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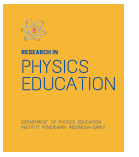

ARTICLE

The implementation Project-Based Learning in lower secondary school: a critical review

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Abstract

The learning that is widely recommended to improve science skills is project-based learning. Several studies show that the application of project-based learning models or methods or learning strategies increases motivation, achievement, problem-solving abilities, and so on. However, in reality, in the field, teachers have difficulty adopting project-based learning in schools, because several supporting factors are inadequate. Supporting factors for the success of project-based learning include a comprehensive curriculum, learning environment, appropriate assessment, student self-efficacy and support from stakeholders, especially parents. This critical review study reviews how research on project-based learning produces learning outcomes according to Project-based learning standards. In the initial stage, the author looked for as many articles as possible regarding project-based learning, especially in the science field, provided the articles were reputable. Then, reputable articles are selected that are appropriate to the implementation of project-based learning. The results of the critical review study show three important points in implementing Project-based learning to be more successful, namely: comprehensive curriculum support; the approach widely used in Project-based learning is STEM; and the implementation of Project-based learning must be adapted to suit the characteristics of students.

Keywords: Project-based learning, Science learning, Secondary School

1. Introduction

Project Based Learning is a recommended lesson in science learning (Almulla 2020; Craig and Marshall 2019; Muzana et al. 2021; Tian et al. 2023)because it can promote students' science skills (Hanif, Wijaya, and Winarno 2019). Students with good science skills can apply ideas that will be realized in useful ways and can solve problems in the real world (Hanif, Wijaya, and Winarno 2019). Science skills are complex skills that must be developed and are still a challenge. In Project-based learning is a learning method or technique that can engage many student roles (Almulla 2020). There is a strong relationship between project-based learning methods and collaborative learning, subject types, iterative learning, and authentic learning, all of which result in student engagement. Project-based learning allows students to share knowledge and information as well as discussions thereby strengthening student involvement in it. Evidence from previous research shows that students who

study with project-based learning experience increased learning achievement with low academic procrastination (Santyasa, Rapi, and Sara 2020).

Implementation of project-based learning from Buck Institute for Education must be carried out in detailed element. Project-based Learning should include the following seven key elements: (1) Begin with challenging questions, (2) Align with learning content objectives, (3) Incorporate 21st-century skills, (4) Facilitate in-depth inquiry that allows students to explore, (5) Provide lots of opportunities for students to choose and express opinions, (6) Provide lots of opportunities for self-assessment and correction, and (7) Present project products to the general public (Craig Marshall, 2019). In its implementation, project-based learning can involve more than one teacher in the form of collaboration, when planning, implementing and evaluating learning. One project can be reviewed from various disciplines so that project learning allows collaboration between subjects (Almulla 2020) Even though Project-based Learning is widely recommended in science learning, in many studies, project-based learning is much easier and more successful at the high-level education, whereas at the school level, many teachers experience difficulties in implementing project-based learning (Kilic and Ozel 2022). Several factors that support success in Project Based Learning include a sustainable and coherent curriculum (Craig and Marshall 2019; He et al. 2023), an appropriate assessment system (Gratchev 2023), fairly good student self-efficacy, environmental learning, as well as parental involvement (Craig and Marshall 2019).

Various methods have been developed so that project-based learning can be more successful at the school level (Muzana et al. 2021; Samsudin et al. 2020; Tian et al. 2023). One method used in America is to create a Project-based learning curriculum (Craig and Marshall 2019; He et al. 2023). In schools that implement a special curriculum, project-based learning is carried out sustainably and coherently. Apart from that, it involves various stakeholders from both the community and government. Schools with a Project Based curriculum involve many parental roles in it. Parental involvement will improve students' science learning (Santamaría-Cárdaba 2020). Other research implements STEM-integrated project-based learning (Hanif, Wijaya, and Winarno 2019; Kartini et al. 2021; Muzana et al. 2021; Putra, Deffinika, Islam, et al. 2021; Samsudin et al. 2020). STEM is an approach that includes Science, Technology, Engineering, and Mathematics. Based on research, it was found that STEM-integrated project-based learning significantly increases students' ICT literacy abilities and problem-solving skills (Muzana et al. 2021) and increases students' self-efficacy (Samsudin et al. 2020) and also supports spatial abilities (Putra, Deffinika, Islam, et al. 2021)(. Apart from that, STEM which is integrated into project-based learning has a positive impact on student creativity, because students will explore their ideas to make their products (Hanif, Wijaya, and Winarno 2019). Previous research (Kartini et al. 2021) shows that the integration of STEM in Project Based Learning can improve problem-solving skills.

Another way to overcome challenges in implementing project-based learning in schools is by implementing micro-project-based learning (Tian et al. 2023). One of the challenges that researchers and teachers often face in real classes is time. In micro project-based learning, learning design still refers to project-based learning but looks for projects that can be completed in a short time.

The implementation of project-based learning at each school level can be adjusted to the characteristics of the students, for example at the elementary school level games can be included in learning. Previous research shows that the integration of games in project-based learning can influence the learning environment, achievement, and learning motivation. The atmosphere of the learning environment improves after using the integration of didactic games in project-based learning (He et al. 2023).

Apart from development in implementation, project-based learning can be developed in teaching materials. One of the developments in teaching materials for project-based learning can be a STEM module, such as the Creative Teaching STEM Module (Othman, Iksan, and Yasin 2022). Teaching materials are very important in learning. It is hoped that creative teaching materials can help students

to better understand concepts, and instructions and help students to learn independently. One of the important things in learning is assessment. Project-based learning not only improves students' cognitive abilities but can improve all aspects of science process skills.

Evidence from previous research in America carried out theory-based standard tests that in terms of theoretical understanding, students who were involved in the Project-based learning curriculum had less significant results than students who attended non-project-based learning curriculum schools (Craig and Marshall 2019). The assessment system in project-based learning must be able to measure all aspects of scientific proficiency. Many assessments have been developed in project-based learning, some of which include replacing regular exams with project-based assessments (Gratchev 2023), using the Project-based Learning Body of Knowledge (PBLBOK) assessment innovation.

2. Research Method

The first thing the researcher does is determine the keywords or topics to be studied. Researchers are interested in project-based learning research so they determine project-based learning topics that are focused on science education. After finding the topic, the researcher looked for various reputable journals regarding project-based learning in the field of science so that 15 selected journals were obtained. The articles that have been selected are then analyzed one by one. Analysis includes the identity of the article, research direction and research objectives, instruments used, data processing, research methods, research results, implications, novelty and future research opportunities. After completing the analysis one by one, the statements which are interwoven from several articles are analyzed and a synthesis is made. The synthesis prepared contains general statements that are almost the same as those conveyed by several articles, findings obtained from the analysis, then conclusions are drawn after which research opportunities that can be carried out on the topic of project-based learning are analyzed.

3. Result and Conclusion

Several articles reveal the same thing that project based learning is highly recommended for science learning. This can be seen from several research evidence that project-based learning can improve science skills. However, the article also indicates that project-based learning is quite difficult to implement due to several factors such as curriculum support which must be comprehensive, students must have self-efficacy, stakeholder support, teacher understanding regarding project based. Various efforts have been made to anticipate these obstacles, starting from integrating various approaches, modifying assessments, creating special project-based curricula, etc. From the results of these modifications and integration, it can be seen that the success of project based in schools. Several countries such as America, China, Turkey, including Indonesia, are very concerned about project-based learning. The government hopes that by supporting project-based leaning in schools, the nation's future will be filled with people who have the skills of the future. Even in America, several schools have created a special Project-Based Learning curriculum.

In its implementation, the stages of project-based learning usually require a long time because they are required to produce products from the project. For the initial stages of implementing project-based learning, this will create obstacles. One way to overcome time constraints is to modify project-based learning in the form of micro-project-based learning. Projects that are usually carried out over a long period of time are selected and adjusted so that the project stages are still carried out but within a short period.

Based on an analysis of articles about project-based learning in science learning, the approach that is most often integrated with project-based learning is the Science, Technology, Mathematics and Engineering approach, abbreviated as STEM. STEM is very suitable to be used in science because STEM collaborates four different science subjects; science, technology, engineering and mathematics, as a holistic unit.

The research shows that integrating E-STEM with project-based learning can improve ICT literacy and problem-solving skills (Muzana et al. 2021). Project-Based learning as a method and STEM as an approach so that it can be said that this integration is an E-STEM Project-Based Learning learning model. ICT literacy and problem-solving skills are skills that are relevant and much needed now and in the future.

Apart from that, STEM integration in project-based learning shows a significant increase in self-efficacy compared to conventional classes (Samsudin et al. 2020). Self-efficacy is very important in achieving desired learning outcomes or goals, besides that self-efficacy can also predict a student's learning mastery. A learning process that integrates STEM and Project-based learning gives students more freedom to learn on their own. Project-based learning STEM emphasizes the design and development of a product which requires students to undergo a STEM process.

In another article, it was found that the integration of STEM with project-based learning was able to increase student creativity in the dimensions of resolution, elaboration and novelty (Hanif, Wijaya, and Winarno 2019). STEM requires students to design, create, test, redesign a product. When combining STEM with Project-based learning, students think of ideas, design, create, test and redesign not alone but in groups. The results of thinking involving several people will produce the best ideas that will increase student creativity.

Another important point obtained from the results of previous research is assessment in project-based learning. Although research shows that there are differences between students who go to schools with a project-based learning curriculum and students who go to schools with a regular curriculum, students with a project-based curriculum look better in the standard final exam assessment but the assessment for project-based learning is worse. It would be good if it could measure other abilities such as high order thinking skills and non-content specific skills such as critical thinking skills, literacy, problem solving skills, creativity and others. Apart from that, efforts are made to ensure that the assessment does not take the form of multiple choices because it is less sensitive in assessing project-based learning (Craig and Marshall 2019).

The results of the critical review study show three important points in implementing Project-based learning to be more successful, namely: the success of project-based learning is largely determined by curriculum support, the learning environment, the assessment system used, and the involvement of parents and the community; the approach widely used in Project-based learning is STEM; and the implementation of Project-based learning must be adapted to suit the characteristics of students. Efforts continue to be made to adapt project-based learning to class conditions so that learning outcomes are maximized.

Science education must produce process, product and attitude elements so that learning choices must be adjusted so that the goals of science education are successful. Project based learning is very important in achieving success in science, therefore studies on project-based learning must continue to be carried out. Currently, most teachers do not fully understand project-based learning and they often cannot differentiate between project-based learning and project assignments.

Based on the result of analysis above, we find an opportunity that research on project-based learning is still very likely to be developed in the future. When related to 21st century demands and the skills that students must have, there is not much research on project-based learning in schools. The research that many find is still not reputable. We see that the gap between the expected results from project-based learning can be addressed in various ways or integration. We see that Project-based learning can be integrated with the Learning Management System in a school. If an LMS is not yet available at school, Project Based Learning can be integrated with the already popular LMS, namely Google Classroom. It is said that Project Based Learning with the e-learning concept helps students in learning without the limitations of space and time (Muzana et al. 2021).

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