



The Effect of the Project-Based Learning (PjBL) Model on Students' Learning Motivation in the Topic of the Periodic Table of Elements

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Abstract

This research is motivated by the lack of student learning motivation at MAN 4 Kampar. This is caused by students having difficulty understanding abstract material as well as the use of learning models that are less varied. The aim of this research is to find out the effect of the Project Based Learning (PjBL) model on student learning motivation in the subject of the periodic table of elements. This research was conducted in the odd semester of the 2025/2026 academic year at MAN 4 Kampar. This study uses a quasi-experimental research type with a pretest-posttest Non-Equivalent Control Group Design. The sample in this study consisted of two classes, namely class X.a as the experimental class and class X.b as the control class. The instruments used were in the form of student motivation observation sheets and student motivation questionnaires. The results of this study showed that in the experimental class using the learning model Project-based learning (PjBL) can boost motivation based on T-test results, which showed a significance value of <0.001, smaller than 0.05. The conclusion of this study is that the Project Based Learning model affects students' motivation to learn the periodic table material.

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INTRODUCTION

Ideal education occurs when the functions and objectives of education are fully achieved, so that education becomes successful (Suhardi, 2019). In the Regulation of the Minister of Education and Culture (Permendikbud) No. 22 of 2016, it is stated that the educational process, namely learning, must be conducted interactively, challengingly, inspiringly, enjoyably, and in a way that motivates students to actively participate, while also providing opportunities for students' creativity. The curriculum plays a very important role in education. This is because the curriculum functions as a guide for learning activities; therefore, without a curriculum, the learning process cannot run properly. The curriculum serves as one of the main factors in the education system to achieve the desired educational goals.

In the classroom learning process, one of the

very important stages in determining students' success in learning is learning motivation (Astuti, 2017). In the learning process, teachers must have an effective and efficient learning model. Using and applying the right learning model with the material being taught is one way to increase students' learning motivation. The success of the teaching and learning process is largely determined by the teacher's ability to manage the teaching and learning process (Suryosubroto, 2007). Chemistry is a branch of science that covers a wide range of knowledge from other scientific fields. Chemistry is the science that discusses the composition, structure, and properties of substances or matter in everyday life (Kurniawati, 2023).

In this material on the periodic table of elements, it is necessary to study previous concepts, one of which is electron configuration,

which is related to determining the position of elements in the periodic table. In this concept, there are rules we need to follow in writing electron configurations, namely the Aufbau principle, Hund's rule, and the Pauli exclusion principle. The material on the relationship between electron configurations and the periodic table contains a lot of memorization. Common difficulties faced by students include writing electron configurations according to the Aufbau principle, struggling to understand electron configurations for transition elements, and in the material on the relationship between electron configurations and the periodic table (Rahman, 2016).

Choosing the right teaching model is an important step in the learning process. Mistakes in using a learning model can hinder improvements in student learning outcomes. In reality, using a teaching model that doesn't match the material tends to produce less than optimal student results. The project-based learning model is an innovative, student-centered approach that positions the teacher as a motivator and facilitator, where students are given the opportunity to work independently and construct their own learning (Putri Dwi). The project-based learning (PjBL) model has several advantages, including being able to boost students' learning motivation (Made, 2014).

According to Wajdi (2017), Project Based Learning provides detailed, thorough, challenging learning experiences over a longer period with the goal of completing a project that produces a product, a satisfying student work. Project Based Learning is a learning approach that gives students the freedom to plan learning activities, carry out projects collaboratively, and ultimately produce work that can be presented to others (Nurohman, 2007). According to Afriana (2016), the PjBL model is a learning model that uses a project (activity) as the core of learning. PjBL learning has been proven to enhance students' creativity.

The motivation to learn that students have in every learning activity plays a big role in improving their learning outcomes in a particular subject. Students who are highly motivated to learn are likely to achieve high learning results too, which means the higher their motivation, the more effort and persistence they put in, the better their learning achievements. Therefore, motiva-

tion is really needed in the teaching process. Motivation is important for successful learning; students with high learning motivation are more likely to succeed in their studies, while low motivation negatively affects their learning progress. So, it can be concluded that learning motivation is one of the factors that influences students' learning success. There are 4 indicators of learning motivation, namely; Attention, Relevance, Confidence, and Satisfaction.

Based on interviews with the Chemistry teacher at MAN 4 Kampar, it was found that high school students need motivation in the learning process. Student motivation greatly affects their learning outcomes. The more motivated and interested students are in a lesson, the better their learning results will be. One of the subjects at the high school level is chemistry. Students in chemistry classes are usually less active and less interested in the material being taught, often feeling bored, unenthusiastic, and sleepy in class. The teaching methods commonly used by teachers are generally not very effective, so teachers need to use a variety of teaching approaches or ones that can boost student motivation to make the classroom more lively and ensure learning runs according to its objectives.

Based on related research, which is about increasing motivation and science learning outcomes using the project-based learning (PjBL) model, it was found that 80% of the results come from using the PjBL learning model in the teaching and learning process

METHOD

Quasi Experiment Design

This study is a type of quantitative research using a quasi-experimental method, specifically a pretest-posttest non-equivalent control group design. The initial design used a pretest before the treatment was given and a posttest after the treatment was administered (Kurniyawati, 2021).

The population in this study consisted of tenth-grade students at MAN 4 Kampar, totaling 90 students. The sampling technique used in this study was purposive sampling, where the samples were chosen based on the test scores of each class. The sample consisted of 58 students from these scores, with class X.a consisting of 29 students in the experimental class and X.b consisting of 29 students in the control class.

The data collection technique used was non-

test. The instruments used for data collection were observation sheets on student learning motivation and student learning motivation questionnaires. The indicators of student learning motivation were based on four motivation indicators: Attention, Relevance, Confidence, and Satisfaction.

In the pretest, before the learning model was applied, students were asked to fill out the student motivation questionnaire before receiving treatment. Students in the experimental class would receive treatment in the form of using the PJBL learning model, while students in the control class They will receive treatment in the form of using the scientific learning model. After the learning model is applied in both classes, at the end, students are asked to fill out a motivation questionnaire after receiving the treatment. From the results of both the pretest and posttest questionnaires, only then can the improvement from the learning model used be seen.

The instruments used in this study were tested for validity through content validity and empirical validity tests, as well as reliability testing. The data obtained were then analyzed using prerequisite tests, namely the normality test and homogeneity test. After the prerequisite tests were conducted, the data were further analyzed using hypothesis testing in the form of a t-test.

RESULTS AND DISCUSSION

Data from Student Motivation Observation Sheets for Each Meeting

Student learning motivation is measured using observation sheets for each class session, with the sheets being filled out with the help of an observer during the learning process. The results of the observation sheets for each session can be seen as follows.

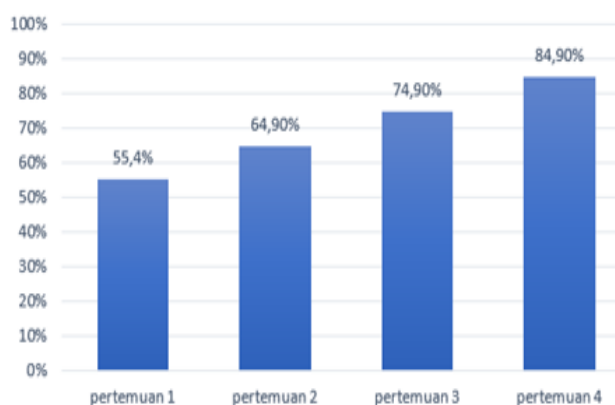


Figure 1. Graph of Student Motivation Sheets for Each Meeting

From the four experiments that were carried out in the experiment class, it was found that the first experiment had a percentage of 55.4%. Then, in the second experiment, the percentage was 64.9%, showing an increase of 9.5%. In the third experiment, the percentage reached 74.9%, which is an increase of 10%. And in the fourth experiment, the percentage was 84.9%, with an increase of 10%. From the student motivation observation sheets, it can be concluded that the project-based learning model can increase students' learning motivation.

Normality Test Data

Normality was tested using SPSS 29 with the Shapiro-Smirnov test. A data set is said to be normally distributed in the Shapiro-Smirnov test if the significance value is greater than 0.05. The results of the normality test for the pretest and posttest in the experimental and control classes are presented in the Table 1.

Table 1. Normality Test Data

	Sig	Nilai Sig
Pretest A	0,081	>0,05
Posttest A	0,519	> 0,05
Pretest B	0,052	> 0,05
Posttest B	0,438	> 0,05

Based on the table above, the pretest and posttest data for the experimental and control classes were obtained. It was found that the Sig. for the pretest in the experimental class was 0.081 and in the control class was 0.052. This indicates that the Sig values for both sample classes are >0.05. So, the data is normally distributed. For the posttest, the Sig. in the experimental class was 0.519 and in the control class was 0.438. This indicates that the Sig values for the posttest in both sample classes are >0.05. So, this data is also normally distributed.

Homogeneity Test Of Pretest And Posttest

The homogeneity test using SPSS 29 descriptive statistics technique, if the significance value > 0.05 then the data is said to be homogeneous, however, if the significance value < 0.05 then the data cannot be said to be homogeneous. The results of the pretest data homogeneity are presented in the Table 2.

Table 2. Homogeneity Test Pretest

	Sig	Nilai sig
Pretest	0,242	> 0,05

The Sig. value was obtained as 0.242, which means the data > 0.05 so the pretest data for both appears to be homogeneous. Meanwhile, the

results of the homogeneity from the posttest are presented in the Table 3.

Table 3. Homogeneity Test Posttest

	Sig	Nilai sig
Posttest	0,129	> 0,05

The Sig value obtained is around 0.128. This means that the post-test data > 0.05, so the second post-test data seems to be homogeneous.

Data from the Learning Motivation Questionnaire Sheets

The student learning motivation questionnaire used a Likert scale. There were five answer choices on the Likert scale used in this research questionnaire: always (SL), often (S), sometimes (KD), ever (P), and never (TP).

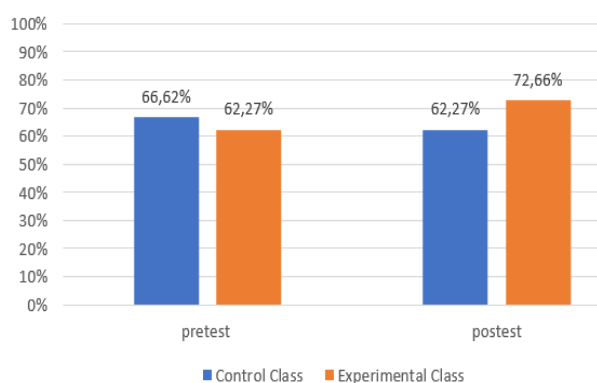


Figure 2. Pretest and Posttest Diagram of Students' Learning Motivation

Based on the diagram above, it can be seen that the percentage score for the experimental class increased from 62.27% to 72.66%, which falls into the good category. Meanwhile, the percentage score for the control class increased from 62.27% to 66.62%, which is also categorized as good. It can be concluded that students' learning motivation showed a significant improvement.

Data from the Hypothesis Testing Results

The hypothesis test used in this study was the t-test, which was conducted to compare the mean scores between two groups and determine the differences between them (Supardi, 2017). The t-test calculation used the data from students' learning motivation results in the project-based learning model, based on the posttest results from both sample classes. Table 4 presents the results of the t-test as follows.

Table 4. T-Test Results

	Sig	Nilai sig
Posttest	<0,001	< 0,05

Based on Table V, it can be seen that the Sig value is < 0.001, which is smaller than 0.05.

Therefore, the results indicate that H_a is accepted and H_o is rejected.

CONCLUSION

Research results show that the project-based learning model affects students' learning motivation. This influence can be seen in the use of a variety of learning models which can boost motivation during the teaching and learning process.

Attention

The results of the research show that for the experimental class on the attention indicator, the pretest score was 70% before applying the PjBL learning model. For the posttest, the percentage increased to 82.7% after applying the PjBL model, in which the PjBL model on the attention indicator made students more interested during the learning process. Students' focus and curiosity can improve when the project-based learning model is implemented. For the control class on the attention indicator, the pretest percentage was 72%, while the posttest was 69.8%. The decrease in the control class score was due to the learning model being focused on lecturing and discussion, which made the class atmosphere feel boring and caused students to be less focused and less interested. It will be about the learning being taught by the teacher.

In the attention indicator in the experiment class, the percentage value is higher than in the control class. This is because the experimental class used a project-based learning model. For the attention indicator, using PjBL (Project-Based Learning) makes students more focused on paying attention to the teacher regarding the material being taught and following the teacher's instructions before working on the project to be designed. Because of this, students understand and grasp the material being taught better. The attention indicator gives a quite high contribution because paying attention is an attitude that is easy for students to practice. This aligns with research by Indah (2018), which explains that the attention aspect from students is a learning motivation indicator with a fairly high percentage because the students already have high awareness I focus my thoughts on the lessons at school.

Relevance

The results of the survey indicate that for the experiment, the relevance indicator (relevance/connection) for the pretest was about

70%, and for the posttest, it was around 86.3%. The increase in percentage occurred because when the PjBL learning model was implemented, students made projects, which included posters related to the periodic table of elements and scrapbooks about the various and unique properties of elements, which could stimulate students' curiosity about the table.

From the students' table projects that had been completed, the teacher explained the groups of elements, the elements commonly found/used in daily life, the types of elements, and which elements could be dangerous if used in everyday life. For the relevance indicator, students were asked to make a project using materials from everyday life daily. On the relevance indicator tested in the experiment, the percentage value was higher than in the control class. The relevance indicator provided a fairly high contribution because learning would be more meaningful if students could understand the benefits of the knowledge they gained.

Confidence

The results of the analysis indicate that in the experiment, the confidence indicator in the pre-test obtained a score of 71.7% and in the post-test, 75%. This percentage increase is because students, during the learning process, were allowed to express their opinions during group presentations related to the projects they had made, including questions, suggestions, and criticisms. This allowed students to exchange ideas. Students were also allowed to answer questions from the teacher according to their own answers, but if a student's answer was incorrect, other students were allowed to provide the correct answer. This way, students could better defend or give opinions related to the material that had been taught.

On the confidence indicator using PjBL, students felt more confident working on group projects and presenting showing the project results to classmates. During the project presentation, students were very excited when presenting until the project presentation was finished. In the control class, the pretest score was 66.2% and the posttest score was 66.2%. This happened because during the learning process, students experienced difficulties, such as being afraid and hesitant about the opinions/answers they wanted to give, whether to the teacher or to their classmates, because they were afraid their

answers might be wrong. In the experimental class, the confidence indicator had a higher percentage than in the control class.

According to the research by Sari (2018), the confidence indicator contributes quite a lot because it reflects attitudes that are easy for students to carry out. Self-confidence is the belief or trust in one's own abilities in learning or in solving problems related to learning. This indicator shows students' bravery in expressing their opinions during discussions or asking questions related to the lessons they are learning.

Satisfaction

The results of the analysis show that for the experiment on the Satisfaction indicator, the pre-test achieved 71.3% and the post-test reached 76.8%. This increase is because when students learn periodic system material using the project-based model, they understand the material better, and this makes them feel happy and satisfied when they successfully complete assignments and the lessons taught by the teacher. For the satisfaction indicator using PjBL, students feel very happy, excited, enthusiastic, and interested in the next material. From previous project work, starting from project planning, you can already see students' interest in the material taught by the teacher.

During project execution and presentation, students feel very happy once the project is completed, and they not only feel happy but also satisfied with the project they have done. In the control class, the pretest score was 62.9% and the posttest score was 65.3%. This is because students feel happy when they understand the material they are learning, allowing them to complete the tasks given by the teacher about the periodic table system. Regarding the confidence indicator in the experimental class, the percentage score was higher than in the control class. According to Sari (2018), the satisfaction indicator contributes quite highly because it is related to students' self-confidence.

RECOMMENDATION

Based on the results of the study, there was an effect of the project-based learning (PjBL) model on students' learning motivation compared to classes that did not use the project-based learning (PjBL) model. Based on the t-test results from the posttest scores of both sample classes, the

significance value obtained was < 0.001 , which is smaller than 0.05. Therefore, H_a was accepted and H_o was rejected, meaning that the project-based learning model can improve students' learning motivation in the topic of the periodic table of elements.

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