

SCIENCE LEARNING INNOVATION WORKSHOP BASED ON PROJECT BASED LEARNING MODEL INTEGRATED WITH ARTIFICIAL INTELLIGENCE TECHNOLOGY FOR SCIENCE TEACHERS

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ABSTRACT In the digital era, educational innovation is crucial to creating effective and relevant learning environments. This paper addresses the need for science teachers to integrate Project-Based Learning (PjBL) with Artificial Intelligence (AI) technology, enhancing both instructional delivery and student engagement in science education. The study aims to equip teachers with the necessary understanding of how AI can be utilized to improve PjBL, focusing on problem-solving, critical thinking, and personalized learning experiences. The method used in this study is participatory, employing a case study and hands-on training approach. Teachers participated in workshops that included theoretical sessions on AI and PjBL, practical applications, and the development of AI-integrated science learning projects. The research analyzed teachers' challenges in implementing PjBL, such as limited understanding, time constraints, and resource shortages, while identifying gaps in AI usage, including a lack of knowledge and technological facilities. The results indicate that while teachers face significant barriers in adopting PjBL and AI, training workshops provide a platform for overcoming these challenges. Teachers gained new insights into AI tools and their applications in science education, leading to innovative project designs. However, continuous support and improved access to technology are necessary to fully integrate these methods into classrooms. The study concludes by recommending ongoing training and better technological support to help teachers effectively adopt PjBL and AI, ensuring interactive and adaptive science education that meets the needs of modern learning environments.

KEYWORDS: *Science Learning; Project Based Learning; Artificial Intelligence.*

1. INTRODUCTION

Innovation in education is an urgent need in today's digital era. Technology continues to develop rapidly, and the world of education must adapt to create a relevant and effective learning environment (Husna et al. 2023; Thana and Hanipah 2023). One approach that is gaining more attention is the use of Project Based Learning (PjBL). PjBL provides students with the opportunity to learn through hands-on experience, solve real problems, and develop critical and collaborative thinking skills (Karan and Brown 2022; Singha and Singha 2024). However, in its application, this approach can be further optimized by utilizing technology, one of which is Artificial Intelligence (AI).

Science teachers have a vital role in preparing the next generation to face global challenges, including those presented by technological advances. More innovative and interactive science learning is needed so that students can understand abstract science concepts more easily and deeply (Alfina et al. 2024; Saba 2024). This is where the integration of AI in PjBL-based science learning becomes relevant. AI can help create a more personalized, adaptive, and immersive learning environment, thereby enriching the teaching and learning process (Cahyanto and Sonjaya 2024; Syukur et al. 2024).

The science learning innovation workshop based on Project Based Learning integrated with Artificial Intelligence technology for science teachers was designed to answer this need. The main objective of this workshop is to provide teachers with an understanding of how to utilize AI technology in teaching and learning activities, especially in project-based science learning. With the application of AI, teachers can enrich learning resources, personalize students' learning experiences, and improve teaching effectiveness (Lutfin et al. 2024).

In addition, this workshop also aims to improve teachers' digital competence in facing the industrial revolution 4.0. Digital competence is very important for teachers in the current era, especially in terms of utilizing various technological tools and applications in teaching. The integration of AI into learning will not only help students, but also support teachers in managing classes more efficiently and intelligently (Anas and Zakir 2024).

In this era of ever-changing education, project-based learning allows students to be actively involved in the learning process (Kamaruddin et al. 2023; Sappaile et al. 2023; Solissa et al. 2024). PjBL encourages students to learn by collaborating, thinking critically, and creating solutions to real problems (Farhurohman 2024). The integration of AI in the PjBL approach can add a new dimension to science teaching by providing deeper data and analysis, providing intelligent suggestions for problem solving, and providing personalized learning content according to each student's needs.

In general, the challenge in learning science in schools often lies in how teachers deliver complex material in a way that is interesting and easy for students to understand. This is where AI technology can help, for example with interactive simulations, learning chatbots, or AI-based assessment tools that can automatically assess students' abilities and provide timely feedback.

In order to maximize the benefits of PjBL and AI integration, it is important for science teachers to understand how to use these tools in the context of learning. Therefore, through this workshop, it is hoped that teachers will gain insights, skills, and inspiration to create richer and more innovative learning experiences for their students.

2. METHOD

This workshop uses a participatory method with a case study approach and hands-on training. Science teachers who attend the workshop are given the opportunity to learn the theory of Project Based Learning and the application of Artificial Intelligence technology in science learning. This method involves several stages as follows:

1. Problem Analysis

Distribution of Google forms to identify teachers' problems in the project-based learning process integrated with artificial intelligence.

2. Theoretical Session

Delivery of information related to artificial intelligence (AI) and science learning based on project based learning.

3. Direct Practice

Designing and developing science learning based on project based learning integrated with Artificial Intelligence.

4. Presentation and Evaluation

Presentation and evaluation of discussion of the results of developing science learning based on project based learning integrated with Artificial Intelligence.

3. RESULT AND DISCUSSION

The activities carried out during this community service activity are as follows:

3.1. Problem Analysis: Distribution of Google Forms to find out the problems of teachers in the integrated project-based learning process using artificial intelligence.

Based on the results of the distribution of the Google form that has been carried out, the following results were obtained:

The obstacles faced by teachers in implementing Project Based Learning (PjBL) in class are dominated by a lack of understanding with many teachers choosing this option (6 respondents), in addition to limited resources and also lack of time. The diagram can be seen in the following image:

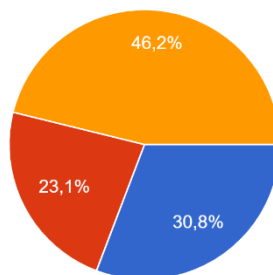


Figure 1. Main obstacles in implementing Project Based Learning (PjBL) in the classroom

Based on Figure 1, it can be seen that the main obstacle in implementing Project Based Learning (PjBL) in the classroom is the lack of understanding of PjBL, where 46.2% of teachers feel that they do not have enough knowledge or skills to implement PjBL effectively in the classroom. This suggests that additional training and mentoring may be needed so that teachers are better prepared to implement this learning model. In addition, lack of time is the second significant challenge, with 30.8% of teachers feeling that the duration needed to implement PjBL is not comparable to the time allocation available in the curriculum. The PjBL method does tend to take longer because it involves research, collaboration between students, and presentation of results. This makes it difficult for teachers to balance the needs of PjBL with the demands of a strict curriculum. Furthermore, the main obstacle in implementing Project Based Learning (PjBL) in the classroom is limited resources, which account for 23.1% of the total challenges faced. This suggests that many teachers have difficulty in providing the materials, tools, and technology needed to support this project-based learning method. The resources in question can be in the form of technological devices, access to laboratories, or adequate teaching materials.

Furthermore, the main obstacles that teachers face in understanding and using Artificial Intelligence (AI) in science learning can be seen in the following graph:

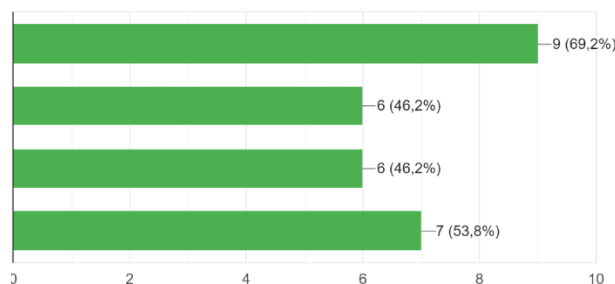


Figure 2. Obstacles in understanding and using Artificial Intelligence (AI) in science learning

Based on Figure 2, it shows various obstacles faced by teachers in understanding and using Artificial Intelligence (AI) in science learning. The biggest obstacle is the lack of understanding of AI, which is experienced by 69.2% of teachers. This indicates that most teachers do not yet have adequate knowledge of AI. In addition, 53.8% of teachers feel less skilled in using AI features, indicating a need for further training. Other obstacles are limited technological facilities, which are felt by 46.2% of teachers, and the absence of clear guidance in applying this technology in learning, which is also complained about by 46.2% of respondents. Overall, these findings indicate that the main challenges in implementing AI in science learning include a lack of understanding, skills, and technological support.

3.2. Theoretical Session: Delivery of information related to artificial intelligence (AI) and science learning based on project based learning



Figure 3. Delivery of Material Related to Artificial Intelligence/AI and Science Learning Based on Project Based Learning

In the initial stage, participants were given a deep understanding of the basic concepts of AI and its application in education, especially in PjBL-based science learning. The speaker explained how AI can be used to support more interactive and adaptive science learning. The concept of Project Based Learning is described as a student-centered learning method, where they learn by completing real projects, improving critical thinking skills, collaboration, and problem solving.

Participants were also introduced to various AI-based tools and applications that can be used in science learning, such as virtual laboratory simulations, learning chatbots, and automated assessment tools. Discussions on the advantages and challenges of implementing AI in the context of science education were also the focus of this session. This theoretical understanding is important as a foundation before teachers can apply technology in their classroom contexts.

3.3. Direct Practice: Designing and Developing Science Learning Based on Project Based Learning Integrated with Artificial Intelligence



Figure 4. Designing and Developing Science Learning Based on Project Based Learning Integrated with Artificial Intelligence

After gaining theoretical understanding, participants are given the opportunity to be directly involved in the learning design process. In small groups, they are asked to design a PjBL-based science learning project integrated with AI technology. The projects developed focus on science topics such as climate change, ecosystems, and renewable energy.

At this stage, teachers are invited to use AI-based tools that have been learned in theoretical sessions. Some groups use AI simulations to explain abstract scientific processes, such as chemical reaction simulations or interactive models of planetary movements. Other groups use AI-based chatbots to help students solve problems during the project. In developing this project, participants not only design learning scenarios but also set learning objectives and evaluation methods that are relevant to the use of AI.

3.4. Presentation and Evaluation: Presentation and evaluation of discussion of the results of the development of science learning based on project based learning integrated with Artificial Intelligence.



Figure 5. Presentation and evaluation of discussion of the results of developing science learning based on project-based learning integrated with Artificial Intelligence

The final stage of the workshop involved presentations from each group on the projects they had designed. Each group explained how they integrated AI into PjBL-based science learning, including the AI tools and techniques used, and how this approach could improve student engagement and understanding of science materials.

After the presentation, an evaluation session was conducted through an open discussion. Other participants and the facilitator provided constructive feedback on the strengths and weaknesses of the projects presented. Some challenges identified during the discussion included technical difficulties in using AI in classrooms with limited infrastructure, as well as the need for sufficient time to adapt the learning design to students' needs. However, in general, participants agreed that the integration of AI provides a new dimension that is very beneficial in improving the quality of science learning. The evaluation also emphasized the importance of ensuring that AI remains a supporting tool and not a substitute for the role of teachers. With the right guidance, the use of AI in PjBL-based science learning can create a richer and more meaningful learning experience for students.

Given the challenges faced, it is clear that efforts to improve teacher competency through further training and mentoring are urgently needed. Training programs that focus on the implementation of Project Based Learning (PjBL) and the use of AI can help teachers develop the skills needed to integrate these innovative technologies and learning methods into their classrooms. In addition, providing adequate technology resources, including access to supporting devices and infrastructure, is a priority to ensure the successful implementation of AI-integrated PjBL. Training also needs to be equipped with clear guidelines for the use of AI, as well as concrete examples that are relevant to science learning.

To overcome the time and resource issues, collaboration between teachers, educational institutions, and other stakeholders is essential. Support from the government or private sector in the form of providing technological facilities and learning resources can help accelerate the implementation of PjBL and AI in schools. In addition, ongoing mentoring or mentoring programs can provide practical guidance for teachers as they begin to implement project-based learning with AI. With a comprehensive and collaborative approach, challenges in implementing PjBL and AI can be overcome, so that teachers can create more interactive, effective, and relevant learning experiences for students.

4. CONCLUSION

In conclusion, the implementation of Project Based Learning (PjBL) and Artificial Intelligence (AI) in science learning faces various obstacles, especially related to the lack of teacher understanding of these two methods. Most teachers feel that they do not have sufficient skills and knowledge to implement PjBL or AI effectively. In addition, limited time and technological resources are also significant obstacles. Therefore, more intensive training and mentoring efforts are needed, as well as increased access to technological facilities, so that teachers can be better prepared to integrate PjBL and AI in the classroom, so that learning becomes more interactive and adaptive in accordance with the demands of modern education.

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