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The Effect of Digital Learning on Student Mathematics Achievement at Junior High School

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Abstract

During the industrial revolution 4.0, technology to help students learn mathematics was developed, one of which is a digital learning platform. The presence of startup companies that market digital learning platforms aims to improve students' achievement. However, some people think the digital learning platforms at this time are considered as a means to seek profit only because currently, the number of digital learning platforms is growing rapidly and vastly. This study aimed to determine the effect of digital learning on student mathematics achievement and the correlation between the level of use of digital learning platforms and mathematics achievement. This study used a quantitative approach with a correlation research type. The population in this study was all students of grade 9 of one junior high school in Banda Aceh, Indonesia, total of 155 students. The instruments were a digital learning platforms usage level questionnaire and student mathematics achievement score. The data analysis used in this study was the chi-squared test and contingency coefficient. The results of the analysis obtained from this study are there is an effect of digital learning on students' mathematics achievement, and the correlation between level of use of digital learning platforms and mathematics achievement was very high. This study is expected to provide information as a basis for consideration, support, and guidance for students to utilize learning resources on digital learning platforms that have been widely available so that improve mathematics achievement.

Keywords: Digital Learning, Learning Resources, Mathematics Achievement, Platform

Introduction

Entering the fourth industrial revolution or known as the Industrial Revolution 4.0 is marked by the emergence of technological breakthroughs in a number of fields, including artificial

intelligence, nanotechnology, quantum computing, biotechnology, Internet of Things and big data. At a fundamental level, industry 4.0 can bring together the digital and physical worlds and offer new opportunities to collect and use information. Digital-based education transformation with a connectivity system in it can provide business opportunities for educational institutions to take advantage of informal education system opportunities easily (Fantini & Tamba, 2020). Sitopu et al. (2022) explained that the growth and development of various types of digital learning are very fast and constantly changing. Digital learning has evolved to include a variety of formal course-based e-learning packages and products, along with a wide variety of complementary or alternative techniques, such as knowledge sharing or links to resources via social media sites and participating in online lectures, webinars, podcasts, or blogs.

Digital learning is learning that uses digital tools or technology in the teaching and learning process. Munir (2017) suggests that digital learning is a system that can facilitate students to learn broader, more and more varied. Learning systems using digital media and resources have the potential to hold more students with different conditions and backgrounds (Zamjani et al., 2020). The facilities provided by the system make it easy for students to study anywhere and anytime without being limited by space, time, or distance. The presentation of learning material is not only verbal but more diverse such as audio, motion, visual, and text. Access to learning resources can be obtained broader with digital learning, making it easier for students to access and obtain information (Munir, 2017)

Sitopu et al. (2022) explained the potential for communication access, digital learning allows students to access various information related to the content they learn, such as social and economic developments. Culture, politics, science, and technology are presented by various sources. Students can also access various references, both in the form of research results, as well as articles and studies in various fields including mathematics. Digital learning paves the way for greater efficiency and collaborative learning, the Internet and World Wide Web have expanded the flow of information and communication exponentially. Pujiriyanto (2019) explains that every second on "big data“, flow a large amount of data that teachers and students can benefit from using the Internet network. Big data is a potential learning resource derived from complex and large-scale data sets. Example of big data application is massive open online course (MOOC) namely, a learning system that is marketed openly, on a large scale with online implementation.

Digital learning using platforms is easily accessible as some of platforms are free from any cost and really helps students in learning. Harususilo (2019) explains that growth of digital learning platforms in Indonesia is the fastest in the world, with a percentage of 25% annually. According to Matschke et al. (2014), based on a survey of the success factors of digital learning and teaching technology, the factor that is the most important for consideration is the availability of content, high quality, and easy to use. The most important factors of technology are its usefulness as a place to store meaningful information and its ease of use.

Startup businesses typically promote digital learning systems to schools. According to Fantini and Tamba (2020), many online course providers provide instruction and the opportunity to learn new skills through websites like *Ruang Guru*, *BahasoTalk*, and *Kelas.com*, which provide online courses to anyone who signs up., Indonesia's e-learning market demand is higher than 25% annually, even more than average for Southeast Asia 17.3%. The e-learning market is expected to grow by 12.2 billion US dollars in 2017, providing potential opportunities for Indonesia, China, America, India, and Brazil. Additionally in 2019, Indonesia will be the top 5 buyers of mobile learning products and services worldwide.

According to Fantini and Tamba (2020), social media platforms like *Instagram*, *Facebook*, and *Youtube* are increasingly being used to provide learning opportunities without the need for in-person interactions. This is particularly dangerous for the continued survival of old course spaces because of this increasingly aggressive promotion. It becomes easier for everyone to access, and more trainees are enrolling in distance learning online courses.

The startup industry selling digital learning platforms is present with the intention of raising student achievement. Student achievement is changes in students' cognitive capabilities, emotional skills or interests, and gross and psychomotor skills all contribute to their academic success (Afandi et al., 2013). Student accomplishments are the results of learning activities. Student achievement can be used to measure educational success. According to Tasya & Abadi (2019), as learning activities are a process, everything linked to student achievement is tied to learning activities. According to Nurrita (2018), student achievement can be achieved when the learning process involves the completion of cognitive, emotional, and psychomotor tasks. Zamjani et al. (2020) stated that, the presence of startup companies who market digital learning platforms aims to improve students' achievement. However, some people think the digital learning platforms at this time are considered as a means to seek profit only because currently the number of digital learning platforms are growing rapidly and vastly.

Based on the above description, the research questions are to determine the effect of digital learning on students' mathematics achievement; and the correlation between the level of use of digital learning platforms and mathematics achievement so that it can be used as a guide for students in determining whether or not they will use these platforms to learn mathematics independently.

Methods

This study used a quantitative approach with a correlation research type. Sugiyono (2009) explained that data analysis in quantitative research is a step that comes after gathering data from all respondents or other data sources. The purpose of a correlation study is to determine whether there is a relationship between two variables and how strong and significant it is (Arikunto, 2007). This study used a correlation research type because it aimed to find out whether there is an effect between variable (X) as the usage level of digital learning platforms and variable (Y) as data on students' mathematics achievement. The population in this study

was 9th grade students in one of the junior high schools in Banda Aceh, totaling 155 students. The instruments were a digital learning platforms usage level questionnaire and students' mathematics achievement.

Techniques used for data collection were by distributing a digital learning platforms usage level questionnaire using a Likert scale. The questionnaire was a closed questionnaire. The questionnaire was adapted from Rahman (2017). Student learning achievement data obtained from documentation of student mathematics learning achievement scores obtained from the teacher's grade book. Data from digital learning platforms usage level questionnaires and students' mathematics achievement scores were analyzed using the chi-square test and contingency coefficient. Data on the usage level of digital learning platforms were classified according to the categories presented in Table 1.

Table 1. Categories of Variable Score Description

No.	Score Criteria	Category of Usage Level of Platforms
1.	$x \leq \mu - 1{,}5\ \sigma$	Very low
2.	$\mu - 0{,}5\ \sigma < x \leq \mu - 0{,}5\ \sigma$	Low
3.	$\mu - 0{,}5\ \sigma < x \leq \mu + 0{,}5\ \sigma$	Moderate
4.	$\mu + 0{,}5\ \sigma < x \leq \mu + 1{,}5\ \sigma$	High
5.	$x > \mu + 1{,}5\ \sigma$	Very High

Source : Rizka (2021). *Pengaruh media sosial terhadap hasil belajar matematika siswa di Sma negeri 14 iskandar muda banda aceh* [Unpublished Skripsi]. Universitas Syiah Kuala.

Data on students' mathematics achievement were classified according to the categories presented in Table 2.

Table 2. Categories of Students' Achievement

Score	Qualification
$85 \leq y \leq 100$	Very good (Excellent)
$70 \leq y < 85$	Good
$55 \leq y < 70$	Moderate
$40 \leq y < 55$	Bad
$y < 40$	Poor

Source : Arikunto (2007). *Prosedur penelitian suatu pendekatan praktek*. Rineka Cipta.

The hypotheses tested in this study are:

H_0: There is no effect of digital learning on students' mathematics achievement at junior high school.

H_1: There is an effect of digital learning on students' mathematics achievement at junior high school.

To test these hypotheses, the chi-square test and contingency coefficient were used. According to Sudjana (2005), chi-squared has many benefits in solving various problems. One of these is to conduct a separate experiment comparing two variables from the B x K contingency list. Chi-squared independent tests can examine affiliations, correlations, or connections between two variables. Chi squared can be used to determine whether there is a relationship between various variables as well as whether certain levels or values of one

variable have an effect on other variables. According to Siregar (2009), the contingency coefficient is a method used to measure the closeness of the relationship (correlation) between two variables, both of which are of the category data type. The correlation test has a close relationship with the chi-square test used in independent testing between two variables, where the contingency coefficient is used in the chi-square formula (Sugiyono, 2009). The chi-square test was carried out with the aim of determining whether or not there is an effect of digital learning on students' mathematics achievement, and then it was continued with a contingency coefficient test with the aim of determining how big the correlation is between the usage level of digital learning platforms and students' mathematics achievement.

Results and Discussion

Based on the data obtained from the digital learning platforms usage level questionnaire, the following is the response to filling out the digital learning platforms usage level questionnaire.

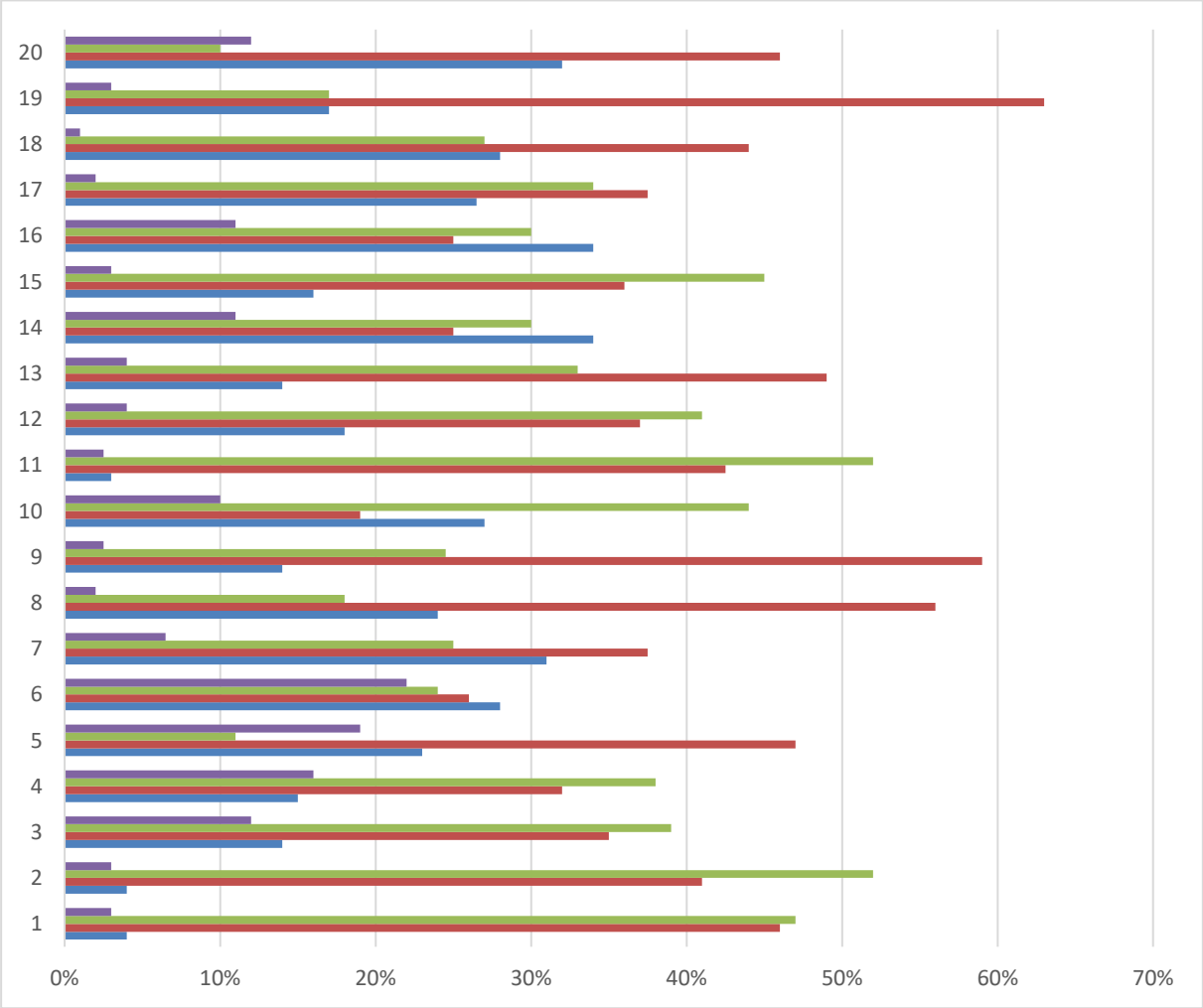

Figure 1. Student responses to the digital learning platforms usage level questionnaire

In Figure 1, the purple bar chart represents the number of times students choose scale 4, the green bar represents the number of times students choose scale 3, the red bar represents the number of times students choose scale 2, and the blue bar represents the number of times

students choose scale 1 in each question. Figure 1 explains the percentage frequency of the number of students answering questions. The questions in the questionnaire are presented in Table 3.

Table 3. Questions of the digital learning platforms usage level questionnaire

Number	Question
1	I access digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) while studying mathematics only
2	I get information about mathematics through digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others),
3	I discuss mathematics lessons through digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others)
4	My insight about mathematics lessons increases when I use digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others)
5	Digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) as supporting means for mathematics learning really help me
6	Digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) make it easier for me to discuss mathematics with friends
7	Digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) help me with my assignments/homework
8	Face-to-face mathematics learning more difficult than learn by using digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others)
9	Every day, I use digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) to study mathematics
10	I prefer learning using digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) to face-to-face learning
11	I open digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) even though I am not studying mathematics
12	I prefer studying mathematics using digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) than mathematics text books
13	I prefer studying mathematics using digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) than studying with friends
14	Using digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) as means for mathematics learning makes me unfocused in studying
15	I don’t like using digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) to study mathematics
16	Digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) help me reduce nervousness when studying mathematics
17	My time spent using digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) to send messages to my friends is longer than my time spent studying mathematics

18	Both students and the teacher use digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) to share information about mathematics learning material and/or assignments and homework
19	I check or open digital learning platforms (Youtube, Brainly, Quipper, Ruang Guru, Zenius, and others) for more than 5 times a day
20	I use digital learning platforms (without using other learning resources) to study mathematics

Data on students' mathematics achievement are presented in Figure 2 that explains the percentage frequency of the scores of student mathematics achievement. After the data is collected and presented in Figure 1 and Figure 2, the normality test was conducted. The normality test in this study used Chi-squared, according to Sugiyono (2009). Based on testing the normality of student response data on the use of digital learning platforms, it was obtained $\mathcal{X}^2$ count on the normality test of 31.47. $\mathcal{X}^2$ table is 11.07. Therefore, $\mathcal{X}^2$ count > $\mathcal{X}^2$ table meaning that the data were not normally distributed. In testing the normality of students' achievement data, it was obtained $\mathcal{X}^2$ count on the normality test of 27.16. $\mathcal{X}^2$ table is 11.07. Therefore, $\mathcal{X}^2$ count > $\mathcal{X}^2$ table meaning that the data were not normally distributed. Thus, a nonparametric statistics test was used.

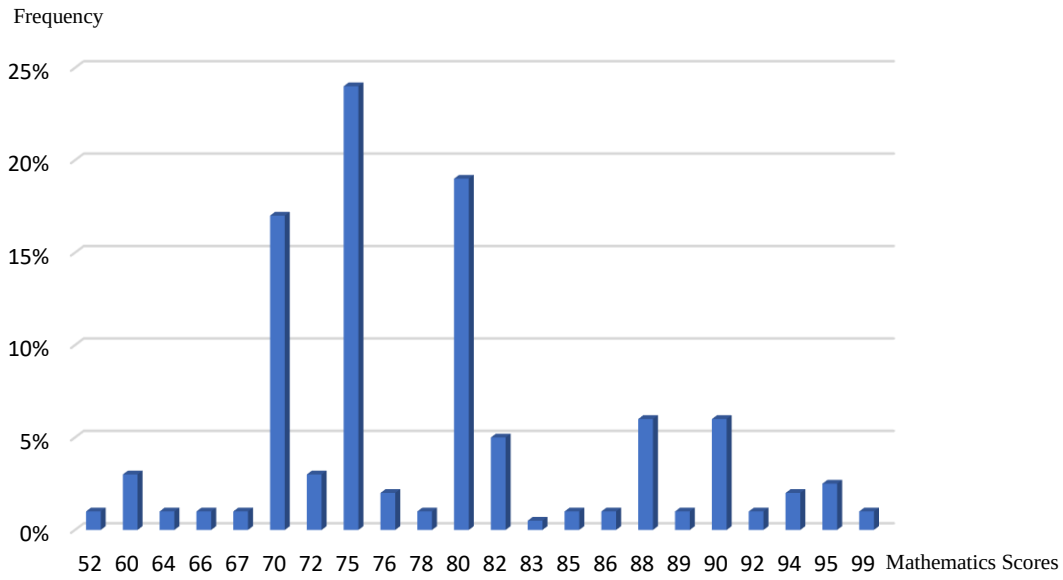

Figure 2. Frequency of Students' Mathematics Achievement

Data on the level of use of digital learning platforms and mathematics achievement were classified into categories as in Table 1. Based on the distribution list of usage levels of digital learning platforms, the average value is 46.03 and a standard deviation of 11.21. Scores of usage levels of digital learning platforms were classified in Table 4.

Table 4. Usage level of digital learning platforms

Score	Qualification/Category	Frequency
$20 \leq y < 31$	Very low	14
$31 \leq y < 42$	Low	37
$42 \leq y < 53$	Moderate	67
$53 \leq y < 64$	High	25
$y \geq 64$	Very high	12

Data on student mathematics achievement were classified into categories in Table 2. Based on the distribution list of mathematics achievement, with an average value of 78.26 and a standard deviation of 8.61. The scores of student mathematics achievement were classified in Table 5.

Table 5. The scores of student mathematics achievement

Score	Qualification/Category	Frequency
$52 \leq y < 61$	Poor	5
$61 \leq y < 70$	Bad	4
$70 \leq y < 79$	Moderate	72
$79 \leq y < 88$	Good	42
$y \geq 88$	Very good (Excellent)	32

Frequency data from Table 4 and Table 5 were entered into Table 6. The data in Table 6 were analyzed to determine the effect of digital learning on students' mathematics achievement with the chi-square test using the B x K contingency list with the chi-square formula according to Sudjana (2005). From the observation frequency and the expectation frequency, after the analysis, it was obtained $\mathcal{X}^2$ count value = 56.22 and $\mathcal{X}^2$ table value = 26.29, therefore $\mathcal{X}^2$ count > $\mathcal{X}^2$ table meaning that H_0 is rejected and H_1 accepted. So, it can be concluded that there is an effect of digital learning on students' mathematics achievement at junior high school.

Table 6. Observation Frequency (O_i) and Expected Frequency (E_i).

Students' mathematics achievement	Usage level of digital learning platforms										Total
	Very low		Low		Moderate		High		Very high		
	O_i	E_i	O_i	E_i	O_i	E_i	O_i	E_i	O_i	E_i	
Poor	2	0.45	0	1.19	2	2.16	1	0.80	0	0.38	5
Bad	2	0.36	0	0.95	0	1.72	1	0.64	1	0.30	4
Moderate	8	6.50	25	17.18	28	31.12	10	11.6	1	5.57	72
Good	2	3.79	5	10.02	26	18.15	8	6.77	1	3.25	42
Very good (Excellent)	0	2.89	7	7.63	11	13.83	5	5.16	9	2.4	32

The contingency coefficient was defined to determine the level of correlation. After being tested with the contingency coefficient, a correlation level of 0.89 was obtained. This shows that there is a significant effect between digital learning and students' mathematics

achievement and usage level of digital learning platforms and students' mathematics achievement have a very high correlation.

Digital technology as learning is also an essential part of everyday life, including complex learning such as Mathematics (Alabdulaziz, 2021). Such studies have proven that multimedia has helped students in mathematics learning, whereas technological innovation has successfully helped students do assignments and introduce impossible material without technology (Rochman & Pertiwi, 2020). According to Abdurrahman (2012), learning methods that are oriented towards traditional approaches such as only placing students as listeners in the teaching and learning process are one of the factors in students' low understanding of mathematical concepts. Students' low understanding of mathematical concepts is one of the factors affecting mathematics achievement (Ardilla & Hartanto, 2017).

Dahlan et al. (2022) explain that learning technology can help students understand and apply technological means in solving difficulties such as their tasks. With the development of electronics in all fields, the learning environment has begun to divide so that students now get various choices that use high levels of innovation and creativity in teaching various sciences, especially mathematics (Kalogiannakis & Papadakis, 2017). Many studies in the field of mathematics teaching technology show that each teacher's perspective on educational technology impacts Students' achievement effectively both during pandemics and other regular times (Adnan, 2020). Technology-based learning is an electronic educational strategy that is easy to do in various places, and there is no time limit like conventional learning methods. Look at the historical background of technology and its general use in several subjects where it depends on the ability of teachers, parents, and experts to provide direction to learning mathematics, which has a very high correlation to success (Rusli et al., 2020).

This study obtained results that were in line with a study conducted by Anisah et al. (2021), Results of the analysis showed that digital learning has a partial effect on achievement, meaning that effective digital learning can improve student achievement. Lin et al. (2017b) revealed that students agreed with the use of digital learning assistance in learning each subject, especially for increasing student learning time, and digital learning indeed can relatively increase learning performance. One study showed that students learn mathematics better when using effective and appropriate technology (Perienen, 2020).

Lin et al. (2017a) explain that the majority of the experimental group (72%) reported that the platform Moodle improved students' achievement, Moodle contains work examples that helped them better understand the work completed in class. Through Moodle, the shy students who never asked questions in normal class were able to ask for and receive feedback from teachers and their classmates. Ahn & Edwin (2018) suggest that a better understanding of how students learn mathematics coupled with an effective platform of mathematical e-learning can enhance meaningful learning of mathematics and make the subject more exciting.

Zamjani et al. (2020), describe that the availability of various (digital learning) platforms will make it easier for parents and students to choose learning platforms that are considered appropriate and according to the student's needs for learning resources, with

learning approaches that are suitable to the students' skills. Platform-based digital learning is also considered to be able to attract student interest and encourage them to enjoy learning activities more. The impact felt by parents after their children use digital learning platforms is that their children's learning achievement and outcomes have increased.

Effective and appropriate digital learning can improve student mathematics achievement. According to Ariningsih et al. (2021), digital learning is a very effective solution at this time because it facilitates teaching and learning activities for students and teachers both offline and online. However, assistance or supervision is needed from parents or teachers because of the openness and freedom of various information that can be obtained on digital media. This is to prevent students from obtaining unhealthy and useless Internet content and being addicted to gadgets. Zamjani et al. (2020) explain that some parents think students' abilities to use the Internet in a directed and healthy way, and digital learning that is widely spread still have negative impacts. This is following Amarulloh et al. (2019) that control of healthy and useful internet content for children has not kept up with the wide range of information that can be obtained from the internet. Students have a high level of addiction to technology. However, in the field of education, students still do not understand the role of digital technology for them. Limited internet Network is a major problem in the development of digital-based learning in Indonesia. This condition was minimized and anticipated by several digital-based learning platforms by providing learning video materials that can be downloaded and used in offline versions, such as on the Quipper, Ruang Guru, and YouTube platforms.

The results of this study are expected to provide information as a basis for consideration, support, and guidance for students to utilize learning resources on digital learning platforms that have been widely available to improve student mathematics achievement. Digital learning has several functions in several mathematics learning activities. Munir (2017) explains that digital learning has three functions in learning activities. The three functions are complementary, substitution, and supplementary. Digital learning can be used by students as an additional, complementary, or substitute for learning mathematics at school, such as in finding mathematics material that is not yet understood, searching for mathematics material that was missed because they were absent during the learning, studying mathematics problems for examinations, searching for mathematics learning videos on platforms, or searching for other alternative sources of additional learning. The presence of digital learning platforms based on open educational resources can be used to support learning. Systematic knowledge and effective mathematics learning will be received by students through the internet network if they have the right and correct concept of its use. Its implementation must still combine with direct learning in the classroom.

Conclusion and recommendations

Based on the results of the study, it can be concluded that there is an effect of digital learning on student mathematics achievement at junior high school and the correlation between level of use of digital learning platforms and mathematics achievement was very high. The

platform in this research is an alternative learning resource for students in addition to learning resources that have been obtained from schools. In this study, digital learning is only limited to digital learning using platforms, so digital learning variables are viewed independently in improving students' mathematics achievement from the use of platforms in digital learning. Technological developments allow continued innovation; the suggestion given as a recommendation for subsequent studies is that researchers can then examine digital learning with other variables that describe other digital learning based on mobile, desktop, or online-based.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been covered completely by the authors.

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