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the Influence of a Generative Learning Model Based on Wave Material Cognitive Conflict on Student Learning Outcomes at Sman 5 Payakumbuh

Novia Agustin[1], Akmam[1*], Yenni Darvina[1], Renol Afrizon[1]

[1] *Department of Physics, Universitas Negeri Padang, Jl. Prof. Dr. Hamka Air Tawar Padang 25131, Indonesia*
Corresponding author. Email: akmam_db@fmipa.unp.ac.id

ABSTRACT

Student learning outcomes in Physics subjects, especially in Wave material, are still low. This is caused by the learning model used in the Wave material not being being the process standards and characteristics of wave learning objectives. A generative learning model based on cognitive conflict is one approach to solving the aforementioned issue. The purpose of this study is to ascertain how student learning outcomes at SMAN 5 Payakumbuh are affected by the use of a generative learning model based on cognitive conflict in Wave content. The type of research is quasi-experimental research with a pretest-posttest Control Group Design. The participants in this study were all SMAN 5 Payakumbuh science class XI students. The information gathered reflects the attitudes, knowledge, and abilities of the pupils toward learning. Two averages are tested for equality as a data analysis technique. The study's findings demonstrate the notable distinctions between classrooms that employ the Problem-Based Learning model and those that employ the Generative learning model based on cognitive conflict.

The average student learning outcome in classes that apply the Generative learning model is 83.14 and in classes that apply the Problem-Based Learning model is 77.26. The influence of the generative learning model based on cognitive conflict can be seen in the learning outcomes of students who have been analyzed and hypothesis tested. Based on the hypothesis test, the t_{table} is 2.006 and the t_{count} is 2.1. The condition for H_0 to be rejected is if $t_{table} < t_{count}$. The tcount value is within the rejection of H_0, so H_I is accepted. Because all variables are controlled, except the learning model, it can be said that the application of the Generative learning model based on cognitive conflict in Wave material has a positive effect on student learning outcomes.

Keywords: Generative Learning Model; Waves; Learning Outcomes**.**

I. INTRODUCTION

Education is a process by which humans develop themselves, so that they can face all changes and problems with an open attitude. Education can be realized in the learning process. Learning is an interaction process carried out by students with educators, students with students, students with learning resources, and students with the surrounding environment. This interaction aims to produce students' insight and knowledge. This can be applied to the Physics learning process. Physics lessons are a subset of science lessons that look at topics connected to natural processes that occur in and around us[1]. This means that physics lessons are lessons related to objects and events that occur in nature and are very close to everyday life.

Based on preliminary research, real conditions are different from theory. There are three things explained in this research, namely the learning process, learning model, and learning outcomes achieved. The learning process carried out in schools should be guided by the 2013 curriculum. However, in real conditions, the learning model used by educators in the Wave material is not optimal for carrying out learning by the standards of the learning implementation process. The problem is the student's ability to reason. When the teacher explains physics concepts, only a few students can understand the concept[2]. Students are not yet optimal in building their own knowledge. This can be seen from the still weak ability of students to assimilate existing knowledge to form new knowledge. This has an impact on students' activeness which will make them have a low ability to question things. This makes students' interest in studying physics low and results in students being less active in

implementing the teaching and learning process[3]. There is a difference between theory and real conditions. To solve this problem researchers have alternative ideas. The idea is to implement a Generative learning model. Generative learning models are learning models that explain how data is generated in several alternative ways[4]. The syntax of the Generative learning model is orientation, cognitive conflict, disclosure, construct, application, and reflection evaluation[5]. Generative learning models can improve students' creative thinking abilities and understanding of concepts.

The Generative learning model connects students' initial knowledge with new knowledge obtained through the thinking process and their active role in learning. The Generative learning model has parts, namely the sequence of learning steps (syntax), reaction principles, social system, and support system[6]. The implementation of a generative learning model requires these four essential elements. Employing the generative learning model has consequences; these consequences comprise the learning impact, which takes the shape of quantifiable learning outcomes, as well as the leading impact, which is also education outcomes[7],[5]. It is envisaged that after completing the stages of the generative learning model, students will possess the information and capacities to expand on their own[8].

Student learning outcomes are measured by instruments. This aspect includes learning outcomes of attitudes, knowledge, and skills. Knowledge learning outcomes are assessed using written examinations in the form of pre-tests and post-tests at the conclusion of the learning process, whereas attitude learning outcomes are assessed using attitude assessment observation sheets during the learning process. The process of evaluating skills learning outcomes involves employing a skills assessment methodology and a scoring rubric. This study intends to ascertain the impact of the generative learning model on the learning outcomes of high school students.

II. METHOD

This kind of study is known as a quasi-experiment. A population is a large group of objects with particular characteristics that the researcher has selected to be studied and the basis for findings[9]. The research population consists of all SMAN 5 Payakumbuh class XI students enrolled in Semester 2 of the 2021–2022 academic year. A sample is a portion of the population that will be taken, both in terms of number and characteristics[10]. Purposive sampling was the method used for sampling in this study. The primary feature of purposive sampling is that the sample is drawn from the same teacher's classes, study schedules that are close together and have almost the same mid-semester exam average[11]. Based on the techniques that have been carried out, XI IPA 1 and XI IPA 2 were determined as samples. In this study, two samples are used. During the learning process, the control class employs a problem-based learning model whereas the experimental class uses a generative learning model.

The instrument used to assess attitude learning outcomes is an observation sheet. Every meeting, an assessment of the attitude learning outcomes is conducted to ascertain the attitudes of the students during the learning process. The scope of the attitude assessment instrument is divided into two, namely spiritual attitudes and social attitudes[12]. The learning outcomes in this research for aspects of students' attitudes that are assessed are limited to four aspects including honesty, curiosity, discipline, and cooperation. The knowledge learning outcome instrument in this research is a written test with multiple choice question sheets accompanied by five answer choices which is carried out at the end of the research. In this research, the test instrument uses 25 questions in objective form, aiming to determine the level of understanding of students. Knowledge learning outcomes are assessed via written examinations in the form of pretests and posttests at the end of the learning process[13]. Skills learning outcomes are assessed using a scoring rubric in a skills assessment framework. While discussion activities are taking place, student learning outcomes in the skills area are being assessed. There are four skill indicators that are assessed during learning. The four indicators assessed are observing, asking questions, processing information, and communicating using a discussion assessment sheet.

III. RESULTS AND DISCUSSION

A. Results

In the even semester of the 2021–2022 academic year, from March 7–May 9, 2022, the research was conducted at SMAN 5 Payakumbuh. Class XI Science 1 served as the experimental group and class XI Science 2 served as the control group in this study. Students' physics learning outcomes, which included attitude, knowledge, and skill learning outcomes, were collected as research data based on the conducted study. Knowledge learning outcomes are assessed using written examinations in the form of a pretest and posttest at the conclusion of the learning process, while attitude learning outcomes are assessed using attitude assessment observation sheets during the learning process. The process of evaluating abilities and learning outcomes involves using an assessment tool[14].

The three research elements' findings demonstrated that the experimental class and the control class had significantly different learning outcomes. This discrepancy suggests that the experimental class's use of the Wave material's Generative Learning Model had an impact on the learning results of the students. These outcomes are from a study of the data. Analysis was done using statistical hypothesis testing for student learning outcomes prior to making inferences from the research findings. According to data analysis, the three components of the data have homogeneous variance and are normally distributed, meaning that the equality of averages test—which compares two averages—is the appropriate method for testing the hypothesis.

The student learning outcomes that were attained following the administration of the pre- and post-tests in both classrooms demonstrate the study's conclusions from the use of the generative learning model based on cognitive conflict. The study's findings demonstrate the notable variations in students' learning outcomes across classes using the PBL (Problem-Based Learning) model and those using the Generative learning model based on cognitive conflict. Starting with the normality test, which is shown in Table 1, data analysis was done using the post-test results for both samples.

Table 1. Calculation Results of the Normality Test for Students' Knowledge Aspects

Class	α	N	Lo	L_t	Description
Experimen	0,05	28	0,106	0,167	Normally Distributed Data
Control	0,05	27	0,136	0,171	Normally Distributed Data

Based on Table 1, shows that the data obtained from the post-test results in the two sample classes are normally distributed. It is shown that $L_0 \leq L_{tabel}$ so it can be concluded that the two experimental classes are normally distributed. Next, the two sample groups were tested for homogeneity. The purpose of this is to determine whether or not homogenous variance accounts for the knowledge competency value data for the two sample classes. The F test, a homogeneity test, was applied in this investigation. Table 2 displays the homogeneity test results for the two sample groups.

Table 2. Calculation Results of the Homogeneity Test for Students' Knowledge Aspects

Class	Varians	F_{count}	F_{table}
Experiment	106,50	0,97	1,921
Control	110,2		

Based on Table 2, shows the $F_h < F_t$ value for both sample groups. This shows that the two sample groups have homogeneous variance. Once it is known that the student's final test result data is normally distributed, a t-test is carried out. To determine whether or not the two sample classes have the same beginning ability, perform a similarity test using two averages for each sample class. Table 3 displays the outcomes of the comparison between the two averages.

Table 3. Results of t-test calculations for student knowledge aspects

Class	N	A	$\bar{X}$	S^2	T_{count}	T_{table}

Experiment	28	0,05	83,143	106,4974	2,1	2,006
Control	27	0,05	77,26	110,199		

Table 3 explains that the results of the average similarity test after carrying out the posttest obtained a value of t_{count} = 2.1 which is within the rejection of H_0. The acceptance criteria for H_0 are or Therefore H_0 is rejected and Hi is accepted $-t_{1-\frac{1}{2}\alpha} < t_h < t_{1-\frac{1}{2}\alpha} - 2{,}006 < 2{,}1 < 2{,}006$. Based on this, it is claimed that there is a substantial difference between the experimental group's and the control group's final exam results when using the Wave material's generative learning model. Therefore, boosting student learning results at SMAN 5 Payakumbuh by the deployment of the Generative learning model based on the cognitive conflict in Wave content is successful.

Assessment of learning outcomes of students' attitudes was carried out using observation sheets during learning activities that took place in 8 meetings. The learning outcomes of students' attitudes that are assessed are limited to four aspects including honesty, curiosity, discipline and cooperation. The attitude learning outcome data taken is the average of each attitude indicator at each meeting for the two sample classes as seen in Table 4.

Table 4. Student Attitude Values Per Meeting

Class	Meeting							
	1	2	3	4	5	6	7	8
Experiment	67.99	67.99	67.99	67.99	67.99	67.99	67.99	67.99
Control	65,735	65,735	65,735	65,735	65,735	65,735	65,735	65,735

Table 4 demonstrates that the experimental class's average score on all attitude-related items is greater than the control class's. Weekly average attitudes in the experimental class increased from 67.99 to 73.27, while those in the control class increased from 65.73 to 70.16. For the two sample classes, the average value of each attitude indicator at eight meetings went up week by week. Appendix 19 displays the findings from the examination of the attitude scores of the pupils. Table 5 displays the average scores for each of the four indicators—honesty, curiosity, discipline, and cooperation—for the attitudes of the students in the Experimental class and the control class.

Table 5. Student Attitude Values Per Indicator

Class	Indicator			
	Honest	Curiosity	Discipline	Cooperation
Experiment	70.63	70.63	70.63	70.63
Control	67.78	67.78	67.78	67.78

Table 5 shows that the experimental class's average score for each of the four indicators—honesty, curiosity, discipline, and cooperation—is greater than the control class's score for the same attributes. The normality, homogeneity, and similarity tests of the two averages were then performed as follows, following the analysis of the average attitude values for the two sample classes.

Table 6. Calculation Results of the Normality Test for Attitude Aspects

Class	α	N	Take a look	Lieutenant	Information
Experiment	0.05	28	0.109	0.167	Normally Distributed Data
Control	0.05	27	0.161	0.171	Normally Distributed Data

The data in the two sample classes are normally distributed, according to Table 6, which is based on the examination of average attitude observations. To ascertain whether or not the sample class is drawn from a homogeneous population, a homogeneity test is then conducted. Table 7 displays the results of the homogeneity test, which was performed by comparing the Fcount and Ftable values.

Table 7. Calculation Results of the Homogeneity Test for Attitude Aspects

Class	Variant	Count	Ftable
Experiment	8.09	0.68	1,921
Control	11.89		

Based on Table 7, it shows that the value of $F_{count} < F_{table}$ in both sample groups. This shows that the two sample groups have homogeneous variance. Once it is known that the students' final test result data is normally distributed, a t-test is carried out. Perform a similarity test of two averages on two sample classes to see whether the two sample classes have the same initial ability or not. The results of the second average similarity test can be seen in Table 8.

Table 8. Results of t test calculations for aspects of student knowledge

Class	N	A	X	S2	Count	Table
Test	28	0.05	83.143	106.4974	2.1	2,006
Control	27	0.05	77.26	110,199		

Table 8 shows the value of T_{count}= 1.626 while T_{table}= 2.006. The acceptance criterion for H_0 is that it is in the H_0 acceptance area. Based on this, it can be concluded that the two sample classes have the same average learning outcomes for the attitude aspect. Therefore, H_0 is accepted and H_i is rejected, meaning that there is no difference in learning outcomes in the attitude learning outcomes aspect of the two samples due to the treatment given.$-t_{1-\frac{1}{2}\alpha} < t_h < t_{1-\frac{1}{2}\alpha}\ atau\ -2{,}006 < 1{,}626 < 2{,}006$.

B. Discussion

The results of students' creative thinking are a good way to gauge how well the generative learning paradigm is being implemented. In this study, two sample classes are used. The assessment class employs the generative learning model, whereas the control class uses the problem-based learning model. The results of the study showed that student learning outcomes in the two sample classes had improved after the pretest and posttest were administered. The pre-test and post-test results for the experimental class are 61 and 83.14, respectively, while the results for the control class are 59.27 and 77.26.

Assessment of learning outcomes of students' attitudes was carried out using observation sheets during learning activities that took place in 8 meetings. The learning outcomes of students' attitudes that are assessed are limited to four aspects including honesty, curiosity, discipline, and cooperation. The research results on the attitude aspect include four indicators, namely the first indicator, namely the assessment of students' honest attitudes when carrying out assignments given by the teacher while learning is in progress. The results demonstrate that the experimental class outperformed the control group in terms of score. Honesty can be understood as the behavior of avoiding cheating in completing academic assignments . This means that applying the right model can help students to better understand the subject matter to avoid cheating behavior.

The second indicator is assessing students' curiosity, this indicator aims to see how students interact in the classroom to ask questions and provide opinions during the learning process[15]. Students in the experimental class exhibit a higher level of curiosity compared to those in the control class, albeit still quite low. The fact that kids are not very interested in asking questions when they are studying is evidence of this. Curiosity is defined as an attitude and behavior that always aims to learn as much as possible about something that one learns, sees, or hears[16].

Curiosity is the drive to look into and try to make sense of things that happen[17]. Based on this understanding, it can be concluded that curiosity is a natural emotion that exists in humans to investigate and find out more deeply about something being studied. Curiosity will make students continue to find out about what they have not or did not know before. Students will always try to find out by getting lots of new information and knowledge to broaden their insight. Students' interest in learning will undoubtedly be piqued by the implementation of the generative learning model since it places a strong emphasis on the active integration of

students' existing knowledge with the content they study through their active participation in the learning process.

An evaluation of students' disciplinary attitudes with reference to their attendance in class and accuracy while entering is the third indicator. Students' attitude assessments in the experimental class yielded better outcomes than those in the control group. This can be seen when students have high enthusiasm for learning and are not late for class. This is in line with what was stated by Hodges who said that discipline can be interpreted as the attitude of a person or group who intends to follow the rules that have been set.

The fourth indicator is the assessment of students' cooperative attitudes in students' interactions with fellow group friends during learning. Cooperation, is frequently also referred to as partnership, and it denotes a plan of action carried out by two or more parties over a predetermined length of time in order to obtain benefits with the guiding principles of mutual need and growth[18]. Cooperation is the result of two or more individuals working together to accomplish a common objective in an integrated way. From this definition, it can be concluded that cooperation is the activity of two or more people to achieve mutually agreed goals within a certain period. Based on research, one of the questions in the LKPD that is used is working on questions in groups. By working on questions in groups, students learn a lot about socialization, leadership, and their own existence. Each group works together to find the correct answer so that healthy cooperation emerges.

The average of each attitude indicator during each meeting for the two sample classes is the attitude learning result data that was collected. The study's findings demonstrated that the experimental class's average score on all attitude-related dimensions was greater than the control group's. Weekly average attitudes in the experimental class increased from 67.99 to 73.27, while those in the control class increased from 65.73 to 70.16. For the two sample classes, the average value of each attitude indicator at eight meetings went up week by week. The application of the wave material generative learning model on the learning outcomes of students at SMAN 5 Payakumbuh was found to have no effect in the attitude learning results because the two sample classes were already recognized as having good attitude competence prior to the generative learning model's application.

Assessment of student learning outcomes in the skills aspect is carried out while discussion activities are in progress. There are four skill indicators that are assessed during learning. The four indicators assessed are observing, asking questions, processing information, and communicating using a discussion assessment sheet. Student learning outcomes in the skills aspect are obtained through a scoring rubric. There are four skill indicators that are assessed during learning. The four indicators assessed are observing, asking questions, processing information, and communicating using a discussion assessment sheet. Based on the research results, the average value per indicator for the skill aspect of the experimental class shows that it is superior to the control class.

The application of this research revealed a number of challenges. The first challenge is that students require early direction in the meeting because they are not accustomed to working out difficulties on their own. The second obstacle is that students are not able to manage their time well, such as when sitting in groups, students will use quite a long time so that for the next meeting, students are allowed to sit in groups immediately at the beginning of the lesson so that it doesn't take a long time. The third obstacle is that there are meetings whose schedules have been moved to the afternoon after school hours due to school events involving students. This change in schedule means that students' enthusiasm for learning is not as effective as when studying according to the school schedule. Another obstacle is the difficulty of generating cognitive conflict in students.

IV. CONCLUSION

Based on the research results, it show that there is an influence of the application of the cognitive conflict-based Generative learning model on the knowledge and skills domain of students, and there is no significant influence on the domain of students' attitudes. Generative learning based on cognitive conflict can help students understand concepts well and improve learning outcomes.

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