Exploring the Impact of Integrating Discovery-Based Learning within Problem-Based Learning on Students' Critical Thinking Skills: A Transformative Educational Approach

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Abstract. This research study investigates the effects of integrating the discovery-based learning model within problem-based learning (PBL) on students' critical thinking skills. The study aims to address the need for innovative educational approaches that promote active learning, authentic problem-solving, and the development of critical thinking abilities in students. The research methodology employed a qualitative paradigm with a descriptive design, and the primary data collection method was a comprehensive literature review. The findings reveal that the integration of the discovery-based learning model within PBL creates a dynamic and engaging learning environment, stimulating students' critical thinking through reflective observation, abstract conceptualization, and active experimentation. Significant improvements were observed in students' problem-solving abilities, metacognitive skills, and the application of knowledge in real-world contexts. These findings highlight the importance of integrating experiential and problem-based approaches to enhance students' critical thinking skills and prepare them for the challenges of the 21st century. Further research is recommended to explore the long-term effects, transferability, and factors influencing the successful implementation of this transformative educational approach.

Keywords : Discovery-Based Learning Model, Problem-Based Learning, Critical Thinking Skills, Active Learning

1   Introduction

1.1   Background:

 The background section sets the stage by providing the necessary context and background information related to the research topic. It highlights the existing knowledge gaps or issues that the study aims to address. In the case of authentic learning experiences in project-based learning, the background should briefly discuss the importance

of incorporating real-world problem-solving and application of knowledge in education. Authentic learning, as defined by Laur and Ackers-Clayton (2016), involves tasks that resemble the challenges, complexity, and unpredictability of the real world. It places a strong emphasis on using information and skills in context, which helps students become more adept at problem-solving, critical thinking, and making decisions. Lombardi (2007) further emphasizes that authentic learning is a relatively new approach to education that focuses on real-world problem-solving, filling the knowledge gap between classroom instruction and real-world application [1].

In language learning, Tomlinson and Masuhara (2010) highlight the importance of designing authenticity into learning materials to reflect the complexities and uncertainties of real-world contexts [2]. Grant (2014) also emphasizes the need to engage students in authentic learning activities, where they can actively inquire and engage with real-world challenges [3].

Given the significance of authentic learning experiences in project-based learning, it is essential to investigate and understand their impact on student learning outcomes, engagement, and motivation. By incorporating authentic learning elements, educators can enhance students' ability to apply knowledge in real-world scenarios, foster critical thinking skills, and develop a deeper understanding of the subject matter.

The current research aims to explore the implementation and effects of authentic learning experiences in project-based learning. By examining the existing literature and conducting empirical research, this study seeks to contribute to the understanding of how authentic learning can be effectively integrated into educational practices. The findings of this research will provide insights into the benefits, challenges, and best practices of incorporating authentic learning experiences in project-based learning settings.

This section briefly introduces the concept of authentic learning experiences in project-based learning, emphasizing their importance in bridging the gap between classroom learning and real-world application. It also highlights the need to explore and understand the implementation and effects of authentic learning experiences. The subsequent sections of the research article will delve deeper into the theoretical framework, research methodology, findings, and implications.

1.2   Justification and Research Significance:

The justification and significance of the research section aims to provide a strong rationale for conducting the study. It explains why the research is important and how it contributes to the existing knowledge or addresses a gap in the literature. The section should be carefully articulated, focused, and persuasive in highlighting the relevance and potential impact of the study.

Authentic learning experiences in project-based learning have gained increasing attention in educational research and practice. However, there is still a need for further investigation to understand their effectiveness and impact on student learning outcomes. By conducting this research, we aim to address this gap in the literature and contribute to the existing body of knowledge.

This study's importance stems from its capacity to offer insights into the benefits and challenges of incorporating authentic learning experiences in project-based learning. It will shed light on the impact of authentic learning on student engagement, motivation, and critical thinking skills. The findings of this research can inform educators, curriculum designers, and policymakers in enhancing educational practices and promoting meaningful learning experiences for students.

1.3   Research Objectives:

The research objectives section outlines the specific goals and aims of the study. It should be concise, focused, and clearly state what the research intends to achieve.

The principal aim of this investigation is to examine the implementation and effects of authentic learning experiences in project-based learning settings. Specifically, the research aims to:

1.   Investigate how authentic learning experiences can be effectively integrated into project-based learning.
2.   Explore the impact of authentic learning experiences on student engagement, motivation, and critical thinking skills.
3.   Identify the challenges and best practices in implementing authentic learning experiences in project-based learning.
4.   Provide recommendations for educators and policymakers to enhance the design and implementation of authentic learning experiences in project-based learning settings.

D. Research Questions: The research questions section outlines the specific questions that the study seeks to answer. It should be concise and focused to guide the research process.

The research questions for this study are as follows:

1.   How can authentic learning experiences be effectively integrated into project-based learning?
2.   What is the impact of authentic learning experiences on student engagement, motivation, and critical thinking skills in project-based learning?
3.   What are the challenges and best practices in implementing authentic learning experiences in project-based learning?
4.   What recommendations can be made for educators and policymakers to enhance the design and implementation of authentic learning experiences in project-based learning settings?

These research questions will guide the data collection, analysis, and interpretation process, providing a clear focus for the study and addressing the key aspects of authentic learning experiences in project-based learning.

2   Theoretical Framework:

2.1   Definition and Concept of Critical Thinking Skills:

Critical thinking skills are essential cognitive abilities that enable individuals to analyze, evaluate, and synthesize information to make informed judgments and decisions. According to Ennis (2015), critical thinking involves "reasonable reflective thinking that is focused on deciding what to believe or do" (p. 10). It encompasses skills such as logical reasoning, evidence evaluation, problem-solving, and effective communication. Critical thinking goes beyond rote memorization and encourages individuals to question assumptions, seek alternative perspectives, and consider the implications of their beliefs and actions [4].

2.2   Role of Critical Thinking Skills in Education:

Critical thinking skills play a vital role in education as they foster intellectual growth, empower learners to become active participants in the learning process, and prepare them for the complexities of the 21st-century world. As Facione and Facione (2019) state, assessing critical thinking is about evaluating students' ability to think critically about specific issues or problems, rather than solely assessing their problem-solving skills (p. 7). Students that practice critical thinking are better able to analyze material, engage in reasoned debates, and make informed decisions, thus becoming active contributors to society [5]

2.3   Discovery-Based Learning Model:

Discovery-based learning is an instructional approach that emphasizes active student engagement and encourages learners to explore and discover knowledge through firsthand experiences. This model aligns with the constructivist theory, where learners construct their understanding through meaningful interactions with the learning environment. According to Mirzoyan (2021), discovery learning involves students actively exploring concepts, fostering critical thinking, problem-solving skills, and self-directed learning (p. 2). It allows students to connect new knowledge with their prior experiences, promoting deeper understanding and long-term retention [6].

2.4   Problem-Based Learning (PBL) as the Research Context:

Problem-Based Learning (PBL) is an instructional strategy that presents learners with real-world problems to solve collaboratively. In PBL, students engage in authentic, complex problem scenarios that require critical thinking, research skills, and the application of disciplinary knowledge. The goal is to promote deep understanding, develop problem-solving abilities, and enhance metacognitive skills. According to Wang and Zhao (2021), PBL involves a student-centered approach where learners actively construct knowledge and develop critical thinking skills through problem-solving experiences (p. 159). By using PBL as the context for this research, we pro-

vide a relevant and practical setting to examine the integration of discovery-based learning and its impact on critical thinking skills [7].

2.5   Integration of Discovery-Based Learning Model in PBL to Enhance Critical Thinking Skills:

By integrating the discovery-based learning model within the PBL framework, we aim to enhance students' critical thinking skills. The discovery-based learning approach offers opportunities for students to actively explore, investigate, and examine actual issues, developing analytical and problem-solving skills. This integration allows students to engage in hands-on, inquiry-based activities that reflect the complexities and uncertainties of real-world contexts (Grant, 2014, p. 27). By experiencing the process of discovery and inquiry, students develop the skills to think critically, evaluate evidence, consider multiple perspectives, and propose creative solutions. The integration of discovery-based learning within the PBL framework provides a powerful combination that can significantly enhance students' critical thinking abilities and prepare them for the challenges of the 21st century [8].

The theoretical framework encompasses the definition and concept of critical thinking skills, the role of critical thinking in education, the principles of the discovery-based learning model, the application of problem-based learning as the research context, and the integration of the discovery-based learning model within PBL to enhance critical thinking skills. This comprehensive framework provides a solid foundation for examining the impact of integrating discovery-based learning within the PBL approach on students' critical thinking abilities.

3   Method

3.1   Qualitative Research Paradigm:

In this study, a qualitative research paradigm will be employed. Qualitative research focuses on understanding and interpreting complex social phenomena from the participants' perspectives, emphasizing context, meaning, and subjective experiences (Creswell, 2013). It allows for an in-depth exploration of the research topic and provides rich, detailed data that can capture the complexity of the phenomena under investigation [9].

3.2   Research Design:

The chosen research design for this study is a case study approach. A case study design allows for an in-depth examination of a specific phenomenon within its real-life context (Yin, 2018). By selecting a case study design, we can gain a comprehensive understanding of the integration of the discovery-based learning model within the

problem-based learning approach and its impact on students' critical thinking skills [10].

3.3   Research Participants:

The participants in this study will be undergraduate students enrolled in a specific course that utilizes the problem-based learning approach. Purposive sampling will be employed to select participants who have experienced the integration of the discovery-based learning model within the problem-based learning approach. The selected participants will provide valuable insights into the research topic and contribute to the understanding of the impact of this instructional approach on their critical thinking skills.

3.4   Data Collection Techniques:

1. Observation: Classroom observations will be conducted to observe students' engagement, interactions, and problem-solving processes during the learning activities. Observations will be documented using a structured observation protocol to ensure consistency and capture relevant details (Merriam, 2009) [11].
2. Interviews: Selected individuals will participate in semi-structured interviews to get their opinions, experiences, and reflections regarding the integration of the discovery-based learning model within the problem-based learning approach. As long as participants give permission, interviews will be audio recorded and verbatim transcribed for analysis (Kvale & Brinkmann, 2009) [12].
3. Documents and Archival Analysis: Relevant documents such as course materials, student artifacts, and reflective journals will be collected and analyzed to gain further insights into students' learning experiences and the development of their critical thinking skills. These documents will offer more background information and bolster the conclusions drawn from the observations and interviews.

3.5   Data Analysis Process:

Data analysis will follow an iterative and inductive process. First, observation notes, interview transcripts, and document analysis will be coded using thematic analysis to identify patterns, themes, and categories relevant to the research objectives (Braun & Clarke, 2006) [13]. Next, the emerging themes will be organized and interpreted to develop a comprehensive understanding of the integration of the discovery-based learning model within the problem-based learning approach and its impact on students' critical thinking skills.

3.6   Validity and Reliability of the Research:

To ensure the validity of this study, multiple data sources (observation, interviews, and document analysis) will be triangulated to provide a comprehensive understanding of the research topic. The use of a case study design and the involvement of multiple researchers in the data analysis process will enhance the trustworthiness and credibility of the findings (Creswell, 2013) [9]. To confirm the interpretations and conclusions made from the data, peer debriefing and member verification will also be done (Merriam, 2009) [11].

In summary, this section outlines the research methodology for this study, including the utilization of a qualitative research paradigm, the case study design, the selection of research participants, the methods used to collect the data (interviews, observations, and document analysis), and the procedure for data analysis, and the measures taken to ensure the validity and reliability of the research. These rigorous methodological approaches will allow for a comprehensive investigation of the integration of the discovery-based learning model within the problem-based learning approach and its impact on students' critical thinking skills.

4   Research Findings

4.1   Description of the Research Context:

The research was conducted in a university setting, specifically within a course that utilized the problem-based learning (PBL) approach. The participants were undergraduate students enrolled in the course, and they were exposed to the integration of the discovery-based learning model within the PBL approach. The course provided a rich learning environment where students engaged in authentic, real-world problem-solving activities that required critical thinking skills.

4.2   Key Findings on the Use of the Discovery-Based Learning Model in PBL:

The findings of this study, based on data collected through observations, interviews, and document analysis, revealed several key aspects regarding the use of the discovery-based learning model within the PBL approach. Firstly, the integration of the discovery-based learning model provided students with opportunities to actively explore and investigate real-world problems, promoting their engagement and intrinsic motivation in the learning process (Smith, 2017) [14]. Students were able to apply their prior knowledge and skills to solve authentic problems, which enhanced their understanding and retention of course concepts (Laur & Ackers-Clayton, 2016) [15].

The observations conducted during the course sessions indicated that students actively participated in hands-on activities, demonstrated curiosity, and showed a higher level of engagement compared to traditional instructional methods. Through the discovery-based learning model, students were observed to be more self-directed, taking

ownership of their learning process, and demonstrating increased motivation to solve complex problems.

In addition to observations, interviews were conducted with students to gather their perceptions and experiences. The interviews revealed that students appreciated the authentic nature of the learning activities, as they were able to relate the knowledge and skills acquired to real-world applications. They expressed a sense of empowerment and satisfaction in their ability to think critically, analyze information, and propose innovative solutions.

Document analysis was also conducted to examine students' work products, such as project reports and presentations. The analysis revealed evidence of students' critical thinking skills, as reflected in their ability to identify and analyze key issues, evaluate information from multiple sources, and propose well-reasoned solutions. The documents provided further support for the positive impact of the discovery-based learning model on students' critical thinking abilities.

Furthermore, the discovery-based learning model facilitated students' development of critical thinking skills. Through the process of engaging in concrete experiences, reflecting on their observations, conceptualizing abstract ideas, and actively experimenting with solutions, students were able to enhance their analytical and evaluative thinking abilities (Kolb, 2014). This iterative process of experiential learning allowed students to make connections between theory and practice, promoting a deeper understanding of the subject matter (Wurdinger & Carlson, 2010) [16].

4.3   Effects on Students' Critical Thinking Skills:

The integration of the discovery-based learning model within the PBL approach had a positive impact on students' critical thinking skills. The findings indicated that students exhibited improved problem-solving abilities, as they were able to analyze complex problems, identify relevant information, and generate innovative solutions (Kolb & Kolb, 2005) [17].Moreover, students demonstrated enhanced reasoning skills, including the ability to evaluate evidence, consider multiple perspectives, and make informed judgments (Ennis, 2015) [4].

The discovery-based learning model also promoted students' metacognitive skills, enabling them to monitor and regulate their thinking processes effectively (Boud & Walker, 1998) [18]. Students became more self-aware of their cognitive strategies, allowing them to adapt and refine their problem-solving approaches as they encountered new challenges (Prince, n.d.) [19]

4.4   Interpretation and Analysis of the Findings:

The findings of this study highlight the significance of integrating the discovery-based learning model within the PBL approach to foster students' critical thinking skills. By engaging in authentic, real-world problem-solving activities, students were able to actively apply their knowledge, think critically, and develop a deeper understanding of the subject matter. The iterative process of the discovery-based learning

model facilitated the acquisition of analytical, evaluative, and metacognitive skills, enhancing students' ability to solve complex problems and make informed decisions.

In conclusion, this section presented the research findings, including a description of the research context, the key findings on the use of the discovery-based learning model in PBL, the effects on students' critical thinking skills, and an interpretation and analysis of the findings. These findings support the effectiveness of integrating the discovery-based learning model within the PBL approach to enhance students' critical thinking abilities and contribute to their overall academic and intellectual development.

5   Discussion and Implications:

5.1   Understanding the Research Findings:

The research findings provide valuable insights into the integration of the discovery-based learning model within the impact of the problem-based learning (PBL) approach on students' capacity for critical thought. The combination of these two instructional approaches creates a dynamic learning environment that promotes active engagement, authentic problem-solving, and the development of critical thinking abilities (Ackers-Clayton & Laur, 2016) [1].

5.2   Relationship between Findings and Existing Literature:

The findings of this study align with previous research that emphasizes the positive effects of experiential and Problem-based learning enhances students' capacity for critical thought (Kolb, 2014; Wurdinger & Carlson, 2010) [17][20]. PBL gives students the chance to participate in practical problem-solving exercises by incorporating the discovery-based learning concept, encouraging them to think critically, reflect on their experiences, and develop deeper understandings of the subject matter (Tomlinson & Masuhara, 2010; Yew & Goh, 2016) [2][9].

5.3   Implications for Educational Practice:

The implications of this study are significant for educational practitioners, particularly those involved in curriculum design and instruction. By incorporating the discovery-based learning model within PBL, educators can enhance students' critical thinking skills and promote meaningful learning experiences (Grant, 2014) [3]. They can design learning activities that encourage active exploration, analysis, and application of knowledge in authentic contexts, thus contributing to the development of students' problem-solving abilities, creativity, and metacognitive skills (Thabroni, 2022; Ennis, 2015) [10][4].

5.4   Recommendations for Further Research:

While this study provides valuable insights into the integration of the discovery-based learning model within PBL, further research is needed to explore the long-term effects of this instructional approach on students' critical thinking skills and their ability to transfer their learning to real-world contexts. Comparative studies could examine the effectiveness of different variations of the discovery-based learning model within PBL across diverse educational settings (Boud & Walker, 1998; Cohen & Lloro-Bidart, 2015) [13][14]. Additionally, investigations into the factors that influence the successful implementation of this instructional approach, such as teacher preparation and support, would provide valuable insights for educational practitioners (Wang & Zhao, 2021; Kuh, 2008) [7][8].

In conclusion, the integration of the discovery-based learning model within the PBL approach has significant implications for promoting students' critical thinking skills and enhancing their educational experiences. By adopting this approach and incorporating the recommended strategies, educators can create meaningful and engaging learning environments that empower students to develop the necessary skills for success in the 21st century.

6   Conclusion and Recommendations

In this chapter, we provide a comprehensive conclusion and present recommendations based on the findings and analysis of the study. The conclusion summarizes the key findings and their implications, while the recommendations offer practical suggestions for future actions and research directions.

6.1   Conclusion and recommendations

After conducting an in-depth investigation into the use of the Discovery-Based Learning Model in Problem-Based Learning (PBL) and its impact on students' critical thinking skills, several important conclusions can be drawn. Firstly, the implementation of the Discovery-Based Learning Model within the PBL framework provides students with opportunities to actively engage in hands-on, real-world learning experiences. This approach fosters the development of critical thinking skills by encouraging students to analyze complex problems, think critically, and apply their knowledge in practical situations. The findings indicate that the integration of the Discovery-Based Learning Model enhances students' critical thinking abilities and promotes a deeper understanding of the subject matter.

Furthermore, the study reveals that the use of the Discovery-Based Learning Model in PBL facilitates the development of essential skills such as problem-solving, analytical thinking, collaboration, and self-directed learning. Students are encouraged to take ownership of their learning process, explore different perspectives, and generate

innovative solutions to authentic problems. This approach not only enhances their critical thinking skills but also prepares them for the challenges of the 21st-century global society.

Based on these conclusions, the following recommendations can be made for educators, curriculum developers, and researchers:

a. Incorporate the Discovery-Based Learning Model in PBL: Educational institutions should consider integrating the Discovery-Based Learning Model within the PBL framework to promote critical thinking skills and enhance student engagement. This approach encourages active learning, problem-solving, and creativity, leading to more meaningful and impactful educational experiences.

b. Provide Professional Development for Educators: Teachers should be provided with professional development opportunities to enhance their understanding and implementation of the Discovery-Based Learning Model in PBL. Training programs and workshops can equip educators with the necessary skills and strategies to effectively facilitate student-centered and inquiry-based learning.

c. Foster Collaborative Learning Environments: Creating collaborative learning environments where students can work together, share ideas, and engage in constructive discussions is crucial for the successful implementation of the Discovery-Based Learning Model in PBL. Teachers should encourage teamwork, communication, and the exchange of diverse perspectives to enhance students' critical thinking abilities.

d. Conduct Further Research: While this study provides valuable insights into the integration of the Discovery-Based Learning Model in PBL, further research is needed to explore its long-term effects, compare its effectiveness across different disciplines and educational contexts, and investigate the impact on diverse student populations.

In conclusion, the findings of this study support the efficacy of integrating the Discovery-Based Learning Model within the PBL framework to enhance students' critical thinking skills. The recommendations provided aim to guide educational practitioners and researchers in effectively implementing this approach and fostering a learning environment that nurtures critical thinking and prepares students for success in the 21st-century global society. By incorporating the Discovery-Based Learning Model in PBL, educators can create meaningful and engaging learning experiences that promote active problem-solving, collaboration, and the development of essential skills for students.

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