Synergy of Distance Learning and PjBL: Building X-Ray Replicas as Learning Tools in Radiation and Disometrology Courses

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Abstract

The aim of this study is to explore the effectiveness of Project-Based Learning (PjBL) in enhancing understanding of physics concepts and collaborative skills among students in an online learning environment using Zoom. Employing a qualitative case study approach, the study population comprises students from the physics program at Universitas Jambi, divided into two groups of five members each, involved in creating X-ray replicas. Research instruments include project guidelines, X-ray replica evaluations, and reflective interviews. Thematic qualitative analysis was conducted to identify patterns and relationships from student interviews and reflections. Findings indicate that PjBL via Zoom effectively enhances conceptual understanding, collaborative skills, motivation, and student engagement. The study underscores the importance of integrating technology in medical physics education and highlights PjBL's potential as an active project-based learning approach in online settings. It asserts that synergy between distance learning and PjBL can enhance the effectiveness of medical physics education, prompting the development of relevant curricula and strategies to enhance student engagement and learning outcomes.

Keywords: PjBL, Distance Learning, X-Ray, Learning Technology, Educational Innovation

Abstract

Tujuan penelitian ini adalah untuk mengeksplorasi efektivitas Pembelajaran Berbasis Proyek (PjBL) dalam meningkatkan pemahaman konsep fisika dan keterampilan kolaboratif mahasiswa di lingkungan pembelajaran online menggunakan Zoom. Dengan pendekatan kualitatif studi kasus, populasi terdiri dari mahasiswa program fisika di Universitas Jambi, yang dibagi menjadi dua kelompok dengan lima anggota masing-masing, terlibat dalam pembuatan replika sinar X. Instrumen penelitian mencakup panduan proyek, evaluasi replika sinar X, dan wawancara reflektif. Analisis data dilakukan dengan analisis kualitatif tematik untuk mengidentifikasi pola dan hubungan dari wawancara dan refleksi mahasiswa. Hasil menunjukkan PjBL melalui Zoom efektif meningkatkan pemahaman konsep dan keterampilan kolaboratif, serta motivasi dan keterlibatan mahasiswa. Temuan ini menyoroti pentingnya integrasi teknologi dalam pendidikan fisika medis dan potensi PjBL sebagai pendekatan untuk pembelajaran aktif berbasis proyek di lingkungan online. Studi ini menegaskan bahwa sinergi antara pembelajaran jarak jauh dan PjBL dapat meningkatkan efektivitas pembelajaran fisika, mendorong pengembangan kurikulum yang relevan, serta strategi untuk meningkatkan keterlibatan mahasiswa dan hasil pembelajaran yang lebih baik.

Kata Kunci: PjBL, Pembelajaran Jarak Jauh, Sinar-X, Teknologi Pembelajaran, Inovasi Pembelajaran.

INTRODUCTION

In today's digital era, education is undergoing a significant transformation with the widespread adoption of technology. The ideal condition for medical physics learning is the creation of an interactive and collaborative learning environment, where students can understand complex concepts through hands-on experience and in-depth discussions.

Project-Based Learning (PjBL) has been recognized as one of the effective methods to achieve this goal, especially in the context of distance learning that is increasingly relevant during the pandemic. PjBL allows students to be actively involved in the learning process, develop practical skills, and work together in teams.

A study by Arifin and Rahmatullah (2021) highlights the positive influence of Project-Based Learning (PjBL) on students' critical thinking skills in the context of physics learning. This study shows that the implementation of PjBL significantly improves students' ability to analyze information, evaluate arguments, and develop solutions based on existing evidence. These findings support the theory that a project-based learning approach is able to stimulate students' critical thinking skills through active and engaged learning experiences (Arifin & Rahmatullah, 2021).

Project-Based Learning (PjBL) has been recognized as one of the effective methods to achieve this goal, especially in the context of distance learning that is increasingly relevant during the pandemic. PjBL allows students to be actively involved in the learning process, develop practical skills, and work together in teams.

However, facts on the ground show that the implementation of PjBL in distance learning still faces various challenges. Students often feel isolated and unmotivated, which has an impact on low engagement and understanding of concepts.

In addition, the limitations of direct interaction and physical practicum are major obstacles in learning medical physics, which requires a deep understanding of the tools and techniques used in this field. This raises questions about how best to overcome these obstacles.

This research issue focuses on how to overcome these obstacles through the synergy between distance learning and PjBL. Although many studies have explored the effectiveness of PjBL in various disciplines, there are still few that discuss its application in online medical physics learning.

This research gap shows the need for a more in-depth study to understand how PjBL can be effectively integrated in distance learning, especially in the context of making X-ray replicates as a learning tool.

The novelty of this research lies in an innovative approach that combines PjBL with distance learning technology using the Zoom platform. With a focus on creating X-ray replicas, this research not only provides practical experience to students, but also improves collaborative skills and understanding of medical physics concepts.

This approach is expected to be a model for other educational institutions in developing adaptive and effective learning methods in the digital era. Thus, this research contributes to the development of relevant curriculum and learning strategies that can improve student engagement and better learning outcomes.

The purpose of this study is to explore the effectiveness of PjBL in improving students' understanding of medical physics concepts and collaborative skills in an online learning environment. Using a qualitative approach to case studies, this study involved students of the medical physics program at the University of Jambi who were divided into two groups.

Each group will be involved in the creation of X-ray replicas, which will be evaluated through project guidance, replica evaluation, and reflective interviews. This research instrument is designed to measure various aspects of the learning process, including concept understanding, collaborative skills, and student motivation.

Data analysis was carried out by thematic qualitative analysis to identify patterns and relationships from student interviews and reflections. This method allows researchers to gain in-depth insights into students' experiences and perceptions during the learning process.

The results of the study are expected to show that PjBL through Zoom is effective in improving concept understanding, collaborative skills, as well as student motivation and engagement. These findings will highlight the importance of technology integration in medical physics education and the potential of PjBL as an approach to active project-based learning in an online environment.

Thus, this research contributes to the development of relevant curriculum and learning strategies that can improve student engagement and better learning outcomes. The synergy between distance learning and PjBL is expected to be an effective solution to overcome challenges in medical physics education.

In addition, this study also aims to identify the factors that affect the success of PjBL in the context of distance learning. These factors include technology support, lecturer involvement, and student readiness to face the challenges of online learning.

This research will also explore how students respond to the use of X-ray replicas as a learning tool. This replica is expected to provide practical experience that is close to real conditions, thus helping students understand medical physics concepts better.

Using a qualitative approach, this study will collect data from various sources, including interviews, observations, and document analysis. This approach allows researchers to get a comprehensive picture of the learning process and outcomes.

The results of this research are expected to make a significant contribution to the development of more effective and innovative learning methods. These findings can also be the basis for the development of education policies that support the integration of technology in learning.

This study will also examine how PjBL can be applied in the context of distance learning in various other disciplines. Thus, this research can provide valuable insights for educational institutions in developing adaptive and effective learning strategies.

By combining PjBL and distance learning technology, this research is expected to provide innovative solutions to overcome challenges in medical physics education. This approach can also be a model for other educational institutions in developing more effective and relevant learning methods in the digital era.

This research aims to provide practical recommendations for lecturers and educational institutions in implementing PjBL in the context of distance learning. This recommendation is expected to help improve the quality of learning and student learning outcomes, as well as encourage the development of a more relevant and adaptive curriculum.

RESEARCH METHODS

This study uses a quasi-experimental type of research to explore the effectiveness of the Project-Based Learning (PjBL) method in the context of distance learning. This study involved the student population from the Faculty of Science and Technology (FST) at the University of Jambi, who participated in the Radiation Physics and Disomy course. The research sample consisted of two groups of students, each consisting of five members, who were purposively selected to participate in the X-ray replicating project.

The research instruments used include a structured project guide, which is designed to guide students in the process of creating X-ray replicas. In addition, evaluation instruments are used to assess the quality of replicas produced by students, which include aspects such as accuracy, detail, and conformity with radiation physics concepts. Reflective interviews with students were also conducted to collect data on their experiences during the project, with a focus on concept understanding, collaborative skills, and learning motivation.

The data analysis techniques applied in this study are qualitative and quantitative analysis. Thematic qualitative analysis was used to identify key patterns and themes emerging from reflective interview data, which provided in-depth insights into the student experience and the effectiveness of PjBL in the context of distance learning. Quantitative analysis was carried out on the X-ray replica evaluation data to objectively measure the quality of project results. The combination of these two analysis techniques allows researchers to provide a comprehensive overview of the impact of PjBL on student learning in Radiation Physics and Disometry courses, and highlight the potential synergies between distance learning and project-based approaches.

RESULTS AND DISCUSSION

This study shows that the use of Project-Based Learning (PjBL) in distance learning significantly improves students' understanding of the concepts of radiation physics and disometry. The quality evaluation data of the X-ray replicas produced by the students showed a noticeable improvement in terms of accuracy and technical details, reflecting a deeper understanding of the concept. These findings indicate that PjBL is able to integrate theory with practice effectively, so that students not only memorize concepts but also understand their applications concretely.

The results of reflective interviews revealed that students felt more motivated and involved in the learning process, which contributed positively to their understanding. This increased motivation is most likely triggered by a challenging and real-life relevant learning format, which makes the subject matter more engaging and meaningful. Students also report that the project helped them develop critical and collaborative thinking skills, which are crucial in the field of medical physics.

The quantitative results of the X-ray replica evaluation showed that the majority of students managed to meet or exceed the standards set in the project guidelines. For example, 80% of students demonstrate a strong understanding of the working principles of X-rays and are able to replicate devices with a high degree of accuracy. This shows that the PjBL method is not only effective in improving conceptual understanding but also in honing students' technical skills.

The success of students in achieving project standards also reflects the effectiveness of the evaluation instruments used in this study. A well-structured evaluation instrument is able to accurately measure student progress, provide constructive feedback, and motivate students to continuously improve their performance. These results confirm the importance of developing comprehensive evaluation instruments in supporting project-based learning.

In addition, findings from reflective interviews indicate that students feel more confident in applying their knowledge in real-world situations. They report that the project experience provides them with valuable practical insights and improves their problem-solving skills. This shows that PjBL is not only effective in an academic context but also provides long-term advantages in students' professional development.

Overall, this study concludes that PjBL in distance learning is an effective strategy to improve students' conceptual understanding and technical skills in the field of radiation physics and disometry. As such, it is recommended that educational institutions consider integrating PjBL into their curriculum, particularly in courses that require in-depth understanding and practical skills. The wider implementation of PjBL is expected to improve the quality of education and the readiness of students to enter the professional workforce.

In the context of distance learning, the integration of technology such as online platforms for collaboration and project presentations is also revealed as an effective means to support student interaction, enrich their learning experience, and increase engagement in the learning process (Arifin & Rahmatullah, 2021).

Project-Based Learning (PjBL) has been proven to be effective in improving students' understanding of concepts and science process skills. PjBL allows students to participate directly in relevant practical activities, thus strengthening their

understanding of the concepts taught as well as developing critical and analytical thinking skills. In addition, PjBL also increases student motivation and involvement in the learning process, with students feeling more challenged and motivated to complete the given project. This is in line with the findings of this study, where the use of PjBL in distance learning with the support of technology such as Zoom, not only improves students' conceptual and technical understanding in radiation physics and disometry, but also strengthens their collaborative skills (Aisyah & Herawati, 2020).

These findings indicate that Project-Based Learning (PjBL) can be an effective approach in improving understanding of complex concepts in medical physics, especially in the context of distance learning. The X-ray replicating project allows students to apply the theory they have learned in practice, deepening their understanding through hands-on experience. This approach shows that project-based learning provides opportunities for students to develop essential practical skills, as well as encouraging them to relate theory to real-world applications.

In addition, the use of technology such as Zoom in the implementation of PjBL has also been proven to support effective collaboration and communication between students, even though they are in different locations. This technology facilitates more intensive discussions and interactions, which in turn increases student engagement in the learning process. The ability to collaborate online allows students to work in teams, share ideas, and provide feedback in real-time, which is crucial in completing complex projects.

From the results of the reflective interviews, some of the key themes that emerged included increased motivation to learn, greater feelings of involvement, and improved collaborative skills. Students report that they feel more challenged and motivated when working on real projects that require the application of physics concepts. This project not only improves their understanding of the material, but also fosters a greater interest in the course.

Students also appreciate the opportunity to work collaboratively with their peers, which enriches the learning process and strengthens their understanding through discussion and knowledge sharing. This collaboration helps students overcome learning difficulties collectively, develop interpersonal skills, and learn how to work effectively in a team. This is an invaluable skill not only in an academic context but also in their future professional careers.

In addition, the results of this study show that the PjBL method is able to overcome several challenges of distance learning, such as lack of social interaction and motivation. By involving students in projects that demand active and collaborative participation, PjBL helps reduce the sense of isolation often experienced in online learning. Students feel more connected to their classmates and instructors, which increases their satisfaction and learning outcomes.

Overall, this study concludes that PjBL in distance learning is an effective strategy to improve students' conceptual understanding and technical skills in the field of radiation physics and disometry. It is recommended that educational institutions consider integrating PjBL into their curriculum, particularly in courses that require in-depth understanding and practical skills. The wider implementation of PjBL is expected to improve the quality of education and the readiness of students to enter the professional workforce.

Overall, this study confirms that the synergy between distance learning and Project-Based Learning (PjBL) can provide a richer and deeper learning experience for students. This combination allows students to combine theory with practice through challenging projects, so they can develop a deeper understanding of complex concepts. This rich learning experience not only enhances students' conceptual understanding but also practical and collaborative skills, which are crucial in the field of medical physics.

Through PjBL, students not only learn to work together in a team but also develop communication and problem-solving skills together. This approach provides opportunities for students to engage in a more active and relevant learning process by encouraging them to collaborate in completing tasks related to practical applications of physics concepts (Aulia & Putra, 2017).

The integration of technology in learning allows students to stay connected and collaborate effectively, even as they learn remotely. The use of platforms like Zoom supports intensive interaction and discussion, so students can work together on projects despite being in different locations. It also facilitates efficient communication and provides access to a variety of digital resources that can enrich the learning process.

These findings have important implications for the development of curricula and teaching practices in the field of medical physics, emphasizing the importance of an interactive, project-based learning approach to improve student learning outcomes. Educational institutions are advised to consider the integration of PjBL in their curriculum, particularly in courses that require in-depth understanding and practical application. Thus, it is expected that students will not only acquire strong theoretical knowledge but also practical and collaborative skills necessary in the professional world of work.

CONCLUSION

This study reveals that the use of Project-Based Learning (PjBL) in the context of distance learning significantly improves students' understanding of the concepts of radiation physics and disometry. The results of the evaluation showed that students were able to achieve a high level of accuracy in making X-ray replicas, reflecting a deep understanding of the material being taught. In addition, reflective interviews showed that students felt more motivated and engaged in the learning process, as well as experienced an increase in collaborative skills. These findings confirm that the synergy between PjBL and distance learning can provide a richer and more effective learning experience for students. The integration of technologies such as Zoom in the implementation of PjBL allows students to collaborate and communicate effectively despite being in different locations, strengthening their understanding through hands-on experience and group discussions.

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