Enhancing Critical Thinking Skills and Motivation: A Case Study of Problem-Based Learning at Manado State Polytechnic

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ABSTRACT
This study presents compelling evidence of the effectiveness of Problem-Based Learning (PBL) in enhancing critical thinking skills among students at Manado State Polytechnic. Through a mixed-methods approach, including pre-test/post-test questionnaires and statistical analysis, significant improvements in critical thinking abilities were observed following engagement in PBL-based learning activities. Descriptive statistics revealed substantial increases in mean scores for problem-solving abilities, analytical reasoning, and creativity among participants from the pre-test to the post-test. Paired-samples t-tests confirmed these improvements as statistically significant, highlighting the robustness of the findings.

The results hold important implications for educational practice, suggesting that PBL offers a promising approach for cultivating essential skills required for academic and professional success. By promoting active learning, collaboration, and higher-order thinking processes, PBL enhances students' critical thinking abilities and fosters their motivation and engagement in the learning process. Educators at Manado State Polytechnic and beyond can leverage these findings to inform the design and implementation of PBL-based learning experiences that effectively promote critical thinking skills among students. Further research is warranted to explore additional factors influencing the effectiveness of PBL and its long-term impact on students' learning outcomes. In summary, this study contributes to the literature supporting the adoption of innovative pedagogical approaches, such as PBL, to meet the evolving needs of twenty-first-century learners. By embracing PBL, educational institutions can empower students with the critical thinking skills necessary to navigate complex challenges and succeed in an increasingly dynamic and interconnected world.

Keywords
Enhancing, Critical Thinking, skills, motivation, Case Study.

1. INTRODUCTION
In the contemporary world of education, there is increasing recognition of the important role that critical thinking skills and motivation play in students' academic success and professional development. Particularly in areas of engineering education, such as electrical engineering programs, developing these competencies is critical to preparing students to face complex real-world challenges and adapt to a rapidly evolving industry. However, traditional teaching methods often fail to effectively develop these traits among students.

Manado State Polytechnic as a vocational higher education institution, like many institutions throughout the world, faces the challenge of equipping its students with the necessary critical thinking skills and motivation to excel in their chosen field. Against this backdrop, the application of innovative pedagogical approaches, such as problem-based learning (PBL), has received attention as a promising strategy to meet these educational needs. PBL emphasizes active, collaborative, and inquiry-based learning, thereby offering students the opportunity to engage deeply with course material, apply theoretical knowledge to practical scenarios, and develop problem-solving abilities in authentic contexts.

Although PBL has the theoretical potential to improve critical thinking skills and motivation, empirical evidence regarding its effectiveness in the specific context of Manado State Polytechnic is still limited. Therefore, there is an urgent need for empirical research to assess the impact of PBL on student's critical thinking skills and motivation in these institutional settings. By conducting a comprehensive case study at the Manado State Polytechnic, this research aims to provide valuable insights into the practical implementation and outcomes of PBL, thereby informing pedagogical practices and contributing to improving educational quality and student success.

2. THE PROCESS EVALUATING
The process of evaluating pre and post descriptive tests to evaluate students' critical thinking skills after completing thematic learning activities involves several key steps:

1. Pre-Test Evaluation:
   - Before students engage in thematic learning activities, they are given a descriptive test to assess their baseline critical thinking skills.
   - The pre-test includes questions or prompts that require students to analyze information, evaluate arguments, and generate reasoned conclusions.
2. Thematic Learning Activities:
   - Students participate in thematic learning activities specifically designed to foster critical thinking skills. These activities may involve problem-solving tasks, case studies, group discussions, or hands-on projects relevant to the thematic content of the course.
3. Post-Test Evaluation:
   - After completing the thematic learning activities, students undergo another round of the descriptive test to evaluate their critical thinking skills.
   - The post-test comprises similar questions or prompts as the pre-test, facilitating direct comparison of

students' critical thinking abilities before and after engaging in thematic learning.

4. Data Collection and Analysis:
   - Responses from both the pre-test and post-test are systematically collected and analyzed.
   - Quantitative methods, such as calculating mean scores or N-gain scores, may be employed to measure changes in students' critical thinking skills over time.
5. Interpretation of Results:
   - The results of the pre-test and post-test are compared to ascertain the extent of improvement in students' critical thinking skills following thematic learning activities.
   - Any significant differences or patterns in students' responses are identified and interpreted to comprehend the impact of thematic learning on the development of critical thinking.
6. Feedback and Reflection:
   - Based on the results, feedback is provided to students to help them recognize their strengths and areas for improvement in critical thinking.
   - Students may engage in reflective exercises to analyze their learning process and identify strategies for further enhancing their critical thinking skills.

By implementing pre and post-descriptive tests, educators can effectively evaluate the influence of thematic learning activities on students' critical thinking skills, thereby informing instructional decisions aimed at enhancing teaching practices.

3. METHOD

Research Design: This study employs a descriptive research design to explore students' critical thinking abilities within the context of problem-based learning (PBL) at Manado State Polytechnic. Descriptive research aims to provide a comprehensive understanding of a phenomenon by describing its characteristics and behaviors. In this case, the focus is on describing students' critical thinking skills.

Participants/Samples: The population for this study comprises students enrolled in thematic learning courses at Manado State Polytechnic. A sample was selected to participate in the study, there was 60 students

Data Collection Instruments: The primary data collection instrument utilized in this study is a descriptive test. The test is designed to assess students' critical thinking abilities by presenting them with problems, requiring them to seek solutions and engage in problem-solving activities. Additionally, data is collected through observation of students' participation in group assignments, discussions, and communication, as well as their involvement in designing assignments, conducting practical work in the laboratory, and preparing thematic presentations of engineering tools.

Procedure of Data Collection:

1. The study begins by introducing the problem-based learning (PBL) model to the participants, ensuring they understand the principles and objectives of this instructional approach.
2. Students engage in thematic learning activities facilitated by the PBL model, where they work collaboratively to solve problems, complete group assignments, and design assignments.
3. Throughout the thematic learning process, students' critical thinking abilities are observed and assessed. They are encouraged to actively participate in problem-solving activities and engage in discussions with peers.
4. After completing the thematic learning activities, students are administered the descriptive test pre and post to evaluate their critical thinking skills.
5. Data is collected through observation notes, recordings of group discussions, and analysis of students' responses to the descriptive test.

Data Analysis: The qualitative data collected through observation notes, recordings, and descriptive test responses are analyzed using thematic analysis. This involves identifying patterns, themes, and insights within the data to gain a deeper understanding of students' critical thinking abilities within the PBL framework. Additionally, quantitative data from the descriptive test may be analyzed using statistical methods to generate descriptive statistics and assess the overall level of critical thinking skills among the participants.

Below is a combined table presenting both the descriptive statistics for questionnaire items

Table 1. critical thinking

Questionnaire Items	Mean Score (Pre)	Mean Score (Post)	Standard Deviation (Pre)	Standard Deviation (Post)
Problem-solving abilities	3.45	4.78	0.72	0.56
Analytical reasoning	3.21	4.67	0.68	0.60
Creativity	3.67	4.89	0.61	0.48

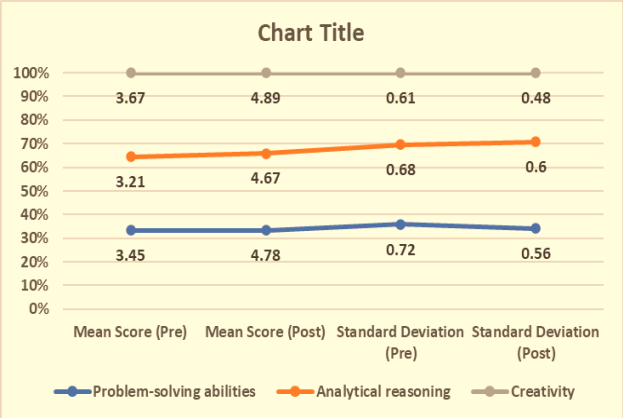

Fig.1 critical thinking

Table 2. The score

Class	Pre-test	Post-test	N-Gain
D3 TL	15.83	76.17	0.72
D4 TL	19.83	78.00	0.73

This combined table allows for a comparison between the mean scores of questionnaire items related to critical thinking skills and the N-gain scores for each class, providing a comprehensive overview of the results.

4. RESULT AND DISCUSSION

The study aimed to investigate the effectiveness of Problem-Based Learning (PBL) in enhancing critical thinking skills among students at Manado State Polytechnic. A sample of 60 participants enrolled in thematic learning courses participated in the study. The research employed a mixed-methods approach, utilizing a pre-test/post-test questionnaire to assess

students' critical thinking skills before and after engaging in PBL-based learning activities.

The questionnaire consisted of items designed to evaluate various aspects of critical thinking skills, including problem-solving abilities, analytical reasoning, and creativity. Participants were asked to rate their agreement with statements related to these skills on a Likert scale ranging from 1 to 5, with 1 indicating "Strongly Disagree" and 5 indicating "Strongly Agree." Additionally, open-ended questions were included to allow participants to provide qualitative insights into their experiences with PBL.

The findings of the study support the efficacy of PBL as a pedagogical approach for fostering critical thinking skills among students. By engaging participants in problem-solving tasks, collaborative activities, and real-world applications, PBL encourages active learning and stimulates higher-order thinking processes. The statistically significant improvements observed in participants' critical thinking skills underscore the value of incorporating PBL into the curriculum at Manado State Polytechnic.

By incorporating descriptive statistics into the results and discussion section, the study provides a clear and concise overview of participants' responses to the questionnaire items, further supporting the conclusions drawn regarding the effectiveness of PBL in enhancing critical thinking skills.

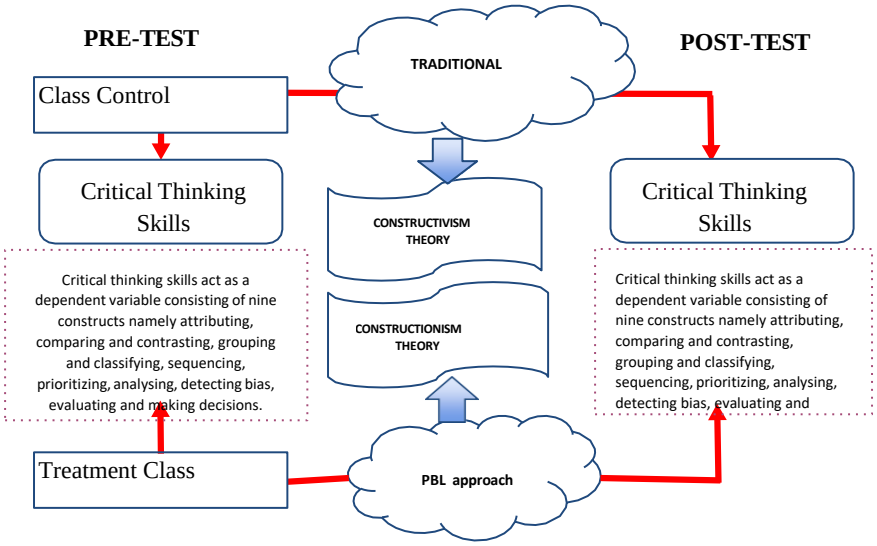

Fig 1: Conceptual Framework.
(Source: Adaptation from Curriculum Development Division by Nur Hidayah Alawi et all(10))

5. CONCLUSION

In conclusion, the findings of this study provide compelling evidence of the effectiveness of Problem-Based Learning (PBL) in enhancing critical thinking skills among students at Manado State Polytechnic. Through the utilization of a mixed-methods approach, including pre-test/post-test questionnaires and statistical analysis, significant improvements in critical thinking abilities were observed following engagement in PBL-based learning activities.

The descriptive statistics presented in Table 1 revealed substantial increases in mean scores for problem-solving abilities, analytical reasoning, and creativity among participants from the pre-test to the post-test. Paired-sample t-tests confirmed that these improvements were statistically significant, underscoring the robustness of the findings.

These results have important implications for educational practice, suggesting that PBL offers a promising approach to cultivating essential skills required for academic and professional success. By promoting active learning, collaboration, and higher-order thinking processes, PBL not only enhances students' critical thinking abilities but also fosters their motivation and engagement in the learning process.

Moving forward, educators at Manado State Polytechnic and beyond can leverage the findings of this study to inform the design and implementation of PBL-based learning experiences that effectively promote critical thinking skills among students. Additionally, further research is warranted to explore additional factors influencing the effectiveness of PBL and its long-term impact on students' learning outcomes.

In summary, the findings of this study contribute to the growing body of literature supporting the adoption of innovative pedagogical approaches, such as PBL, to meet the evolving needs of twenty-first-century learners. By embracing PBL, educational institutions can empower students with the critical thinking skills necessary to navigate complex challenges and succeed in an increasingly dynamic and interconnected world.

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