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The Effectiveness of STEM-Based MURDER Learning Model Assisted by Quizizz to Improve Students' Numeration Ability

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Abstract: The numeracy of 10th-grade students at SMAN 3 Slawi is still not optimal and needs improvement. This is because students are not accustomed to dealing with non-routine problems. This research aims to determine the effectiveness of the STEM-based MURDER learning model assisted by Quizizz in improving students' numeracy. In this study, the proportion test of student completeness obtained a Sig. value of 0.004, indicating that the proportion of students class experimental exceeded the classical completeness, reaching 42%. In the test of average differences, a Sig. value of 0.004 was obtained, meaning that the numeracy ability of the experimental group was higher than control group. In terms of improvement, the N-Gain test resulted 0.28, which falls into the interval $\langle g \rangle < 0.3$, indicating that the improvement in students' numeracy using the STEM-based MURDER learning model assisted by Quizizz is relatively low.

Keywords: numeracy, STEM, MURDER, quizizz.

Abstrak: *Numerasi siswa kelas X SMAN 3 Slawi masih belum optimal dan perlu ditingkatkan, hal tersebut terjadi karena siswa tidak terbiasa dengan permasalahan berupa soal non-rutin. Penelitian ini bertujuan untuk menentukan efektivitas model pembelajaran berbasis STEM MURDER yang dibantu oleh Quizizz dalam meningkatkan numerasi siswa. Dalam penelitian ini, uji proporsi ketuntasan siswa diperoleh nilai Sig. 0,004 dengan demikian proporsi ketuntasan siswa yang dikenai pembelajaran MURDER berbasis STEM berbantuan Quizizz melampaui tuntas secara klasikal mencapai 42%. Pada uji perbedaan rata-rata diperoleh nilai Sig. 0,004 yang artinya kemampuan numerasi siswa kelas eksperimen lebih dari numerasi siswa kelas kontrol. Dalam peningkatannya dilakukan dengan uji N-Gain diperoleh N-Gain score sebesar 0,28 berada pada interval $\langle g \rangle < 0.3$, bahwa peningkatan numerasi siswa dengan menggunakan model pembelajaran MURDER berbasis STEM berbantuan Quizizz tergolong rendah.*

Kata kunci: *numerasi; MURDER; STEM; dan quizizz.*

▪ INTRODUCTION

Numeracy is the ability, confidence, and willingness to involve quantitative or spatial information in making decisions based on information in everyday life (Alberta, 2013). The Program for International Assessment of Adult Competence (PIAAC) explains that numeracy is the ability to use, transmit, use, interpret or decipher, to communicate information or mathematical ideas and play an active role in managing mathematical problems from various situations in people's lives (Curry, 2019) . Han, et al (2017) stated that by mastering numeracy students will have sensitivity to numeration (sense of number) and its relation to daily life so that it can help students compete with other nations in terms of human resources. PISA tests 3 aspects of mathematics (OECD, 2018:7), namely: Content, Process and Context. The content component relates to materials related to mathematics learning at school; Change and Relationships; Space and shape; Quantity; Uncertaninty. The process domain according to OECD (2018) includes a person's ability to formulate, employ and interpret mathematics in solving problems.

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The context component is divided into four contexts: personal, educational and occupational, general and scientific.

According to data from the Ministry of Education and Culture (2021), based on the results of the 2018 Program for International Student Assessment (PISA) which was released on December 3 2019, Indonesia is in the low performance with high equity quadrant. The average reading ability score is 371 and the average mathematics score is 379. These results are lower than the average score of OEDC countries, which is 487. Paying attention to the PISA survey results from year to year, makes it necessary for Indonesia to carry out a comprehensive mapping of the quality of education in order to improve the quality of learning. Based on this, the National Assessment (AN) was officially implemented by the Ministry of Education and Culture (Kemendikbud) in 2021. Indonesian students are not only required to be able to work on mathematics problems, but are also expected to be able to solve problems related to mathematics. In this case, students' ability to master understanding simple texts is good, but in understanding complex texts students tend to lack mastery.

Based on the results of interviews with mathematics teachers at SMA N 3 Slawi, information was obtained that students' abilities in solving problems were not completely good. students solve sequence and series problems by writing numbers and mathematical symbols directly without providing information about the numbers and symbols. In accordance with the mathematical numeracy indicators, students are able to use various numbers and mathematical symbols in solving problems in daily life or non-routine problems, but students have not fully provided information from the symbols and numbers related to the answers. Thus, it is necessary to provide solutions in the form of learning activities that can make students active in improving students' numeracy skills.

According to Aslinda, et al (2019), accuracy in choosing learning models as time goes by has become very important. Therefore, one suitable model is the MURDER (Mood Understand Recall Detect Elaborate and Review) learning model. According to Hanasah et al. (2016) argue that MURDER learning is an alternative learning to improve students' mathematical literacy skills. Apart from that, competition in the 21st century demands competent human resources in science, technology, engineering design and mathematics, so it is hoped that education can integrate four scientific disciplines (Milaturrahmah, Mardiyana, & Pramudya, 2017). STEM learning is able to answer future challenges. Where technology-based education is collaborated with the disciplines of science, mathematics and engineering. Arifin, et al (2020) stated that STEM invites students to integrate subjects and correlate them with everyday life. Thus, one of the mathematics lessons that is in accordance with the independent learning curriculum in accordance with literacy and numeracy is using the STEM (Science, Technology, Engineering and Mathematics) approach (Niam & Asikin, 2020). Apart from this, learning media in the mathematics learning process is very necessary so that students are more interested in learning. One way of learning with media to help students is the Quizizz application. In research by Nisa, A. C. (2023), the quizizz application is able to improve students' numeracy skills and can make learning fun without losing the meaning of learning itself.

Based on the description above, as an effort to increase numeracy, it is necessary to apply the MURDER (Mood Understand Recall Detect Elaborate and Review) model with a STEM approach to help students explore their potential through discussions and be more

active in learning activities. Apart from that, the use of Quizizz learning media will help students carry out the learning process. In accordance with this description, researchers conducted research entitled "Effectiveness of STEM-based MURDER Learning Assisted by Quizizz to Improve Students' Numeracy Ability".

Based on this background, the formulation of the research problem is whether the numeracy of students who received STEM-based MURDER learning assisted by Quizizz achieved classical completion, whether the average numeracy of students in the experimental class with STEM-based MURDER learning assisted by Quizizz was higher than the control class which uses the PBL learning model, and whether the implementation of STEM-based MURDER learning assisted by Quizizz improves students' numeracy skills.

▪ METHOD

Research Design and Procedures

The type of research used is quantitative research. The nonequivalent pre-test-post test control group design is the design used in this research. A pre-test was carried out before treatment, as well as a post-test afterwards in the control and experimental groups (Lestari & Yudhanegara, 2017). Pre-test data in this study was used to test whether the initial abilities of the two samples had the same initial abilities or not. The experimental class applied in STEM-based MURDER learning with the help of Quizizz is given the symbol (E) and the control class applied the PBL model is given the symbol (K). In the experimental class and control class, a pre-test was carried out before treatment. The final ability test (post-test) is carried out after the main material has been studied.

Participants

The research was carried out at SMA Negeri 3 Slawi toward tenth grade students in 2023/2024 academic year. The population in this study were all students in class In this study, samples were taken using cluster random sampling or random class techniques. The samples in this study were taken from two classes, namely experimental class X.4 and control class X.9.

Instrument

In this research there are two variables, namely, the independent variable is the learning model while the dependent variable is student numeracy. The data collection methods used in this research are test, interview and documentation methods. In this study, the pretest and posttest questions consisted of 5 descriptive questions according to the students' numeracy indicators. In testing the numeracy aspect, the content components used in this research are rows and series material related to Quantity. Abidin (2017) stated that the numeracy assessment includes 7 basic abilities, namely communication, mathematising, representation, reasoning and argument, devising strategies for solving problems, using symbols, using mathematics tools. In this research, the grid used corresponds to seven indicators of students' basic numeracy abilities. The context of the questions used for each question item is different, the questions are in the form of descriptions of everyday problems related to the context of personal, work, general and scientific problems. The test method is used to obtain data on students' numeracy abilities. In this study, the sample group received the same material, namely rows and series.

Before learning is carried out, a student's initial numeracy ability test is carried out. Learning activities were carried out in three meetings. Then a final test is carried out to determine students' numeracy abilities. The test questions used have been tried out and questions have been selected that meet the requirements for good questions based on reliability and validity. In this research, the validity and reliability results were obtained as follows in table 1 and table 2.

Table 1. Item analysis of pretest questions

Question No.	Sig.	Criteria
1	0.000	Valid
2	0.000	Valid
3	0.030	Valid
4	0.008	Valid
5	0.000	Valid

Table 2. Item analysis of pretest questions

Question No.	Sig.	Criteria
1	0.007	Valid
2	0.000	Valid
3	0.925	Invalid
4	0.002	Valid
5	0.012	Valid
6	0.000	Valid

Based on the SPSS 25.0 output results which are summarized in table 1 and table 2, in the pretest questions all the questions are valid and can be used, while in the posttest questions there is one question that has a Sig value. > 0.05 so question item number 3 is invalid. Posttest questions were used for questions number 1, 2, 4, 5 and 6. Next, we analyzed the reliability of the questions with the help of SPSS 25.0 software with decision making based on the Cronbach's Alpha coefficient. A question is said to be reliable if the Cronbach's Alpha value is > 0.70. Cronbach's Alpha values were 0.773 and 0.757. Thus, it shows that the Cronbach's Alpha value is > 0.70, so the test questions tested both pretest and posttest are reliable.

Data Analysis

Based on the results of data analysis of students' initial ability scores, data was obtained which showed that the samples taken came from a population that was normally distributed, had the same variance, and there was no difference in the average within the population. The results of the initial test and final test of students' numeracy abilities were then analyzed to test the truth of the research hypothesis. The final test scores were tested for classical completeness with the proportion test, the average difference test with the independent sample test, and the normalized gain.

▪ RESULT AND DISSCUSSION

Based on the results of the pretest and posttest scores carried out in this research, the average pretest score for exponential material in class X.4 was 49, while class X.9 had an average score of 44.5. Both classes are taught by the same teacher with adequate

classroom facilities for learning, in each class there are students with high, medium and low learning abilities. The two sample classes were given a numeracy test after receiving experimental class and control class learning treatment or posttest questions. Based on the classical completeness test, the Actual Complete Limit score was obtained with a value of 54. It was obtained that the average score for the experimental class exceeded the value of 54. Furthermore, in the classical completeness test with the classical completeness criteria set, 42% of students exceeded the BTA. The SPSS output results obtained are as follows in table 3.

Table 3. Proportion test and independent sample test

		Category	N	Observed Prop.	Prop. Test	Exact Sig. (1-tailed)
Experimental group	Group 1	<= 54	7	.19	.42	.004[a]
	Group 2	> 54	29	.81		
	Total		36	1.00		

a. Alternative hypothesis states that the proportion of cases in the first group < .42.

From table 1, the Sig value is obtained. 0.004, the proportion of students who were subjected to Quizizz-assisted STEM-based MURDER learning exceeded classical completion, reaching 42%. In testing the average difference between the numeracy test scores of groups of students in STEM-based MURDER learning assisted by Quizizz and the numeracy test scores of groups of students in PBL learning, the results obtained were Sig. 0.004. Thus the Sig value. < 0.05. So H0 is rejected, so the average numeracy score of students who take part in STEM-based MURDER learning assisted by Quizizz is better than the average numeracy score of students who take part in PBL learning. The average score for the experimental class or class X.4 is 64.38 and for the control class or class X.9 is 53.52. Apart from that, the proportion of students' numeracy completion in the Quizizz -assisted STEM-based MURDER model is more than the numeracy of students taught with PBL learning. Apart from carrying out the completeness test and average difference test, a test for increasing numeracy ability (normalized gain test) was also carried out. Based on the results of the N-Gain score test calculation, the average N-Gain score for the experimental class was 20.48%. Meanwhile, the average N-Gain score for the control class was 8.99%. The following is a table of categories for interpreting the effectiveness of N-Gain according to Hake (1999).

Table 3. Interpretation of N-gain (Hake, 1999)

Percentage (%)	Criteria
< 40	Ineffective
40-55	Less Effective
56-75	Moderately Effective
>76	Effective

Hake (1999) states that in the N-Gain effectiveness interpretation category, score gain <40% is included in the ineffective category. Thus, the percentage values from the experimental class and control class are not effective in increasing student numeracy, but there are differences in the experimental class and control class. In the independent samples test the Sig value. obtained 0.04 < 0.05, thus it can be concluded that the average

increase in the experimental class is better than the control class. Apart from this, the mean percentage value of the experimental class is greater than the control class.

Based on calculations, the n-gain value is 0.28, which indicates that the increase in student numeracy using the STEM-based MURDER learning model assisted by Quizizz is relatively low. These results indicate that the implementation of the STEM-based MURDER learning model assisted by Quizizz has low effectiveness on student numeracy in class X sequence and series material but has increased. In line with Elfi's (2019) research, his research showed that after being treated with the MURDER model, the numeracy shown was better than in the experimental class after being treated with the MURDER model. This is because in the STEM-based MURDER learning process students are interested in science problems which are applied in solving mathematical problems, apart from that in the learning process by cultivating a good mood so that students are motivated in learning sequence and series material and understand the learning. Hasanah (2016) stated that it provides optimal opportunities for students to learn independently, interpret contextual material and understand it in depth. Apart from this, the students' activeness in answering the trigger questions given by the teacher was very enthusiastic. Anggreni (2019) stated that MURDER learning makes students more actively involved and enjoyable in the learning process, students are more motivated in learning by conveying the gestures used to help students understand the concept. In STEM-based MURDER learning with the help of Quizizz, during quiz practice using Quizizz, students were more interested in doing it and because of the ranking of the quiz results, students were very enthusiastic about doing it. In STEM-based MURDER learning with the help of Quizizz, during quiz practice using Quizizz, students were more interested in doing it and because of the ranking of the quiz results, students were very enthusiastic about doing it. In Mulyati's (2020) research, the Quiziz application was effective in using the learning process in cycle I and cycle II, increasing student learning outcomes from 63% to 78% in cycle II. As in Hasanah's (2016) research, it is stated that the process component aspects of numeracy are fulfilled when students are given MURDER learning. In Afifah's (2019) research, STEM-based learning is able to provide improvements in thinking abilities and mastery of concepts. Lou, et al (2017) stated that STEM-based project learning provides a good improvement score of 0.95 points in increasing students' creativity. Abdi (2020) stated that STEM learning that integrates scientific disciplines generally has characteristics that are able to continuously integrate this knowledge in one learning experience such as contextual learning in real life. Likewise, in the control class with the PBL learning model, students were active in group learning but in the learning process there were not many exercises such as quizzes in the Quizizz application. This resulted in a lack of practice in solving mathematical problems so that the results of the control class students' numeracy tests were lower when compared to the experimental class.

From the analysis results that have been obtained, it is concluded that Quizizz-assisted STEM-based MURDER has low effectiveness in improving students' numeracy skills but there is still an increase in student results. Numeracy has increased because there are things in Quizizz-assisted STEM-based MURDER learning in the learning process by understanding the concept of the problem and exploring it, as well as in the practice questions which are given in a fun and interactive way followed by students in the Quizizz application they use. In Wahyuningtyas' (2016) research, MURDER learning

had a positive impact on mathematics learning achievement for students. This is because in the MURDER learning model, students are motivated to be more active in participating in the learning process and if they cannot solve problems they will ask other students in the process of collaborating in learning.

▪ CONCLUSION

Based on the results of the research and discussion that have been presented, the hypothesis test that has been carried out by researchers regarding students' numeracy abilities in STEM-based MURDER learning with the help of Quizizz achieves classical completeness, namely the proportion of students achieving a posttest score higher than BTA completeness, namely 42%. Furthermore, the average numeracy ability of students after applying STEM-based MURDER learning with the help of Quizizz is better than the average numeracy ability of students before implementing STEM-based MURDER learning with the help of Quizizz. Apart from that, there was an increase in the number of students who used STEM-based MURDER learning with the help of Quizizz experiments, more than the average class that used PBL learning. However, the normalized N-Gain test has a low effectiveness value with a Gain score of 0.3. This happens because in using the MURDER learning model and the PBL learning model there are almost similarities which make learning more meaningful and students more active. In STEM-based MURDER learning, Quizizz helps students get more practice questions by using the Quizizz application. STEM-based MURDER learning assisted by Quizizz needs to be implemented in the classroom as an innovation in mathematics learning to improve students' numeracy skills. Likewise, by using the Quizizz application, the Quizizz learning media can be used as an alternative evaluation tool for practicing questions for students.

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