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The Effectiveness of Application of the PBL Model Assisted by Powtoon Animation Media on HOTS Skills of High School Students on Momentum and Impulse Material

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ABSTRACT

The purpose of this research is to find out the High Order Thinking Skills (HOTS) ability of class X students after the application of the problem-based learning model assisted by Powtoon animation media and after the application of conventional learning models, as well as to find out which learning model is more effective in improving student HOTS class X. Research methods used are quantitative with quasi-experiment research design two group pretest-posttest. The population of this study was class X students at SMA Swasta Cerdas Murni, and the samples used were students of class X MIPA 1 as the experimental class and X MIPA 2 as the control class. Data collection was carried out with HOTS questions on the pretest and posttest. The results showed that the average pretest scores in the experimental and control classes were 37.4 and 35.5, respectively, while the average posttest scores obtained in the experimental and control classes were 80.7 and 75.2. The average N-Gain score in the experimental class is 0.70 and belongs to the "high" category, while in the control class, the average N-Gain score is 0.61 and belongs to the "medium" category. This study concludes that there is a better improvement after applying the problem-based learning model assisted by Powtoon animation to students' HOTS abilities so that the problem-based learning model assisted by Powtoon animation is more effective in improving students' HOTS abilities compared to conventional learning models.

INTRODUCTION

Education has long been used as a human foundation to provide welfare and advance civilization. The position of education is very concerning to the government. It can be seen from the Law of the Republic of Indonesia (2003) Number 20 concerning the National Education System, where education is interpreted as a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have spiritual strength, religion, self-control, personality, intelligence, noble character, and skills needed by himself, society, nation, and state. Based on the elaboration of the law, it is

stated that every educated person should be able to be active in developing his potential and study diligently. It is the basis for realizing quality education obtained by each individual, group, or system.

Realizing a quality education system is more challenging than imagined. There are still several aspects that need fixing, so it is difficult for some students in Indonesia to obtain a quality education. Even though in the 21st-century learning era as it is today, several skills are required to be mastered, such as collaboration, critical thinking and problem-solving, creativity, innovation, and communication where these skills are included in higher thinking skills or better known as HOTS abilities (Mulyasa & Fatmawati, 2018). Helmawati (2019) reveals that HOTS is one of the skills related to finding problems through creativity through observation, planning, and strategies for solving problems that teachers should teach students.

Mastery of HOTS abilities by students in Indonesia itself still needs to be solved. One of the main factors causing the low HOTS ability of students in Indonesia is due to the learning in most schools oriented toward teacher-centered teacher-centered learning systems (Suratno et al., 2020). several other aspects that contribute to the problem of students' low HOTS abilities are teaching staff, learning strategies, time, assessment, teaching materials, and use of ICT (Nurdyansyah & Fahyuni, 2016).

The problems described above are supported by the results of interviews obtained with one of the physics teachers, where students tend to be passive in learning physics dominated by mathematical concepts. The minimal use of media and teaching materials also supports the low participation of students in learning physics. Based on the results of these interviews, it can be seen that students' HOTS abilities still need to improve due to low student participation in learning. Therefore, to overcome this, it is necessary to apply innovative learning to arouse students' interest in participating in physics learning.

According to Saharsa et al. (2018), choosing the right learning methods, models, and media can stimulate students' thinking skills to create meaningful learning in the classroom. The problem-based learning model can spur students to be active in learning. Learning in the problem-based learning model is oriented towards a contextual problem where the problems given are taken from real life, which impacts students to be more able to understand a concept and physics principles in a natural form (Saharsa et al., 2018). According to Rusman (2012), the problem-based learning model is a model that can optimize students' thinking skills because this model has a syntax in which some of the learning activities are carried out in structured groups. It is supported by Wijayanti & Jatmiko (2022), who reveal that virtual learning that applies a problem-based learning model effectively increases students' HOTS abilities.

The problem-based learning model will be better if applied to learning media, especially technology-based learning media. In this study, the authors used Powtoon animation as a medium because Powtoon is an interactive medium that can present visual and audio content in the form of animated videos (Kurniasari et al., 2021). Several studies related to testing the feasibility of Powtoon animation revealed that this animation was considered feasible enough to be used as a learning medium.

Based on the problem description above, the authors want to conduct research related to applying the problem-based learning model assisted by Powtoon animation in learning physics. Therefore, the aims of this research were: 1.) To find out the HOTS abilities of class X students after applying the problem-based learning model assisted by Powtoon animation media in physics learning. 2.) find out the HOTS abilities of class X students after applying conventional learning models in learning physics. 3) Knowing which learning model is more effective in improving the HOTS abilities of class X students, problem-based learning models assisted by Powtoon animation media or conventional learning models.

METHODS

The method used in this research is quantitative with a quasi-experimental design. *Quantitative research methods* are studied used to examine certain populations or samples where sampling can be done randomly with research instruments as a tool for collecting data (Sugiyono, 2015). This study used two group pretest-posttest as a design to know students' HOTS abilities after applying the Powtoon animation-assisted problem-based learning model and to find out how effectively the Powtoon animation-assisted problem-based learning model improves students' HOTS abilities.

This research was conducted at SMA Swasta Cerdas Murni in the even semester of the Academic Year 2021/2022. The population in this study is class X and the sampling technique used is random cluster sampling; this technique was chosen because the population is not individual but consists of groups of individuals (clusters). From this sampling, it was obtained that class X MIPA 1 as an experimental class that applied the problem-based learning model assisted by Powtoon animation with a total of 32 students and X MIPA 2 as a control class that applied a conventional learning model with a total of 31 students. The variables in this study consisted of one independent variable and one dependent variable. The independent variable was the problem-based learning model assisted by Powtoon animation, and the dependent variable was students' HOTS abilities. In more detail, the following is a table of research designs from the two pretest-posttest groups:

Table 1. Two-Group Pretest-Posttest Research Design

Class	Pretest	Treatment	Posttest
Experiment	T_1	A	T_2
Control	T_1	B	T_2

Information :
T_1 = Initial test (pretest) in the experimental class and control class
T_2 = Final test (posttest) in the experimental class and control class
A = Learning by applying the problem-based learning model assisted by Powtoon
B = Learning by applying conventional learning models.

The instrument used in this study is the HOTS test instrument using Momentum and Impulse material validated by the validator. The test instrument was presented in the form of a pretest given before applying two different treatments and in the form of a posttest after applying two different treatments. The data analysis used in this study is the prerequisite test, which consists of the normality test and data homogeneity test. Furthermore, to prove the hypothesis that has been formulated, the n-gain score test is used in this study to see the average difference based on the pretest and posttest data obtained and the effectiveness of the two treatments based on the research hypothesis that has been formulated. The N-Gain score is a form of data analysis test. The N-Gain score test is carried out to find the difference in the average pretest data and posttest data in each group, both the experimental and control groups. In addition, the N-Gain score test is used to see the effectiveness of a learning system that has been implemented. The score distribution categories in the N-Gain test can be seen in Table 2.

Table 2. N-Gain Score Distribution Categories

Normalized Gain Value	Category
$\geq 0{,}7$	High
$0{,}3 \leq (< g >) < 0{,}7$	Medium
$< 0{,}3$	Low

(Hake, 1998)

RESULTS AND DISCUSSION

Results

This research was conducted at SMA Swasta Cerdas Murni to know students' HOTS abilities after applying the problem-based learning model assisted by Powtoon animation and conventional learning models on momentum and impulse material. Based on the research objectives set, the research data consists of the acquisition of pretest and posttest results in both the experimental and control classes. Then the data were analyzed using the prerequisite test, which consisted of the normality and data homogeneity tests. Suppose the data is declared normal and homogeneous. In that case, the data analysis process is continued with the n-gain score test to determine which treatment is more effective in increasing students' HOTS abilities. These data will be described in the following explanation.

1. Experimental and Control Class Pretest Results

The pretest results are an initial description of students' HOTS abilities before treatment in the form of a problem-based learning model assisted by Powtoon animation and conventional learning models in physics learning. Data from students' pretest results in the experimental and control class can be seen in Figure 1.

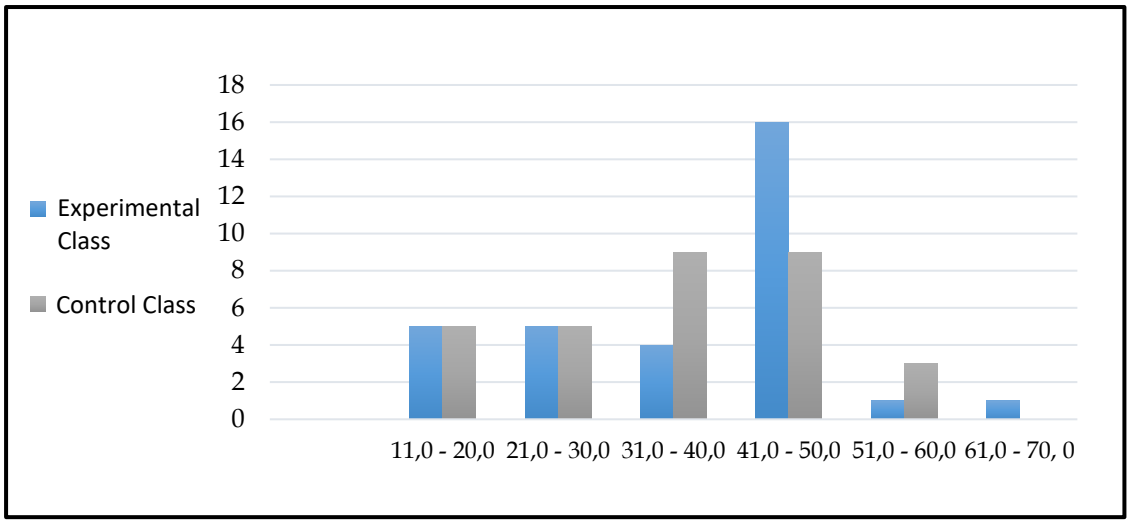

Fig 1. Experimental and Control Class Pretest Results

Figure 1 shows that the value intervals obtained by students in the experimental class applied the problem-based learning model assisted by Powtoon animation, and the control class applied the conventional learning model. The figure above shows that the acquisition of pretest scores in the experimental and control classes is similar. However, in some intervals, such as the value interval of 31.0 – 40.0, the pretest scores of control class students dominate

in these intervals. In comparison, the experimental class dominates the value interval of 41.0 – 50.0. The average pretest score in the experimental class was 37.4, with a standard deviation of 12.13. The average pretest score in the control class was 35.5, with a standard deviation of 12.18.

2. Posttest Class Experiment and Control Results

The posttest results are the final picture of the increase in students' HOTS abilities after being given different treatments using a problem-based learning model assisted by Powtoon animation media and conventional learning models in physics learning. Data on student posttest results in the experimental and control class can be seen in Figure 2.

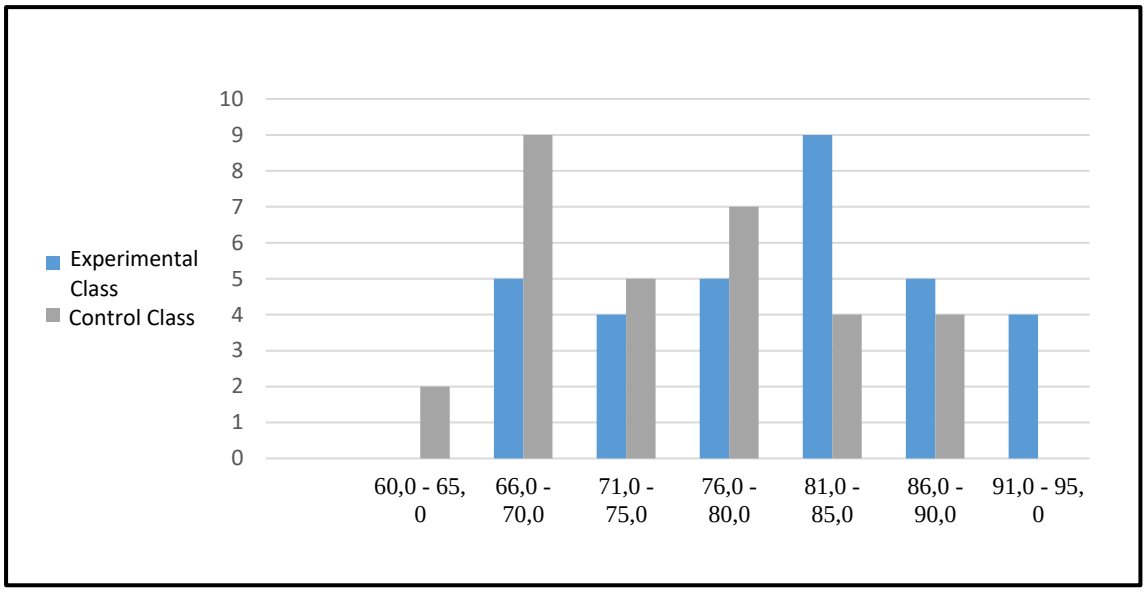

Fig. 2. Experimental and Control Class Pretest Results

Figure 2 presents the value intervals obtained by students in the experimental and control classes. The picture above shows that, in general, the acquisition of posttest scores in both the experimental and control classes has touched a fairly high-value interval, some of which even passed the Minimum Completeness Criteria (KKM) standard, which is a score of 70. As in the experimental class, which applies the media-assisted problem-based learning model, Powtoon animation dominates the value intervals 81.0 – 85.0 and 91.0 – 95.0. The average posttest score for the experimental class was 80.7, and for the control class, it was 75.2, with a standard deviation in the experimental class of 7.90 and the control class of 7.55. Based on the description of the data, it is known that the HOTS abilities of students in the experimental class that apply the problem-based learning model assisted by Powtoon animation media are superior to the control class that applies conventional learning models.

However, to measure the effectiveness of the two treatments by applying different models, the n-gain score test is needed in this study. However, before the data is analyzed using the n-gain score test, each piece of data should be confirmed through the prerequisite test stage, namely the normality and homogeneity tests. Here is the presentation.

3. Prerequisite Test Results

Normality test

The normality test was carried out to know whether the data (pretest and posttest) were normally distributed. In this study, the type of normality test used was the Liliefors test. The results of the normality test can be seen in Table 3.

Table 3. Normality Test Results

Group	Pretest Data		Posttest Data		Information
	L_{count}	L_{table}	L_{count}	L_{table}	
Experment	0,151	0,156	0,085	0,156	Normal
Control	0,094	0,159	0,05	0,159	Normal

Table 3 shows that the L_count pretest value in the experimental class is 0.151, and the L_{count} posttest value in the experimental class is 0.085. The value of L_{table}obtained from the number of students in the experimental class of 32 people is 0.156 with a significant level of $\alpha = 0{,}05$. From these data, it is known that $L_{count}<L_{table}$ which indicates that the two data in the experimental class are normally distributed. Furthermore, the normality test conducted in the control class obtained the result that the L_{count}pretest value in the control class was 0.094 and the L_{count} posttest value in the control class was 0.05. The L_{table} price obtained from the number of students in the experimental class of 31 people is 0.159 with a significant level of $\alpha = 0{,}05$. Based on the description of the data, it is known that $L_{count}<L_{table}$ which indicates that the two data in the control class are normally distributed.

Homogeneity Test

A homogeneity test was carried out to determine whether the pretest and posttest data in the two sample groups were homogeneous. Homogeneity testing in this study was carried out using the F test. Homogeneity test results can be seen in Table 4.

Table 4. Homogeneity Test Results

Group	Pretest Data		Posttest Data		Information
	F_{count}	F_{table}	F_{count}	F_{table}	
Experiment	1,020	1,828	1,209	1,834	Homogen
Control					Homogen

In Table 4 it can be seen that the F_{count} of the pretest data is 1.020 and the F_{table} is 1.828 at the significance level α = 0.05. In the posttest data, the F_{count}obtained was 1.209 and the F_{table} was 1.834 at the significance level $\alpha = 0{,}05$. Based on the description of the data, it is known that $F_{count} < F_{table}$ where it can be concluded that the pretest and posttest data in the experimental and control classes have the same homogeneous variance).

4. N-Gain Test Results

The N-Gain Score test was conducted to find out whether there was an increase in students' HOTS abilities in two classes given different treatments. In addition, the ¬n-gain test was carried out to see whether the problem-based learning model assisted by Powtoon animation media effectively increased students' HOTS abilities. The results of the n-gain score test in the experimental and control classes can be seen in Table 5.

Table 5. Result of *N-Gain Score*

Class	N-Gain Score	Category
Experiment	0,70	High
Control	0,61	Medium

In Table 5, it can be seen that the average n-gain score in the experimental class is 0.70, where this value is included in the "high" category. However, in the control class, the average n-gain score in the control class is 0.61, which is in the "moderate" category. Based on the acquisition of the n-gain score, it can be concluded that the class that applies the problem-

based learning model assisted by Powtoon animation media has better HOTS abilities than the class that applies the conventional learning model.

Discussion

The results obtained in this study indicate that applying the problem-based learning model assisted by Powtoon animation media is more effective in increasing students' HOTS abilities than conventional learning models on momentum and impulse material. This statement is supported by the results of research that has been done where the experimental class that applies the problem-based learning model assisted by Powtoon animation media has an average pretest score of 37.4 and an average pretest score in the control class is 35.5. The average yield is similar in line with research conducted by (Derlina&Sitepu, 2018). Based on the pretest results, the student's initial HOTS abilities in both the experimental and control classes were similar. However, after obtaining the posttest results, it was found that the average posttest score for the experimental class was 80.7, and the average posttest score for the control class was 75.2, where there was a significant difference in the results between the experimental class and the control class.

However, more than this difference is needed to test the effectiveness of the two treatments that have been applied. Research conducted by Nashiroh et al. (2020) revealed the effectiveness of implementing the two models using the n-gain test. Based on the n-gain test that has been carried out, it is known that the average n-gain score in the experimental class is 0.70, and this score belongs to the "high" category. In the control class, the average n-gain score obtained was 0.61, and this score was included in the "medium" category. Based on these results, it is known that the problem-based learning model assisted by Powtoon animation media is more effective in increasing students' HOTS abilities compared to classes that apply conventional learning models.

There is an increase in students' HOTS abilities in physics learning that applies the problem-based learning model assisted by Powtoon animation media, one of which is caused by the characteristics of the problem-based learning model, which is oriented towards problem-solving. It aligns with research conducted by Suratno et al. (2020), where research revealed that the main focus of learning in the problem-based learning model is skills in solving various real problems given to students. HOTS ability is needed in problem-solving because, in HOTS ability, several thinking skills are accumulated, such as critical thinking, creative, logical, and other abilities. The statement above is also in line with research conducted by Kafiar et al. (2021), which revealed that solving problems in the problem-based learning model using HOTS abilities can be done by students both individually and in groups (teams). In addition, another factor that increased students' HOTS abilities was the syntax of a more varied and scientific learning model. It is supported by research conducted by Komariah et al. (2019: 104) and Annisa & Derlina (2021), which revealed that the syntax in the problem-based learning model could stimulate students to learn and work to solve a problem in groups. Another visible impact of the learning experienced by students is that the ability to explore and process information increases quite rapidly. Research conducted by Wijayanti&Jatmiko (2022: 153) revealed that students' ability to process information when applying the problem-based learning model can make it easier for them to understand various concepts, especially physics concepts, some of which have quite complex concepts so that students are more flexible in finding solutions to solve problems and draw conclusions.

The selection of learning media contributes to perfecting the application of problem-based learning models in the classroom. Technology-based learning media is quite common in this era, where this media can create quality and meaningful learning areas. Research conducted by Sari et al. (2021) also supports the application of technology-based learning

media, where in their research; it is revealed that choosing this type of learning media can support the problem-based learning model principle that wants all students to participate in learning. The choice of Powtoon as a learning medium is also seen from its feasibility. Its varied features can assist users in creating interesting content in terms of content material, animation, fonts, colours, and other components. The feasibility of using Powtoon as a learning medium has been tested by several experts, such as Farizi et al. (2019) and Ningsih&Fitria, (2021), which revealed that Powtoons fall into the appropriate and valid category to be used as learning media. It was proven in this study that the posttest results were obtained, which revealed that students' HOTS abilities increased rapidly after applying the problem-based learning model assisted by Powtoon animation media.

CONCLUSION

Based on the data analysis that has been carried out and presented, it is known that the HOTS abilities of class X students at Smart Pure Private High School T.A 2021/2022 in physics learning that apply the problem-based learning model assisted by Powtoon animation media with momentum and impulse material have improved better compared to HOTS abilities of students who apply conventional learning models. This statement is supported by the results of the average pretest scores and the average posttest scores in the experimental class were 37.4 and 80.7, respectively. Meanwhile, the control class's average pretest and posttest scores were 35.5 and 75.2, respectively. In addition, the results of the average N-Gain score obtained by the experimental class were 0.70, where this value was included in the "High" category, and the average N-Gain score of the control class was 0.61 and included in the "Moderate" category. Based on the data presented, the problem-based learning model assisted by Powtoon animation media effectively improves students' HOTS abilities. Several aspects affect students' HOTS abilities after applying the problem-based learning model assisted by Powtoon animation media; namely: the learning model focuses on problem-solving, scientific learning stages, and the selection of innovative and appropriate media to use. The development of learning by applying the problem-based learning model accompanied by Powtoon animations hopes to inspire educators to maximize the application of technology in systems previously designed in the field of education, especially in physics subjects that require strong thinking skills.

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