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LITERATURE REVIEW: THE EFFECT OF PROJECT-BASED LEARNING ON STUDENT MOTIVATION AND ACHIEVEMENT IN SCIENCE

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Abstract

Project Based Learning (PBL) is a student-centred educational approach where learners acquire knowledge and skills through in-depth investigation of complex and authentic problems or challenges. In PBL, students are actively engaged in a long-term learning process, working collaboratively to design, develop and produce real products or solutions, while integrating multiple disciplines and developing 21st century skills. The research method in this study is literature. The results showed that PBL was consistently positively correlated with increased student intrinsic motivation and academic achievement in science. However, the review also identified challenges in implementing PBL, including the need for careful planning and adequate support. Thus, PBL offers a promising approach to improving the quality of science education, with significant potential to prepare students for the real-world demands of the modern era.
Keywords: Project Based Learning, Motivation, Student Achievement, Science.

INTRODUCTION

Science education plays a crucial role in preparing young people to face the challenges of the 21st century. Science education is a field of study that focuses on teaching and learning scientific concepts, the scientific method, and critical thinking skills in the context of natural science. It encompasses a wide range of disciplines such as physics, chemistry, biology, earth science, and astronomy (Begum et al., 2022).. The main goal of science education is to develop scientific literacy in learners, which includes conceptual understanding, scientific process skills, scientific attitudes, knowledge application, awareness of science, technology, and society issues, and scientific communication skills. (Zen et al., 2022).

Science education not only aims to prepare students to become scientists in the future, but also to create citizens who are science literate, able to make informed decisions, and participate in public discussions on scientific and technological issues. (Nuryono, 2022).

In the modern context, science education also increasingly emphasises interdisciplinary approaches, inquiry-based learning and the use of technology to enhance students' learning experience. However, various studies show that student interest and achievement in science tends to decline in various countries, including Indonesia. This

phenomenon is a concern for educators and policy makers, given the importance of science literacy in the current era of technology and information. (Sauri et al., 2022)..

Low student motivation and achievement in science can be caused by various interrelated factors. One of the main factors is students' perception that science is a difficult and abstract subject, so they feel unable to master it. This is often exacerbated by ineffective teaching methods, where teachers focus more on memorising concepts rather than understanding and practical application. (Barlian et al., 2022).. In addition, the lack of relevance between the science material taught and students' daily lives can also lower their interest and motivation. Another factor that plays a role is a less supportive learning environment, including inadequate laboratory facilities or limited opportunities to conduct experiments and scientific investigations (Yuliati et al., 2022). (Yuliati et al., 2022)..

External factors such as family and community influences can also affect students' motivation and achievement in science. Lack of support and encouragement from parents or negative stereotypes about careers in science can reduce students' interest. In addition, an overly exam-orientated education system and a dense curriculum often make students feel pressured and lose the joy of learning science. Limited access to quality educational resources, especially in remote or less developed areas, can also be an obstacle for students to develop their interest and abilities in science. All these factors interact and contribute to students' low motivation and achievement in science (Sitopu et al., 2024); (Guna et al., 2024); (Fawait et al., 2024)..

Project-Based Learning (PBL) is emerging as a promising alternative to address these issues. PBL is a pedagogical approach that engages students in complex and meaningful projects, allowing them to explore real-world problems and develop innovative solutions. This method is believed to increase students' intrinsic motivation, develop critical thinking skills, and improve conceptual understanding in science. (Syakhrani & Aslan, 2024); (Sartika & Fransiska, 2024)..

Various studies have been conducted to test the effectiveness of PBL in science learning. For example, a study by Thomas (2000) showed that PBL can increase student engagement and deep understanding of science materials. Meanwhile, research by Krajcik and Blumenfeld (2006) indicated that PBL can increase student motivation and problem-solving skills in the context of science. (Royani et al., 2024)..

Nonetheless, there are still gaps in our understanding of how PBL affects student motivation and achievement at different levels of education and in different cultural contexts. In addition, factors that influence the successful implementation of PBL in science learning still need to be further explored.

Research Methods

The study in this research uses the literature method, which is a research approach that involves collecting, analysing, and synthesising information from various written sources relevant to the research topic. This process includes a systematic search of academic databases, scientific journals, books, research reports, and other credible

sources to identify, evaluate, and integrate existing findings. (Sahar, 2008); (Arikunto;, 2000). Researchers use this method to build a comprehensive understanding of a topic, identify gaps in existing knowledge, formulate new research questions, or provide a theoretical context for empirical research. Literature research methods allow researchers to capitalise on existing knowledge, avoid unnecessary duplication of research, and provide a solid foundation for further research development. The quality of literature research largely depends on the researcher's ability to analyse, synthesise, and interpret information critically and objectively. (Fadli, 2021).

Results and Discussion

The Effect of Project Based Learning on Student Motivation

Project-Based Learning (PBL) is a student-centred teaching method in which learners are actively involved in the learning process through working on complex and authentic projects. In this approach, students are presented with challenging questions or problems, which then encourage them to design, plan and execute projects that result in real products or presentations. (Tambunan & Sihite, 2020). PBL emphasises interdisciplinary learning, problem solving, critical thinking skills, collaboration, and communication. This method aims to connect academic knowledge with real-world situations, increase learning motivation, and develop 21st century skills necessary in life and future careers. Through PBL, students not only gain a deeper understanding of the subject matter, but also learn to manage time, resources, and work in teams, as well as develop independence and responsibility in their learning process. (Indriyani et al., 2024)..

Learning motivation is an internal and external drive that moves a person to carry out learning activities, maintain learning activities, and direct students' learning attitudes and behaviour. It is a psychological force that encourages students to pursue learning goals, overcome challenges, and persevere in the face of difficulties during the learning process. Learning motivation can come from within the student (intrinsic), such as curiosity, interest, and desire for achievement, or from outside (extrinsic), such as rewards, praise, or the desire to avoid punishment. (Sasmito et al., 2023).. Factors that influence learning motivation include the learning environment, teaching methods, teacher-student relationships, and the relevance of learning materials to students' lives. High learning motivation tends to result in active engagement in learning, perseverance in the face of difficult tasks, and better academic achievement. Therefore, understanding and improving learning motivation is a key aspect in creating an effective learning environment that supports student success. (Sunardi et al., 2021).

Project-based learning (PBP) has a significant influence on students' learning motivation. This approach offers authentic and relevant learning experiences, which can increase students' interest and engagement in the learning process. By exposing students to challenging and meaningful projects, PBP fuels curiosity and a spirit of exploration, which are essential components of intrinsic motivation. (Haq, 2020).

One of the ways PBP increases motivation is through giving students autonomy. In PBP, students have the freedom to choose certain aspects of their project, plan their approach, and make decisions throughout the process. This autonomy gives students a sense of ownership over their learning, which can increase motivation and commitment to the task. In addition, successful completion of challenging projects can increase students' sense of competence and self-efficacy, which in turn fuels motivation for further learning. (Rahayu & Afnita, 2023)..

PBP also encourages collaboration and social interaction, which can have a positive effect on learning motivation. Working in groups to complete projects allows students to share ideas, learn from each other and build social skills. These interactions can create a supportive and enjoyable learning environment, which can increase students' motivation to actively participate in learning activities. In addition, the presentation of project results to a wider audience can provide additional motivation for students to do their best in their work (Sudarjo & Suyitno, 2023)..

However, it is important to note that the effectiveness of PBP in increasing learning motivation may vary depending on its implementation. Projects that are too difficult or too easy can reduce motivation, so there needs to be an appropriate balance in the level of challenge. In addition, adequate support from teachers, constructive feedback and appropriate assessment are also important to ensure that PfP actually increases students' learning motivation. With proper implementation, PBP can be a powerful tool to increase learning motivation, encourage active student engagement, and develop self-learning skills essential for future academic and professional success. (Zakiah & Aslan, 2024).

Furthermore, Project Based Learning (PBP) also plays a role in developing important 21st century skills, such as problem solving, critical thinking and creativity. When students engage in complex and multidisciplinary projects, they are encouraged to use a variety of skills and knowledge in an integrated manner. This process not only enhances their understanding of the subject matter, but also motivates them to develop skills that are relevant to the real world. Awareness of the relevance and practical application of what they learn can be a strong motivator for students to continue learning and developing themselves. (Zakiyyah et al., 2024)..

Another aspect of PBP that has an effect on motivation is its ability to accommodate a variety of learning styles and intelligences. By providing flexibility in how students demonstrate their knowledge and skills, PBP can motivate students who may feel less engaged in traditional learning methods. For example, students who are more visual or kinesthetic may feel more motivated when they can express their understanding through projects involving design, construction or multimedia presentations. (Judijanto et al., 2024); (Iksal et al., 2024).

Thus, Project Based Learning has great potential to increase students' learning motivation through various mechanisms. PBP creates an authentic learning environment, encourages student autonomy, facilitates collaboration and develops relevant skills. This approach also allows students to see a direct connection between what they learn in class

and real-world applications, which can increase their interest and motivation. However, the success of PBP in increasing student motivation depends on effective implementation. Educators need to ensure that the projects are appropriate for students' ability levels, provide sufficient support, and create an environment that encourages independent exploration and learning. With the right approach, PBP can be a very effective tool to increase learning motivation, encourage students' active involvement in the learning process, and prepare them to face future challenges. Therefore, the integration of PfP in the educational curriculum can be an important step in creating more meaningful and motivating learning experiences for students.

The Effect of Project Based Learning on Student Achievement

Learning achievement is the result achieved by a student after going through the learning process in a certain period of time, which is generally measured through various forms of evaluation such as tests, exams, or performance assessments. This learning achievement reflects the level of understanding, mastery of knowledge, and skills that students have acquired in a particular subject or field of study. (Irwan et al., 2024).. Learning achievement not only includes cognitive aspects (knowledge), but can also include affective (attitudes) and psychomotor (skills) aspects, depending on the learning objectives and evaluation methods used. Learning achievement is often used as an indicator of the success of the teaching and learning process and is the basis for assessing student progress, as well as for evaluating the effectiveness of teaching methods and curriculum. (Juliani & Aslan, 2024).

Project-Based Learning (PBL) has shown a significant positive impact on student achievement in various aspects. This approach integrates knowledge and skills through a meaningful inquiry process, where students are actively involved in designing, solving problems, making decisions, and completing real projects. Through PBL, students not only gain a deeper understanding of the subject matter, but also develop critical thinking skills, creativity, and complex problem-solving abilities. (Sari et al., 2020).

One of the main influences of PBL on student achievement is increased motivation and engagement in the learning process. When students are given the opportunity to work on projects that are relevant to real life and match their interests, they tend to be more enthusiastic and committed to their learning. This often results in increased attendance, more active participation in class, and a greater desire to pursue knowledge beyond the assigned task. As a result, students not only achieve better academic results, but also develop a positive attitude towards lifelong learning (Ha, 2021).

PBL also contributes to the development of critical 21st century skills, such as collaboration, communication and digital literacy. Through teamwork on projects, students learn to negotiate, divide tasks and manage conflict, all of which are valuable skills for future success. The ability to present project results and communicate effectively with various audiences also improves. In addition, the use of technology in research and

project presentation enhances students' digital skills, preparing them for an increasingly technologically connected world. (Khan, 2024).

Furthermore, PBL promotes student achievement through the development of metacognitive abilities and self-directed learning. Students learn to plan their projects, monitor progress, and evaluate results, which are essential skills for self-management and lifelong learning. The reflection process that is an integral part of PBL helps students identify their strengths and weaknesses, set personal learning goals, and develop strategies for self-improvement. These abilities not only improve their current academic performance, but also prepare them for success in further education and future careers. (Sabrowsky et al., 2024)..

In addition to these impacts, Project Based Learning also has a positive influence on the development of students' social and emotional skills. Through collaboration on projects, students learn to empathise, manage emotions and build positive interpersonal relationships. They also develop a sense of responsibility and leadership when managing their projects. (Nurjani, 2023). These skills are not only essential for academic success, but also invaluable in their future personal and professional lives. In addition, PBL often involves interaction with communities or professionals outside of school, giving students a better understanding of the real world and potential future careers. (Nurfiyati & Indawati, 2021)..

Project Based Learning also promotes differentiation and inclusion in education. As projects can be tailored to different ability levels and learning styles, this approach allows students with varying backgrounds and abilities to participate and succeed. Students who may struggle in traditional learning often find motivation and success through PBL, as they can demonstrate their strengths in ways that may not be apparent in standardised assessments. This can boost students' confidence and self-esteem, which in turn can improve their overall academic performance (Prastiko et al., 2023)..

As such, Project Based Learning has been shown to have a significant and positive influence on student achievement in various aspects. This approach not only improves academic understanding and learning outcomes, but also develops essential skills needed for success in the 21st century. Through PBL, students experience increased motivation, deeper engagement in the learning process, and the development of skills such as critical thinking, creativity, collaboration and communication.

Moreover, PBL promotes independent learning, improves metacognitive skills, and prepares students for lifelong learning. The development of social-emotional skills, adaptability to real-life situations, and increased inclusion in education are significant additional benefits. Taking all these benefits into consideration, it can be concluded that Project Based Learning is a highly effective approach in holistically improving student achievement, preparing them not only for academic success, but also to face challenges in the real world and contribute positively in an ever-changing global society.

Effectiveness of Project Based Learning in Science

Science learning is an educational process that focuses on the understanding and application of scientific concepts, the scientific method, and principles of nature through observation, experimentation, and critical analysis. It involves the systematic exploration of natural phenomena, development of hypotheses, collection of data, interpretation of results, and drawing conclusions based on empirical evidence. (Campos-Roca, 2021). Science learning aims to develop students' scientific literacy, improve critical and analytical thinking skills, and foster curiosity and appreciation of the complexity of the universe. Through hands-on and minds-on approaches, students not only acquire factual knowledge, but also develop science process skills, problem solving, and the ability to apply scientific thinking in the context of everyday life and global issues. (Sahertian & Effendi, 2023)..

Project-Based Learning (PBL) has been shown to be highly effective in improving students' understanding and engagement in science. This approach allows students to apply their scientific knowledge in a real-world context, develop problem-solving skills and improve critical thinking. Through complex and meaningful science projects, students can integrate various concepts from different disciplines, reflecting the interdisciplinary nature of modern science. (Effendi & Sahertian, 2023)..

One of the main advantages of PBL in science learning is its ability to increase student motivation and engagement. When students are given the opportunity to choose and design their own projects, they tend to be more emotionally and intellectually invested in the learning process. This leads to a deeper understanding of scientific concepts and better knowledge retention. In addition, PBL encourages the development of important 21st century skills, such as collaboration, communication, and creativity, which are highly valued in science and technology careers. (Pravitasari, 2024).

Research has shown that students who engage in project-based learning in science tend to show significant improvements in academic achievement compared to traditional teaching methods. They also show improvements in conceptual understanding, ability to apply knowledge in new situations, and scientific enquiry skills. PBL has also been shown to be effective in addressing common misconceptions in science, as students are able to explore and test their own ideas through experimentation and practical data analysis. (Sotamba-Romero & Fajardo-Dack, 2022)..

Despite its effectiveness, the implementation of PBL in science learning also faces challenges. It requires careful planning, effective time management and adequate resources. Teachers need to have strong facilitation skills and the flexibility to guide students without over-directing. Assessment of science projects can also be complex, requiring careful rubrics and diverse evaluation methods (Utami & Indawati, 2021). However, with proper preparation and institutional support, PBL can be a highly effective tool in improving the quality of science learning, preparing students for future scientific challenges, and fostering a new generation of scientists and critical thinkers (Pristyadi & Anam, 2021). (Pristyadi & Anam, 2020)..

Furthermore, the application of Project Based Learning (PBL) in science also provides significant long-term benefits. Students exposed to this method tend to develop a greater interest in careers in STEM (Science, Technology, Engineering, and Mathematics). The practical experience gained through science projects gives them a real picture of how scientists work, enhances their understanding of the scientific process, and builds confidence in their ability to contribute to this field. In addition, PBL also encourages the development of broader science literacy among students, enabling them to better understand and engage with scientific issues in everyday life and society. (Darmawati, 2022).

Furthermore, PBL in science has the potential to bridge the gap between theory and practice. By exposing students to real-world problems and asking them to develop science-based solutions, this approach prepares them for the challenges they will face outside the academic environment. It also encourages innovation and creativity, as students are often asked to come up with original solutions to complex problems. In addition, PBL can be tailored to different levels of ability and interest, allowing for effective differentiation in diverse science classes. (Widari, 2021).

In conclusion, Project Based Learning has proven to be a highly effective approach to science learning. It not only improves students' conceptual understanding and practical skills, but also develops a number of important skills needed for success in the 21st century. PBL encourages active student engagement, increases learning motivation and facilitates a deeper understanding of scientific concepts.

While its implementation can be challenging and requires resources and careful planning, the long-term benefits of PBL in science are significant. This approach prepares students not only for careers in STEM fields, but also to become science-literate citizens who are able to think critically about complex scientific issues. By continuously developing and refining PBL methods in science learning, we can create a generation of scientists and thinkers who are better prepared to face future global challenges. Therefore, the integration of PBL into the science curriculum should continue to be encouraged and supported at all levels of education.

Conclusion

Project-based learning (PBL) has a significant positive influence on student motivation and achievement in science. Various studies have shown that the PBL method successfully increases students' active involvement in the learning process, encourages curiosity and builds intrinsic motivation to learn science. This approach has also proven effective in improving students' conceptual understanding, problem-solving skills and critical thinking ability, which in turn contributes to improved academic achievement in science.

Nonetheless, it needs to be recognised that the successful implementation of PBL depends on various factors, including teacher readiness, resource availability and appropriate project design. Challenges in PBL implementation, such as time management

and complex assessments, need to be overcome to maximise its benefits. However, with careful planning and adequate support, PBL offers a holistic and effective learning approach in science education, preparing students not only to excel in academics but also to face future real-world challenges.

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