The Effect of Problem Based Learning Model Accompanied with Virtual Reality Media on Science Learning Outcomes and Critical Thinking in Grade VI Students in Elementary Schools

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ABSTRACT

One of the factors that can influence students' science learning outcomes is the learning model and learning media applied by the teacher. The extent to which the influence of the learning approach and media on students' science learning outcomes needs further research. Therefore, the purpose of this study was to test how the influence of the Problem Based Learning model and virtual reality learning media on science learning outcomes in grade VI Elementary School students. To answer the research problem, a Quasy Experimental research design with a Nonequivalent Control Group Design pattern was applied. The population of this study included 56 grade VI elementary school students using a purposive sampling technique. The research data were collected using a test instrument. After the data was completely collected, the data were analyzed using the t-test data analysis technique. The results of the study showed that there was a positive influence of the learning model, namely Problem Based Learning and Virtual Reality Media on learning outcomes and Critical Thinking of grade VI Elementary School students. Keywords: Problem Based Learning Model, Science Learning Outcomes, and Critical Thinking.

INTRODUCTION

The era of globalization that is full of various life problems encourages humans to be critical and innovative. This attitude is one of the efforts to survive. This can be seen in various fields of life, both economic, social, technological, and educational. In this context, student learning must be linked to science and various life problems in society. Related to this, science learning plays an important role as their capital in preparing themselves to face the real life that they will face.

So far, science learning, especially in Elementary Schools, has not been able to meet the expectations as desired above (Amalia Fitri, skk, 2021; Adnyana, & Yudaparmita, 2023). The results of observations show that the results of science learning at Ditotrunan 01 Elementary School are still more oriented towards theoretical explanations and have not been directed at real cases in the field, so that learning becomes less interesting for students. The result of this kind of learning is that students' learning motivation is low and student learning outcomes are also low. The results of observations during 2 learning sessions in 2 classes showed that out of 56 Class VI students, there were 40 students who had low motivation (71.43%) [the remaining 16 students (28.57%) had high motivation. Meanwhile, in terms of learning outcomes, there were 32 students (57.14%) who got scores below the expected average score, which was 75; and the remaining 24 students (42.86%) achieved scores above the expected average.

The low motivation and learning outcomes of science must be addressed properly, because if not addressed immediately it can affect the quality of learning outcomes in Elementary Schools in the long term. One way to overcome this is to apply good learning methods and media, which are in accordance with the

characteristics of science learning materials. One learning approach that is considered suitable for improving motivation and learning outcomes of science in elementary schools is the application of the Problem-based learning model. Because by implementing the problem-based learning model, in the learning process students are directly faced with various real-life problems and are trained in how to solve them. Learning like this will create many challenges for students' minds, so that it can arouse their learning motivation. In addition, learning like this will also be able to arouse students' critical thinking patterns. Likewise, the use of virtual reality media, it is expected to make science learning more realistic and attract students' attention. If learning motivation can be increased, then students' science learning outcomes and critical thinking will also increase.

The improvement of students' motivation, learning outcomes and critical thinking skills must be achieved well if we want rapid progress for this nation. Because science education plays an important role in the development of modern society in the 21st century. Science education is related to time to move. Logarithmic training is closely related to the development of science and technology (Erlistiana et al. 2022; Qomariyah & Subekti, 2021). On the other hand, the education curriculum must also accommodate the needs of developing students' critical thinking skills. The development of students' critical thinking has begun since the implementation of the 2013 curriculum. The 2013 curriculum has combined spiritual competence, skills and critical thinking skills. However, at the implementation level, it still cannot be done optimally, and here it requires the role of teachers to be able to encourage students to be able to follow this independently. If they can develop themselves independently, then it will be able to optimize learning outcomes, including science learning.

One of the recommended learning models for improving learning motivation, learning outcomes and critical thinking is problem based learning (Eggen & Kauchak, 1996). In the learning process through the problem based learning model, it is expected that students can learn optimally involving the physical and mental optimally through various learning activities of thinking, acting, and being directly involved in the process of solving real problems faced in life, both now and in the future. Thus, students' sensitivity in facing the reality of life can be formed from the beginning and it is hoped that later it can form behavior and attitudes that can satisfy and appreciate the environment well. Through science learning using the problem based learning model, it is expected that students will grow the ability to think logically, analytically, systematically, critically, and creatively, reflectively and the ability to adapt and socialize.

The main cause of the low achievement of students' logical, analytical, systematic, critical, creative, and reflective thinking skills is the learning method that is still dominated by memorization and teacher-centered learning. Teachers often focus on achieving curriculum targets in a short time, so that learning is more instructional than participatory. According to Hayes & Devitt (2008), there are still many learning processes in schools that have not implemented or developed critical thinking skills for students. This is in accordance with the results of research by Sudarmini, Kosim, & Hadiwijaya (2015) which states that learning activities that only emphasize cognitive aspects in the form of memorization can affect low learning outcomes. Another study by Kurniahtunnisa, Dewi, & Utami (2016) states that low learning outcomes indicate that students' critical thinking skills are still low. Therefore, teachers are obliged to help students develop their critical thinking skills which are needed to solve a problem.

In various studies, it is stated that problem-based learning has an important role in improving students' ability to think critically. Because problem-based learning is a learning model that invites students to think critically by answering problems and finding alternatives as solutions. Furthermore, Hmelo-Silver (in Eggen & Kauchak, 1996) said that problem-based learning is a model in learning that uses problems as a focus to develop problem-solving skills, materials, and self-regulation. The core of problem-based learning is the presentation of authentic and meaningful problems to students (Santrock, 2008; Arends, 2013; Marra, et al., 2014). Learning in schools, especially Elementary Schools, needs to be well planned using innovative, interesting and fun learning models and by using learning media to attract students' attention and interest in learning, and learning outcomes will be more optimal. Such learning must occur in all subjects applied in

elementary schools, including Science learning (Andriyani & Suniasih, 2021; Astriani & Sudarma, 2019). Basically, science is a way of finding out about nature systematically to master a collection of knowledge in the form of facts, concepts, principles, discovery processes and having a scientific attitude.

The problem based learning model has several advantages compared to other learning models. The advantages of implementing the PBL model for students according to Sanjaya (2014), include: (1) better understanding of the lesson content, (2) challenging to find new knowledge, (3) increasing learning activities, (4) understanding problems in the real world, (5) more enjoyable, (6) developing critical thinking, and (7) applying knowledge. The opinion above is in line with Beringer (2007) who stated that implementing problem based learning can have a positive impact on students, including: learning becomes enjoyable, thinking logically, increasing reflection on learning outcomes, reducing memorization methods, learning is more active and challenging, and developing high-level thinking skills.

Problem based learning model is one of the effective learning approaches in training critical thinking skills, problem solving, and collaboration. However, problem based learning has several weaknesses that are often complained about, such as limitations in providing real experiences and the difficulty for students to understand the context of the problems given (Savery, 2006; Hung, 2011). The use of Virtual Reality technology can be a solution to overcome these limitations (Bahar, 2014), by allowing students to experience a deeper, more immersive, and contextual learning experience. Therefore, researchers minimize these weaknesses by implementing a problem based learning model accompanied by Virtual Reality media.

Virtual Reality or VR media was chosen because it is multimedia. Multimedia media is "a combination of various media elements such as text, images, animation, video" (Rusman & Riyana, 2013). The multimedia nature as explained above is found in Virtual Reality media. Virtual Reality offers a solution to overcome these weaknesses. With VR, students can directly experience real situations that are designed immersively and realistically. According to research conducted by Huang et al. (2010), the use of VR in learning can improve students' understanding of the context of the problems faced, because students can interact directly with a virtual environment that imitates real-world situations. This greatly helps students understand abstract concepts or complex problems.

A more immersive learning experience can also be achieved through VR. Students can experience simulated physical environments, such as scientific laboratories or professional work environments, that are difficult to access in traditional classroom settings. VR also allows students to practice problem solving in a safe environment, without the fear of real failure. Ultimately increasing self-confidence and critical thinking skills (Radianti et al., 2020). Teachers or educators must be ready to face the 4.0 era. in the current era of globalization. Era 4.0. This readiness is shown by the teacher's ability to use IT in learning. And this is part of the nature of the times of students, so teachers must be able to provide learning according to the nature of the times of students through the use of IT, one of which is by using VR (Virtual Reality) media. In the use of technology, especially in the era of the Industrial Revolution 4.0 in learning activities, there are very important basic elements, namely teaching methods and learning content which are often obstacles. Because teachers are sometimes not able to choose the right content to give to students using IT. Because not all content is suitable for using IT, it can also only be done by using concrete objects and the like.

This VR media can be used in a problem-based learning model that starts with a learning problem and needs to be solved individually. This model also focuses on student activities in problem solving (Andriyani & Suniasih, 2021; Winoto & Prasetyo, 2020). Students do not only receive learning materials in the same direction as when using traditional learning methods. With the Problem Based Learning learning model, the learning process is expected to take place naturally in the form of student activities to strengthen problem-solving skills and increase student independence, so that students are able to formulate, solve and conclude for themselves what they have learned in terms of This is a reflection. Research results (Kristiana & Radia, 2021; Suari, 2018). States that the application of the problem based learning model has a significant effect on student learning outcomes. Meanwhile, according to (Hendriana, 2018) states that there is a difference

between learning in a contextual way and learning by implementing problem based learning. Therefore, this means that the problem based learning model can have a significant impact on learning outcomes in general.

Other studies on the use of VR media state that the use of VR media can improve students' learning outcomes and critical thinking (Sun, Lin, & Wang, 2010; Charles, et al, 2023). This can be interpreted that the results of studies on the use of the PBL model and VR media on students' learning outcomes and critical thinking produce varying findings. One of the challenges faced in science learning is making abstract concepts more real and easier for students to understand. (Satuti & Atmojo, 2025). VR media as an interactive technology can provide a deeper and more realistic learning experience. According to Riyana (2007), VR allows students to see and experience firsthand situations or objects that are difficult to access in everyday life. Thus, VR can be an effective medium in science learning to improve learning outcomes and critical thinking skills.

Based on the explanation above, problem based learning with Virtual Reality application is a combination of learning model strategies and media that are considered appropriate as a supporting learning process that accommodates students to improve their critical thinking skills. With Virtual Reality, it can be used as an alternative as a means of learning science in dealing with existing problems. Therefore, the problem in this study can be formulated as follows: "How is the Effect of the Problem Based Learning Model Accompanied by Virtual Reality Media on Students' Learning Outcomes and Critical Thinking in Science Lessons in Elementary Schools?"

RESEARCH METHOD

To find the answer to the formulation of the research problem, a study was conducted using the Quasi Experimental design (Masyhud. 2021). This study was conducted by comparing one experimental group that was given treatment with the Problem Based Learning model accompanied by Virtual Reality media with a control group without being given treatment with the Problem Based Learning model accompanied by Virtual Reality media. The research pattern applied was the Nonequivalent Control Group Design (Masyhud, 2021). The Quasi Experimental research design with the Nonequivalent Control Group Design pattern can be described in diagram 1 as follows:

	Pretest	*Treatment*	*Posttest*
Group 1	O_1	X	O_2
Group 2	O_1	X	O_2

Description:

O1 : Pretest

X : Treatment

O2 : Posttest)

(Source: Masyhud, 2021:167)

Diagram 1. Research Design Nonequivalent Control Group Design

The subjects in this study included VIA and VIB students at Ditotrunan 01 Elementary School, Lumajang, East Java, Indonesia with 28 students in each class. Both classes (experimental and control) were statistically declared homogeneous based on the results of the homogeneity test conducted using the t-test (Masyhud, 2024). The sampling was carried out using the "Purposive Sampling" sampling technique (Masyhud, 2021)

Then, to obtain the data that will be used for the research hypothesis test, the data collection technique used is the learning outcome test, learning motivation questionnaire, and critical thinking test. After the required

data is fulfilled, the data is analyzed using the independent t-test data analysis technique. However, before the data analysis is carried out, the data is first tested for normality using the Kolmogorov Sminrnove technique and based on the test results, the data has been declared normally distributed; Therefore, it meets the requirements for data analysis using the t-test (Masyhud, 2024).

The results of data analysis conducted using the t-test data analysis technique assisted by the SPSS version 26 program showed an empirical t-value of 2.677 and the results showed that it was greater than the critical t-value at a significance level of 5% at a level of freedom of 54, which was 2.021 (2.677> 2.021). Therefore, based on the results of the data analysis, it can be concluded that Ha is accepted and H0 is rejected. This means that there is an effect of the application of the problem-based learning model accompanied by Virtual Reality media on students' science learning outcomes at Ditotrunan 01 Elementary School, Lumajang, East Java, Indonesia.

Likewise, the analysis of the influence of the use of problem-based learning models accompanied by Virtual Reality media on students' critical thinking skills showed an empirical t-value of 13.33 and the results showed that it was greater than the critical t-value at a significance level of 5% at a level of freedom of 54, which was 2.021 (13.33> 2.021). Therefore, based on the results of the data analysis, it can be concluded that Ha is accepted and H0 is rejected. This means that there is an influence of the application of problem-based learning models accompanied by Virtual Reality media on students' critical thinking skills in Science Lessons at Ditotrunan 01 Elementary School, Lumajang, East Java, Indonesia

RESEARCH RESULTS AND DISCUSSION

The results of data analysis using the t-test technique that has been carried out show that: (1) there is an influence of the application of the problem based learning model accompanied by Virtual Reality media on science learning outcomes in Class VI students at Ditotrunan 01 Elementary School, Lumajang, East Java, Indonesia, and (2) there is an influence of the application of the problem based learning model accompanied by Virtual Reality media on critical thinking skills in Science Lessons in Class VI students at Ditotrunan 01 Elementary School, Lumajang, East Java, Indonesia.

After it was known that there was an influence of the application of the problem based learning model accompanied by Virtual Reality media on science learning outcomes and critical thinking skills in Grade VI students at Ditotrunan 01 Elementary School, Lumajang, East Java, Indonesia. Then the next data analysis was continued with an analysis of the level of effectiveness or degree of relative effectiveness (Masyhud, 2024) which aims to determine the magnitude of the relative contribution of variable X (application of the problem based learning model accompanied by Virtual Reality media) to variable Y (students' science learning outcomes and students' critical thinking skills). The analysis was carried out using the Degree of relative effectiveness (DRE) formula.

The results of the DRE analysis on the contribution of variable X (implementation of the problem based learning model accompanied by Virtual Reality media) with variable Y1 (students' science learning outcomes) showed that the contribution of the variable of the application of the problem based learning model accompanied by Virtual Reality media to the variable of students' science learning outcomes (Y1) was obtained at 37.14% (including moderate effectiveness). This means that 37.14% of the part of the science learning outcomes of Grade VI students at Ditotrunan 01 Lumajang Elementary School is influenced by the variable of the application of the problem based learning model accompanied by Virtual Reality media; while the remaining 62.86% of the part of the students' science learning outcomes is influenced by other variables not included in this study. These variables can come from internal factors of students such as intelligence, learning motivation and student health. Some others are influenced by external factors, such as learning carried out by teachers, the completeness of the students' learning environment and facilities, the exercises obtained, and the students' environment. However, how much influence each of these factors still needs further research.

Furthermore, the results of the DRE analysis of the variables of the application of the problem based learning model accompanied by Virtual Reality media (X) on the variable of students' critical thinking skills (Y2) obtained an effectiveness coefficient of 78.31% (including high effectiveness kayrgoti). This means that 78.31% of the critical thinking skills of Grade VI students at Ditotrunan 01 Lumajang Elementary School are influenced by the variable of the application of the problem based learning model accompanied by Virtual Real media; while the remaining 21.69% of the critical thinking skills of students are influenced by other variables not included in this study. These variables can come from internal factors of students such as intelligence, learning motivation and student health. Others are influenced by external factors, such as learning carried out by teachers, training obtained, and the student's environment. However, how much influence each of these factors still needs further research.

Based on the description of the data analysis and its results above, it can be stated that the use of the Problem Based Learning model and Virtual Reality media can make the process and results of science learning and critical thinking skills of grade VI students at Dasae School more effective. Therefore, the use of the Problem Based Learning model and Virtual Reality media can be recommended for use as a method and media for science learning in Elementary Schools, especially for Grade VI students. While for learning other subjects and other classes, further research is still needed.

When viewed from a theoretical perspective, the Problem Based Learning model is a learning model that is based on a real-life problem to improve students' ability to acquire knowledge, think critically, and solve problems. This can be seen clearly in the steps of implementing the Problem Based Learning model, with the involvement of students in the learning process and accompanied by the use of Virtual Reality media that helps students in making learning more realistic. Based on this, students in learning will be able to be maximally involved, both physically and mentally, so that the learning process will be optimal and thus the learning outcomes will also be optimal.

In terms of advantages, the Problem Based Learning model has several advantages, including being able to provide students with awareness that learning activities are not always centered on the teacher but also depend on the motivation of the students. This can be seen in research activities that have been carried out in experimental classes, where through the application of this model students play an active role with the motivation they have in solving problems in the learning process. This research is in line with the results of the study Meanwhile, (Dalgarno & Lee, 2010). Problem based Learning combined with VR (Virtual Reality) in science learning, students get the following benefits: More interactive learning - VR allows students to explore scientific concepts in a virtual environment that resembles the real world. 2. Improving conceptual understanding - With 3D visualization, students find it easier to understand complex concepts than just reading books or seeing two-dimensional images. 3. Improving learning motivation - An interesting virtual environment makes students more enthusiastic about learning and active in the problem-based learning process.

CONCLUSION AND SUGGESTIONS

Based on the formulation of the problem, research hypothesis, data analysis, research results and discussion, it can be concluded that: (1) The application of the Problem Based Learning learning model accompanied by Virtual Reality Media can improve science learning outcomes in Grade VI Elementary School students. The relative effectiveness level of using the problem based learning model accompanied by virtual reality media is 37.14%. This means that 37.14% of the science learning outcomes of Grade VI Elementary School students are influenced by the variable of the application of the problem based learning model accompanied by Virtual Reality media; while the remaining 62.86% of the science learning outcomes of Grade VI Elementary School students are influenced by other factors; (2) The application of the Problem Based Learning learning model accompanied by Virtual Reality Media can improve critical thinking skills in Grade VI Elementary School students. The relative effectiveness level of using the problem based learning model accompanied by virtual reality media is 37.14%. This means that 37.14% of the science learning outcomes of

Grade VI Elementary School students are influenced by the variable of implementing the problem based learning model accompanied by Virtual Reality media; while the remaining 62.86% of the science learning outcomes of Grade VI Elementary School students are influenced by other factors; (2) Implementing the Problem Based Learning model accompanied by Virtual Reality Media can improve critical thinking skills in Grade VI Elementary School students.

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