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Improving Student's Mathematical Problem Solving Through Quizizz

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ABSTRACT

The impact of the 4.0 Industrial Revolution on Education in Indonesia affect school activities rapidly. Teachers no longer educate only in classrooms, but they are also able to utilize technology to conduct distance learning. One interactive application that can be used as a form of question exercise is Quizizz. The study aims to determine the effectiveness of the Quizizz interactive media-assisted drill method on students' mathematical problem-solving abilities. The research approach is quantitative and the type of this research is quasi-experimental with a pretest-posttest non-equivalent control group design. The population in this study was class X students while the sample consisted of two classes. Data collection techniques were carried out with tests of students' mathematical problem-solving abilities and questionnaires. The results pointed out that the average value of the final examination in the experimental class was 73.06 while in the control class was 60.97. It shows that students' mathematical problem-solving ability, assisted by Quizizz media, is better than learning without using Quizizz. There is an influence of Quizizz media-assisted student learning activities on students' mathematical problem-solving abilities by 52.6%. Student activities during the three meetings increased significantly by 86.74% with excellent criteria. Students have a positive response to learning using the Quizizz. Based on these results, it can be concluded that Quizizz is effective to improve mathematical problem-solving abilities.

Introduction

The ability to solve mathematical problems is one of the essential mathematical skills and needs to be mastered by students who study Mathematics (Hendriana et al., 2017). Problem-solving is also one part that is required to complete Mathematics learning. It means that to enhance creativity, logic, criticism, and systematic thinking, students must master a series of problem-solving in Mathematics (NCTM, 2000). Therefore the ability to solve mathematical problems is a significant part of the learning goals to be achieved (Surya et al., 2017)

PISA 2018 results showed that Indonesia's PISA rating dropped when compared with 2015. Furthermore, for the mathematics category, Indonesia ranked 73 with an average score of 379 (Tohir, 2019). This condition was strengthened by the author's observations when conducting a preliminary study in one of Dukuputang State High Schools. Mathematics learning still uses the traditional ways; the teacher explains, gives examples of questions, exercises, and ends with providing assignments. Based on the results of the interview, the Mathematics teacher gives items that refer to printed books from the

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-As the aim of the research is to find the effectiveness, so please state clearly the result that the learning with the device is more effective to improve students' problem solving abilities compared to the control class.
- Name of school should be hidden for ethical

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1.The research's gap
2.The novelty of the research by showing the state of the art
3.The aim of the research
4.Why Quizizz is preferable compared to other quiz apps?

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government and LKS from the publisher. These problems are not yet focused on the mathematical problem-solving procedure. Limited time is also an obstacle for the teacher to adjust students' answers overall.

Furthermore, the learning media used is PowerPoint and has not yet optimized the function of an android smartphone as a learning resource. Students' mathematical problem-solving abilities are still far from expectations. Some causes of profound mathematical knowledge, in general, are the availability of learning resources, the learning process, the strength of teachers, and national education policy (Siswono et al., 2017). Students usually lack of motivation to actively participate in learning activities. Young students often seek to have some fun learning experiences in class, but Mathematics is a subject which is perceived by students as not having much "fun" (Zhao, 2018). Therefore, the teachers have an essential role in managing student interaction with learning resources to achieve the desired results (Sugiyanti & Muhtarom, 2016). Student involvement in solving mathematical problems can be optimized with the help of instructional media.

Efforts that are alleged to be able to develop mathematical problem-solving abilities are using smartphone media as a learning resource. Some free applications that can be utilized including Edmodo, Socrative, Kahoot, Quizizz, Google Classroom, Flubaroo, Edpuzzle, and many others. Game-based learning is one of the advancements in technology (Wang & Tahir, 2020). One effort to introduce modern technology in the classroom is through gamification, which aims to increase student satisfaction in mathematics (Bullón et al., 2018). According to Burguillo's research, digital game-based learning can effectively increase student attention, interest, creativity, and community relations (Burguillo, 2010). Quizizz is a game-based educational app that brings multiplayer activities to classrooms and makes in-class exercises interactive and fun (Zhao, 2018). Unlike other educational apps, Quizizz has game characteristics like avatars, themes, memes, and music, which are entertaining in the learning process. There are two main modes in Quizizz, namely the instructor mode as a quiz maker, which can be accessed via Quizizz.com, and the player mode, in this case, is students, which can be accessed via www.Quizizz.com/join (Saleh&Sulaiman, 2019). This application is also equipped with a timer to answer each question; if a student answers quickly, the student will get more points compared to students who respond in a long time (Juniarta et al., 2020). Quizizz also allows students to compete with each other and motivates them to study. Students take the quiz at the same time in class and see their live ranking on the leaderboard. Although working on the questions at relatively the same time, it is difficult for students to cheat because the questions and answers are given randomly (Akhtar et al., 2019). Instructors can monitor the process and download the report when the quiz is finished to evaluate students' performance (Çeker&Özdaml, 2017). Using this app in the mathematic classroom helps stimulate students' interest and improve students' engagement.

Several studies related to the effectiveness of using Quizizz have been done. Quizizz is effective in increasing student learning activities in accounting classes and having a positive impact on their learning experience (Zhao, 2018). Furthermore, Quizizz is an interactive quiz application that is more effective in increasing student enthusiasm in learning because it replaces the old quiz way that only involves paper and pens (Wibawa, 2019). However, research using Quizizz that focuses on looking at the effectiveness of Quizizz on mathematical problem-solving abilities has never been revealed.

Therefore, the purpose of this study is to look at the effect of student activity in solving problems with the quiz-aided drill method on students' mathematical problem-solving abilities. Secondly, it is to identify the difference in increasing the ability to solve mathematical problems between students who apply the Quizizz-aided drill learning

method and learn without Quizizz assistance. Thirdly, it is to find out the activities of students who use Quizizz-aided drill learning methods. Fourthly, it is to know students' respond to the use of Quizizz.

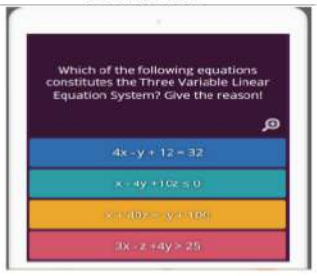
Research Methods

Quasi-experimental research utilizing a post-test only control group design was employed to check whether there is a cause-effect relationship among the variables, data, and how the data will be compared (Creswell&Clark, 2011). A quantitative approach is used to compare the final grades of students who have different treatments.

The population in this study were all students of class X at one of the state high schools in Dukuputang in 2019-2020. The research sample was taken using a purposive sampling technique. The selected sample consisted of 67 high school students, grouped in the experimental class and the control class. High school students are chosen as samples because they have entered the development stage of formal operations as a provision for problem-solving. The class could be matched based on the students that had the same background of knowledge. The normality of both classes was needed to do a parametric test, purposed to prove that the classes are in the normal distribution (Pallant, 2010). The experimental class consisted of twenty-five women and eleven men, while in the control class consisted of twenty-one and ten men. The two classes were given different treatments. The experimental class was learned using the Quizizz-assisted drill method while the control class learned by the drill method without the help of Quizizz. Data collection techniques used were tests to determine the ability of problem-solving and questionnaires to find out students' responses in learning using drill methods assisted by Quizizz interactive media. The multiple-choice test uses Quizizz media, but the students solve the problem along with a coherent solution.

Problem-solving ability test consists of 6 questions, arranged based on indicators: identify data coverage for problem-solving, make a mathematical model of everyday situations or problems, and explain or interpret the results according to the original question, as well as check the truth of the results or answers. Before the instrument is used, it must be tested on classes that have studied the material system of the three variable linear equations. Examples of problem-solving skills in Table 1.

Table 1.
Problem-solving Ability Test

No	Indicator	Trial and error
1.	Identify data coverage for problem-solving	

Commented [NI5]: -Show conditions (state clearly) of on how the use of Quizizz in the learning process to improve students' mathematics problem-solving abilities claimed to be effective.
- Why do you use post-test only control group design?
-Name of school or class should be hidden for ethical
-Why do you use purposive sampling than cluster sampling?
-How to develop the test and questionnaire instrument? How is the validity and reliability of the instrument?

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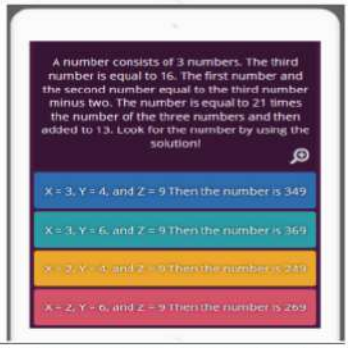
4.Iya pak, karena sampel tersebut dipilih berdasarkan pertimbanganguru pengampu mata pelajaran
5. Validitas dan reliabitas sudah coba saya jelaskan pak
6. Instrument angket sudah disertakan

2. Make a mathematical model of everyday situations or problems.

3. Explain or interpret the results according to the original problem, as well as check the truth of the results or answers.



Before using mathematical problem solving, a trial is carried out on the quality of the problem. It is done by looking at the validity and reliability of each item. Test the validity of the test instrument using Pearson product-moment correlation. An instrument is valid if it can reveal the data of the variables studied precisely or with high validity. The results of the validity test are presented in Table 2.

Table 2
Results of the Validity Test

No	Validity Index	Level of Validity
1.	0,533	Medium
2.	0,420	Medium
3.	0,455	Medium
4.	0,666	High
5.	0,891	High
6.	0,755	High

Table 2 shows that all questions are valid, meaning that all items can be used in research. Right test questions besides high validity, also have high reliability. Then, to calculate the reliability of 6 questions, the SPSS 22 program is used. The result of the reliability test is presented in Table 3.

Table 3
Reliability Statistics

Cronbach's Alpha	N of Items
.665	6

Table 3 shows that the reliability is greater than 0.665, which indicates a highly reliable instrument. Based on the validity and reliability test results, six items that have been tested include proper criteria. Therefore these questions can be used as questions in research. A self-learning pre-test in multiple-choice-question format embedded in the Quizizz media was administered to the students to determine their prior knowledge in problem-solving skill. Afterwards, the students followed a written post-test session. At the end of learning, the questionnaire was distributed to measure their response after learning the Quizizz media. Students' response to Quizizz questionnaire consisted of 20 statements. Each statement was measured using a Likert scale level with five answers, namely Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), Strongly Disagree (SD). The statements in the questionnaire are listed in Table 4.

Table 4
Questionnaire student responses to Quizizz

No.	Statement	Alternative Answers				
		SA	A	N	D	SD
1.	The display of math quiz on this Quizizz application is interesting.					
2.	This math quiz makes me more excited about learning mathematics.					
3.	Using this, Quizizz makes learning mathematics not dull.					
4.	I think the visual appearance (photos, pictures, etc.) on this Quizizz quiz app is exciting.					
5.	I feel that Quizzis using the Quizizz app increase my learning motivation.					
6.	I am very interested in quizzes using this Quizizz application.					
7.	Learning mathematics with quizzes using the Quizizz application is little use to me.					
8.	I prefer to work on quiz questions using the Quizizz application.					
9.	The question presented according to what I learned in school.					
10	I feel that learning mathematics using the Quizizz application makes it very easy for me to work on and understand questions.					
11	The material presented is easy to understand.					
12	This quiz contains an evaluation test that can test how far I understand the material that has been taught at school.					
13	The sentences used in the question are clear and easy to understand.					
14	The language used in this math quiz is simple and easy.					
15	The mathematical symbols used are simple and easy to read.					
16	With the existence of this Quizizz application, it is very easy for me during exams.					
17	I find it more challenging to understand the quiz questions presented in the Quizizz application.					
18	In my opinion, the Quizizz application is easily accessible.					
19	The Quizizz application is easy to use.					
20	I think the menus and facilities (buttons) in the Quizizz application are easy to understand.					

Post-test data are processed with inferential statistics. Saphiro Wilk test is used for normality tests because the sample is less than 50. while the homogeneity test is the Levene test. To find out the average difference, a t-test is used if the data is normally distributed. Meanwhile, if the data are not normally distributed, the Mann-Whitney test is used. The gain test is used to determine the results of increasing students' mathematical problem-solving

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Commented [NI9]: Please elaborate more why motivation is needed to be measured in order to know the effectiveness of the apps in improving students' mathematics problem-solving ability.

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skills between before and after learning. The processed gain data is obtained from the difference between the pre-test and post-test scores of the experimental class.

Questionnaire data analysis can be done on the percentage of student answers. The questionnaire ratings are in Table 4.

Table 4.
Criteria for Percentage of Student Responses to Quizizz Media

No.	Percentage	Criteria
1.	90 – 100	Very Good
2.	80 – 89	Good
3.	70 – 79	Enough
4.	60 – 69	Less
5.	<60	Very Less

After the data analysis process is carried out, the conclusion whether or not the use of Quizizz in learning is effective by looking at the criteria: firstly, the existence or absence of the influence of the activities of students who use Quizizz on their mathematical problem-solving abilities; secondly, the differences in mathematical problem-solving skills between the experimental and control classes; thirdly, the activities of students who use Quizizz; fourthly, students' respond to learning by using Quizizz media.

Results and Discussion

Result

Teaching and learning activities in Mathematics at one of the state high schools in Dukupuntang were carried out during five meetings. The research data were obtained through evaluation activities, namely, formative tests conducted by students in the form of multiple-choice tests and through observation of learning stages using Quizizz media-assisted methods. The type of test given is multiple choices, but students ought to solve the problem and how to solve them. Students work on problems with problem-solving steps and are limited by the time set in Quizizz. One of the students' answers after being given a learning treatment using Quizizz in Figure 1.

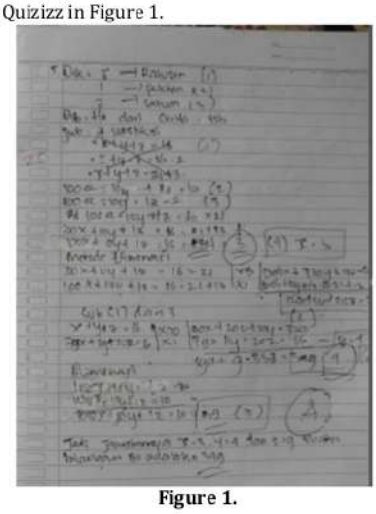

Figure 1.

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2.Use references to support your discussion and position of this research towards previous studies
3.Please rearrange the image to be more visible
4.At the end of discussion section, the author should provide the discussion in more general situation, for example discuss the findings with IR 4.0 issue

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Figure 1 displays that students are already able to understand the problem, link the known elements, choose a solution to the problem, and solve the mathematical model. However, students still have not re-examined the correctness of the solution. Based on the results of the interview, students immediately choose the answers on Quizizz without re-checking the answers that have been obtained.

The first step in using Quizizz for teachers is to register as a teacher by logging in to the link www.Quizizz.com using the email or google account they used when registering. After having an account, ask questions for later learning activities. When the lesson arrives, the teacher opens the practice questions on the Quizizz profile then click "My Quizizz", after that double-click on the training material to be carried out. Once ready, select "live game" for direct training. The teacher can also download statistical data about student performance in the form of an Excel spreadsheet. The first step in using Quizizz for students is to visit the address www.Quizizz.com. Then students enter the code that has been shown by the teacher to join the Quizizz platform. After all, students enter with the game rules. Students can also see the results of the correct or wrong answers after the process is complete. The Quizizz display that has been implemented is shown in Figure 2.

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Figure 2. Teaching and Learning Activities Using Quizizz

Implementation of learning in general is when the students are asked to observe and learn the material that has been presented at Microsoft power points and games in the form of practice questions on media Quizizz. In face-to-face learning, students are reminded again by asking the material that has been studied previously, namely the content of the Two-Variable Linear Equation System (SPLTV). By presenting a daily problem related to SPLTV to be understood and answered by students, the teachers communicate the learning objectives to be achieved, conveys the scope of the material to be studied, motivate students by explaining the importance of learning SPLTV material. In the core activities, the teacher organizes students in study groups. Then, students are asked to make observations on the examples of problems that have been explained and examples of problems related to SPLTV. Students work the exercises in groups. Each group consists of two or three people. After creating groups, group representatives enter Quizizz media to take part in Quizizz games. The teacher goes around, guides, observes, assesses students' abilities, and helps each group that has difficulties in solving problems or challenges in taking Quizizz. The next stage is the examination of group results. The work of students will appear immediately after the estimated time is up. The last step is giving group awards. Students receive positive feedback and reinforcement in the oral, written, and prize as an appreciation form of the students' efforts. Teacher and students conclude the material that has been learned. Learners discuss to make a summary of the content that has been submitted. The experimental and control class worked on the post-test questions in writing in the last meeting. The following

descriptive data are the results of the pre-test and post-test in the experimental class and the control class can be seen in Table 6.

Table 6.
Descriptive Research Data Results

Statistics	Experiment Class		Control Class	
	Pre-test	Post-test	Pre-test	Post-test
Student (N)	36	36	31	31
Biggest value	45	90	65	90
Smallest value	15	35	8	40
Range of values	30	55	57	50
Average value	25,44	66,86	30,35	60,97
Variance	54,31	156,40	249,70	235,97
Std.Deviation	7,37	12,51	15,80	15,36

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Table 6 shows that the experimental class experienced an average increase of 47.54. While the control class experienced an average growth of 30.62. It means that both classes have a significant increase in the average. Furthermore, the data will be analyzed using statistical tests to see the effect of student activity on mathematical problem-solving abilities as well as differences in the ability of the experimental class and the control class.

The Effect of Quizizz Media Assisted Method on the Students' Mathematical Problem Solving Ability

The effect of student activity using Quizziz on students' mathematical problem-solving abilities can be determined by conducting analysis testing that is a simple linear regression test and determination. The test results are in Table 7.

Table 7.
Output Linear Regression

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	35.918	5.731		6.267	.000
	Student's Activity	3.417	.610	.693	5.601	.000

Table 7 shows that the results of the output show the value of Sig. of 0,000; this value is smaller than the value of α = 0.05. Because of the Asyn value. Sig (2-tailed) <α, then H_0 is rejected, and H_1 is accepted as significant. In short, it can be concluded th there is a significant influence on student activity in mathematics learning using Quizizz on the ability to solve mathematical problems.

Table 8.
coefficient of determination

Model	R	R Square	Adjusted R Square	Std. An error of the Estimate
1	.725[a]	.526	.510	7.37

Table 8 shows that R Square of 0.526 (0.526 x 100% = 52.6%). It means that the ability to solve mathematical problems can be influenced by the variable implementation of the Quizizz media-assisted method by 52.6%. In contrast, 47.4% is explained by other variables besides the variables used in the study.

Student activity has increased from the first meeting to the last meeting. Students who were initially unenthusiastic in group learning were eventually enthusiastic. Students also become more active in teaching and learning activities, not ashamed to ask questions and help each other. It is in line with Saleh & Sulaiman's research, which states that the use of Quizizz makes students more confident, actively involved in class, learning is more student-centered, so it is more effective (Saleh&Sulaiman,2019). Participants play Quizizz in class;

each student plays on their smartphone or laptop; the teacher must make sure every one of them has joined the Quizizz by entering the code that has been shared (Mei et al., 2018).

The Difference in Increasing the Ability to Solve Mathematical Problems between Students Who Apply with the Quizizz-Aided and without Quizizz Assistance

Before testing the difference in increasing the ability to solve mathematical problems between the two classes, normality test is first performed to determine the data distribution Normality test in this study was used to test the N-Gain data from each group, namely the experimental class, and the control class to find out whether the data obtained was normal or not. The normality test used is the Shapiro-Wilk test because the sample used is less than 50 students (Sundayana, 2015).

Table 9.
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
N_gain_Eksp	.224	31	.000	.878	31	.002
N_gain_Kontrol	.120	31	.200*	.964	31	.364

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 9 shows that tests of normality, Sig. by using Shapiro-Wilk 0.002 for N-Gain experimental class and 0.364 for the N-Gain control class. It turns out that for the N-Gain experimental class the Significant/ Sig. values smaller than the probability value of Sig. or 0.05> 0.002. It means the data is not normally distributed. As for the N-Gain control class, the Sig. is greater than the probability value of Sig. or 0.05 <0.364, which means the data is normally distributed.

The N-Gain experimental class data is not normally distributed. In contrast, the N-Gain control class data usually is distributed so that it is continued with non-parametric statistics using the Mann Whitney-U Test. The Mann Whitney-U test aims to find out the real difference between the average of two populations with the same distribution through two independent samples taken from both populations.

Table 10.
Output Uji Mann Whitney U N-Gain Experiment Class and Control Class

	N_GainGab
Mann-Whitney U	339.500
Wilcoxon W	835.500
Z	-2.751
Asymp. Sig. (2-tailed)	.006

Table 10 shows that the value of Asymp. Sig. (2-tailed) of 0.006 < 0.05. This results in that H_0 is rejected and H_1 is accepted, meaning that there is a difference in the mathematical problem-solving ability of the experimental class students with the control class. The results of this study are in line with Albeta, et al. who stated that in classes taught classical learning and increase in chemistry learning outcomes was obtained by 39.5%, while for classes taught ICT-based tournament learning using Quizizz obtained an increase in chemistry learning outcomes by 75.2% (Albeta et al., 2020).

Student Activity Observation Sheet

The data on the observation sheet of student activities shows that in conducting the learning process, researchers conducted exercises by those listed in the lesson plan. They were starting from the events in the preliminary activities, which included entering the class on time, opening the lesson by saying greetings, asking for readiness to follow the experience, conveying the material, delivering the objectives, and learning methods used,

motivating students, and exploring students' prerequisite knowledge. Activities in the core activity are explaining the content and giving examples of practice questions in the form of online games on Quizizz media. Afterwards, students discuss and correct the problems on Quizizz media.

At the first meeting, the teacher discussed the prerequisite material and the characteristics of the three-variable linear equation system so that students did not look active. Still, some students dared to ask the teacher about what they did not understand yet. Students began to be enthusiastic about the learning process after being introduced to an online game application to practice math problems called Quizizz. However, there were still some students who did not understand how to use the media. Furthermore, the 3rd meeting, students were already seen to be active in the learning process. They were accustomed to using interactive media Quizizz and dared to ask questions about anything they had not yet understood. Student activities in the learning process also determine the effectiveness of the teaching methods and learning resources used. The graphs of student activity in the experimental class at the 1st meeting to the 3rd meeting of the experimental class can be seen in Figure 3.

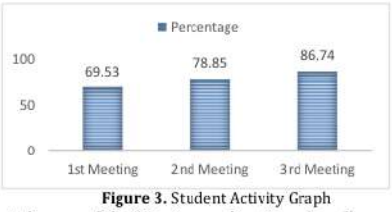

Figure 3. Student Activity Graph

Figure 3 shows that the use of the Quizizz application also allows students to be actively involved in learning outside the classroom. It can be monitored with the number of Quizizz that can be completed, the number of badges awarded, the number of challenges that are tried, the number of resources downloaded, and the level students have achieved (Stewart & Chung, 2016). Based on the results of a survey conducted by Permana & Permatawati, it shows that students prefer to do live Quizizz in class rather than as homework assignments (Permana & Permatawati, 2020). Therefore, the teacher as a facilitator still plays an essential role in learning.

Students' Responses to Quizizz Interactive Media

A student response questionnaire is used to assess students' responses after using Quizizz media. The results of the analysis of the questionnaire data responses of students to the Quizizz media can be seen in Figure 4.

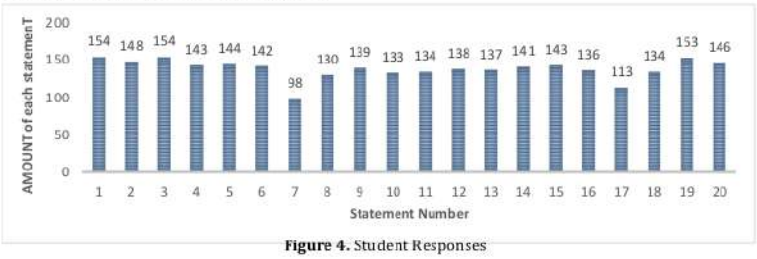

Figure 4. Student Responses

Figure 4 shows the results of student responses using questionnaire learning using drill methods assisted by Quizizz interactive media, and almost all students felt the benefits and usefulness of the learning process. Quizizz display that is interesting, as well as something new for students, makes learning not dull. These aspects get the highest score in the questionnaire assessment of 88%. The improvement of problem-solving skills in this study is in line with the results of Sulastri, et al. The application of the LAPS-Talk-Ball learning model integrated on Android-based interactive games can train students' complex problem-solving abilities and based on the results of the calculation of the gain test in the experimental class the results obtained are 0.707 (Sulastri et al., 2019). In this research, the total score derived from the calculation of 36 responses, as many as 2760, and the percentage of respondents for the overall statement that is 76.67%, with proper interpretation. These results are in line with Meng et al. study that works on questions with Quizizz applications limited by time. The ranking given during the quiz makes students feel satisfied, more focused, competitive, and motivated in solving questions (Meng et al., 2019). Some disadvantages of using Quizizz include that the platform is only available in English and online, so an internet connection is required to create and respond to the quiz (Junior, 2020). The use of Quizizz-aided media drill methods is more effective in improving student learning outcomes than conventional methods. Quizizz is a measurable learning tool that can motivate and engage students with all of its content (Amornchewin, 2018). However, the results of this study are not in accordance with Göksün and Gürsoy. The use of the Quizizz application in gamification activities used in research does not have a positive effect on academic achievement and student participation (Göksün & Gürsoy, 2019).

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Conclusions

The conclusions showed that there is an effect of student learning activities that use Quizizz on problem-solving skills. There is a difference in the improvement of problem-solving skills between classes that use Quizizz and without Quizizz. Student activity in three meetings has increased. Students' responses to the use of Quizizz were included in both criteria. From these aspects, it can be concluded that the Quizizz media is effectively used in learning to improve mathematical problem-solving abilities. Quizizz as a learning media is very relevant in dealing with changes, where mathematics learning in the era of industrial revolution 3.0 is still dominated by props while in the period of the industrial revolution 4.0 is more on the use of software applications. Therefore, to face the era of the industrial revolution 4.0, mathematics learning must combine conventional and online learning

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