology in practicing mathematical skills through the examples that were not elaborative.

Regarding the second didactic aspect, [4] explains that technology plays a role in facilitating students to develop and hone mathematical skills. The dominant 62.5% gave examples of Geogebra but in limited explanations such as its use to draw geometric shapes. There was no further information from the teacher in elaborating the statement. This shows the limitations of teachers in understanding math skills. Even if it is related to the first aspect, some teachers as much as 25% couldnot clearly distinguish mathematical work and math skills. Thus, giving examples was still inaccurate because the differences between mathematical work and math skills were interpreted vaguely by a number of teachers. This should be understandable considering that these skills are closely related to algorithms, a procedure that is carried out routinely in mathematical problems such as working on solutions to systems of two-variable linear equations using Geogebra [11]. Skills are defined as a series of algorithms for finding solutions to routine mathematical problems.

And finally only one in 8 teachers was able to give the correct response to questions related to examples of using technology to help develop mathematical concepts. In this case the software provided with examples of its use in the material to build mathematical concepts has been conveyed correctly. This indicates that the teacher understood the meaning of the concept as an abstract mathematical idea and at the same time understands the software and its use to build the concept. Other teachers were not even able to provide examples of mathematical concepts and how they can be developed with the help of technology. In other words, the teacher did not understand how the relevant technology is used for this purpose. Considering that this group of teachers was the same subject in the study of understanding abstract mathematical objects by [12], it is clear that understanding of the didactic aspects of technology cannot be built because of problems in interpreting mathematical concepts and the weakness of providing software examples and their use. The existence of this inability presumably made the teacher unable to relate one another to be an example of appropriate and correct elaborative use.

4. CONCLUSION

Finally, the results and discussion of the two research questions provide an overview of the real conditions of high school mathematics teachers who are in group of the Musyawarah Guru Mata Pelajaran (MGMP) of Bintan Regency in using technology in learning and understanding the didactic aspects of technology. First, related to how they use the technology, information is obtained that even though all the teachers have been involved in integrating technology in learning, its use is still very limited due to the consideration of its selection and limited forms of use as well. Furthermore, the consideration of choosing the right software in learning in relation to mathematics content is still very limited. Regarding the didactic understanding of technology in mathematics learning,

information is obtained that less than 50% of teachers understand the use of technology to help mathematical work with examples and the right forms of use. Regarding the aspect of using technology to hone mathematical skills, 62.5% dominantly gave an example of one software but in a limited explanation such as its use to paint geometric shapes. There was no further information from the teacher in elaborating the statement. This shows the limitations of teachers in understanding math skills. Even if it is related to the first aspect, some teachers as much as 25% cannot clearly distinguish mathematical work and math skills. Thus, giving examples is still inaccurate because the differences between mathematical work and math skills are interpreted vaguely by a number of teachers.

Finally, the didactic aspect of technology in terms of building conceptual understanding can only be understood by one teacher by giving examples and using and using mathematical concepts appropriately. Almost all teachers do not understand the third didactic aspect due to a weakness in understanding the definition of mathematical concepts, providing examples of software and how the software is able to accommodate concept development. Some of these things occur because between one and the other are still problems so that teachers cannot build a didactic understanding of the third technology. Thus, on top of this situation, it can be concluded that the use of technology in learning and didactic understanding of technology of teachers who are in group of the Musyawarah Guru Mata Pelajaran (MGMP) of Bintan Regency is still far from the ideal situation expected of a mathematics educator.

REFERENCES

[1] S. Putrawangsa, U. Hasanah, Integrasi teknologi digital dalam pembelajaran di era industri 4.0. *Jurnal Tatsqif*, vol. 16 no. 1, 2018. pp. 42–54.

[2] A. Mahmudi, Pengembangan pembelajaran matematika, 2009, [Online] *http://staff. Uny. Ac. id/sites/default/files/tmp/Pengembangan% 20Pemb*

[3] P. Astuti, F. Febrian, Diseminasi online multimedia pembelajaran matematika yang dikembangkan menggunakan videoscribe, *Jurnal Anugerah: Jurnal Pengabdian Kepada Masyarakat Bidang Keguruan dan Ilmu Pendidikan*, vol. 1 no. 1, 2019, pp. 19–24.

[4] P. Drijvers, Secondary algebra education. Springer. 2010.

[5] A. Bennison, M. Goos, Learning to teach mathematics with technology: A survey of professional development needs, experiences and impacts, *Mathematics Education Research Journal*, vol. 22 no. 1, 2010, pp. 31–56.

[6] P. Drijvers, P. Boon, Van Reeuwijk, Algebra and technology, in: *P. Drijvers (Ed.), Secondary algebra education.* Revisiting topics and themes and exploring the unknown (pp. 179-202). Rotterdam, The Netherlands: Sense. 2010.

[7] I. Irwanto, Focus group discussion: A simple manual, Yayasan Obor. 2006.

[8] S. Siregar, Meningkatkan kemampuan guru dalam menerapkan pembelajaran kontekstual melalui Focus Group Discussion FGD)DI SMK Negeri 1 Sirandorung Tahun Pelajaran 2017/2018," *NUSANTARA: Jurnal Ilmu Pengetahuan Sosial, vol. 5 no.* 1, 2018, pp. 14–19.

[9] N.R. Lailly, A.W. Wisudawati, Analisis soal tipe Higher Order Thinking Skill (HOTS) dalam soal UN kimia SMA Rayon B Tahun 2012/2013, *Jurnal Kaunia*, vol. 11 no. 1, 2015, pp. 27–39.

[10] Y. Afiyanti, Focus group discussion (diskusi kelompok terfokus) sebagai metode pengumpulan data penelitian kualitatif," *Jurnal Keperawatan Indonesia*, vol. 12 no. 1, 2008, pp. 58–62.

[11] A. Jupri, Peran teknologi dalam pembelajaran matematika dengan pendekatan matematika realistik, in: *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika*, vol. 1, 2018, pp. 303–314.

[12] P. Astuti, F. Febrian, Pemahaman objek abstrak matematika guru sekolah menengah atas di kabupaten bintan, *Jurnal Anugerah: Jurnal Pengabdian Kepada Masyarakat Bidang Keguruan dan Ilmu Pendidikan*, vol. *2* no. 1, 2020, pp. 13–18.