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Applying the Problem-Based Learning Model to Computer Network Topics Through the Use of Video Media

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A B S T R A C T

This study aims to describe the implementation of the Problem-Based Learning (PBL) model in teaching computer network topics using video media among eleventh-grade students at SMA Nasrani 3 Medan. The PBL model, which emphasizes learning through real-world problem-solving, is designed to foster students' critical thinking, independence, and active engagement in the learning process. This research employed a classroom action research design, conducted in two cycles. Data were collected through questionnaires, interviews, and assessment sheets administered after the instructional sessions. The collected data were analyzed through data reduction, data display, and conclusion drawing. The findings indicate that the application of the PBL model supported by video media significantly enhanced students' critical thinking skills and their ability to solve problems effectively. Thus, the PBL approach proves to be effective in improving both the learning process and outcomes in computer network instruction.

1. Introduction

Learning is an interactive process that involves teachers, students, and learning resources within a structured environment (Dewanto et al., 2018). In this context, teachers serve as facilitators who provide guidance and support to enable the transfer of knowledge, skills, attitudes, and values to students. According to Kumalasari (2013), learning is a systematically designed, implemented, and evaluated process that helps students achieve their learning objectives effectively and efficiently. Sanjaya (2011) further explains that learning is a complex system whose success can be viewed from two perspectives: product and process. The product perspective focuses on learning outcomes, while the process perspective highlights the educational values gained throughout the learning experience.

The success of learning is highly influenced by the instructional model adopted by the teacher. As noted by Hanafy (2014), a learning model refers to the strategies or techniques used by educators to deliver content and achieve instructional goals. Suprijono (2010) describes instructional models as frameworks used to guide classroom learning design and implementation. Similarly, Joyce and Weil (as cited in Rusman, 2014) view instructional models as long-term plans that assist teachers in organizing content, strategies, and learning activities that align with students' needs.

One instructional model recognized for enhancing learning quality is Problem-Based Learning (PBL). PBL is a student-centered approach that begins with real-world problems as the foundation for learning (Huda, 2013). This model encourages students to think critically, solve problems either

individually or collaboratively, and construct knowledge through active inquiry. Barrows and Tamblyn (1980) introduced PBL as a response to the observed inability of students to apply theoretical knowledge to real-life situations. As Barbara points out, "Problem-Based Learning is an instructional method that encourages learners to apply critical thinking, problem-solving skills, and content knowledge to real-world problems and issues".

Linda and Sara emphasize that PBL focuses on inquiry that is closely tied to real-life contexts. Tan describes PBL as a progressive, student-centered learning approach that uses unstructured, complex problems as the starting point for instruction. Glazer adds that PBL actively engages students in resolving complex issues in realistic settings, often in team-based environments that emphasize collaboration, dialogue, decision-making, and leadership. Barrows and Kelson argue that PBL is not only a curriculum but also a learning process that fosters essential skills such as critical thinking, problem-solving, independent learning, and teamwork.

In the context of secondary education, particularly in teaching computer network topics, PBL is considered highly relevant. Students are required not only to understand technical concepts but also to apply them in solving real-world problems. The integration of video media in PBL can further enhance students' understanding by providing visual representations of abstract and complex concepts, thus facilitating deeper learning.

Previous studies have demonstrated that the application of PBL can significantly improve students' conceptual understanding, engagement, and learning outcomes. Therefore, this study aims to describe the implementation of the Problem-Based Learning model supported by video media in teaching computer networks to eleventh-grade students at SMA Nasrani 3 Medan. The findings of this study are expected to contribute to the development of innovative instructional models and to enhance both the learning process and student outcomes through the application of contextual and meaningful learning strategies.

2. Research Methods

This study employed a Classroom Action Research (CAR) design, as defined by Arikunto (2010), which is a systematic inquiry into classroom practices that are deliberately introduced and observed within the context of a real learning environment. The research was conducted at SMA Nasrani 3 Medan over two instructional meetings.

The subjects of this study were 16 students from class XI in the first semester of the 2022/2023 academic year, consisting of 10 male and 6 female students who acted as recipients of the intervention. The instructional actions were carried out by the ICT (Information and Communication Technology) teacher of class XI. Additionally, a peer teacher served as an observer of the classroom implementation process, while the principal of the school provided institutional support and served as a key data source.

This research followed the Classroom Action Research model developed by Kemmis and Taggart, which consists of four interconnected components arranged in a spiral cycle: (1) Planning, (2) Action, (3) Observation, and (4) Reflection (Darmadi, 2011:248). Data collection methods in this study included tests, observation, questionnaires, and documentation. The specific techniques are described as follows:

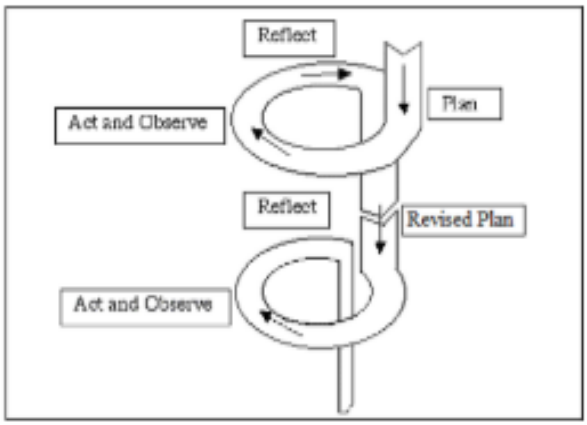

Figure 1. Research methods

1. Tests were administered to assess students' learning outcomes in the subject of computer networks. These tests were given at three stages: before the intervention (pre-test), during the learning process (formative assessment), and after the intervention (post-test). The test scores were analyzed to determine students' mastery of the learning material.
2. Observation was conducted systematically using an observation checklist. Observers used this instrument to record classroom activities and student engagement related to the implementation of the Problem-Based Learning (PBL) model supported by video media.
3. Questionnaires were used to evaluate students' responses to the learning process, including their engagement, motivation, and perceived effectiveness of the PBL model.
4. Documentation served to supplement the findings through supporting data such as photos, lesson plans, and student work products.

The instruments used in this research included observation sheets, test items (evaluation sheets), and questionnaire forms. Observation sheets guided the researchers in recording relevant teaching and learning activities, while questionnaires helped to monitor and evaluate each cycle of the action to ensure alignment with the research objectives. The indicator of success in this study was determined based on students' academic performance and engagement. Specifically, the intervention was considered successful if:

1. The class average score reached at least 75.0, and
2. At least 90% of students obtained scores equal to or above the minimum passing grade (KKM) of 70.0.

3. Results and Discussion

Based on the table of student learning outcomes, the pre-cycle condition shows that out of 16 students, only 7 students (32.40%) achieved the minimum passing grade. Following the implementation of the first cycle, a significant improvement was observed. The learning outcomes in cycle I indicated that 9 students (75%) achieved the minimum passing grade, which was an improvement from the pre-cycle where only 2 students (13%) met the criteria. Although there was improvement, this result did not yet meet the success indicator set at 70%. After improvements were made in cycle II, the learning outcomes showed an even more significant increase, with 13 students (95%) achieving the minimum passing grade, representing an improvement of 3 students (5%) compared to cycle I.

3.1. Result

The overall results of the student scores obtained from the research conducted at SMA 3 Nasrani are presented in the following graph:

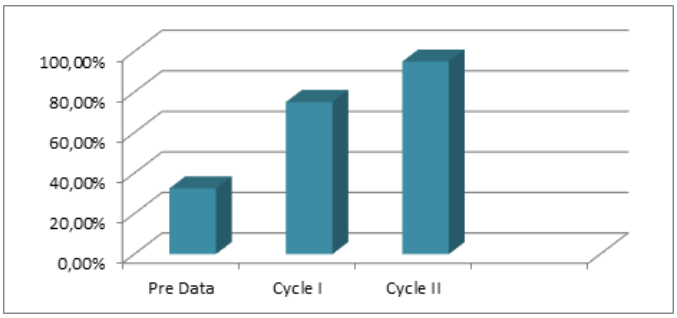

Figure 2. Learning outcomes

3.2. Discussion

Preliminary observations of Grade XI students at SMA 3 Nasrani revealed the results of the end-of-semester assessment for the first semester of the 2022/2023 academic year, as presented below.

Table 1. Pre cycle results

No	Type of research	Research result
1	Number of students	16
2	Completed	7
3	Not completed	9
4	Completion	32,40%
5	Average	59.99

The pre-cycle test results indicated that the students achieved an average score of 70.88, which remains below the school's Minimum Mastery Criteria (KKM) set at 75. Information and Communication Technology (ICT) is a crucial subject for students, as it equips them with the ability to operate various technological tools in response to the rapid advancement of digital developments (Dewanto et al., 2018).

ICT instruction at school is not an isolated subject; rather, it encompasses several integrated components within the learning process. The study of ICT primarily focuses on addressing real-world technological issues and global technological advancements. Therefore, Grade XI students in the first semester are expected to master competencies related to technology development in both developed and developing countries. Achieving these competencies requires collaborative efforts from teachers, students, and supporting learning tools.

In practice, however, student competence regarding global computer networking remains relatively low. Based on a study conducted by the author in the 2022/2023 academic year at SMA 3 Nasrani Medan, involving 16 students (10 male and 6 female), the average score was only 55.59, with just 7 students (32.40%) reaching the minimum required score.

According to Dewanto et al. (2018), computer network practice is a mandatory subject within the Informatics Engineering Education program, taught during the first semester of Grade XI. In the field, students are expected to be proficient in operating network equipment, installing LAN and internet systems, performing network tests, applying subnetting, VLAN configuration, routing, and blocking. Therefore, mastering this subject is essential in preparing students to meet industry-standard competencies.

The core competencies include understanding the fundamentals of networking and LAN, installing RJ-45 connectors on UTP cables, testing cable quality, building LANs, configuring IP addresses, understanding public IP allocation using Classless Addressing, performing subnetting and

routing using the VLSM method, conducting network connection tests, and analyzing wireless technology to establish LAN connections. These elements reflect the teacher's creativity in making the learning process engaging and motivating students to actively participate and think critically.

The Informatics Engineering Education program also emphasizes pedagogical competence for its graduates. By applying learning models that promote critical thinking in the classroom, pre-service teachers can gain practical experience that will support their effectiveness as future educators.

The preliminary observations conducted on Grade XI students of SMA 3 Nasrani revealed the initial findings of the study carried out during the first semester of the 2022/2023 academic year, as follows:

Table 2. Results of cycle I

No	Type of research	Research result
1	Number of students	16
2	Completed	9
3	Not completed	7
4	Completion	75%
5	Average	70,88

Based on the pre-cycle learning outcomes of 16 eleventh-grade students at SMA 3 Nasrani—consisting of 10 male and 6 female students—it was found that only 7 students (34.28%) achieved the minimum passing criteria (KKM) score of 70, while 9 students (65.71%) did not meet the requirement. The average class score was 70.88. During the pre-cycle phase, the teacher primarily used a lecture-based approach, where students were passive recipients who only listened and took notes. The instruction was conducted over two sessions (2 × 90 minutes), based on the Lesson Plan (RPP), with the core topic being computer networking. In Cycle I, the teacher maintained the lecture method but began to incorporate a Problem-Based Learning model by asking individual questions and recognizing group achievements based on individual progress. The instructional process began with preliminary activities such as greetings, classroom management, attendance checks, explaining the learning objectives, and providing motivation. The core session involved material delivery and group discussions, followed by a closing session that included an announcement of the next topic and a group prayer. Observation data indicated that while the teacher delivered lessons with clear direction and purpose, many students remained disengaged, and group discussions lacked effectiveness. Evaluation results in Cycle I showed a positive trend, with the class average increasing to 78.38; 9 students (74.80%) met the KKM, while 7 students (25.71%) did not. Despite this improvement, student engagement was still uneven. Reflection on Cycle I revealed several contributing factors: some students struggled to follow the learning model, group collaboration was not optimal, and understanding was limited to certain students. As a result, Cycle II introduced instructional improvements by applying a Problem-Based Learning model supported by video media. The learning process began with a brief review of the previous material, followed by the delivery of new content using a problem-based approach enhanced by visual media, aiming to increase overall student engagement and comprehension.

The observations following the second cycle of research conducted on Grade XI students at SMA 3 Nasrani showed an improvement in learning outcomes compared to the previous cycle. The study, carried out during the first semester of the 2022/2023 academic year, indicated that the majority of students had achieved the established Minimum Mastery Criteria (KKM). This improvement suggests that the instructional model applied in the second cycle was more effective in enhancing students' understanding of the subject matter.

Table 3. Results of cycle II

No	Type of research	Research result
1	Number of students	16
2	Completed	13
3	Not completed	3
4	Completion	95%
5	Average	80,00

Based on the observation results, the implementation of the second cycle showed a noticeable improvement in student learning outcomes. During this session, many students were able to answer the given questions correctly and demonstrated a good understanding of the material. Several students were actively involved in asking questions and expressing their ideas, indicating their comprehension of the lesson, as evidenced by their ability to solve the assigned problems. The evaluation results from Cycle II revealed an average student achievement score of 85.37, with 13 students (94.28%) meeting the Minimum Mastery Criteria (KKM), while only 3 students (5.71%) failed to reach the standard.

The success observed in Cycle I indicated that only a portion of the students showed increased participation, while others remained passive. Reflections on the factors contributing to low student participation included: (1) Some students were unable to follow the steps of the lecture-based model due to feelings of boredom and fatigue during the lesson, which affected their concentration; (2) Group collaboration in discussions was not optimal; and (3) Only certain students were able to fully understand the material and find solutions to the problems assigned to their groups. The teaching process followed the Lesson Plan (RPP) over two sessions (2 x 90 minutes). In the second cycle, instruction was carried out using the Problem-Based Learning model, supported by video media. The process included: (1) A brief review of previously covered material, followed by new content delivered using Problem-Based Learning; and (2) Practice questions provided with the aid of instructional videos. The remaining steps were conducted similarly to those in Cycle I.

4. Conclusion

Based on the results of the research conducted at SMA 3 Nasrani Medan over two sessions, it can be concluded that the implementation of the Problem-Based Learning (PBL) model effectively enhanced students' learning outcomes and motivation. This improvement is evident from the increase in the average score of student learning in Information and Communication Technology (ICT), which rose from 70.88 prior to the intervention, to 74.80 in Cycle I, and 85.37 in Cycle II. Additionally, the percentage of students achieving the Minimum Mastery Criteria (KKM) also showed significant improvement, from 34.28% before the intervention, to 74.80% in Cycle I, and 94.28% in Cycle II. Based on these findings, the researcher offers the following recommendations: (1) Teachers at SMA 3 Nasrani are encouraged to implement the Problem-Based Learning model in their ICT lessons to enhance learning outcomes for 11th-grade students, (2) Students are advised to be more active in the learning process, both individually and in groups, particularly when using the Picture and Picture method in ICT lessons, and (3) The school should adopt policies that encourage teachers to utilize innovative and engaging teaching models to improve student learning outcomes.

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