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The Effect of The Problem Based Learning Model With Animated Video on Students' Hots Ability on The Material On Human Movement Systems

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Abstract

This study aims to investigate the effect of the Problem-Based Learning (PBL) model assisted by animated videos on students' Higher Order Thinking Skills (HOTS) in the topic of the human movement system among eighth-grade students at SMP Negeri 12 Medan. The research employed a pretest–posttest control group design with a sample of 60 students, divided into an experimental class (30 students using PBL with animated videos) and a control class (30 students using expository learning). Improvement in students' HOTS was measured using the N-Gain score from the average posttest results. The N-Gain score for the experimental class was categorized as moderate. The data were analyzed using a one-tailed t-test. The average posttest score of the experimental class was 84.50, compared to 67.50 in the control class. Hypothesis testing revealed tcount=2.32 and ttable=2.045, indicating that tcount > ttable. There- fore, it can be concluded that students taught with the Problem-Based Learning model assisted by animated videos achieved significantly higher HOTS compared to those taught with expository learning ,

Keywords: *: PBL Model, Animation Videos, HOTS Abilities, Human Movement System.*

INTRODUCTION

Education is a major investment and a central issue for every nation, especially for developing nations that are actively building their countries such as Indonesia. Development can only be carried out by humans who are prepared for it through education (Wulandari & Surjono, 2013). Education is a human effort to develop innate potentials, both physical and spiritual, to obtain results and achievements so that they reach maturity and become complete human beings (Marshal, 2022). In Law No. 20 of 2003 Article 1, Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have spiritual religious strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation, and state.

21st-century skills required by students include solving real-life problems (Diani, Irwandani, Al-Hijrah, …, & 2019, 2018). Technology in education plays a crucial role in the

ongoing educational revolution. In 21st-century education, the 4.0 revolution no longer centers the teacher's role on the learning process, but rather on providing resources and media to meet students' learning needs (Rivaldi, Putra, & Putra, 2018).

The development of increasingly sophisticated technology must be matched by the progress of education in schools. Today, technology, with its advantages, facilitates fast and unlimited access to information, allowing students to easily obtain learning materials. Modern education utilizes technology as a tool, both in the form of media and learning resources, to acquire knowledge and facilitate human activities (Mulyono & Ampo, 2021).

In science learning, students are required to understand and explain the concepts and principles of science relationships to help them understand the environment and nature in everyday life. Students are also required to read the subject matter to effectively achieve learning objectives. Reading is a crucial component in the 21st century for survival in today's era of globalization.

Reading can be viewed as an interactive process between language and thought to understand learning concepts. Science learning is engaging and meaningful when using learning media that facilitates student comprehension. Much scientific knowledge is also expressed in written form, so students must have a strong interest in reading to acquire this knowledge (Sipayung, 2019).

Natural Science is a body of knowledge that explains natural phenomena. Essentially, science is a process, product, and scientific attitude. As a process, science means how knowledge is obtained; as a product, it means the results obtained in science; and as a scientific attitude, it means efforts to equip, train, and instill positive values in students. Students must be able to describe the origins of science products so that science is not merely a matter of memorizing natural phenomena. A good science learning process generally develops students' knowledge. Students are required to develop their knowledge in learning in the 21st century.

21. The 2013 curriculum, in particular, places greater emphasis on a scientific approach, with learning actively involving students to train them to develop their thinking skills. One of the skills developed in the 2013 curriculum is Higher Order Thinking Skills (HOTS). HOTS is a high-level thinking skill where the thinking process is not merely memorizing but also involves understanding and critical analytical thinking processes. HOTS is included in the highest level of cognitive learning outcomes in the realm of analyzing, evaluating, and creating. Students' HOTS will develop well if they can accept science learning, so a trigger is needed to encourage students to learn, namely student motivation for science (Syamsidah & Suryani, 2018).

Based on observations and interviews with a science teacher teaching grade VIII at SMP Negeri 12 Medan, the classroom learning process is teacher-centered and rarely implements the Problem-Based Learning model. The classroom learning model uses a conventional model. Teachers focus more on mastering the material and rarely use learning models that require students to make direct observations through investigative activities. This results in students being less active in the learning process and low ability to solve

problems in the form of analysis, Creating and inventing are components of higher-order thinking (HOTS). Students' low levels of higher-order thinking skills are also evident in daily test results that do not meet the minimum passing grade (KKM) (Sujiono, Handoyo, & Ruja, 2017).

Based on the above problems, to overcome them, a learning model is needed that can help and foster student interest in being able to learn a science material by having higher-order thinking skills. Inappropriate use of learning models can make students bored, monotonous and have difficulty in learning a learning material. Therefore, the model used must be appropriate to the objectives of a learning, the type of material to be taught and the expected students to have higher-order thinking skills. Therefore, a learning model is needed that is oriented towards students, so that they are able to develop higher-order thinking skills and solve problems faced in everyday life (Yahya, 2023).

Problem Based Learning is a learning method that uses real-life problems as a context where students can learn critically and are able to solve problems and master the basic concepts of the material. This learning is a learning model that seeks solutions to problems related to everyday life and develops students' way of thinking. Problem Based Learning (PBL) applies a learning approach that fosters critical thinking, problem-solving skills, and the application of information regarding real-world problems and situations. Through their own experiences, students will acquire the role of adults and develop creative thinking, problem-solving, and intellectual abilities through the use of the PBL approach. This is supported by the results of research conducted by AL-fikir et al (2018) that the application of the PBL model is very effective in improving critical thinking and problem-solving skills in students. The PBL model is effective for improving students' critical thinking skills because the purpose of this PBL model is not only to convey knowledge to students, but also to develop critical thinking and problem-solving skills (Farisi et al., 2017). Through the PBL learning model, students are expected to be able to create ideas/concepts using their own language and students are required to be able to find problems and solve them themselves, with the teacher as a facilitator.

The PBL model compared to other learning models has the following advantages: students are given their own tasks, thus encouraging them to take greater responsibility for their work and improve their knowledge and skills; they also discuss problems with friends in groups and are given challenges that exceed their abilities with collaboration between students with different levels of knowledge to help their learning (Setiawan, 2022).

According to research conducted by Masrudiah (2020) on the influence of the PBL model on students' higher-order thinking skills with the title "The Influence of the PBL Model on Elementary School Students' Higher-Order Thinking Skills" where the research results obtained were 71% of students were able to work on HOTS-based questions well as obtained from post-test scores. So it can be said that the PBL model has a positive effect on higher-order thinking skills. Furthermore, researchers combined the PBL model with media that sufficiently follows technological developments to be able to attract students' desire to learn, namely by using animated video media. This is based on the fact that computer

information and technology (ICT) is useful as an alternative in teaching using creative learning and innovation for the needs of creativity and innovation in educational devices. It focuses on three interrelated possibilities for change, namely, technology, culture, and pedagogy. Animated videos are animation and visualization programs, so they are very useful in science learning (Gong, Liu, You, & Yin, 2021).

Learning media that aligns with technological advances is expected to alleviate student boredom during the learning process. Media in learning functions as a tool to clarify messages delivered by teachers. Media also serves as an aid to individual learning, where the media's role is to fully serve students' learning needs. Therefore, learning media must be effective and efficient, tailored to their needs. Learning media that best suits the needs of 21st-century students today is computer-based learning media, one of which is animated video (Ulandari, Amry, & Saragih, 2022).

Based on the background of the problem above, the researcher is interested in conducting research with the title "The Effect of Problem Based Learning Model with Animated Videos on Students' HOTS Abilities in Human Movement System Material in Class VIII of SMP Negeri 12 Medan"

METHOD

This research was conducted at SMP Negeri 12 Medan JL. MH Thamrin No. 52, Medan Kota District, Medan City, North Sumatra 244267. This research was conducted in the 2024/2025 academic year.The population in this study was all 824 students in grade VIII at SMP Negeri 12 Medan.A research sample is a portion of a population. The sample is intended to describe the characteristics of a population in a study. The sampling technique used is random sampling. It is called simple because the sample members are drawn from the population randomly without considering the strata within the population (Flamboyant, Murdani, & Soeharto, 2018).

In conducting this research, the design used is pretest-posttest control group design. The type of research used is quantitative with a Quasi Experimental type involving two classes given different treatments, namely the experimental class was given a problem-based learning model with animated videos and the control class was given conventional learning to determine students' HOTS abilities by giving tests to both classes before and after being given treatment.

The interview technique used by the researcher was to find the problems to be researched. The researcher conducted an interview process with a science teacher at SMP Negeri 12 Medan to find out how the teacher carried out the learning process in class (Heng, 2018).

The tests used by the researchers in this study consisted of two tests: a pretest and a posttest. These tests were administered twice: before and after the treatment. The tests consisted of 20 multiple-choice questions (Khoiriyah & Husamah, 2018). The purpose of these tests was to identify the effects and differences between the use of problem-based

learning models on students' HOTS and expository learning models (Siagan, Saragih, & Sinaga, 2019).

Documentation is used by researchers as a tool for collecting written data or facts that will be presented as physical evidence of research that will strengthen the data used regarding the names of students who are members of the population and the list of grades for the science subject of class VIII at SMP Negeri 12 Medan.

RESULTS AND DISCUSSION

Description of Research Results

The research instrument was a test on students' HOTS abilities consisting of 25 multiple-choice questions with 4 options and a research instrument in the form of an observation sheet on students' HOTS abilities. The test instrument was declared valid by an expert validator, then tested on 30 students of grades IX-9 at SMP Negeri 12 Medan. The test instrument trial was conducted to determine the validity, reliability, level of difficulty, and discriminatory power of the test instrument, as explained below (Indriansyah, 2021).

The validity of the test is calculated using the product moment correlation. To interpret the validity value of each item, the value is adjusted to the r-product moment value table with a significance level of 5% = (α=0.05), with the criteria rhitung > rtable = 0.361. The results of the validity test for students showed that out of 25 questions, 20 questions were valid, namely questions number 1, 2, 4, 5, 6, 7, 9, 10, 11, 12, 13, 17, 19, 20, 24 and 25. The data from the test validity calculation results can be seen in appendix 7.

Test difficulty level analysis is used to find out whether the test used is included in the easy, medium or difficult categories. Based on the calculation of the 20 questions, there are 17 questions that are categorized as medium, and 3 questions that are categorized as difficult. Data on the results of calculating the level of difficulty can be seen in Appendix 9.

The ability of a question to differentiate between high-ability students and low-ability students can be measured from the discriminatory power of the test instrument. The results of the discriminatory power calculation using the discriminatory power formula with the help of a calculation table show that out of 20 questions, 11 are categorized as sufficient, 4 are categorized as good, and 5 are categorized as poor. Data on the results of the calculation of the level of difficulty can be seen in Appendix 10 (Harsela, 2023).

The reliability of the test is used to obtain the stability of the measuring instrument, so that if the measuring instrument is used it always gives consistent results. Based on the calculation results using the Kudar Richardson 20 (KR20) test, the calculated r is obtained

= 0.6344, where rtable = 0.35. The test reliability criteria can be determined using the calculated r > rtable criteria, so it can be concluded that the 25 questions are reliable. The test validity calculation results can be seen in Appendix 8.

Results of Data Analysis of Students' HOTS Ability Research

Experimental Class Value Data

The average pretest score of students in the experimental class obtained before being given the treatment of using the Problem Based Learning learning model with animated

videos was 45.833 with a standard deviation (SD) of 8.416 and after being given the treatment, the student's posttest score was 84.50 with a standard deviation (SD) of 6.740. This can be seen in graph (Syarhoh, Siddik, & Mulawarman, 2022).

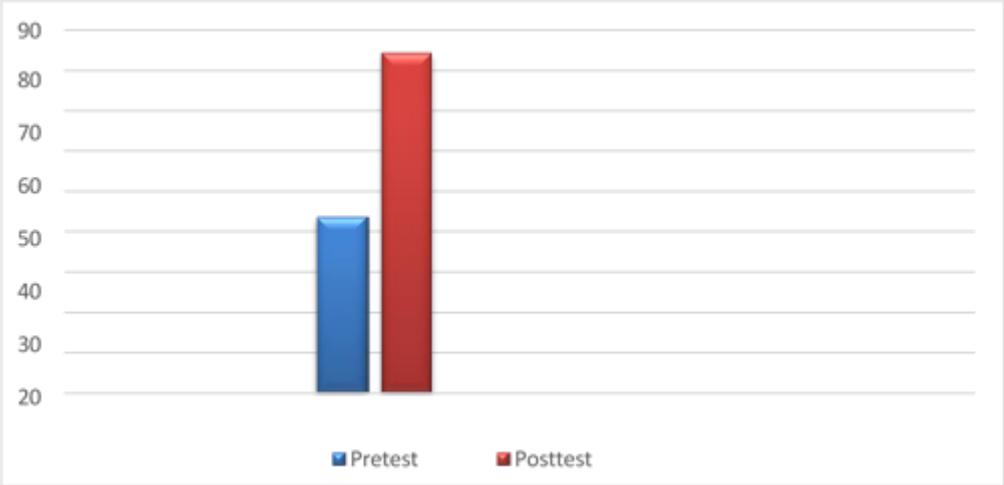

Figure 1. Differences in Pre-test and Post-test Scores for the Experimental Class

Data Values in the Control Class

The average pretest score in the control class obtained before the learning material was 44.167 with a standard deviation (SD) of 10.834 and after being given the treatment, the students' posttest score was 67.50 with a standard deviation (SD) of 10.728. This can be seen in graph 4.2. Complete data can be seen in appendix 12 (Pranata, Kartika, & Zulherman, 2021).

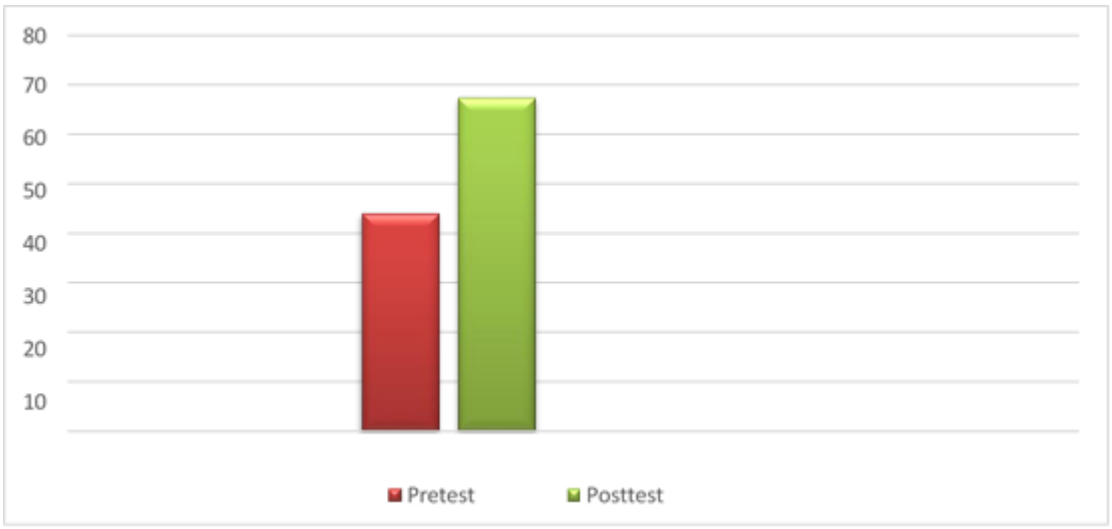

Figure 2. Differences in Pre-test and Post-test Scores of the Control Class

Based on Figure 4.2, the pretest and posttest scores in the control class show that the control class also experienced an improvement after the learning process. However, the scores achieved by students were higher in the experimental class than in the control class.

This indicates that the use of the Problem-Based Learning model with animated videos is superior (Kusumahwardani, Pramadi, & Maspupah, 2022).

The normality test was conducted using the Liliefors test with a significance level of α = 0.05. Where the results of the normality test for the pretest and posttest data of the experimental class and the control class showed normal results, as seen in table 4.1. For complete calculations, see 13. In the experimental class, L0 (X) < L or 0.155 < 0.161, so that the initial student ability data has a normal distribution. L0 (Y) < L or 0.147 < 0.156, so that the student learning outcome data is normally distributed. In the control class, L0 (X) < L or 0.136 < 0.161, so that the initial student ability data has a normal distribution. L0 (X) < L or 0.121 < 0.161, so that the student learning outcome data is normally distributed.

A data homogeneity test was conducted to determine whether the two sample groups came from a homogeneous population. Data homogeneity testing was conducted using the F test at a significance level of α = 0.05, which is briefly presented in (Haq, Purwantono, Irzal, & Rahim, 2022). Based on the calculation results, it is concluded that the pre-test value data obtained is F-calculated < F-table = 1.657 < 1.861, because the F-calculated value is smaller than F-table, it can be

It was concluded that the pretest learning outcomes of students from both classes had uniform (homogeneous) variance. In the posttest value data, the calculated F value < Ftable = 0.394 < 1.861 was obtained. Because the calculated F value was smaller than the Ftable, it can be concluded that the posttest learning outcomes of students from both classes had uniform (homogeneous) variance.

Hypothesis Testing (One-Sided Test)

Hypothesis testing of the research data results was conducted using a one-tailed t-test to determine whether there was an effect of the use of the problem-based learning model with animated video media on students' HOTS abilities. In this study, the average post-test was 84.50 for the experimental class and 67.50 for the control class. After hypothesis testing, the t-count value was 2.32 and the t-table value was 2.045. Thus, it can be concluded based on data analysis that the Ha hypothesis is accepted, namely t-count is greater than t-table, or 2.32 > 2.045. For complete calculations, see Appendix 15 (Syaifudin, 2019).

Learning Outcome Improvement (N-Gain)

The N-gain test of the research data aims to measure the extent of student understanding after being given learning. Before learning with the existing learning model and media, students were first given a pretest of 20 multiple-choice questions to determine their initial abilities. Then, at the end of the meeting, students were given a posttest with identical questions to determine their level of understanding. From the calculation results, an increase in learning outcomes (N-Gain) of 0.70 (70%) was obtained, which is briefly presented in Table 4.3. The results of the normalized N-gain test calculation of the pretest and posttest data can be seen in Appendix 16.

Table 1. N-Gain Calculation Results

Group	Pretest	Posts	N	N-Gain	Information
Experiment	45.8333	84.5	30	0.70	Currently

Discussion

This research was conducted at SMP Negeri 12 Medan, which was conducted by teaching directly or face to face in the classroom. This research involved two classes with different treatments, where in class VIII-3 as the control class was taught with an expository model with animated videos on the human movement system material, while in class VIII-8 as the experimental class was taught with a problem-based learning model with animated videos on the same material. The implementation of this research took place for three meetings. The first two classes were given pretest questions, and in the next meeting they were given different learning model treatments in each class and the final meeting in both classes was given a posttest. The pretest and posttest questions given had been tested for validity, reliability, discrimination power, and level of difficulty of the questions (Mahatir, 2021).

Learning in the experimental class begins when the learning materials are ready and the students are ready to begin learning. Previously, students have formed small groups. The first step in implementing this model is "orienting students to the problem." At this stage, students are asked to watch an animated video about the human locomotor system. Before entering the learning, at the beginning of the video, there is a problem related to the material, then students answer or find a solution to the problem in the video. The second stage is "organizing students to learn." At this stage, students who have been divided into several groups are given a Student Worksheet (LKPD) to work on. The third stage is "guiding individual and group investigations," where students are directed to discuss and work on the problems in the video after the material is explained in the video. The fourth stage is "developing and presenting results." Students are asked to present the results of their completed discussions, and representatives from each group present the results of their discussions (Septiani & Suyanti, 2022). The fifth stage is "analyzing and evaluating the problem-solving process." Students are asked to respond to the results of the presentations presented. In this study, the learning process was carried out in accordance with the steps of the problem-based learning model. The steps of the Problem Based Learning model used were orienting students to the problem, organizing students to learn, guiding individual or group experiences, developing and presenting work results, and analyzing and evaluating the problem-solving process, and were supported by research (Asma, Sesmiarni, Iswantir, & Aprison, 2022).

In this study, prerequisite tests were first conducted on the pretest and posttest data from the experimental and control classes using normality and homogeneity tests. Twenty validated multiple-choice questions were used. The results showed that the data were normally distributed and homogenous. This indicates that the experimental and control

classes had the same initial conditions. Furthermore, to determine the effect of the problem-based learning model on students' critical thinking skills, a hypothesis test was conducted.

In the initial understanding test, the experimental class obtained an average pretest score of 45.833. Meanwhile, the control class obtained an average pretest score of 44.167, a score that is relatively low. After being given learning using the problem-based learning model assisted by animated videos in the experimental class, the average student score increased to 84.50. Meanwhile, the average posttest score of the control class taught with the expository model assisted by animated videos was 67.5 with a lower increase than the experimental class (Huda et al., 2020). This means that the high-level thinking ability (HOTS) of students taught with the PBL model with animated videos is higher than the high-level thinking ability (HOTS) of students taught with the expository model with animated videos. The use of animated media in the learning process can improve students' high-level thinking ability (HOTS) which has been proven to be successful. This fact is supported by previous research which states that the use of MPBM assisted by animated videos has a positive impact on students' critical thinking abilities (Herayanti & Habibi, 2017). This research is in accordance with research conducted by previous researchers, namely research (Nuraini & Munandar, 2018) "There is an influence of MPBM assisted by animated media on students' critical thinking abilities in the form of increased abilities in terms of:(a) focusing questions, (b) analyzing arguments/identifying reasons, (c) inducing and considering the results of induction, (d) evaluating/assessing the results of consideration, (e) providing reasons" (Fauziah & Ninawati, 2022)..

Learning using the expository model is monotonous. Learning is one-way. Teachers in the expository model teach using lectures and explanations. Classroom learning initially runs smoothly, and students are initially enthusiastic about learning new material. However, over time, learning becomes less enjoyable and students quickly become bored. With the expository model, students are given less opportunity to develop their potential, so they can only address problems according to the teacher's instructions.

In the prerequisite test, namely the normality test, the pretest L count value was 0.155 and the posttest L count value was 0.147, while the normality test in the control class obtained a pretest L count value of 0.136 and a posttest L count value of 0.121 with an L table value of 0.161 with a significance level of 0.05. (Rachmawati & Erwin, 2022). From these data, it shows that the L count < Ltable then the pretest and posttest data are normally distributed. Then for the homogeneity test, the Fcount value for the pretest value is 1.657 and the Fcount for the posttest value is 1.861 with a significance level of 0.05. From these data, it shows that Fcount < Ftable, so the class of both classes is said to have a uniform or homogeneous variance. Furthermore, for the results of the hypothesis test, the tcount value is 2.32 and the ttable value with a significance level of 0.05 is 2.045. Where it is found that tcount > ttable is 2.32 > 2.045. So it can be concluded that H0 is rejected and Ha is accepted, then the HOTS ability of students with the problem-based learning model with animated videos is higher than the HOTS ability of students with expository learning with animated videos (Susila, Hidayat, Shohibul, & Rizky, 2024).

Based on the findings of this study, students' HOTS abilities on the material of human motion systems taught using the problem-based learning model with animated video media on HOTS abilities are higher than students' learning gains with expository learning. The same research findings were also obtained by Masrudiah, (2020) "There is an influence of the PBL model on high-order thinking skills of elementary school students, where the research results obtained were that 71% of students were able to work on HOTS-based questions well as obtained from post-test scores."

The improvement of students' HOTS abilities was measured using the N-gain test. Based on the data obtained, the increase in N-gain of students' HOTS abilities in the experimental class was higher than the control class. Based on the N-gain test, students' HOTS abilities in the experimental class before using the problem-based learning model with animated videos and after the learning treatment with the problem-based learning model with animated videos experienced an increase in learning outcomes (N-Gain) of 0.70 (70%) in the moderate category (Palimbong, 2021). A rapid increase occurred in post-treatment learning gains, the pre-test gains of students in the experimental class were 45.833, increasing in the post-test results to 84.50. Meanwhile, the pre-test results of the control class were 44.167, increasing in the post-test results to 67.50. The post-test results of these two classes indicate that learning using problem-based learning with animated video media can develop students' HOTS abilities. This is in line with research conducted by Suyanti et.al., (2024) "This research shows that the application of the Problem Based Learning (PBL) model combined with Animation Video media on Acid Base material in grade XI SMA can significantly improve students' HOTS literacy skills. This increase is especially seen in the reasoning aspect (C4), where students in the experimental group showed higher results compared to the control group". The same research was also conducted by Rahmadani et,al., (2025) "The average pretest and posttest of the experimental class were 41.8 and 80.02, while the control class was 41.0 and 73.2. The t-test results showed that both in the pretest (t count = 0.750 < t table = 1.99) and posttest (t count = 0.692 < t table = 1.984), there was no significant difference between the two classes. Thus, the PBL model using animated videos does not have a significant effect on students' high-level thinking skills on static electricity material."

This study also supports Sari et al.'s (Saleh & Woro Andhini, 2022) opinion that PBL enhances students' activeness, creativity, and critical thinking skills because they are challenged to solve problems, not simply receive information (Tullah, Widiada, & Tahir, 2022). The integration of animated videos into learning adds a concrete visual aspect, strengthening students' appeal and understanding of the material (Fakhri, Bektiarso, & Supeno, 2018). Overall, these results confirm that the application of the PBL model combined with visual media such as animated videos can improve the quality of science learning, particularly in the higher cognitive domain (Suprapto, Apriandi, & Pamungkas, 2019).

CONCLUSION

From the results of the research that has been carried out, it can be concluded that:

1. This study shows that there is an influence of the use of problem-based learning models with animated video media on the HOTS abilities of class VIII students on the material on the human movement system at SMP Negeri 12.
2. The combination of problem-based learning models and animated video media helps improve students' HOTS abilities.
3. Students who learn using the problem-based learning model with animated videos show a higher increase in HOTS compared to the expository model.

Suggestion

Based on the research results, discussion and conclusions above, the author provides the following suggestions:

1. For teachers and prospective teachers, it is hoped that they can apply learning by using the problem-based learning model with animated video media to improve students' HOTS abilities.
2. For future researchers, it is recommended to conduct research with different learning materials or media in an effort to increase learning independence and improve student learning outcomes.

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