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# Influence of Project Based Learning Models and Learning Interest on Critical Thinking Skill Students of Class X SMAN 4 Wajo

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**ABSTRACT:** This study is a true experiment which employs 2x2 factorial design. The purpose of this study is to analyze the difference in critical thinking skills of students who are taught using the Project Based Learning model and those taught with the Discovery Learning model are reviewed as a whole and reviewed from those who have high and low interest in learning. The sample in this study is 61 students from classes taught using Project Based Learning, and 61 students taught using Discovery Learning. The hypothesis test was carried out with a two-track anava, showing the average score of critical thinking skills of students who were taught using the Project Based Learning model of 21.64 and those who were taught using the Discovery Learning model of 19.13. The difference in the average score of critical thinking skills of students who were taught using the
Project Based Learning model and the Discovery Learning model for students who had high interest in learning was 24.82 and 21.35. Meanwhile, the average scores of critical thinking skills of students who were taught using the Project Based Learning model and those taught using the Discovery Learning model for students who had low interest in learning physics were 19.12 and 17.35. Based on the description of the hypothesis test, it can be concluded that there is a difference between the Project Based Learning model and the Discovery Learning model on students' critical thinking skills, there is a difference between the Project Based Learning model and the Discovery Learning model on the critical thinking skills of students with high interest in learning, there was a difference between the Project Based Learning model and the Discovery Learning model on the critical thinking skills of students with low learning interest, and there was no interaction between the learning model and learning interest on the critical thinking skills of students.

**KEYWORDS:** Project Based Learning, Discovery Learning, Learning Interest, Critical Thinking Skills

## I. INTRODUCTION

Education is one of the pathways to achieving well-being for all of humanity because it plays a crucial role in enhancing the quality of human resources. Education is expected to produce a golden generation capable of competing in the era of globalization with its complex demands. Therefore, to improve the quality of human resources, the enhancement of educational quality should also be carried out.

The Indonesian government has revised the curriculum as an effort to improve educational quality and to align the curriculum with students' needs and the development of the times. The curriculum is dynamic and continuously developed or adapted according to the context and characteristics of the students, to build competencies that meet their current and future needs.

The most recent curriculum revision is the Kurikulum Merdeka, initiated by the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia, Nadiem Makarim. The Kurikulum Merdeka provides flexibility for educators to create quality learning that meets the needs and learning environments of students, with a primary focus on a paradigm shift towards student-centered learning.

The Kurikulum Merdeka emerges as an answer to the intense competition in human resources globally in the 21st century. There are three major competencies in the 21st century: thinking, acting, and living in the world. Thinking competencies include critical thinking, creative thinking, and problem-solving. Acting competencies include communication, collaboration, digital literacy, and technology literacy. These competencies must be applied in 21st-century learning, as this era demands individuals who continuously innovate and possess high creativity (Indarta et al., 2022).

Teachers, when teaching 21st-century students, must adjust their strategies, models, and methods based on the characteristics of this generation. Teachers can no longer teach with conventional, standard, or mediocre strategies. They must be innovative, enriching and updating their knowledge and skills to provide engaging and interactive learning activities that encourage students to actively and independently develop 4C skills: critical thinking, communication, collaboration, and creativity (Puspitarini, 2022).

However, in reality, a common issue in schools is that students are often not given the opportunity to actively participate in learning. Learning is still predominantly teacher-centered. The classroom learning process does not encourage the development of students' thinking skills in solving problems. Yet, thinking skills are among those that need to be developed in 21st-century education, especially critical thinking skills.

According to Hasanah, Sunarno, & Prayitno (2021), the improvement of students' critical thinking skills is influenced not only by the various learning modules and approaches used but also by other factors such as age, gender, facilities, teacher competence, and student intelligence levels. Therefore, these factors can serve as considerations for educational innovations aimed at enhancing students' critical thinking skills. Teacher innovation in selecting non-monotonous learning models also plays a role in improving students' critical thinking skills.

Direct observations conducted at SMA Negeri 4 Wajo showed that many students were uninterested in studying Physics due to a long-standing mindset that Physics is a difficult subject primarily involving formulas. As a result, students tend to be passive in learning, which also affects their collaboration with peers. Students solve Physics problems guided by the teacher, relying solely on their instructions. They do not independently tackle Physics problems, thus failing to develop their critical thinking skills as expected in 21st-century education. This mindset leads to a lack of interest in pursuing education in Physicsrelated fields, resulting in poor outcomes in learning, including critical thinking skills, and indicating low student interest in Physics.

Interest in learning refers to a feeling of liking or curiosity about a learning activity without being prompted to study. It is also a driving factor for students, based on their interest, pleasure, and desire to learn. Indicators of interest in learning include feelings of enjoyment, curiosity, acceptance, and student involvement. Students must develop an interest in learning Physics before aspects of their skills, such as critical thinking, can be maximized in education, particularly through the selection of appropriate learning models.

A learning model that can foster critical thinking skills and enhance students' interest in learning, especially within the Kurikulum Merdeka, is Project-Based Learning (PjBL). PjBL begins with fundamental questions that culminate in a product. In PjBL, the learning process involves the following steps: (1) determining fundamental questions; (2) project planning; (3) scheduling; (4) monitoring; (5) testing results; (6) evaluating experiences. In this model, students are the center of learning and have the freedom to learn. Consequently, the impact of PjBL includes: (1) students are challenged to solve real problems, (2) students become more active in learning, (3) students' performance during project implementation is more organized, (4) students have freedom in completing projects, and (5) students are motivated to compete in producing the best projects. Through PjBL, students are engaged in completing projects that lead to the application of critical thinking processes.

Research on the PjBL learning model has previously been conducted by Permata, Koto, & Sakti (2018), showing differences in students' interest in learning Physics and critical thinking abilities between those taught using the PjBL model and those taught with assignment methods. Another study by Zahroh (2020) concluded that the PjBL model positively influences students' critical thinking skills. According to Anggreni, Festiyed, & Asrizal (2019), using the PjBL model significantly impacts both high school and vocational school students in enhancing their critical thinking abilities in Physics education.

Based on the above description, the researcher is interested in conducting a study titled "Influence of Project-Based Learning Models and Learning Interest on Critical Thinking Skills Students of Class X SMAN 4 Wajo."

## II. METHOD

This research is a true experimental study conducted from October to December at SMAN 4 Wajo. The research design used is a factorial design 2×2. In this design, there are two class groups that are the subjects of the study: one group receives treatment using the Project-Based Learning (PjBL) model, and the other group is taught using the discovery learning model. The population of this study consists of all Class X students at SMAN 4 Wajo, with a sample drawn from four classes selected using simple random sampling.

**Table 1. Factorial Design 2x2**

| **Learning Interest (B)** | **Learning Models** | |
|---|---|---|
| | **Project Based Learning Model ($A_1$)** | **Discovery Learning Model ($A_2$)** |
| High ($B_1$) | [A1, B1] | [A2, B1] |
| Low ($B_2$) | [A1, B2] | [$A_2$, B2] |
| $\sum$ | [A1, B1] + [A1, B2] | [A2, B1] + [A2, B2] |

The research variables consist of: 1) independent variables: the Project-Based Learning model and the Discovery Learning model; 2) moderator variables: high and low learning interest; 3) dependent variable: critical thinking skills. Data collected in this

study uses a learning interest questionnaire developed based on indicators of learning interest, including feelings of enjoyment, student involvement, interest, and attention. Data were also collected through tests of critical thinking skills based on indicators proposed by Facione, which include interpretation, analysis, inference, evaluation, and explanation.

Data analysis techniques in this study are divided into two parts: analysis related to the instruments used in the research and analysis of data obtained during the study (descriptive and inferential). Instrument analysis includes calculations of validity, reliability, difficulty level of the critical thinking skills test, and the discriminating power of the test. The data analysis of research results is divided into two: 1) descriptive statistical analysis involving calculations of mean, standard deviation, maximum score, minimum score, and frequency distribution; 2) inferential statistical analysis using two-way analysis of variance (ANOVA), preceded by prerequisite tests consisting of normality tests using the Liliefors test and homogeneity of variance tests.

## III. RESULT AND DISCUSSION

The description of the critical thinking skill scores of the students was obtained by conducting a descriptive analysis of the scores obtained through critical thinking skills tests, which can be seen in Table 2.

**Table 2. Statistics of Students' Critical Thinking Skill Scores**

| Empirical | Learning Models (A) | |
|---|---|---|
| | Project Based Learning ($A_1$) | Discovery Learning ($A_2$) |
| Maximum Score | 29 | 26 |
| Minimum Score | 12 | 9 |
| Sample Size | 61 | 61 |
| Average Score | 21,64 | 19,13 |
| Standard Seviation | 4,38 | 4,41 |

Table 2 shows that the average score of the experimental class using the Project Based Learning model is higher, at 21.64, compared to the average score of the class using the Discovery Learning model, which is 19.13. Similarly, the highest and lowest scores in the experimental class using the Project Based Learning model are higher compared to the control class taught using the Discovery Learning model.

Further details on the frequency distribution of critical thinking skills scores for students in the control and experimental classes can be seen in Table 3 below.

**Table 3. The Frequency Distribution of Critical Thinking Skills Scores for Students in the Experimental and Control Classes**

| Interval | Category | Frequency | | Percentage | |
|---|---|---|---|---|---|
| | | Experimental | Control | Experimental | Control |
| 0 – 6 | Very Low | 0 | 0 | 0 % | 0% |
| 7 – 13 | Low | 3 | 10 | 4,9 % | 16,4 % |
| 14 – 20 | Medium | 24 | 24 | 39,3 % | 39,3 % |
| 21 – 27 | High | 29 | 27 | 47,5 % | 44,3 % |
| 28 – 34 | Very High | 5 | 0 | 8,2 % | 0 % |
| | Total | 61 | 61 | 100% | 100% |

Table 3 above illustrates that the majority of students in the experimental class have critical thinking skills scores categorized as medium and high, with frequencies of 24 and 39, respectively, translating to percentages of 39.3% and 47.5%. Meanwhile, for the very low and low categories, the frequencies are 0 and 3, with percentages of 0% and 4.9%, respectively. Additionally, the very high category has a frequency of 5 and a percentage of 8.2%.

In the control class, the categorization of scores also predominantly falls within the medium and high categories, with frequencies of 24 and 27, translating to percentages of 39.3% and 44.3%. On the other hand, 10 students scored within the low category, representing 16.4%. However, there are no students who scored in the very low and very high categories.

The results of the descriptive analysis of students' interest in learning scores for both the control and experimental classes are presented in Table 4 below.

**Table 4. Statistics of Students' Learning Interest Scores in the Experimental and Control Classes**

| Class | Learning Interest Score | | Average Score |
|---|---|---|---|
| | Maksimum | Minimum | |
| Experimental | 136 | 87 | 113,2 |
| Control | 141 | 95 | 114,7 |

The table above shows that the students' learning interest scores are actually higher in the control class compared to the experimental class. This can be seen from the maximum, minimum, and average scores obtained between the two classes.

Hypothesis testing was conducted using two-way analysis of variance (ANOVA) with an F-test and a significance level of α = 0.05, performed manually using Microsoft Excel. The reference is that if the calculated F value is greater than or equal to the table F value (Fhitung ≥ Ftabel), then the null hypothesis (H0) is rejected. However, before conducting hypothesis testing, descriptive statistical calculations were performed to provide an overall picture of the data groups being tested, the results of which can be seen in Table 5 below.

**Table 5. The Statistic Descriptive 2 x 2 Factorial Design**

| Learning Interest | Statistical | Learning Models (A) | |
|---|---|---|---|
| | | *Project Based Learning* ($A_1$) | *Discovery Learning* ($A_2$) |
| High ($B_1$) | n | 17 | 17 |
| | ∑x | 422 | 363 |
| | ∑x^2 | 10700 | 7903 |
| | [redacted] | 24,8235 | 21,3529 |
| Low ($B_2$) | n | 17 | 17 |
| | ∑x | 325 | 295 |
| | ∑x^2 | 6449 | 5515 |
| | [redacted] | 19 ,1176 | 17,3529 |
| ∑K | n | 34 | 34 |
| | ∑xt | 747 | 658 |
| | ∑xt^2 | 17149 | 13418 |
| | $\bar{x}t$ | 21,9706 | 19,3529 |

The inferential data analysis technique used to test the hypothesis involves parametric analysis, specifically variance analysis (ANOVA) with a 2×2 factorial design, and the summary of the test results is as follows.

**Table 6. The Summary of ANOVA Test Result**

| Source of Variance | Sum of Square | Degree of Freedom | $(s^2)$ Variance | Fcalculate | Ftable 0,05 | Test Decision |
|---|---|---|---|---|---|---|
| Between Group | 3 | 529,22 | 176,41 | 11,200 | 2,75 | $H_o$ rejected |
| Between A | 1 | 400,37 | 400,37 | 25,420 | 3,99 | $H_o$ rejected |
| Between B | 1 | 116,49 | 116,49 | 7,396 | 3,99 | $H_o$ rejected |
| Interaction (A x B) | 1 | 12,37 | 12,37 | 0,785247 | 3,99 | $H_o$ accepted |

***1) Overall, there is a difference in the critical thinking skills of students taught using the Project Based Learning model compared to those taught using the Discovery Learning model among the Class X students at SMAN 4 Wajo***

The testing of the first hypothesis based on ANOVA analysis shows Fcount = 11.20 and Ftable = 2.75 (F count ≥ F table), leading to the conclusion that $H_0$ is rejected, or in other words, $H_1$ is accepted. This means that, overall, there is a difference in critical thinking skills between students taught using the Project Based Learning model and those taught using the Discovery Learning model among the Class X students at SMAN 4 Wajo.

The significant difference between students taught using the Project Based Learning model and those taught with the Discovery Learning model is due to the differing learning steps, which also have different educational focuses. The Project Based Learning model emphasizes that students understand a concept and principles through project work, allowing them to experience meaningful learning through their own knowledge.

This aligns with the research conducted by Undari et al. (2023), which suggests that learning through the Project-Based Learning model can enhance critical thinking, communication, creativity, and collaboration skills in the learning process. Through Project-Based Learning, students' creativity can be honed as they ultimately become capable of generating new ideas and applying them to problem-solving based on critical thinking. This learning model also provides students with the opportunity to construct their own knowledge, both independently and in groups, through active and enjoyable learning experiences.

***2) For students with high learning interest, there is a difference in critical thinking skills between those taught using the Project Based Learning model and those taught using the Discovery Learning model***

The testing of the second hypothesis based on learning interest shows F count = 25.42 and F table = 3.99 (F count ≥ F table), leading to the rejection of $H_0$. This confirms the second hypothesis that, for students with high learning interest, there is a difference in critical thinking skills between those taught using the Project Based Learning model and those taught using the Discovery Learning model among the class X students at SMAN 4 Wajo.

The difference in interest in physics between students taught using the Project Based Learning model and those taught using the Discovery Learning model can also be seen in the fact that students with high learning interest are more enthusiastic and engaged in the learning process. They show higher attention, interest, and involvement. Learning through the Project Based Learning model actively involves students in completing a project, which increases their interest in the material. Thus, every step of the Project Based Learning model, combined with high student interest, can optimize their critical thinking skills in terms of interpretation, analysis, inference, evaluation, and explanation.

***3) For students with low learning interest, there is a difference in critical thinking skills between those taught using the Project Based Learning model and those taught using the Discovery Learning model***

The analysis of the third hypothesis shows F count = 7.396 and F table = 3.99 (F count ≥ F table), leading to the rejection of $H_0$. This indicates that in the group of students with low learning interest, there is a difference in critical thinking skills between those taught using the Project Based Learning model and those taught using the Discovery Learning model among the Class X students at SMAN 4 Wajo. This can be observed from the average scores of students with low learning interest: those taught using the Project Based Learning model achieved a higher critical thinking skills score of 19.12 compared to those taught using the Discovery Learning model, who scored 17.35.

Although the difference is not very significant, students with low learning interest in the experimental class remained actively engaged in learning because the stages of the Project Based Learning model provide opportunities for students to collaborate and complete projects with their group members. As a result, even with low learning interest, students can optimize their existing skills, including critical thinking skills.

***4) There is no interaction between the learning model and learning interest regarding the critical thinking skills of students***

The fourth hypothesis regarding the interaction effects, based on the variance sources of the learning model and learning interest, resulted in F count = 0.79 and F table = 3.99 (F_count ≤ F_table), leading to the acceptance of $H_0$ and rejection of $H_1$. This means that there is no interaction effect between the learning model and learning interest on the critical thinking skills of students.

Students taught using either the Project Based Learning model or the Discovery Learning model show no interaction effects on those with high or low learning interest. This is evidenced by the average critical thinking skills scores of students with both high and low learning interest in the experimental class being higher than those in the control class. Additionally, students with high learning interest in both the experimental and control classes still maintain higher critical thinking skills scores compared to those with low learning interest.

Therefore, in terms of achieving critical thinking skills, the learning model and learning interest do not interact significantly. This indicates that the Project Based Learning model effectively enhances the critical thinking skills of students, regardless of whether they have high or low learning interest. Consequently, the implication of this research is that the characteristics of the Project Based Learning model can develop students' critical thinking skills in learning.

The factors influencing the lack of interaction between the learning model and students' interest in critical thinking skills can be examined through the research process conducted. Several factors indicated as causes for the absence of interaction include the application of the Project-Based Learning model, which is deemed not yet optimal because its implementation occurs over a short period, preventing students from fully adapting to the learning model. Additionally, students are considered unaccustomed to the Project-Based Learning worksheets that require them to independently seek solutions to problems and design their own steps to construct projects. As a result, in the learning process, students tend to seek assistance and guidance from teachers, as they are usually more familiar with solving theoretical problems.

This description aligns with what Tibahary & Muliana (2019) stated, that the success of the learning process for students is influenced by both internal and external factors. Internal factors refer to conditions in the learning process originating from within the individual, leading to changes in behavior. Some aspects included as internal factors are intelligence, talent, skills, motivation, and physical and mental conditions. External factors are those conditions outside the individual that influence their learning. External factors include the school environment, family, and community (socio-economic status, socio-cultural conditions, and community circumstances). These factors were not deeply examined in this study, as it focused on the application of the learning models between Project-Based Learning and Discovery Learning.

## CONCLUSIONS

Based on the analysis and discussion presented in the previous chapter, the following conclusions can be drawn; First, overall, there is a difference in the critical thinking skills of students taught using the Project Based Learning model compared to those taught using the Discovery Learning model among the Class X students at SMAN 4 Wajo. Second, for students with high learning interest, there is a difference in critical thinking skills between those taught using the Project Based Learning model and those taught using the Discovery Learning model. Third, for students with low learning interest, there is also a difference in critical thinking skills between those taught using the Project Based Learning model and those taught using the Discovery Learning model. Forth, there is no interaction between the learning model and learning interest regarding the critical thinking skills of students.

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