



The Effect of Quizizz and Learning Independence on Mathematics Learning Outcomes

Khasanah*, Anugrah Lestari

Faculty of Teacher Training and Education, Universitas Islam As-Syafi'iyah Jakarta, Indonesia

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*Correspondence Address:

khasanahrcl.mtp@uia.ac.id

Abstract: The purpose of this study was to determine the effect of Quizizz media and independent learning on mathematics learning outcomes on the subject of derivative functions, with worksheet media as the control variable. They rely on an experimental method with the two-way analysis of variance (ANOVA) and the Tukey analysis. The results showed a significant difference where the mathematics learning outcomes of class XI students who were taught using Quizizz media were higher than those taught using worksheet media. There is an interaction of learning media with independent learning on mathematics learning outcomes of class XI students. The mathematics learning outcomes of the eleventh-grade students who have high learning independence and were taught using this media are higher than the learning outcomes of students who were taught using worksheets. This study concludes that there are Quizizz media's effect and learning independence on mathematics learning outcomes based on the analysis results. This study's results have implications for choosing Quizizz media and the relationship between learning media interactions with students' learning independence.

INTRODUCTION

Obstacles in the learning process can sometimes result in unsuccessful learning objectives, such as in mathematics. Some of the obstacles that can hinder students who have low interest in learning mathematics, students' perceptions, media, and models (Rahmawati et al., 2020), lack mathematical problem-solving skills. The results of observations in class XI students in Bandar Lampung, the average learning outcomes are still below the minimum criteria, this is one of the causes because of the lack of mathematical problem-solving abilities of students (Syazali, 2015).

The modern era with better education quality should encourage practical learning activities and learning

outcomes above the minimum mastery criteria. Computer technology and internet networks in mathematics learning are expected to learn mathematics more effectively and bring innovation to the learning process (Nugroho et al., 2017). From the results of observations, several other observations found ineffectiveness innovation in the use of learning devices so that students experience boredom (Hendra & Suparman, 2019). The minimum criteria at school are low because the students' knowledge of prerequisite materials is low. This is important because, for the next topic, students have understood the prerequisite material. However, usually, they do not remember what they have learned before. This means that there is an effect of mastery of prerequisite materials on

students' mathematics learning outcomes (Purnama Putri et al., 2014)

Smartphones have various benefits that can help the teacher design an innovative and attractive learning process, such as Quizizz. It is evident from the research results showing the use of the Quizizz smartphone-based application as a fun learning medium so that it makes students enthusiastic about participating in learning (Wibawa et al., 2019). Findings Wihartanti (2019) shows a significant difference between classes using the smartphone-based Quizizz application compared to classes using conventional models in their learning process (Wihartanti et al., 2019). Mei, Zalika, and Adam (2018) applied the Quizizz during the Arabic language proficiency class. All students were very active in answering questions posed by the researchers and discussing the topic more (Mei et al., 2018).

Quizizz is one of the interactive media that class teachers can apply. This fun learning media that Quizizz has a colorful display, graphics designed in the form of a game, players can choose an avatar. When playing, there is a sound (Mac Namara & Murphy, 2017), which is expected to be wrong. One solution to improve student mathematics learning outcomes. Then the use of Quizizz learning media is compared the results with the use of worksheet media as a control variable in this experimental research. In learning activities, generally, the media used to practice questions are textbooks, student worksheets, modules, etc. Worksheets' primary function is as training and deepening of material (Yaumi, 2018). Student Worksheet is a stimulus or teacher guidance in learning that will be presented in writing. In writing, it is necessary to pay attention to visual media criteria as visual media to attract students' attention (Fannie & Rohati, 2014).

Mei, Zalika, and Adam have not researched have not paid attention to

aspects of student characteristics and different student personalities. Of course, the success of achieving satisfying mathematics learning outcomes depends on the feelings, character, and habits of the students themselves. For example, one aspect that affects students' ability to do math problems correctly is independent learning. Suppose they have low learning independence and less awareness of learning. In that case, they will depend on other people, who will also affect their learning outcomes. Oktavera (2015) states that the interactions between learning media and learning outcomes are independent (Oktavera, 2015). Likewise, Rijal and Bachtiar (2015) expressed a positive relationship between attitudes, independent learning, and student learning styles with cognitive learning outcomes in Biology (Rijal & Bachtiar, 2015). The higher the level of student learning independence, the higher the ability to solve mathematical problems (Sundayana, 2018). There is a significant effect of learning independence on student achievement (Mulyaningsih, 2014).

From the Gap analysis above, research on the influence of Quizizz as a learning medium and independent learning on mathematics learning outcomes needs to be done. They are making scientific contributions to find the influence of independence and the influence of learning media at the same time to improve mathematics learning outcomes.

THEORETICAL SUPPORT

As defined by Sharon in Kristiyani, learning outcomes are continuous changes in ability that come from one's experience and interaction with the world (Kristiyani & Budiningsih, 2019). On the other hand, Skinner, cited by Barlow in his book *Educational psychology: The Teaching-Learning Process*, in the journal Shafi'i, Skinner argues that learning is an adaptation of the process of behavior

adjustment place progressively (Syafi'i et al., 2018). Students' learning outcomes are the result of interactions of various factors that affect both the environment or students themselves (Indria & Ramadhan, 2019). Moreover, learning outcomes can be used as a benchmark for developing skills in the learning process (Yusuf & Amin, 2016).

Mathematics is the result of human thought related to ideas, processes, and reasoning (Sembiring & Situmorang, 2015). One learning process is still found in education today, teaching mathematics. This shows mathematics as an essential scientific discipline (Putra et al., 2018). Learning mathematics is functioned to develop numeracy, measurement, formula derivation, and utilization of measurement and geometry, algebra, opportunity and statistics, calculus, and trigonometry to be applied daily (Cahyaningsih, 2018). Mathematics learning outcomes focus on the outcomes in the cognitive domain that relates to students' thinking ability-oriented learning objectives (Gunawan & Palupi, 2016), intellectual learning outcomes consisting of six aspects, i.e., remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6) (Anderson & Krathwohl, 2001). On the other hand, the formulation of graduation competency standards is set in line with Bloom's taxonomic theory. The learning objectives include developing the realm of attitudes, knowledge, and skills (Chotimah & Fathurrohman, 2018). On that ground, mathematics learning outcomes refer to students' constant behavior changes after participating in the learning process in a particular time that focuses on the cognitive domain.

According to the National Education Association (NEA) in Baharun, media functions as an object that can be manipulated, seen, heard, read, and discussed, as well as an instrument used correctly in the learning process and can affect the effectiveness of learning.

learning program (Baharun, 2016). Implementation of learning is supported by using learning media to motivate students (Tamrin et al., 2017). The concept of learning media devices can be such as (modules, textbooks, documents, assessment instruments), learning resources, and actual and virtual learning environments (Subkhan, 2016). Seels and Glasgow classify media types into two categories: the choice of traditional media and the latest technology media choice (Arsyad, 2017).

Quizizz is one of the interactive media, as strengthened by Zhao stating that "Quizizz is an educational app that enables students to participate in fun multiplayer class activities" (Zhao, 2019). Akhtar also asserts that Quizizz functions as game-based learning, becoming a medium with various benefits. Teachers observe students' understanding and their involvement (Akhtar et al., 2019). Mac Namara and Murphy stated that the Quizizz app is appropriate to be incorporated in the learning process as it has a colorful display, along with graphics in the form of audio games where the player can choose one's avatar (Mac Namara & Murphy, 2017). Hence, Quizizz as a learning medium is an app to deliver messages in the learning process that can be downloaded on the App Store or accessed directly via the website. The app is intended for online learning exercises or Quizizz via smartphones, laptops, or tablets.

In addition to Quizizz, the standard learning media applied in the learning process and exercise includes textbooks, worksheets, and modules. The primary function of worksheets is for intensive practice and learning (Yaumi, 2018). According to Haryonik and Bhakti, worksheets contain a summary of material and practice questions that help and facilitate students in learning activities (Haryonik & Bhakti, 2018). The worksheet encompasses several activities that actively involve the students, such as

a simple experiment, discussion, and learning exercise (Joyo Sampurno et al., 2015). In brief, the worksheet serves as a printed learning medium used to deliver messages in the learning process comprising learning materials, instructions, and exercises the students will work on in a written form. The application of learning media needs to consider students' characteristics and learning materials since the media should be right on target.

One of the aspects contributing to students' ability to work on mathematical problems correctly is learning independence. Students come with different levels of independence. After all, this learning independence can affect learning outcomes (Al Aslamiyah et al., 2019). Independent is the basic word for independence which means to stand alone, allowing someone to be following and directing themselves according to their level of development (Bungsu et al., 2019). Independence is an individual's behavior that can initiate, solve problems, and be confident of performing learning activities (Rijal & Bachtiar, 2015).

Meanwhile, Sunayana argues that learning independence refers to a learning process where each individual can take initiatives, with or without others' assistance, in determining their learning activities, e.g., formulating learning objectives, learning sources (people or objects), checking out learning needs, and controlling their learning process (Sundayana, 2018). An independent person's characteristics are self-confidence, responsibility, directing and developing themselves, diligence, initiative, creative and do something by themselves (Hartono, 2016). Therefore, learning independence is students' behavior on their awareness, without relying on others, to carry out learning activities independently. Learning independence can be measured by the aspects of confidence, responsibility, and self-control in learning.

METHOD

This research uses quantitative research with experimental methods and Design Factorial Group 2 x 2. There is an experimental group and a control group. The experimental group was treated with Quizizz media (A1). In the control group without treatment, the conventional media used was worksheet media (A2). Each group has seen high (B1) learning independence and low learning independence (B2).

Table 1. Design Factorial Group 2x2

		B	
		B ₁	B ₂
A	A ₁	A ₁ B ₁	A ₁ B ₂
	A ₂	A ₂ B ₁	A ₂ B ₂

Detail:

A : Learning Media

B : Independence in learning

A₁ : Quizizz learning media

A₂ : Worksheet learning media

B₁ : High learning independence

B₂ : Low learning independence

A₁B₁ : Groups of students who learn using Quizizz media and have high learning independence

A₂B₁ : Groups of students who learn using worksheet media and have high learning independence

A₁B₂ : Groups of students who learn using Quizizz media and have low learning independence

A₂B₂ : Groups of students who learn using worksheet media and have low learning independence

The target population involved 324 eleventh-grade students. Then sampling refers to the experimental sample size. It is said that the sample size for experimental research can range from 15 to 50 respondents (Sukmadinata, 2006). The sampling process to determining the sample is used for analysis purposes. First, the researcher determines the sampling technique in this study is random. The researcher chooses two classes randomly to be sampled by lottery to determine the experimental group and the control group. After the researcher applied the technique, the researcher

obtained a sample from class XI-B with 36 students as the experimental group and class XI-C with 36 students as the control group.

Furthermore, after the sample has been obtained, then the researcher chooses the sample to be used for the analysis of the hypothesis test in a way that is viewed from the learning independence of students, the researcher takes a group of high and low levels of learning independence by using the theory of Guilford, namely the score obtained from the results of the independence questionnaire then the results are ranked. As many as 27 % of the upper group will be stated as having high independence. Meanwhile, 27 % of the lower group was stated as the group that had low independence.

In the final stage, after ranking students who are not included in the high or low independence category, the data from these students is not used. The sample used in this study is 20 respondents per group consisting of 10 respondents who have high learning

independence and ten respondents who have low learning independence.

There were two instruments utilized to collect the data, including 1) a post-test to measure mathematics learning outcomes, 2) a learning independence questionnaire adapted from the independence indicator, where the results of this questionnaire are to group students whose questionnaire results fall into the category of high and low learning independence. The collected data were further analyzed using the Descriptive Test, Levene's Test, Kolmogorov-Smirnov Test, Two-Way ANOVA and was continued with the Tukey Test. All statistical tests used SPSS version 21, with a hypothesis decision using a significant value of 0.05.

RESULT AND DISCUSSION

The results reveal that the research data's descriptive analysis includes the meaning, standard deviation, minimum score, maximum score, and variance; these are presented in Table 2.

Table 2. Score Recapitulation of Mathematics Learning Outcomes

	A ₁	A ₂	A ₁ B ₁	A ₁ B ₂	A ₂ B ₁	A ₂ B ₂
N	20	20	10	10	10	10
Minimum Score	6	5	11	5	6	10
Maximum Score	19	18	19	10	15	18
Mean	12.60	10.60	15.90	7.90	9.30	13.30
Std. Deviation	4.512	3.545	2.885	1.663	3.234	2.751
Variance	20.358	12.568	8.322	2.767	10.456	7.567

Table 2 is a recapitulation of data descriptions of the learning outcomes of respondents (students). This is a description of each column in the table above. The results of learning mathematics in the experimental group were taught using Quizizz treatment (A₁). Mathematics learning outcomes of students who are taught without treatment are using worksheets (A₂). Then the student learning outcomes of each experimental and control group were seen based on their high and low learning independence, the learning outcomes of

students who were taught with the Quizizz treatment who had high learning independence (A₁B₁). The mathematics learning outcomes of respondents who are taught using worksheets have high learning independence (A₂B₁). The learning outcomes of students taught by the Quizizz treatment have low learning independence (A₁B₂). Students' learning outcomes in mathematics are taught using worksheets that have low learning independence (A₂B₂). Table 1 shows the averages students' scores using Quizizz media (A₁) more significant than students'

average score using worksheet media (A₂).

After the descriptive test analysis, the data were tested for normality and homogeneity as a test of data analysis requirements before testing the hypothesis by applying SPSS Statistics 21 through the Kolmogorov-Smirnov and Levene's Test. It is shown that the data normality and homogeneity requirements are

fulfilled so that the analysis of variance (ANOVA) in testing the hypotheses is then undertaken.

The two-way analysis of variance is intended to test the main effect, interaction effect with a hypothesis decision using a significant value of 0.05, applies the SPSS 21 software. The result of data analysis with ANOVA is provided below Table 3.

Table 3. The result of ANOVA Calculation with the Significance Level $\alpha = 0.05$ towards Mathematics Learning Outcomes

Tests of Between-Subjects Effects					
Dependent Variable: Mathematics Learning Outcomes					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	403.600 ^a	3	134.533	18.485	.000
Intercept	5382.400	1	5382.400	739.566	.000
A	40.000	1	40.000	5.496	.025
B	3.600	1	3.600	.495	.486
A * B	360.000	1	360.000	49.466	.000
Error	262.000	36	7.278		
Total	6048.000	40			
Corrected Total	665.600	39			

a. R Squared = .606 (Adjusted R Squared = .574)

Table 3 serves as a guideline for testing the first research hypothesis. The formulation of the first hypothesis is H_0 : Students taught by applying the Quizizz get less than or equal to mathematics learning outcomes than those using the worksheet, H_1 : Students taught by applying the Quizizz get higher mathematics learning outcomes than those using the worksheet. Table 2 indicates that the medium influence significance gets less value than $\alpha = 0.05$ ($0.025 < 0.05$), meaning that H_0 is rejected, and H_1 is accepted. Thus, students taught by applying the Quizizz reach higher mathematics learning outcomes than those using the worksheet. As a primary subject, mathematics serves as one of the compulsory subjects in the education curriculum. Teachers use a Quizizz app as an alternative to learning media since it complies with today's development of learning media. The Quizizz is an interactive medium for pre-test, post-test, learning exercise, material strengthening, remedial program, intensive practice and

learning, and the like that can be accessed on smartphones.

The Quizizz application is a web tool that can create interactive Quizizz; of course, Quizizz can attract students' attention by doing fun math exercises. Media Quizizz is suitable for the digital generation because they like digital, the internet, online games, and more. Then the advantages of Quizizz can also improve student learning outcomes and encourage students to be the best. This is because in the Quizizz feature, when students start the quiz, they can find out quickly what rank they are in. This can spur students to be the best and try to be in the first rank (Ekowati et al., 2021). These advantages can affect the mathematics learning outcomes of the students. The research data reveal that students in the experimental and control classes have different learning outcomes; students taught by relying on the Quizizz achieve higher learning outcomes than those taught using the worksheet. So,

Table 4. Multiple Comparisons Tukey's

(I) Group	(J) Group	Mean Difference	Std. Error	Sig.	95 % Confidence Interval	
					Lower Bound	Upper Bound
A ₁ B ₁	A ₁ B ₂	6.60*	1.206	.000	3.35	9.85
	A ₂ B ₁	8.00*	1.206	.000	4.75	11.25
	A ₂ B ₂	2.60	1.206	.155	-.65	5.85
A ₂ B ₂	A ₁ B ₁	-2.60	1.206	.155	-5.85	.65
	A ₁ B ₂	4.00*	1.206	.011	.75	7.25
	A ₂ B ₁	5.40*	1.206	.000	2.15	8.65

The third hypothesis is H_0 : Students with high learning independence taught by applying the Quizizz reach less than or equal to mathematics learning outcomes than those using the worksheet. H_1 : Students with high learning independence taught by applying the Quizizz reach higher mathematics learning outcomes than those using the worksheet. The above table 4 indicates that the value of $\text{sig} = 0.00$ is less than the level of $\text{sig } \alpha = 0.05$ ($0.00 < 0.05$), signifying that H_0 is rejected and H_1 is accepted. The analysis results show Students with high learning independence taught by applying the Quizizz reach higher mathematics learning outcomes than those using the worksheet. The average learning outcomes of $A_1B_1 = 15.90$ and $A_2B_1 = 9.30$, or in other words, the average learning outcomes of A_1B_1 are higher than A_2B_1 . The utilization of the Quizizz for students with high learning independence can significantly influence mathematics learning outcomes due to its feature that can draw students' attention to do mathematics exercises, which has them achieve better learning outcomes. In a study by Rafnis, the final percentage of 85 % with the "very interesting" criterion. The study concludes that the Kahoot platform is appropriate for creating interactive and joyful learning (Rafnis, 2019). Kahoot is a learning medium with similar characteristics to Quizizz. This present study is in line with the previous study.

The fourth hypothesis is H_0 : Students with low learning independence taught using the Quizizz get more significant than or equal to mathematics

learning outcomes than those taught using the worksheet. H_1 : Students with low learning independence taught using the Quizizz get lower mathematics learning outcomes than those taught using the worksheet. Table 3 shows that the value of $\text{sig} = 0.01$ is less than the level of $\text{sig } \alpha = 0.05$ ($0.00 < 0.05$), meaning that H_0 is rejected, and H_1 is accepted. The analysis results show students with low learning independence taught by using the Quizizz have lower mathematics learning outcomes than those taught by using the worksheet. The analysis results are also proven by the difference in average learning outcomes of students with low learning independence taught by employing the Quizizz and those using the worksheet. The average learning outcomes of $A_1B_2 = 7.90$ and $A_2B_2 = 13.30$, or in other words, the average learning outcomes of A_2B_2 are higher than A_1B_2 .

In contrast with the Quizizz, the worksheet as a printed learning medium was used in the conventional learning process. The students are familiar with worksheet media. The students with low learning independence find it simpler to use the worksheet. Similarly, Estuningsih notes that the worksheet is utilized to achieve a particular learning objective without any information about students' characteristics because this learning medium is used by considering students' general conditions (Estuningsih, 2013). For this reason, the worksheet is more appropriate to apply to students who have low learning independence.

These studies prove that Quizizz media and independent learning affect

student learning outcomes with derivative function subjects. Student learning outcomes taught by Quizizz in the experimental group are higher than the average learning outcomes of students in the control group. Why the experimental group learning outcomes are higher because they are given special treatment, namely being taught with Quizizz media, the application of Quizizz is given to every math exercise, in the Quizizz application it also attributes a funny picture feature with motivational words and when students move on the next question will be entertained with pictures so that doing the exercises feels fun. They can be motivated to compete because there is a scoreboard that appears every time a question changes.

Whereas the control group was not given special treatment, learning was running as usual exercises were done with worksheets. In this study, the researcher also analyzed the learning outcomes in terms of the level of independence so that the results could show which media was more suitable for the level of student learning independence in this learning.

CONCLUSION

This study resulted in several conclusions. There is an effect of Quizizz media on mathematics learning outcomes. Also, there is an interaction between learning media and learning independence on mathematics learning outcomes. Based on level learning independence, students with high learning independence taught by employing the Quizizz achieve higher mathematics learning outcomes than those taught using the worksheet. Students with low learning independence taught by applying the Quizizz get lower mathematics learning outcomes than those with low learning independence taught by using the worksheet. This study's results have implications as a reference in choosing quiz media and the relationship between learning media interactions with students' learning independence.

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