Volume 7, Nomor 2, Desember 2023
Numerical: Jurnal Matematika dan Pendidikan Matematika
http://journal.iaimnumetrolampung.ac.id/index.php/numerical
DOI:https://doi.org/10.25217/numerical.v7i2.

Problem-based Learning Model Assisted by Interactive Animation Videos on Numeracy Ability in Spatial Building Materials

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Article Info
Article History:
Received: 17-06-2023
Revised: 06-11-2023
Accepted: 15-11-2023

Keywords:
Interactive Animation Videos;
Numeracy Ability;
PBL;
Spatial Building

Abstract

Students in the era of school digitalization need numeracy skills. Numeracy ability is related to solving a problem. The Problem-based Learning (PBL) model is suitable for solving a problem with the help of interactive animated videos. This study aims to determine whether the PBL model assisted by interactive animated videos influences students' numeracy abilities. The research method used is quantitative in the form of an actual experiment. The sample in this study consisted of students in classes VIIB and VIIC, who were chosen randomly. The data collection techniques used are documentation and tests. The data analysis techniques used are normality test, homogeneity test and independent sample test. The research results show that the calculated t-value > t-table where t-value = 8.132 and t-table = 1.697. This means there is a significant difference in the average student numeracy ability between the experimental and control groups. PBL model assisted by interactive animated videos in solving questions on spatial building materials, students were less able to analyze the information presented, less able to interpret the data collection and not yet able to make conclusions.

INTRODUCTION

School digitalization is one focus of improving the quality of education in the era of independent learning [1]. The quality of the education system in schools will be influenced by advances in science and technology [2]. Education is vital in ensuring students' learning and creativity skills and media and information technology literacy [3], [4]. Education requires the collaboration of various tools and facilities, including digital facilities that can be used as learning resources learning tools [3], [5]. Education can access information that will help improve the quality of education in an area based on the curriculum implemented.

The curriculum currently being implemented in education is the independent learning curriculum as a replacement for the 2013 curriculum implemented by the Minister of Education and Culture, Nadiem Makarim [6]. Freedom to learn stimulates teachers to create innovations with great potential for teaching and learning activities [7]. The independent learning curriculum has four central educational policies, namely, 1) National Standard School Examinations (USBN) will be abolished and returned according to school policy, 2) National Examinations (UN) will be

Print ISSN: 2580-3573, Online ISSN: 2580-2437

changed to Minimum Competency Assessments (AKM), 3) Simplification of Learning Implementation Plans (RPP) from 13 components to 3 components, and 4) New Student Admission (PPDB) is proportionally oriented [8].

The second policy, the Minimum Competency Assessment (AKM), is based on the 2018 PISA score announcement policy, where Indonesian students' reading and numeracy skills are relatively low and lag behind other countries [8]. Survey results obtained from PISA show that literacy is low, around 70%, numeracy 71%, and science 60% [9]. This shows that Indonesia must complete educational mapping to improve learning standards [10]. The implementation of the National Assessment (AN) was formalized by the Ministry of Culture and Culture (Kemendibud) in 2021, and the National Examination (UN) no longer applies [11]. The Minimum Competency Assessment is part of the National Assessment (AN). The Minimum Competency Assessment (AKM) focuses on literacy and numeracy [10].

Literacy and numeracy are basic abilities students need to face life after completing their education. Besides that, they are connected to students' decision-making [10]. Numeracy itself is the ability to solve problems in various circumstances that are relevant to people as Indonesian citizens and citizens of the world by applying mathematical concepts, methods, facts and tools [12]. The ability to formulate, apply and interpret mathematics in various contexts and use mathematical reasoning and concepts, procedures, and facts to describe, explain or predict events is called numeracy ability [13].

Numeracy, which is the focus of the National Literacy Movement (GLN) and the Minimum Competency Assessment (AKM) is an effort made by the government to improve the quality of education in Indonesia which reflects the results of the international assessments PISA (Program for International Student Assessment) and TIMSS (Trends International Mathematics and Science Study) which is not yet satisfactory [14]. This can be seen in the achievements in mathematics competency, where the increase has not been significant. In 2012, Indonesia got 375 points. In 2015, it got 386 points, and in 2018, Indonesia got 379 points [15]. Indonesia is in 72nd place out of 78 countries [16]. This proves that there is a decrease in the average mathematics points.

Considering Indonesian students' numeracy abilities are still low, as shown by the 2018 PISA results, attention and effort are needed to improve these abilities in educational activities, especially in teaching and learning activities (KBM) [17]. Apart from that, numeracy in Indonesia is still low because most of the material tested is in the form of real-world contextual problems, and students are not yet familiar with real-world problem-solving questions and cannot analyze information in various forms [18]. A teaching strategy that provides students with as wide an opportunity as possible to communicate their mathematical ideas, hone their critical thinking skills, and work on problems given by the teacher is needed. Moreover, students will try to solve problems and create their problems [19]. Thus, strategies are needed in the form of appropriate learning models and learning media.

These problems require appropriate, practical and innovative learning models [18], [20], [21]. The teaching and learning process must change from a conventional to a Problem-based Learning (PBL) model. PBL is a teaching style that uses real-world challenges to teach students how to think critically, solve problems, and obtain information [22], [23]. PBL is a learning model that encourages active student participation and involves students in solving problems [24], [25].

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PBL is a learning strategy that uses general situations as a background for students to learn critical thinking, problem-solving skills, and subject matter topics [26]. PBL is suitable for improving students' numeracy skills because the learning process includes numeracy indicators, such as those in the PBL [18]. In this way, students can improve their numeracy skills.

Learning models and media are also needed to support the PBL process in the classroom. Students need media that can create a clear picture to describe a sustainable scenario so that it can motivate students to develop ideas and concepts [7]. Learning media supports learning activities by presenting information and knowledge to individuals or groups. Learning media can optimize student participation during the learning process [2]. In this case, the media will be interactive animated videos.

Video is one of the learning media that is considered better and more exciting and not monotonous because it contains elements of both media types, namely audio and visual. Learning videos can also be effective for students [27]. Video media is a learning medium that can help teachers convey complex topics to students to communicate and understand [28]. Videos can be played back according to students' needs and requirements, fostering interest and motivating them to pay attention to the lesson [24]. Animation is used as a presentation highlight and is very effective for illuminating complex ideas that can be represented with simulations [29]. It is hoped that interactive animated videos can support the PBL process on students' numeracy abilities at SMP Negeri 2 Pagar Alam. Below is an interactive animated video display.

Figure 1. Interactive Animation Video Display

Based on the explanation of the discussion above, researchers want to utilize the PBL model assisted by interactive animated videos to develop students' numeracy abilities. Previous researchers have conducted quite a lot of research on numeracy skills, from elementary school to university students. As Ambarwati and Kurniasih [13] showed, the average score of the experimental class was higher than the control class, and the use of YouTube-assisted PBL had an effect and was better than conventional numeracy literacy. That animation was effective because it could improve student learning outcomes and was declared suitable for use. Other research conducted by [26] showed that the results of the PBL model affected numeracy abilities.

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METHODS

The proper experimental design method was used in this research, with a quantitative approach in the form of a pre-test-post-test control group design [30]. The population in this research was 7th-grade students at State Middle School 2 Pagar Alam, consisting of 9 classes with 287 students. Two classes were chosen randomly for the research sample. The selected classes were class VII.B, with 31 students as the experimental class, and class VII.C, with 30 students as the control class. The experimental class was treated as a PBL model assisted by interactive animated videos implemented in the even semester of the 2022/2023 academic year.

Data collection techniques, documentation and tests include photos and videos during learning, while the test contains a pre-test (initial test) and a post-test (final test) of numeracy abilities. Before conducting the research, the researcher conducted a trial test of the instrument on other classes who had studied spatial building material. The results of the instrument trials were then tested for validity, reliability, level of difficulty, and distinguishing power using SPSS version 22 software, where the instrument-test results were suitable for use in research.

Data was analyzed using two steps. The first step is initial data analysis (pre-test) and final data analysis (post-test). Initial data analysis includes normality and homogeneity tests using SPSS version 22 software to test whether the two classes are normally distributed and homogeneous in the initial conditions. Meanwhile, the final data analysis includes a normality test, homogeneity test and hypothesis test independent sample test using SPSS version 22 software to see whether the post-test scores for numeracy ability in both classes are normal and homogeneous, as well as see the influence of providing a PBL model assisted by interactive animated videos on experimental class.

RESULTS AND DISCUSSION

The researcher starts learning in class VII.C, or experimental class, by saying hello, praying, taking students' attendance, and starting a little game to motivate students to be enthusiastic about learning. The researcher began to focus students' attention by showing the learning media; then, the researcher communicated the learning objectives regarding geometric figures (tubes and cones). The researcher conducted an apperception on the students by asking and answering, "Have you ever studied geometric shapes?" All students answered, "Have you ever", the researcher again asked the question, "Try to mention what spatial shapes you know?" some answered, "Cube", some answered "Beam", some answered "Tube," and some answered, "Cone". The researcher again asked the question, "From the types of spatial structures that you mentioned, try to give examples of spatial structures that exist in everyday life." There were six children who answered, namely Anggita, Suci, Azzahra, Haris, Akbar, and. The six answered, "cupboard, pencil box, flower pot, a gallon of water, birthday hat, house roof," and the researcher answered, "Yes, that is right, that is a good answer."

After carrying out the apperception, the researcher informed the learning model that would be used in the learning, namely, explaining the learning steps using the PBL model.

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Figure 2. Problem Orientation

In Figure 2, the teacher explains the learning objectives and the logistics required, proposes phenomena, demonstrations, or stories to raise problems, and motivates students with games, such as asking questions related to the material to be given. The teacher provides learning materials on the LKPD and asks students to prepare textbooks and LKS from school.

Figure 3. Organizing

In Figure 3. The researcher is dividing a group of 31 students into five groups. Four groups have six people, and 1 group has seven people. After dividing the groups, the researcher distributed the LKPD to each group. Then, the researcher asked students to watch the interactive animated video on the whiteboard.

Figure 4. Investigation Stages

In Figure 4, the researcher invites students to watch an animated video to help investigate the problems available in the LKPD. Teachers encourage students to collect information

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appropriate to the material being studied. Students also conduct investigations by looking for information in animated videos, textbooks and worksheets, and teachers encourage students to discuss, exchange opinions, get explanations and solve problems.

Figure 5. Assisting with Investigation

In Figure 5, the teacher helps students carry out investigations. The teacher provides direction by asking students to read the instructions in their respective groups' LKPD. The teacher provides direction when students have questions.

Figure 6. Development and Presentation

Figure 6 shows each group presenting the results of the discussion that they have obtained. This presentation experience is the first time they have done this. They carried out experiments: 1 student measured the cardboard given, two students cut it, two students measured the results obtained, and one student recorded his friend's work. After everything was done, they could find a solution to the problem; they got a formula they had to find by experiment. During the discussion, all groups followed the presentation well. The group explains what they have discussed with their group, and the other groups listen and listen to the group making the presentation, and so on. The experience of presenting in front of the class was their first experience, so no students had asked questions about the group presenting in front of the class.

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Figure 7. Analysis and Evaluation

In Figure 7. After the presentation, the teacher gives one question in an essay containing story questions according to the material provided. The teacher carries out an analysis and asks students to provide conclusions about the learning that has been carried out.

Figure 8. Experimental class post-test

In Figure 8, the researcher gave the experimental class a final test or post-test. The final test of students' numeracy abilities after treatment using a PBL model assisted by interactive animated videos.

DATA ANALYSIS

Before learning was carried out, the researcher analyzed the result data before it was given treatment (pre-test) to see the initial conditions of the control and experimental classes using SPSS version 22 software.

The normality test is carried out to determine whether something is normal or not data [31]. The normality test in this study used SPSS Version 22 Kolmogorov-Smirnov[a.]. Normality test analysis in this study used SPSS Version 22 Kolmogorov-Smirnov [a.] Normality test results using Kolmogorov-Smirnov [a] for the experimental class 0.087 $\geq 0{,}05$ and the control class 0.195 $\geq 0{,}05$. Both classes have a normal distribution, as proven by the normality test, which is above the 5% significance level.

The homogeneity test was carried out after the normality test. Based on the analysis of the test of homogeneity of variance using SPSS version 22 software, it is known that the significance value (Sig.) Based on the Mean is 0.429, the value is 0.429 > 0.05, so it can be concluded that the variance of the pre-test data on the numeracy ability of experimental class students and the pre-test data on the numeracy ability of control class students are the same or homogeneous. The homogeneity test was carried out after the normality test. Based on the analysis of the test of homogeneity of variance using SPSS version 22 software, it is known that the significance value

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(Sig.) Based on the Mean of 0.557 and the value of 0.557 > 0.05, it can be concluded that the variance of the post-test data on the numeracy ability of experimental class students and the pre-test data on the numeracy ability of control class students are the same or homogeneous.

After analyzing the initial data above, learning was done by applying a PBL model assisted by interactive animated videos to the experimental class and direct learning to the control class. Then, at the end of the lesson, a post-test on numeracy skills was given to see whether providing a PBL model assisted by interactive animated videos on numeracy skills affected the experimental class.

The independent sample t-test is used to determine whether there is a difference in the means of two unpaired samples. The independent sample t-test in this research was used to look at whether "Is there a difference in students' numeracy abilities in spatial material between the PBL model assisted by interactive animated videos and the conventional model?" and whether "Is there an influence of the PBL model assisted by interactive animated videos on students' numeracy skills in spatial construction material in class VII SMP Negeri 2 Pagar Alam for the 2022/2023 academic year?" This test was carried out using SPSS version 22 software.

Table 1. Group Statistics

	Class	N	Mean	Std. Deviation	Std. Error Mean
Numeracy ability	Experiment Post-test	31	82.51	10.618	1.907
	Control Post-test	30	62.23	8.732	1.594

Based on table 1. group statistics, displays the results of descriptive statistical analysis such as average per group, standard deviation and standard error. The analysis results show (a) the number of valid data is 61 (31 students with the PBL model assisted by interactive animated videos and 30 students with conventional learning). (b) the average numeracy ability of the experimental class with the PBL model assisted by interactive animated videos was 82.51, and the control class with conventional learning was 62.23. (c) standard deviations of 10, 618 and 8.732, respectively.

Table 2. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Capability Numeracy	Equal variances assumed	.349	.557	8.132	59	.000	20.278	2.494	15.288	25.268

It provided that if sig (2-tailed) > 0.5, then H0 is accepted; if sig < 0.5, then H0 is rejected. Based on the output above, the sig value is obtained. (2-tailed) is 0.000 < 0.05, meaning H0 is

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rejected. So, it can be concluded that the PBL model assisted by interactive animated videos affects students' numeracy abilities. At a significant level $\alpha = 5\%$with the test criteria for rejecting H_0 and dk respectively $(n_1 - 1) = (31 - 1)$ with the interpolation formula, we get $t_{table} = 1.697$. It can be seen that $t = 8.132 > 1.697$, then H_0 is rejected, and H_1 is accepted, meaning the research hypothesis is accepted. So, using the PBL model assisted by interactive animated videos influences students' numeracy skills in spatial construction material in class VII of SMP Negeri 2 Pagar Alam for the 2022/2023 academic year.

Based on the results of research conducted, there is a difference in the numeracy abilities of students at SMP Negeri 2 Pagar Alam between classes taught using the PBL model assisted by interactive animated videos and classes that are not taught using the PBL model assisted by animated videos interactive, the average score of students in the experimental class is 82.51, and the control class is 62.23. Hence, the hypothesis in this research is that there is an influence of the use of PBL models assisted by interactive animated videos on students' numeracy skills in spatial building materials in class VII of State Middle Schools 2 Pagar Alam for the 2022/2023 academic year and the truth can be accepted. This is proven based on statistical calculations $t_{count} = 8.132$ and $t_{table} = 1.697$, which shows $t_{count} > t_{table.}$

Meanwhile, the analysis test uses the normality, homogeneity, and hypothesis tests. The normality test uses the Kolmogorov-Smirnov test with normal distribution results. The homogeneity test uses the Homogeneity of variance test based on a significant value of > 0.05 to make this study's control and experimental classes homogeneous. Meanwhile, the hypothesis test was carried out using an independent sample t-test by looking at the sig (2- 2-tailed) value. Based on the results of the hypothesis test, it can be concluded that H_1 is accepted, so it can be said that there is a significant influence on the ability of the problem-based learning model assisted by interactive animated videos—student numeration in building materials in class VII SMP Negeri 2 Pagar Alam.

The problem-based learning model encourages authentic problems to become the focus of learning so that students can solve related problems and be trained to have high numeracy literacy and think critically [32]. Numeracy literacy cannot be separated from mathematics subjects [33]. This is because numeracy is a study of analysis in mathematics learning [34]. Mathematical knowledge not only gives an individual numeracy ability, but numeracy also includes skills in applying unstructured rules and concepts. So, by studying numeracy in mathematics subjects, students' literacy scores will, of course, increase.

Numeracy literacy in PBL creates abilities in mathematics lessons. This is because the components of implementing narrative literacy cannot be separated from the scope of mathematics lessons. Mathematics is a science related to exact knowledge that has been opened between organisms systematically, including the laws and ideas of logical reasoning. The new finding in this research is that students' motivation to understand and find solutions to the problems presented provides value. This can be seen from the advantages of PBL in the phase where students have to find solutions to mathematical problems given by the teacher. Students look for these sanctions and design how to minimize problems [35]–[37]. Then the advantage of PBL is that students must be skilled in communicating the results of their findings to their friends in the class so that students feel challenged to understand the findings of the problem given [20], [21]. Numeracy literacy in thematic learning of students in the classroom can be done by

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providing stimuli to students through contextual-based problems. This impacts the characteristics of students to be focused and interested in the contemporary nature that stimulates students' curiosity [25].

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CONCLUSION

Based on the results of the research and discussion, it can be concluded that there is an influence of the PBL model assisted by animated videos on the numeracy abilities of students in class VII of SMP Negeri 2 Pagar Alam, which can be seen in the results of the analysis of hypothesis testing using paired sample t-test and independent sample t-test with a significant value of 0.000. Application of the PBL model assisted by interactive animated videos in experimental class VII B when students solve questions in essay form, can write and use numbers and symbols in solving problems, can analyze the information presented, can interpret data sets and can make conclusions from the questions given so that it can improve students' numeracy skills in learning. On the other hand, in the VII C control class, which was not taught to use a PBL model assisted by interactive animated videos in solving questions on spatial building materials, students were less able to analyze the information presented, less able to interpret the data collection and not yet able to make conclusions.

Based on the research results obtained, the researcher provides the following suggestions. Students hope to increase their enthusiasm for learning, be more motivated and active, and find it easier to understand spatial material when participating in mathematics learning using the PBL assisted by interactive animated videos. This research can be used as a reference in learning models and media used in future research. However, do not take too much material for research.

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