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Implementation of the Problem-Based Learning Model to Enhance Students' Critical Thinking Skills in Information and Communication Technology Subjects

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A B S T R A C T

This study investigates the implementation of the Problem-Based Learning (PBL) model to enhance students' critical thinking skills. The research aims to improve the critical thinking ability of students through the application of PBL in a classroom setting. A classroom action research design was employed, involving students of Grade X at SMA YAPIM Medan as the research subjects. The intervention was carried out over two cycles. Data collection techniques included observation, interviews, documentation of test results, and evaluations conducted at the end of each cycle. The findings of the study indicate that: (1) there is a significant effect of the PBL model compared to the discussion model on students' problem-solving abilities; (2) students with high achievement motivation demonstrate significantly better critical thinking skills than those with low motivation; and (3) there is a significant interaction between the learning model, achievement motivation, and students' problem-solving abilities. It can be concluded that students taught using the PBL model exhibit superior problem-solving capabilities compared to those taught through traditional discussion methods.

1. Introduction

Critical thinking is generally defined as the ability to think clearly and rationally, enabling students to better understand problems and find optimal solutions to those problems (Firdaus, Nisa, & Nadhifah, 2019). It forms the foundation of self-motivation, self-discipline, self-monitoring, and self-correction, all of which are essential for effective communication and problem-solving (Najmina, 2017).

In the context of integrated ICT education, which plays a crucial role in modern learning, various internal and external factors influence learning outcomes. Among the external factors are teachers, parents, and the broader community. Teachers, in particular, are expected to master subject matter and deliver it effectively. Teaching and learning are dynamic processes involving interconnected elements such as students, teachers, curriculum, and learning facilities. For learning to be effective, sufficient infrastructure, engaging learning models, and active student participation are essential to prevent boredom and disengagement (Andinny & Lestari, 2016).

Classroom observations reveal that students often display low levels of engagement—chatting during lessons, lacking the confidence to ask or answer questions, and hesitating to solve problems in

front of the class (Ulwiyah, 2020). Despite efforts by teachers to implement various instructional models, student outcomes have remained suboptimal, and learning activities often remain monotonous. This results in decreased motivation and passive classroom behavior, highlighting the need for alternative learning approaches that incorporate diverse strategies, methods, and techniques to enhance learning outcomes (Hasil, Ips, & Sosial, 2013).

Further observations at the research site revealed several instructional challenges (Joesyiana, 2018). First, a significant number of students did not pay attention during lessons, with behaviors such as daydreaming, joking, and distracting others being common. Second, the instructional strategies employed did not encourage active or interactive student participation. Third, students were insufficiently involved in learning activities (Hapsari, 2011). Consequently, the learning process lacked student-centered engagement and failed to meet expectations, particularly concerning the development of students' critical thinking skills (Muah, 2016).

One of the key competencies teachers must possess is the ability to select and implement effective instructional models that enhance students' critical thinking skills in line with the intended learning objectives (Hotimah, 2020). By employing diverse instructional models, teachers can prevent monotony and encourage deeper comprehension through critical engagement with the learning material (Monti, Novoa, & Vizcaíno, 2003).

Critical thinking is vital for students to effectively solve real-world problems. It is a systematic process used in various mental activities, such as problem-solving, decision-making, reasoning, analyzing assumptions, and conducting scientific inquiry (Utomo & Hardini, 2023; Saputri, 2020). One instructional model known to foster these skills is Problem-Based Learning (PBL), especially when combined with student worksheets (LKS) as a means of guiding independent learning and reinforcing conceptual understanding (Sman & Tarab, 2013; Faturohman & Afriansyah, 2020). These worksheets, tailored to the PBL approach, present problems and related questions to facilitate group discussion and promote collaborative learning.

Implementing PBL can transform the learning process into a more effective experience by shifting the focus from teacher-centered to student-centered learning. It trains students to speak confidently and encourages them to think critically beyond textbook content by engaging them in problem-solving and meaningful classroom interaction (Farhana et al., 2023).

To address the issues outlined above, it is essential to employ a learning model that systematically trains students in critical thinking and problem-solving. PBL is a suitable approach because it emphasizes critical and analytical thinking in the quest for solutions to real-world problems (Handayani & Muhammadi, 2020). As students engage in self-directed inquiry and find their own answers, their understanding becomes deeper and more meaningful, resulting in improved learning engagement and critical thinking skills (Yulistiana & Setyawan, 2020).

Based on this background, the present study seeks to investigate "The Implementation of the Problem-Based Learning Model to Improve Critical Thinking Skills among Grade X Senior High School Students".

2. Research Methods

2.1. Research Setting

This study was conducted at SMA YAPIM Medan, located on Jalan Air Bersih, Sudirejo I, Medan Kota District, Medan City, North Sumatra. The research subjects consisted of 35 tenth-grade students (15 male and 20 female students) in the odd semester of the 2022/2023 academic year. The research was carried out during the implementation of the School Field Introduction Practice (Praktek Pengenalan Lapangan Persekolahan, PLP).

2.2. Research Procedure

This research employed a Classroom Action Research (CAR) design. The study was conducted in two cycles, following a learning model based on E-learning and problem-based strategies. The model used was adapted from the classroom action research design developed by Suarsana and Mahayukti (2013), which involves planning, acting, observing, and reflecting in each cycle.

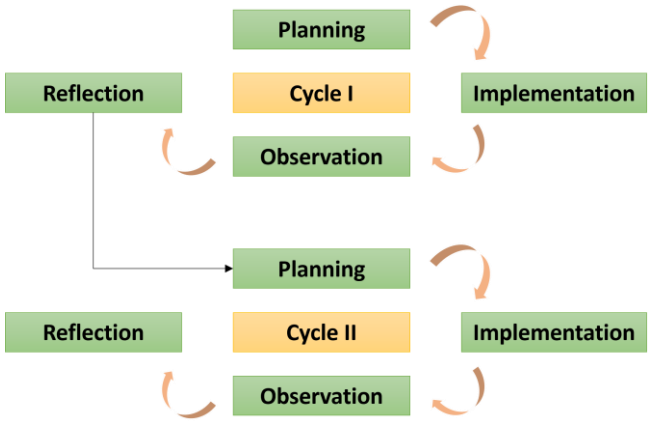

Figure 1. Classroom Action Research Flow (adapted from Suarsana & Mahayukti, 2013)

2.3. Data Collection Techniques and Data Analysis

This study employed both quantitative and qualitative approaches in data collection and analysis. Quantitative data were obtained through pre-tests and post-tests aimed at measuring students' problem-solving and critical thinking abilities. Qualitative data were collected through observations, interviews, and documentation to gain deeper insights into students' learning behaviors and processes.

The qualitative data were analyzed using descriptive methods, while the quantitative data were analyzed by calculating the percentage of students achieving the minimum critical thinking competency level. The following table shows the classification of students' critical thinking levels:

Table 1. Categories of students' critical thinking skills

Percentage	Category
95% – 100%	Very Active
80% – 90%	Active
70% – 80%	Fairly Active
50% – 65%	Less Active

The following formula was used to calculate the percentage of students who achieved critical thinking competence:

$$P = \frac{n}{N} \times 100$$

Where:

P = Percentage of students who achieved critical thinking competence

n = Number of students scoring above 75 out of 100

N = Total number of students

The learning mastery criteria based on critical thinking skills were defined as follows:

1. Individual mastery: A student is considered to have critical thinking skills if they achieve a score > 75 out of 100.

2. Classical mastery: A class is considered to have achieved critical thinking competence if at least 80% of the students meet the individual mastery threshold.

3. Results and Discussion

3.1. Cycle I Implementation and Student Activity

Based on classroom observations during the first cycle, students in Grade X exhibited varied learning behaviors. Some students demonstrated active participation, while others showed low engagement and underdeveloped critical thinking skills. Attentive students paid close attention to the teacher's explanations, while inattentive ones engaged in side conversations, adopted passive learning behavior when asked questions, and displayed signs of disinterest, such as lethargy and disorganized seating. Table 2 presents the results of student activity in Cycle I:

Table 2. Students' Critical Thinking Activity in Cycle I (Meeting I and II)

No	Meeting I (%)	Category	Meeting II (%)	Category
1	70%	Fairly Active	72%	Fairly Active
2	75%	Fairly Active	77%	Fairly Active
3	70%	Fairly Active	75%	Fairly Active
4	72%	Fairly Active	77%	Fairly Active
5	77%	Fairly Active	80%	Fairly Active
Average	**73%**	**Fairly Active**	**76%**	**Fairly Active**

From the table above, students' critical thinking activity in Meeting II increased from 70% to 72%, an improvement of 2%. In terms of questioning, student engagement increased from 71.67% to 75%, and later to 77%, indicating a 5% increase overall. For information collection, there was an increase from 72% to 75%. Meanwhile, communication activities reached 80% in Meeting II, up from 77% in Meeting I.

Despite these increases, student performance on the post-test in Cycle I showed only 10 out of 35 students (30%) met the minimum passing score of 75 out of 100. Thus, 70% of the students had not yet achieved the expected critical thinking performance. This indicates that the majority of students still faced challenges in understanding the learning materials adequately.

Several students admitted to not studying before the test, citing difficulty understanding the textbook due to its dense and complex language. Additionally, the teacher noted that students enjoyed the use of the Problem-Based Learning (PBL) model, as it made ICT lessons more engaging and easier to follow.

However, since the classical completeness criteria (minimum 80% of students scoring >75) had not yet been met, the research proceeded to Cycle II to address these issues.

3.2. Cycle II Implementation and Outcomes

Cycle II was conducted on Thursday, December 10, 2023. This cycle focused on observing students' learning behaviors related to gathering, processing, and communicating information provided by the teacher. Table 3 presents the activity levels observed:

Table 3. Students' Critical Thinking Activity in Cycle II (Meeting I and II)

No	Meeting I (%)	Category	Meeting II (%)	Category
1	85%	Active	88%	Active
2	76%	Fairly Active	82%	Active
3	87%	Active	88%	Active
4	87%	Active	88%	Active
5	91%	Very Active	93%	Very Active
Average	**79%**	**Active**	**88%**	**Active**

The data reveal a significant improvement in students' critical thinking behavior from Cycle I to Cycle II. In the post-test conducted at the end of Cycle II, 23 out of 35 students (approximately 90%) scored above 75, meeting the classical completeness threshold. Only 2 students remained below the expected score.

The improvement was largely attributed to strategic adjustments made by the teacher, including the creation and distribution of simplified summary materials. During the reflection stage, the teacher and researcher analyzed observational data and concluded that the application of the PBL model significantly improved student engagement and critical thinking skills.

3.3. Interpretation and Pedagogical Implications

The successful implementation of the PBL model in Cycle II aligns with the research objective to enhance students' critical thinking. PBL promotes inquiry-based learning, encouraging students to think scientifically and systematically in solving real-world problems (Suarsana & Mahayukti, 2013). The increase from 30% (Cycle I) to 90% (Cycle II) in student achievement illustrates the model's effectiveness.

Critical thinking, a core component of higher-order thinking skills, involves logical reasoning, analysis, problem-solving, and evidence-based decision-making (Wardani & Suripah, 2023). By incorporating real-life problems into classroom instruction, PBL enables students to independently build understanding and engage in reflective inquiry, thereby fostering deeper cognitive engagement.

These findings affirm that PBL is a suitable instructional model for developing students' critical thinking skills, provided that it is supported by well-prepared instructional materials and proactive teacher facilitation.

4. Conclusion

Based on the research findings and discussion, it can be concluded that the application of the Problem-Based Learning (PBL) model in Information and Communication Technology (ICT) instruction significantly improves students' critical thinking skills. This is demonstrated by an increase in the percentage of students achieving classical mastery from 30% in the first cycle to 90% in the second cycle. The effectiveness of the PBL model lies in its ability to engage students in meaningful problem-solving activities, thereby enhancing their analytical and reflective thinking. Therefore, it is recommended that teachers consider PBL as an alternative instructional approach in the classroom. Teachers should also clearly communicate the learning stages to students to support their understanding and participation. Moreover, this study may serve as a reference for future research involving different subjects and educational levels, and educators are encouraged to explore various instructional models to further enrich student learning experiences.

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