

EFFECT OF THE PROBLEM BASED LEARNING MODEL WITH CONCEPT MAP ON PHYSICS STUDENTS ACHIEVEMENT

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ABSTRACT

One of the impacts of The Programme for International Student Assessment (PISA) on Indonesia is the change in the curriculum in the Indonesian education system. The curriculum that is implemented today, emphasizes students on 21st century skills and the change from teacher center to student center. The reality in the field, learning Physics in class shows that teachers still approach directly and involve students less in the learning process so that students are less motivated in learning which makes learning outcomes low. The purpose of this study was to see the effect of the problem based learning model with concept map on physics students achievement. This type of research is quasi experimental design. The instrument used in this study is a test instrument. The results showed that the average score of students in the experimental class of 63.88 was higher than the sample class of 59.21. Accompanied by quiz data, it also showed that the average score of the experimental class was higher than the control class at each meeting. The results of the hypothesis test obtained by the $z_{\text{calculate}} > z_{\text{table}}$ are $7.16 > 1.96$ so that it can be said to reject H_0 accept H_1 . Thus, the application of the PBL model accompanied by concept maps can be used and applied to students so that their learning outcomes increase.

Keywords : problem based learning, concept maps, and student achievement



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I. INTRODUCTION

Education is a conscious effort made by the person responsible for building the future of students with the aim of achieving maturity and independence [1]. Education in a country will reflect the form of human resources of that country. The more quality education in a country can improve the quality of its human resources [2]. Therefore, improving the quality of education is non-negotiable in order to increase human resources in various countries, one of which is Indonesia.

The quality of Indonesian education at the international level can be seen from several international education assessment programs, one of which is The Programme for International Student Assessment (PISA). Based on PISA results, Indonesia experienced a decrease in 2018 when compared to 2015. Three aspects assessed in PISA decreased namely the reading ability aspect with 397 points to 371, the mathematical ability aspect with 386 points to 379, and the science aspect with 403 points to 396 [3]. Assessments on these three aspects emphasize students in applying knowledge and skills in real situations. Students must demonstrate the capacity to analyze, use logic, and communicate effectively when identifying, interpreting, and solving problems in a variety of situations [4].

Seeing the results of PISA that has been followed by Indonesia since 2000, the government is trying to make improvements in the field of education. One of the actions taken by the government is to make changes to the curriculum. At the present time, the curriculum applied is the 2013 curriculum.

In The 2013 curriculum emphasizes a learning approach to student competence in accordance with the mandate conveyed in PISA related to the emphasis on 21st century skills, namely communication, collaborative, critical thinking and problem solving, creativity and innovation [4]. The 2013 curriculum instills students' soft skills and hard skills through three aspects, namely attitudes, knowledge, and skills. In addition, in the learning process this curriculum is student-centered so that the teacher is no longer dominant in the classroom but rather as a facilitator and students are required to be active in learning activities [5].

The implementation of the 2013 curriculum in the field shows that teachers still approach directly and involve students less in the learning process which results in low student learning motivation. Low student learning motivation is characterized by when the learning process takes place, students only listen to the teacher's explanation and then record it in a notebook. When teachers try to see students' understanding by asking a few questions or giving students a chance to ask questions, students tend to choose to be silent. When given assignments that are done directly at school, most of the students wait for answers from other friends without trying themselves first. This can make student learning outcomes low. The average score obtained in the field from each class XI of Science is seen from the final exam scores of semester 1 of the 2021/2022 academic year, namely 48.4 class XI Science 1, 51.8 class XI Science 2, and 40.7 class XI Science 3 with Minimum Completeness Criteria (KKM) applied in schools which are 80.

Regarding student learning motivation, an effort is needed so that students have high learning motivation so that student learning outcomes increase. To increase this learning motivation, it is necessary to give motivation to students. Motivation is divided into two, namely intrinsic motivation is motivation that comes from within students and intrinsic motivation is motivation that comes from outside students such as invitations, encouragement, coercion, or orders so that with these conditions students want to learn or do something [6]. Trinsic motivation is needed by students in order to help students achieve success in learning. By providing motivation to students, it is hoped that they will be able to provoke motivation from within students. The activation of the trinsic ek s given to students is by using varied methods by no longer applying conventional methods in the learning process [6]. One model that can be used to increase student motivation is *Problem Based Learning* (PBL). In the application of PBL models can include concept maps in several PBL syntax.

The PBL model requires students to learn to solve problems related to the real world so as to foster students' critical thinking skills. The problems raised in PBL must meet several criteria, namely the problem is authentic, causes a sense of mystery or confusion, is meaningful, broad in scope, and beneficial to students [7]. Authentic problems are problems that must be rooted in the real life of students. The problem given is a problem that can cause mystery or confusion by students. Problems should be meaningful to students and appropriate to their level of intellectual development. Problems must be broad enough to allow teachers to achieve their teaching goals but limited enough to make lessons feasible in time, space, and resource constraints. Good problems should benefit from group effort.

There are five syntaxes of the PBL model, namely orienting students to problems, organizing learning activities, guiding independent and group investigations, developing and presenting work, , , analyzing and evaluating the problem-solving process [7]. , In the PBL syntax, it can be said that in the early stages there is a presentation of a problem to students. Then students are organized into several groups for problem-solving discussions guided by the teacher. During the investigation of the problem, students will be encouraged to seek information. Students can search for reading resources in libraries, data bases, internet, obsional sources or make observations. Furthermore, the results of the discussion are made in a work such as reports, videos, models, and then presented to other groups. After that, proceed to the analysis and evaluation stage assisted by the teacher. At the analysis stage, all students are given the opportunity to contribute to the expression of ideas.

The concept map is a product of learning tools that have been developed by Joseph D. Novak and D.B. Gowin since 1984. The emergence of the concept map idea at that time was based on cognitive theory developed by Ausubel (1968) describing that the initial knowledge possessed by students is an important factor that affects learning processes and outcomes [8]. A concept map is an attempt to understand the subject matter by mapping thoughts literally in the form of illustrations of concrete graphics by stating meaningful relationships between concepts in the form of propositions so as to form a hierarchy.

The use of concept maps can make learning meaningful. Concept maps are useful learning tools creating opportunities to improve critical thinking skills by giving students the opportunity to learn in meaningful ways [9]. Conceptmapping requires students to elaborate and organize information in meaningful ways that can be realized by the way students understand meaning rather than memorizing [10]. Meaningful learning will have three benefits, namely the information obtained will be more durable, improve the concepts that have been mastered by students because they relate new information to previous relevant concepts, and make it easier for students to remember the material they have learned if re-encountered [11].

The use of concept maps can be applied in PBL models. This is because the PBL model has complementary properties with concept maps [12]. Concept maps and PBL are both processes of reactivating previous knowledge and elaborating with prior knowledge. As well as the use of real problems in concept maps and PBL models.

In the learning process, teachers will see student understanding through learning outcomes. Learning outcomes are evidence of students' abilities that are tested in a learning period by assessing knowledge, attitudes, skills in students with changes in behavior. The assessment of learning outcomes in the 2013 curriculum includes three aspects, namely attitude aspects, knowledge aspects, and skill aspects [13]. Each aspect has a different technique in its assessment. Attitude aspects are assessed by observation, self-assessment, and peer assessment techniques. Aspects of knowledge with written test techniques, oral tests, and assignments. While the skill aspect uses performance techniques or practicum, projects, portfolios, and products.

Student learning outcomes can be improved by fostering student learning motivation, one of which is through learning models applied in the classroom. So that researchers are interested in conducting research by applying the PBL model accompanied by a concept map. The purpose of this study is to see the effect of the problem based learning model with concept map on physics students achievement

II. METHOD

The type of research carried out is experimental research. The purpose of experimental research is that there is treatment given to the unit under study. The design used is quasi experimental design. The choice of this design in research is because when conducting experimental research there are difficulties in obtaining a control class that functions fully as a controller of outside variables that can affect the experiment. The research design used is posttest-only control design.

Sampling in this study began by collecting UAS 1 Physics FY 2021/2022 scores from all population classes. After that, a normality test was carried out on the data using the Liliefors test so that all classes of the population were normally distributed. Then, a homogeneity test was carried out using the Bartlett test and found that all classes of population data were homogeneous. Next, determine two sample classes randomly, so that the sample classes are XI IPA 1 and XI IPA 2. Finally, to determine the experimental class and control class using currency techniques so that the experimental class is XI IPA 2 and the control class is XI IPA 1

In this study, the independent variables are concept maps, dependent variables, namely learning outcomes, moderator variables, namely PBL models, and control variables including the material used, subject teachers, time allocation, number and type of questions tested are the same. At the beginning of this study using secondary data sourced from the Physics Teacher the research site. The data that will be used to test the hypothesis is primary data through the final test given to students.

Research procedures are made so that research can run systematically. There are three stages in this study, namely the preparation stage, the implementation stage, and the completion stage. In the preparation stage, what is done is to make proposals, determine the place and schedule of research, take care of correspondence, determine samples, prepare lesson plans, teaching materials, and media used, and prepare grids and trial questions. At the implementation stage, the implementation carried out was carrying out the learning process in both sample classes, for the control class only applied the PBL model while in the experimental class applied the PBL model accompanied by a concept map. Finally, the completion stage is to give the final test to both sample classes, collect data on the final test results and then analyze, compile a research report, and ask for a letter from the school that has conducted research.

The data taken in this study is the value of students' knowledge competence. The data collection technique is in the form of a written test in the form of multiple choice. The instruments used for the posttest are multiple-choice test instruments that have passed the validity, reliability, differentiation, level of difficulty, and distraction tests. The data analysis techniques carried out are normality tests, homogeneity tests, U (Mann-Whitney) tests. The normality test carried out aims to ensure that the data is normally distributed. The Homogeneity Test is used to ensure the data has the same variance. The U (Mann-Whitney) test is an alternative to the t test because the data do not satisfy parametric statistics.

III. RESULTS AND DISCUSSION

In this study, for problem solving in the control class students made it in the form of written answers. As for the experimental class, students make concept maps, but these concept maps contain material that can help solve

problems. The written answers and concept maps created by students from the experimental class can be seen in Figure 1.

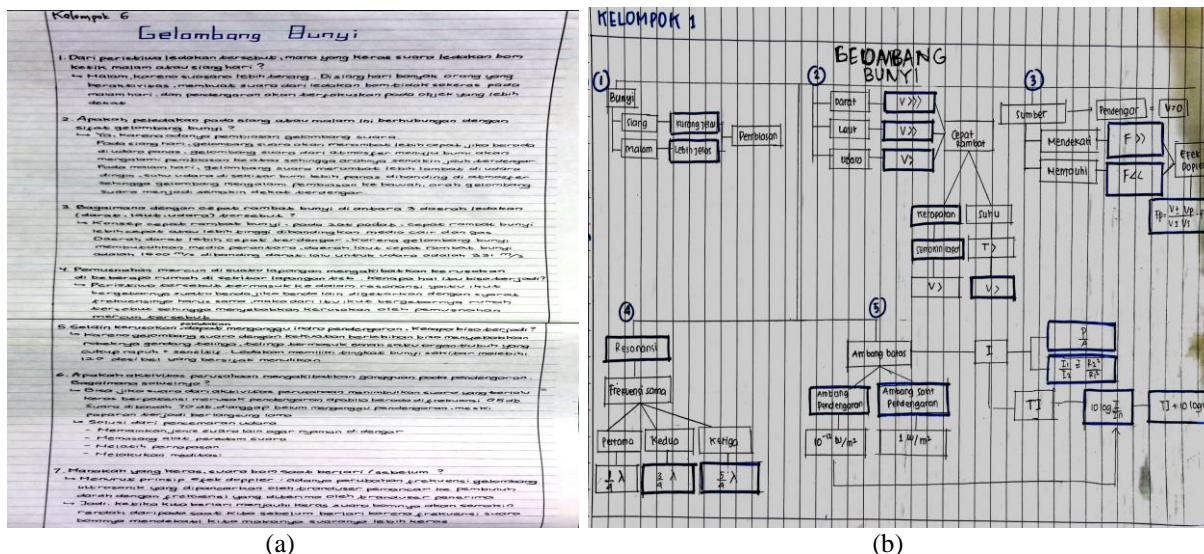


Figure 1. (a) Written answers of students from the control class (b) concept maps from the experimental class
 The teacher together with the experimental class students made a concept map in the fifth stage of the PBL model. The concept map can be seen in Figure 2. Making a concept map aims to summarize the material learned on that day. As for the control class, the teacher and students summarize the material like notes in general.

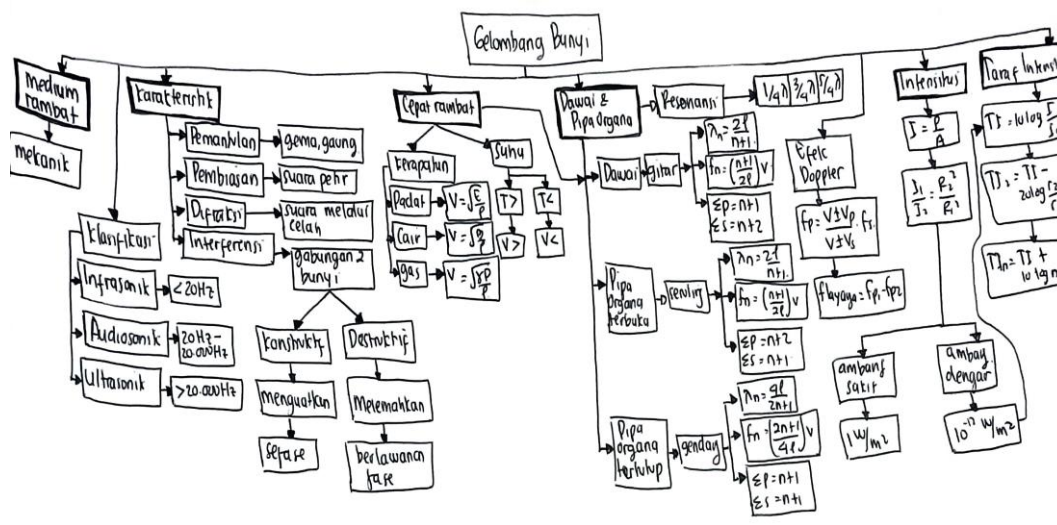


Figure 2. Concept maps created by teachers with students

In this study, to close learning at each meeting, quizzes were given to students in both sample classes. This quiz is to see students' understanding of the material learned on that day. The average quiz scores at each meeting of both sample classes can be seen in Table 1 and the bar chart of quiz scores at each meeting can be seen in Figure 3.

Class	Quiz 1	Quiz 2	Quiz 3	Quiz 4
Control	71, 818	70,909	60,303	79,030
Experiment	73,056	75,833	62, 778	79,889

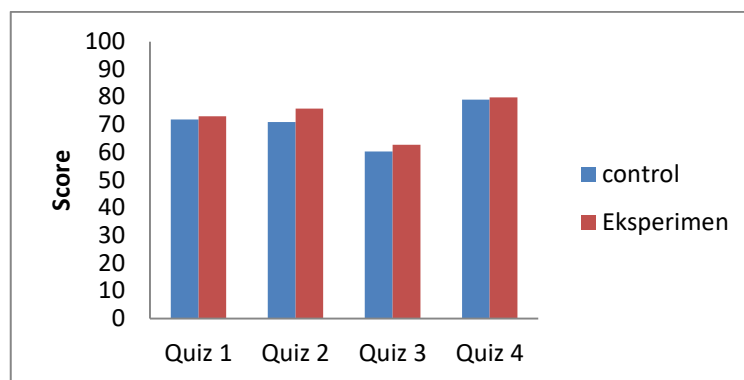


Figure 3. Bar chart of the average value of both quizzes of the sample class

Based on Table 1 and clarified by the bar chart in Figure 3, it can be seen that at each meeting, the quiz scores obtained by the experimental class are higher than the sample class. In addition to quiz scores, in this study also obtained data on the learning outcomes Of class XI IPA from posttest results in both sample classes. Based on the results of posttest, obtained statistical calculation results with an average value (\bar{X}), standard deviation (S), variance (S^2), median, and mode of both sample classes as shown in Table 2.

Table 2. Description of *Posttest* Values of Both Sample Classes

Class	N	Lowest Value	Top Rated		S	S^2	Median	Modus
Control	33	93	27	59,21	16,08	258,73	60	60
Experiment	36	93	27	63,88	16,90	320,78	67	73

Based on Table 2, it can be seen that the average score of students' knowledge in the experimental class was higher than in the control class. Likewise, the value of standard deviation and variance in the experimental class is higher than in the control class. To see whether or not the application of the PBL model is affected by a concept map, it can be seen by conducting a hypothesis test. But before conducting a hypothesis test, a normality test and a homogeneity test are first carried out.

Data analysis carried out based on posttest results on both samples began by conducting a normality test as in Table 3. The normality test uses the Liliefors Test to ensure the sample comes from a normally distributed population. From the results of the normality test carried out, the price of L_o was obtained. Then this L_o price is compared to the L_{table} at a real level of 0.05.

Table 3. Normality Test Results of Both Sample Classes

Class	N	α	L_o	L_t	Information
XI IPA 1	33	0,05	1,825	0,154	Abnormal
XI IPA 2	36	0,05	1,709	0,147	Abnormal

Table 3 shows that the data obtained from the posttest results in both classes of samples are not normally distributed. It was shown that both sample classes had $L_o > L_t$ values at a real level of 0.05, namely the control class of $1.825 > 0.154$ and the experimental class of $1.709 > 0.154$. Looking at the data that is not normally distributed, then to test the hypothesis using the U Test (Mann-Whitney).

This U-test (Mann-Whitney) is an alternative to the t-test because the data do not meet parametric statistics. In this study, there were 33 control class students and 36 experimental class students so that the U Test used was the U Test with a large sample (>20) as shown in Table 4.

Table 4. Results of Hypothesis Test Using U Test (Mann-Whitney)

Class	N	α	Z_{hitung}	$Z_{\alpha/2}$
XI IPA 1	33	0,05		
XI IPA 2	36	0,05	7,16	1,96

Based on Table 4 show price Z_{count} of 7,16 and $Z_{\alpha/2}$ amounted to 1,96. Criterion reject H_0 if $Z_{count} < -Z_{\alpha/2}$ Or $Z_{count} > Z_{\alpha/2}$ or there is this study $Z_{count} > 1.96$ which means value Z_{count} is within the rejection area of H_0 . Based on these results, H_1 is accepted meaning that there is a difference between the learning outcomes of the two samples so that it can be said that the application of the PBL model accompanied by concept maps can affect on physics students achievement

The increase in average scores in both sample classes when compared to the initial sample data indicates that learning motivation for students is starting to grow. As according to Dalyono [14] one of the factors that influence learning outcomes is student interest and motivation. Interest arises because of a strong desire driven by motivation. This can be seen when researching, students begin to get used to expressing their opinions and trying to find information from various sources for problem solving and cooperate with each other in groups. One of the abilities cultivated in students in the PBL model is the ability to solve problems. PBL models foster problem-solving skills through collecting data and analyzing data [15].

Including concept maps in this study, makes improvements to student learning outcomes. This is because the concept map applied can help students in the learning process including identifying the key to a lesson concept, helping students to think deeper, helping students make an easy arrangement of lesson concepts so as to facilitate the exam [16]. In addition, the visual nature of concept maps can help students understand the relationships between a wide variety of ideas and more effectively learn new materials in outline. Concept maps can also make it easier for students to learn so as to increase student understanding [17]. This increase in student understanding is because the concept map develops a meaningful learning process so that students do not just memorize the subject matter but understand the material.

The application of the PBL model accompanied by this concept map has also previously been studied by other researchers. These researchers include with the title of research on the influence of problem-based learning models using concept maps on student learning outcomes [15], learning Physics through problem-based learning (PBL) models accompanied by concept maps in MAN 2 Jember [18], and with the title of research on the effect of problem-based learning models accompanied by concept maps on results learning on class XI biological excretory system material at SM Gajah Mada Bandar Lampung for the 2015/2016 academic year [19]. From this study, the same conclusion was given to the results of his research, namely the influence of the PBL model accompanied by a concept map on student learning outcomes. In general, existing research is carried out using conventional models in the kotrol class and PBL models in the experimental class. The update in this study is to use PBL models in both sample classes. However, for the experimental class it is accompanied by making a concept map.

IV. CONCLUSION

After conducting research and continuing with analyzing the research data, it can be concluded that the application of the PBL model accompanied by a concept map has an effect on physics students achievement. This is characterized by the high average score of each quiz and the average score of posttests in classes that apply the PBL model with a concept map compared to classes that only apply the PBL model without a concept map. In addition, based on the results of the hypothesis test that rejects H_0 and accepts H_1 .

ACKNOWLEDGMENT

Thank you to parents and families who have given motivation and prayers, Mr. Drs. Gusnedi, M. Si as a supervisor who has guided and provided input in making this article, Mrs. Dr. Desnita, M. Si and Mrs. Wahyuni Satria Dewi, S.Pd., M. Pd. who have provided input in making this article, Mr. and Mrs. UNP Physics lecturers who have provided their knowledge, as well as friends who provide motivation in making this article.

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