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Research Article

THE EFFECT OF PROJECT-BASED LEARNING ON THE METACOGNITIVE SKILLS OF STUDENTS IN VOCATIONAL HIGH SCHOOLS

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Abstract

This study aims to examine the effect of project-based learning on students' metacognitive skills at Bhakti Samudera Vocational High School, Surabaya. This study uses a quasi-experimental design with a control group and an experimental group to compare student outcomes with project-based learning and conventional learning methods. Data was collected through questionnaires before and after the intervention to measure students' metacognitive skills. The experimental group received project-based learning instructions, while the control group followed conventional methods. Data analysis involved calculating mean scores and paired sample t-tests to test statistical significance. The findings of this study indicate that students in the experimental group with project-based learning have higher metacognitive skills compared to the control group. This shows the positive impact of project-based learning on students' metacognitive development. The implications of this study highlight the importance of integrating project-based learning as a pedagogical approach in vocational high schools. By providing students with opportunities to apply knowledge in real-life situations, solve problems, and develop higher-order thinking skills, project-based learning enhances the metacognitive abilities needed in the modern world. However, it should be acknowledged that this study has limitations, such as the specific context of Bhakti Samudera Vocational High School and the use of a questionnaire as a measuring tool. Future studies should involve a more diverse sample and use more objective measurement methods to further explore the effects of project-based learning on metacognitive skills. In conclusion, this study shows that project-based learning has a positive and significant influence on increasing students' metacognitive skills at Bhakti Samudera Vocational High School. This supports the application of project-based learning as an effective teaching strategy to promote metacognitive development and equip students with the competencies needed for future success.

Keywords: project-based learning, metacognitive skills, vocational high school.

INTRODUCTION

The changing times that require individuals to master 21st-century skills have had a significant impact on education (Anazifa & Djukri, 2017). As a result, there has been a shift in learning activities. In the 21st century, learning should focus on equipping learners with essential 21st-century skills, work habits, and character traits that are believed to be crucial for achieving success in life. Project-Based Learning is an approach that involves teachers guiding students to create comprehensive practical projects, either individually or in groups, as part of a series of educational activities (Xie, 2016). This approach enables students to apply their knowledge in specific work situations and design products to solve practical problems. By incorporating Project-Based Learning, students can enhance their practical skills and problem-solving abilities, preparing them for the challenges of the modern world. This pedagogical approach aligns with the demands of the 21st century and ensures that students develop the necessary competencies to thrive in their future careers. According to Regulation No. 23 of the Minister of National Education No. 23 of 2006 concerning graduate competence, vocational high schools are the only path that can lead to creative careers, both individually and in groups (Permendiknas, 2006). Skills development comes from a learning process that encourages cognitive, behavioral, and psychological growth in students. One of the factors that contribute to the development of skills is the learning process, which includes the selection and implementation of appropriate learning models.

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Based on real conditions at Bhakti Samudera Vocational High School, electrical engineering subjects related to students' competence in the electricity field are part of the grouping of productive subjects. This subject has a minimum completeness criterion limit of 75. However, in reality, there are still students who have not reached this standard. So far, the teaching and learning process carried out in class XII at Bhakti Samudera Vocational High School, Surabaya, has not used a project-based learning model, so students' thinking processes and metacognitive skills are not optimal for Electrical Engineering. To enhance students' metacognitive skills, the Project-Based Learning model is applied. The Project-Based Learning model can be used as a learning approach that uses projects or activities as learning media. This will educate students to explore, investigate, interpret, analyze, and collect information to achieve various learning outcomes. Previous Study findings show that project-based learning strategies can improve learning quality (Eskrootchi & Oskrochi, 2010). They combined a project-based learning approach with computer-based simulation media in their research. This research concludes that students develop knowledge through a combination of interaction, interpretation, peers, and teachers while using technology. In previous studies about Project-Based Learning to facilitate the acquisition of specific competencies in the electrical engineering field, the results showed that project-based learning involves students actively discussing, making plans, solving problems, and increasing motivation (Iturregi *et al.,* 2017). The enhancement of metacognitive skills is important in learning electrical engineering at Bhakti Samudera Vocational High School, Surabaya. Metacognitive skills help develop students' ability to learn cognitive strategies in electrical engineering subjects.

Metacognitive skills allow students to select and invent strategies explicitly by thinking about their understanding of the task demands, their available cognitive resources, and their own experience of solving similar problems (Rahman *et al.,* 2010). The metacognitive knowledge dimension includes knowledge of general awareness as well as knowledge of awareness and self-awareness. The emphasis is on students becoming more aware of knowledge and being responsible for their ideas. The learning development of students tends to be better when they realize their thoughts are related to general awareness, which leads to actions based on that awareness. Once this awareness is realized, students can begin the thought process by designing, monitoring, and assessing what they have learned. Metacognitive skills help students solve problems and improve their learning performance. In this context, this study aims to examine the effect of using project-based learning on the Metacognitive Skills of Students in Vocational High schools.

METHODS

This study uses quasi-experiments. Quasi-experimental studies are commonly used in educational research to evaluate the effectiveness of educational interventions or programs (Gopalan *et al.,* 2020). The research subjects consisted of 56 students, who were divided into 28 students in the control class and 28 students in the experimental class. The control class should be similar to the experimental class in terms of relevant characteristics such as age and the class into which the groups are divided. The control class aims to help rule out alternative explanations for research results. For example, if the experimental class shows a greater increase than the control class, the intervention likely caused the increase compared to other factors (Sahli *et al.,* 2016).

Data regarding students' metacognitive skills were collected through a questionnaire. Questionnaires were given to students before and after learning. There are 30 statements, where positive statements are given a score of 4 for "strongly agree," a score of 3 for "agree," a score of 2 for "disagree," and a score of 1 for "strongly disagree." For negative statements, a score of 1 was given for "strongly agree," a score of 2 for "agree," a score of 3 for "disagree," and a score of 4 for "strongly disagree." Therefore, the score of this variable is calculated as the sum of the scores of all items. The hypothesis in this research is whether there is an effect of project-based learning on students' metacognitive skills. To test the research hypothesis, a paired sample t-test was used. Post-test analysis was carried out by comparing the post-test scores between the experimental and control groups to evaluate the effectiveness of the intervention. The t-test was used to determine whether there was a significant difference between the two groups after the intervention.

RESULTS

Post-test analysis was carried out by comparing post-test scores between the experimental group and the control group to determine the effectiveness of project-based learning on students' metacognitive skills.

Data from the control class showed that the average metacognitive skill was 77.75, while in the experimental class, the average metacognitive skill was 94.50 (Table 2). The results of the t-test showed a t value of -3.384 and a Sig (2-tailed) value of 0.02, which means the value is less than 0.05 (Table 3). Therefore, it can be concluded that there is a significant effect of the project-based learning model on students' metacognitive skills.

Table 1. Metacognitive Skills Questionnaire

Number	Statement
1	I feel happy when I study electrical engineering subjects.
2	I feel confident when facing exams in electrical engineering subjects.
3	I am afraid of being electrocuted during the electrician's practice.
4	I feel that I do not understand when studying electrical engineering subjects related to calculations.
5	I feel happy when there is an electrical engineering practice lesson.
6	I feel happy during the electrical engineering subject.
7	I am confident when dealing with people who are better at electrical engineering than I am.
8	I will not push myself if I fall behind in understanding electrical engineering subjects.
9	I try my best to learn electrical engineering subjects related to the material.
10	To be the smartest in understanding the subject of electrical engineering is my desire and goal.
11	I think that there is always a way out if I have difficulty solving electrical engineering problems.
12	I study electrical engineering subjects according to the planned schedule.
13	Being the smartest and understanding electrical engineering concepts is not my goal.
14	I think that if I can't solve an electrical engineering problem, it means that the electrical engineering problem is wrong.
15	I will tell my friends about electricity concepts that I know if they don't understand.
16	I increase the frequency of studying electrical engineering if I fall behind in electrical engineering subjects.
17	I care about the practical implementation of electrical engineering subjects.
18	I don't care if I fall behind my friends in electrical engineering.
19	I am not interested in helping my friends who have difficulty studying electrical engineering.
20	I share work with my friends if I work on electrical engineering assignments in groups.
21	I always tell my friends if there is a problem in electrical engineering class.
22	I do not care if my friends have difficulty studying electrical engineering.
23	I will always share my knowledge with my friends, even though I do electrical engineering assignments in groups.
24	I will not correct my practical work if there is a mistake.
25	I am confident when working in groups with friends who are better at electrical engineering than I am.
26	I am confident when working in groups with friends who are less good at electrical engineering than I am.
27	I don't need to pay close attention to the electrical engineering practice that is being carried out because I am sure that I can complete it.
28	I will follow the procedure steps during the electrical practice so that there are no mistakes in carrying it out.
29	I always conclude that project work is always related to the theory of conceptual understanding of the theory of evaluation.
30	I feel happy when I can present and evaluate the results of the electrical practical work that I am doing so that I will have a better understanding of implementation in the world of work later.

Table 2. Descriptive Experiment and Control Group

Group	Mean	N	Std. Deviation	Std. Error Mean
Experiment	94.5000	28	15.40202	2.91071
Control	77.7500	28	16.85587	3.18546

Table 3. Result from uji t for experiment and control group

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Experiment–Control Group	-16.75000	26.19107	4.94965	-26.90584	-6.59416	-3.384	27	.002

DISCUSSION

The results of the analysis show that there are significant differences between the experimental group that uses project-based learning and the control group that does not use this model. This shows that the application of project-based learning effectively improves students' metacognitive skills. The results of this study are consistent with the findings of previous research showing that project-based learning can help students develop student metacognitive awareness by encouraging them to reflect on their learning and think about how they learn best. This can help students become more aware of their thinking processes and develop strategies to study more effectively in the future (Yusuf & Widyaningsih, 2020). Other findings indicate that Modified problem-based learning (M-PBL) can be used in chemistry classes to develop students' metacognitive and problem-solving skills. A study found that implementing a modified problem-based learning strategy had a better effect than conventional strategies on students' problem-solving skills and metacognitive knowledge. Modified problem-based learning involves students working on real-world problems that require them to apply their knowledge and skills to find solutions (Jusniar *et al.,* 2023). Metacognitive skills have an important role in learning electrical engineering at Bhakti Samudera Vocational High School. Metacognitive skills assist students in developing effective cognitive strategies in electrical engineering subjects. In this study, the application of project-based learning specifically aims to improve students' metacognitive skills. The results of the analysis show that the experimental class that uses project-based learning has an average higher metacognitive skill compared to the control class. Thus, the use of project-based learning models can be considered an effective strategy to improve students' metacognitive skills. This learning model allows students to apply their knowledge in real situations, solve practical problems, and develop higher-order thinking skills. In the context of vocational high schools, where the development of productive competencies is very important, a project-based learning approach can be an appropriate method for preparing students to face the increasingly complex demands of the world of work.

Conclusion

This study demonstrates that implementing project-based learning positively and significantly affects the metacognitive skills of students at Bhakti Samudera Vocational High School. The experimental class, using project-based learning, exhibited higher metacognitive skills compared to the control class. Project-based learning enables students to apply knowledge, solve practical problems, and develop higher-order thinking skills. Previous research supports these findings, showing that project-based learning improves learning quality and student motivation. In vocational high schools, where developing productive competencies is crucial, project-based learning is an effective strategy for preparing students for the demands of the workforce. Applying project-based learning in electrical engineering successfully improved metacognitive skills at Bhakti Samudera Vocational High School. These findings highlight the importance of innovative and relevant learning approaches aligned with 21st-century education. Project-based learning effectively enhances metacognitive skills, preparing students for future challenges. However, this study has limitations, including the need for caution in generalizing findings as it focused on specific vocational high schools. Additionally, using a questionnaire to measure metacognitive skills may affect the accuracy and validity of the data. Future studies should involve more vocational high schools and employ varied and objective measurement methods to deepen understanding of project-based learning's impact on metacognitive skills. In conclusion, this study provides evidence that project-based learning improves metacognitive skills at Bhakti Samudera Vocational High School. These results contribute to the development of innovative and relevant learning approaches aligned with 21st-century education.

REFERENCES

Anazifa, R. D., & Djukri. (2017). Project-based learning and problem-based learning: Are they effective to improve student's thinking skills? *Jurnal Pendidikan IPA Indonesia*, *6*(2), 346–355. https://doi.org/10.15294/jpii.v6i2.11100

Eskrootchi, R., & Oskrochi, G. R. (2010). A Study of the efficacy of project-based learning integrated with computer -based simulation - STELLA. *Educational Technology and Society*, *13*(1), 236–245. https://www. researchgate.net/ publication/220374264_A_Study_of_the_Efficacy_of_Proj ect-based_Learning_Integrated_with_Computer-based_ Simulation_-_STELLA

Gopalan, M., Rosinger, K., & Ahn, J. Bin. (2020). Use of Quasi-Experimental Research Designs in Education Research: Growth, Promise, and Challenges. *Review of Research in Education*, *44*(1), 218–243. https://doi.org/10. 3102/0091732X20903302

Iturregi, A., Mate, E., Larruskain, D. M., Abarrategui, O., & Etxegarai, A. (2017). Work in progress: Project-based learning for electrical engineering. *IEEE Global Engineering Education Conference, EDUCON*, *April*, 464–467. https://doi.org/10.1109/EDUCON.2017.7942888

Jusniar, J., Syamsidah, S., & Munawwarah, M. (2023). Stimulating Metacognitive and Problem Solving-Skills

Students' on Chemical Equilibrium through Modified Problem-Based Learning (M-PBL) Strategy. *Jurnal Penelitian Pendidikan IPA*, *9*(2), 471–477. https://doi.org/10.29303/jppipa.v9i2.1753

Permendiknas. (2006). Peraturan Menteri Pendidikan Nasional Republik Indonesia Nomor 23 Tahun 2006 Tentang Standar Kompetensi Lulusan.

Rahman, S., Yasin, R. M., Ariffin, S. R., Hayati, N., & Yusoff, S. (2010). Metacognitive skills and the development of metacognition in the classroom. *International Conference on Education and Educational Technologies - Proceedings*, *April 2020*, 347–351.

Sahli, J., Maatoug, J., Harrabi, I., Ben Fredj, S., Dendana, E., & Ghannem, H. (2016). Effectiveness of a Community-Based Intervention Program to Reduce Hypertension Prevalence among Adults: Results of a Quasiexperimental Study with Control Group in the Region of Sousse, Tunisia. *Global Heart*, *11*(1), 131–137. https://doi.org/10.1016/j.gheart.2016.01.001

Xie, X. (2016). The Application of Project-based Learning in Higher Vocational Computer Courses. *2nd International Conference on Education Technology, Management and Humanities Science*, *Etmhs*, 310–313. https://doi.org/10.2991/etmhs-16.2016.69

Yusuf, I., & Widyaningsih, S. W. (2020). Implementing e-learning-based virtual laboratory media to students' metacognitive skills. *International Journal of Emerging Technologies in Learning*, *15*(5), 63–74. https://doi.org/10.3991/ijet.v15i05.12029

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