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Implementation of Generative Learning Models with Probing Question Methods in Static Fluid Learning

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ABSTRACT

Learners who cannot connect the new knowledge received with previous knowledge will find it difficult to understand learning, causing low learning outcomes. The solution offered is to apply a generative learning model with the probing question method. The purpose of the study was to determine the effect of applying a generative learning model with probing question method on the learning outcomes of students in Static Fluid material class XI. The type of research is Quasi Experimental. The study population was all students of class XI Science. Sampling using purposive sampling technique. The research sample is XI Science 4 class as an experimental class and XI Science 5 class as a control class. A written page in the shape of an objective serves as the tool. The findings revealed a substantial contrast between classes using PBL learning models with probing question techniques and classes using generative learning models with these techniques in terms of the learning outcomes of the students. When compared to the control class, the experimental class's average learning outcomes were 81, while it was 78.4. At a significant threshold of alpha = 0.05, it was determined that t_{count} *= 8.704 and* t_{table} *= 1.995 based on the equality test of the two averages. If* $t_{table} < t_{count}$*, then* H_0 *must be disregarded. The significance of* t_{count} *lies in the rejection of* H_0 *and acceptance of* H_1*, which demonstrate that the generative learning model with the probing question method has a beneficial impact on learning outcomes.*

Keywords: *Generative Learning Model, Probing Questions, Learning Outcomes*

I. INTRODUCTION

Learning strives to enhance students' learning processes and consists of a sequence of activities that are planned and organized to do so[1]. Physics is one of the courses that students study. The study of environmental and natural events is the emphasis of the science discipline of physics[2]. Physics is a topic that investigates phenomena in nature[3]. Learning physics involves abstract concepts[4]. The goal of learning physics is to help students develop their cognitive abilities so that they are not only proficient in the psychomotor and cognitive domains but also able to facilitate thinking that is organized, critical, and creative. Because physics is more impressed with many formulas, some students frequently see physics lectures in school as being tough.

.In order to improve students' ability to reason as they acquire knowledge, critical thinking abilities must be incorporated into learning in order to meet the needs of the twenty-first century. Students are less critical and involved in the learning process than is actually the case; they merely listen to the teacher explain without understanding what is being taught, forget it in the next lesson, and repeat the process the next time. This is reflected in the small number of students who actually ask questions, which results in poor learning outcomes. In order to create new information, learners have not been able to combine their prior knowledge with the knowledge they acquire during the learning process. The quality of learning has not improved as a result of the applied learning paradigm. Good education necessitates a good learning model as well; it must be highly relevant. Even though the content is sound, the learning model is uninteresting, therefore don't hold your breath for sound learning outcomes. The learning model is interesting, but the methodologies and approaches employed are poor, which will also affect how entertaining the learning is[5,6]. It can be necessary to use strategies and models that are distinct from those used for other types of learning in order to foster an environment that is conducive to learning and pleasurable. To improve the quality of learning, innovative, skilled, and entertaining educators need to have a variety of ideas and strategies[7,8]. The development of emotional intelligence, the development of creativity in learning, the application of love-based discipline, igniting the desire to learn, problem-solving, the use of learning resources, and student participation are some methods to improve the quality of learning, among others[9]. It is possible to raise the standard of learning in a number of ways, one of which is to raise educational standards in general[10]. The learning model can be updated in order to increase the learning experience's quality.

This learning model's purpose is to serve as a manual or guide for educators and learning designers while creating or carrying out learning activities[11]. Prior knowledge is the primary prerequisite for learning, and one of the reasons why students struggle to comprehend some concepts is because the new information they are receiving does not relate to their prior knowledge, which inhibits their ability to think critically[12]. This tendency worries that because comprehension has not improved as seen by the poor learning results, pupils' abilities will not develop. This implies that there are issues with how physics is taught in schools, and that efforts must be made to get pupils involved in the learning process. This problem can be resolved by implementing the proper learning models, techniques, and objectives. According to the generative learning paradigm, this perspective is valid. Linking fresh concepts to the learners' current body of knowledge is the aim of the generative learning model.

The generative learning model is a method of instruction that places an emphasis on a more engaging and relevant classroom learning environment so that students may actually feel what they are learning[13,14]. The generative learning model is a teaching strategy that gives students the opportunity to independently construct new material concepts by utilizing their prior knowledge to produce aspects of memory, integration, organization, and elaboration[15]. Through a generative learning strategy, students have the chance to strengthen their social skills, develop their thinking abilities, and gain solid knowledge[16]. When a learner receives, processes, stores, and retrieves information from their memory, they are engaging in a set of mental actions known as the thinking process[17]. Processing takes place during thinking between incoming information and the human brain's cognitive structure, or schema. Through the assimilation or accommodation process, new information and experiences will be processed with adaption[18].

Assimilation and accommodation will take place as a result of the deployment of generative learning models in learning. Assimilation is the process by which new knowledge is incorporated into the learners' pre-existing cognitive framework. The assimilation does not alter the learners' prior knowledge or schema; rather, it develops the created schema. In other words, the accommodation process involves modifying existing schemes to suit them with new scenarios that do not fit with existing schemes[19]. This assimilation and accommodation process will result in a range of new knowledge that learners will own. The assimilation and accommodation process, which finally results in the production of new knowledge for learners, will be supported by educators who have a wealth of knowledge, students who have a good way of thinking, and complete facilities in the learning process.Remembering, integration, organization, and elaboration are the four components of the generative learning paradigm. Four essential components of the generative learning model are the motivation process, learning process, knowledge development process, and generation process[20].

The six components of Akmam 2022's generative learning model with cognitive conflict strategy directed to creative thinking are orientation, cognitive conflict, disclosure, construct, application, and reflection. The orientation syntax includes information on learning materials that educators use to encourage and prepare students. How educators present problems to students is described in this problem delivery syntax. By giving students a stimulus based on the problem and delivering the problem, educators help students develop solutions to these problems. Educators will lead the class so that there are no misunderstandings. In the idea disclosure syntax, which contains educators who assist students in finding solutions to issues, different concepts in students will be guided by educators.

Educators help pupils develop directed thinking skills in order to produce the same idea. Educators provide students the chance to choose material that will be utilized to build concepts that they already have. Syntax used in knowledge development aids in concept understanding. Educators will instruct students to combine new knowledge with prior knowledge to form new knowledge. The search for concepts is guided by educators. After that, problem-solving will make use of the knowledge that the learners have constructed. The application syntax is used for problem solving; with this syntax, learners are expected to be able to apply what they have learnt in order to increase their knowledge. This vocabulary for reflection and evaluation describes how educators provide students feedback[14]. With the help of this generative learning model, students can be given the chance to communicate their ideas and comprehend concepts. In this manner, learning is no longer one-way and students can participate actively in it. Additionally, students receive instruction in communicating ideas and concepts. According to the generative learning paradigm, students take a more active part in developing their knowledge, with educators serving as mediators and facilitators in the classroom[21–23].

The generative learning model has the advantages of allowing students to express their initial understandings, opinions, and thoughts on a concept, training them to be able to express ideas, teaching them to respect others who are expressing ideas, and teaching them that learning is more meaningful if students discover their own knowledge. Of course, this will make students better understand the material provided. Students are expected to communicate their thoughts and be prepared to correct any miconceptions so that they can build upon the knowledge they already possess; The teacher helps and directs students to create what is taught by fostering an intense classroom environment where they may compare their thoughts with those of their peers. This makes it simpler to organize lessons and simpler to comprehend the perspectives of students[24,25]. The addition of the probing question technique makes the generative learning model a full learning process. The learning process is accompanied with inquiries.

The use of basic to complex questions that act as a stimulus for students to develop their own ideas is known as probing inquiries. Before they arrive at a solution, learners are forced to comprehend a problem more thoroughly by asking probing questions. Learners attempt to make connections between the questions they will respond to and the knowledge and experience they already possess as they search for and find solutions to these challenges[26]. By emphasizing it, this probing question aids educators in determining how in-depth students' understanding is. Based on the facts given above, it is hypothesized that there is a correlation between the usage of the generative learning model and the probing question strategy on learning outcomes in static fluid material.

II. METHOD

With a posttest-only control design, this kind of study is referred to as quasi-experimental research. Two groups, one chosen at random for each, make up this research design. The control class refers to the second group that did not get therapy whereas the first group, known as the experimental class, did. The experimental class is treated as a result of using the generative learning model in conjunction with the probing question approach, whereas the control class is treated using the PBL learning model in conjunction with the probing question approach. Table 1 provides an overview of this research design.

Table 1. Research Design

Group	Treatment	*Posttest*
Experiment	X	O
Control	-	O

(Source: Ref[27])

Description:

X : The treatment given to the experimental group

- : Treatment given to the control group

O : Posttest (final test) of experimental and control groups

Because they have certain features and qualities, population is a vast group of things that academics have chosen to examine and then draw conclusions from[28]. The subjects in this study were all students in grade XI at *Science* Senior High School 14 Padang during the academic year 2022–2023. Purposive sampling, which is a sample selection method with certain concerns, was the sampling approach employed[29]. By using samples from classes with the same teacher and a near class average, the author is able to create two groups for the experimental and control classes. The experimental class in this study was the XI *Science* 4 class, while the control class was the XI *Science* 5. The comparability of the two averages derived by the two sample classes having the same initial ability was examined for both sample classes. On the final day of the study, both sample classes will get a written sheet with up to 25 multiple-choice questions on it. The generated learning result data (Posst-test) will be examined using t-test statistics to see whether the hypothesis is accurate.

III. RESULTS AND DISCUSSION

A. Results

The results of the two sample classes' various treatments revealed that the learning outcomes of students in classes that used generative learning models with the probing question method and classes that used PBL learning models with the probing question method were significantly different. Table 2 displays the results of the knowledge tests taken by pupils in the experimental and control classes.

Table 2. Results of Calculation of Values on Knowledge Aspects

Class	Highest Value	Lowest Value	X	S	S^2
Control	92	56	78,40	9.998	99.953
Experiment	96	60	81.0	10,876	118.29

The statistics from Table 2 show that the average level of student knowledge in the experimental class is higher than the level in the control class. The statistics from Table 2 show that the average level of student knowledge in the experimental class is higher than the level in the control class. Figure 1 shows a comparison of the two sample classes' student learning outcomes.

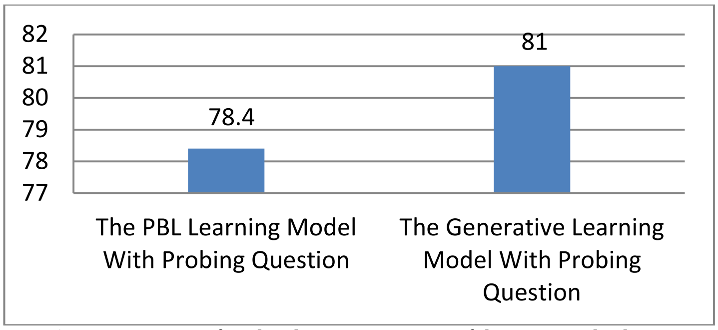

Fig.1. Comparison of student learning outcomes of the two sample classes

On the basis of this graph, it is possible to compare how well students learned after utilizing the generative learning model and the probing question approach as well as the PBL learning model. In the experimental class, student learning outcomes were 81, while in the control class, they were 78.4. Hypothesis testing will be done after the normality test and homogeneity test are completed to determine whether or not the application of the generative learning model with the probing question method has an impact on learning outcomes.

The experimental class's pupils achieved learning outcomes of 81, while the control class's students achieved learning outcomes of 78.4. Starting with a normalcy test, data analysis based on the findings of the posstest on both samples is conducted. To confirm that the sample is drawn from a population with a regularly distributed population, the normality test applies the Liliefors Test. The price L_o was ascertained from the findings of the conducted normalcy test. The cost of L_o is then compared to $L_{tabel's}$ cost at an actual level of 0.05. The data from the posttest results of the two sample classes have a $L_o < L_t$ value at a real level of 0.05, with the control class having a value of $0.148<0.149$ and the experimental class having a value of $0.136<0.147$. This shows that the two sample classes' data are normally distributed. Table 3 displays the full results of the normalcy test computation.

Table 3. Results of Normality Test Calculation of Learning Outcome Data

Class	α	N	Lo	Lt	Description
Experiment	0,05	36	0,136	0,147	Normal
Control	0,05	35	0,148	0,149	Normal

Following that, the data will be utilized to perform a t-test for hypothesis testing. We ran a homogeneity test first before moving on to the hypothesis test. The purpose of this homogeneity test is to confirm that the populations from which the two samples were drawn have the same variance. The homogeneity test yielded Fh = 1.183 and Ft at a threshold of 0.05 at dk numerator 35 and dk denominator 34, respectively, yielding results of 1.767. These findings indicate that Fh F (0.05); (35,34), indicating homogenous variances across the two data groups. Table 4 displays the homogeneity test's full calculation results.

Table 4. Results of Homogeneity Test Calculation of Learning Outcome Data

Class	N	S^2	A	Fh	Ft	Description
Experiment	36	118.29	0,05	1,183	1,767	Homogen
Control	35	99,953	0,05			

The results of the normality and homogeneity tests demonstrate that the two sample classes have homogeneous variances and are normally distributed. So, using the t test, the similarity test of two means is performed for the hypothesis test. The Independent Hypothesis Test Calculation of Post-test Results Data results can be explained by the fact that, at a real level of 0.05, the test results yielded values of $t_{hitung} = 8.704$ and $t_{tabel} = 1.995$. The results of the calculation indicate that the value of th is within the H_0 rejection zone. Based on these findings, H_1 is accepted, indicating that there is a difference in the learning outcomes between the two samples, indicating that the use of the generative model in combination with the probing question method can have an impact on student learning outcomes. Table 5 shows the complete computation results for the hypothesis test.

Table 5. Results of Test of Equality of Two Means

Class	N	A	$\overline{X}$	S^2	t_h	t_t
XI *Science* 4	36	0,05	81,0	118.29	8,704	1,995
XI *Science* 5	35	0,05	78,40	99,953		

Based on the results of the hypothesis test, a normality test, homogeneity test, and data analysis were performed. Both sample classes are demonstrated to be regularly distributed by a normality test. The homogeneity test reveals that the variances in both data sets are homogeneous. The results of the t test for testing hypotheses were t_{hitung} = 8.704 and t_{tabel} = 1.995 with a significance level of 0.05. In the case of $t_{hitung}>t_{tabel}$, it is discovered that the value of th is in the Ho rejection area and H_1 is accepted, indicating a significant difference in the learning outcomes between the two sample classes. As a result, it can be concluded that using the generative model in conjunction with the probing method has an impact learning Results of Students in Static Fluid Material Class XI.

B. Discussion

There is a considerable difference between the two classes after the final test is given to both sample classes. Based on the data analysis of the hypothesis test results which showed that the two sample classes had homogeneous variances and normal distribution, the hypothesis test obtained the value of tcount = 8.704 and ttable = 1.995 with a significant level of 0.05. There is a considerable difference between the learning outcomes of the two sample classes. For the value of tcount> ttable is known to be in the Ho rejection area and H_1 is accepted, this indicates that the use of the generative model with the probing question method has an influence on student learning outcomes on Static Fluid Material Class XI.

The orientation syntax is where the generative learning model starts. The orientation syntax describes how instructors get students ready and motivate them[14]. By looking at attendance, learners are ready. Educators can motivate their pupils by giving them information about the subjects they are studying. The orientation phase necessitates pupils' thinking becoming more focused and diversified. This study's content deals with static fluid. Learners consider this static fluid more thoroughly. Educators will explain issues to students in accordance with the subject matter. The problem presented to learners occurs in the syntax of problem delivery. This problem delivery syntax contains how educators deliver problems to learners. The delivery of the problem contains important information by providing a stimulus[14].

Stimulus is given in the form of questions about the problem presented. Based on material about Archimedes' law. An example of a problem that educators ask learners is 3 chicken eggs put into different glasses of water, the first glass without salt, the second glass with an additional 2 spoons of salt and the third glass with an additional 4 spoons of salt. "What happens to the three eggs? Will they occupy the same position?". Based on the problem, the educator guides learners to find the answer to the problem. Learners will be guided by the educator so that they do not have different concepts. Different concepts in learners will be guided by educators in the idea disclosure syntax. This syntax contains educators who help learners find solutions to problems[14]. Educators do not explain all learning materials. In order to produce the same concept, educators help pupils develop the ability to think strategically. Educators provide pupils the chance to choose facts that will help them build the concept they have in order to solve a problem.

Knowledge construction occurs in the construct syntax. This syntax contains educators constructing learners' knowledge. Educators direct learners to construct knowledge quickly and efficiently[30]. Knowledge construction helps learners to understand concepts[14]. Educators will instruct students to build knowledge by tying together old and new ideas, so that participants' understanding from one idea will lead to the creation of multiple ideas or that their knowledge spreads. Educators can help students identify concepts by asking questions that delve deeper; doing so will force students to concentrate on what they already know. The depth of the pupils' knowledge will be known to the educators. At this point, new knowledge is produced through a process of assimilation and accommodation, and learners' knowledge is expanded with the aid of probing inquiries. Learners' knowledge that has been constructed will then be used in problem solving. Problem solving is carried out in the application syntax, in this syntax learners are asked to be able to apply what has been learned to build knowledge[14]. This application syntax is done by giving problems to students. In order to tackle challenges, students are encouraged to think critically and creatively in a variety of ways during the application stage[31].

The problem given is a problem about static fluid. Learners are required to be able to apply the concepts they have learned to answer questions using their own abilities. Problems that have been solved by students are then given feedback. Educators provide feedback on reflection and evaluation syntax. This syntax contains how educators provide feedback to students[14]. Students' solutions to problems are addressed by educators, who also offer clarification or understanding of previously acquired material and direct students to identify the advantages and disadvantages of the learning process. Educators also tell students when to stop learning.

IV. CONCLUSION

Results revealed a substantial difference between classes using PBL learning models with probing question methods and classes using generative learning models with probing question methods. The application of the generative learning model with the probing question method on the Static Fluid material is found to have a positive impact on student learning outcomes, as can be seen in the student learning outcomes that have been analyzed and hypothesis tested.

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