Analysis of The Implementation of Problem-Based Learning Model Integrated with Ethnoscience in Enhancing Critical Thinking Skills in Elementary Science Education

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Abstract

The development of the times demands education to prepare a generation that is technologically competent and highly competitive. 21st-century skills, such as critical thinking, creativity, communication and collaboration, are essential in addressing complex life challenges. However, low critical thinking skills among students, especially in Science and Social Studies (IPAS), hinder this goal. Teaching methods that do not actively engage students in critical thinking lead to suboptimal learning outcomes. One solution is the implementation of the Problem-Based Learning (PBL) model integrated with ethnoscience, which combines problem-solving with cultural or local wisdom, helping students connect the material to their real-life experiences. This study aims to analyze the application of PBL integrated with ethnoscience to improve critical thinking skills in IPAS learning for grade IV elementary school students. The study involved 32 students at SD Negeri 1 Wonoharjo, Boyolali Regency, observed directly. The results show that PBL integrated with ethnoscience improves student engagement and critical thinking. By incorporating local wisdom, students can relate the material to their daily lives, fostering critical thinking and helping them find solutions to real-world problems.

Keywords : problem-based learning, ethnoscience, critical thinking skills, ipas learning, local wisdom, 21st-century education.

Abstrak

Seiring perkembangan zaman, Pendidikan bertujuan untuk mempersiapkan generasi yang kompeten secara teknologi dan memiliki daya saing tinggi. Keterampilan abad 21, seperti berpikir kritis, kreativitas, komunikasi, dan kolaborasi, menjadi sangat penting dalam menghadapi tantangan kehidupan yang kompleks. Namun, rendahnya kemampuan berpikir kritis pada peserta didik, terutama dalam pembelajaran Ilmu Pengetahuan Alam dan Sosial (IPAS), menjadi penghambat tercapainya tujuan tersebut. Metode pengajaran yang tidak melibatkan peserta didik secara aktif dalam proses berpikir kritis menyebabkan hasil belajar yang kurang optimal. Salah satu solusi adalah penerapan model Problem-Based Learning (PBL) yang terintegrasi dengan etnosains, yaitu pendekatan pembelajaran yang menggabungkan pemecahan masalah dengan etnosains, sehingga membantu peserta didik menghubungkan materi pembelajaran dengan pengalaman nyata mereka. Penelitian ini bertujuan untuk menganalisis penerapan PBL yang terintegrasi dengan etnosains dalam meningkatkan kemampuan berpikir kritis pada pembelajaran IPAS peserta didik kelas IV sekolah dasar. Penelitian ini melibatkan 32 peserta didik di SD Negeri 1 Wonoharjo, Kabupaten Boyolali, yang diamati secara langsung. Hasil penelitian menunjukkan bahwa PBL terintegrasi dengan etnosains meningkatkan keterlibatan peserta didik dan kemampuan berpikir kritis. Dengan mengintegrasikan kearifan lokal, peserta didik mampu mengaitkan materi pembelajaran dengan kehidupan sehari-hari mereka, sehingga mendorong berpikir kritis dan membantu mereka menemukan solusi atas permasalahan dunia nyata.

Kata kunci: problem-based learning, etnosains, kemampuan berpikir kritis, pembelajaran IPAS, kearifan lokal, pendidikan abad ke-21.

INTRODUCTION

As times evolve, education is designed to prepare a generation that is technologically adept and highly competitive in meeting societal demands. Therefore, every aspect of education, including standards, assessment, professional development, curriculum, teaching methods, and learning environments, must be aligned to equip students with 21st-century skills necessary for success in work and life (Louwah Sermona et al., 2022). These 21st-century skills encompass critical thinking, creativity, communication, and collaboration (Lusi Susianti et al., 2023). Such skills are essential for preparing students to address increasingly complex life challenges in the future.

The low level of critical thinking skills among students in Science and Social Studies (IPAS) learning results in passive responses to real-life problems, leaving them without the initiative to analyze these problems and leading to less thoughtful decision-making (Purnamasari, Susi, et al., 2021). Poor critical thinking skills also negatively affect students' learning outcomes, as they are unable to analyze concepts and connect them with real-life experiences (Aditsy, et al., 2021). Research conducted by Aditsy et al. revealed that fifth-grade students at SD Baiturrahman, East Jakarta, exhibited low critical thinking skills in science learning. Interviews indicated that students struggled to meet several critical thinking skill indicators.

The lack of critical thinking skills and understanding of science concepts among students can be attributed to several factors, one of which is the use of teaching models that fail to support student learning needs or stimulate critical thinking processes. Teaching models must align with students' learning needs and be contextual to their lives, enabling them to better understand concepts by relating what they learn to real-world experiences.

One teaching model that can enhance critical thinking skills is Problem-Based Learning (PBL). In this approach, students are presented with real-world problems from their environment to solve. They analyze issues, interpret data, evaluate information, draw conclusions, and propose solutions. The steps involved in the PBL model align with the indicators of students' critical thinking skills.

To design contextual learning relevant to students' lives, instructional materials can be integrated with real-world problems and local culture or wisdom. This integration helps students make meaningful connections between scientific concepts and their everyday experiences. Additionally, critical thinking skills can be developed through problem analysis and solution-finding activities, combining knowledge and experience.

The integration of IPAS material with local culture and wisdom is known as ethnoscience. According to Aikenhead (2002), ethnoscience derives from the Greek and Latin roots *ethnos*, meaning "nation," and *scientia*, meaning "knowledge." Ethnoscience refers to the knowledge possessed by a particular nation, tribe, region, or social group, which forms part of local wisdom (Woro Sumarni, 2018). Ethnoscience emerges from the norms and beliefs of a community in a specific area, shaping their understanding of nature.

The urgency of this research lies in the pressing need to develop teaching methods that not only enhance students' scientific understanding but also foster critical thinking skills through the integration of ethnoscience into the PBL model. Given the importance of critical thinking in addressing 21st-century challenges, this study aims to

provide relevant and contextual solutions for teaching Science and Social Studies (IPAS) in elementary schools while strengthening the connection between scientific knowledge and local culture within students' environments.

Previous studies, such as those by Risamasu et al. (2023), have explored the integration of ethnoscience-STEM into the PBL model to improve science process skills and conceptual mastery. However, these studies did not specifically address the critical thinking skills essential for 21st-century learners. This study seeks to examine the implementation of the PBL model integrated with ethnoscience to enhance critical thinking skills, an area not thoroughly explored in prior research.

Based on the explanation above, this research aims to analyze the implementation of the Problem-Based Learning model integrated with ethnoscience in enhancing critical thinking skills in IPAS learning for elementary school students. The study focuses on evaluating the suitability of this integrated model in fostering critical thinking skills in elementary IPAS education.

METHOD

This research employs a descriptive qualitative methodology, with the subjects being 32 fourth-grade students from SD Negeri 1 Wonoharjo, Kemusu District, Boyolali Regency. Data collection was carried out through direct observation of the teaching and learning activities involving teachers and students in the application of the Problem-Based Learning (PBL) model integrated with ethnoscience. The instruments used were observation sheets to record the activities of both teachers and students during the learning process.

The data analysis technique applied in this study is qualitative analysis with a descriptive approach. Data collected through observation were analyzed by categorizing the activities conducted by teachers and students based on the syntax of the PBL model integrated with ethnoscience. The analyzed categories include the syntax of the learning model, reaction principles, social system, support system, instructional impact, and accompanying effects. Each element was examined to evaluate the extent to which the implementation of this learning model enhances student engagement and critical thinking skills. The collected data were then presented in the form of descriptive narratives to illustrate the outcomes of the learning implementation in the classroom context.

RESULTS AND DISCUSSION

Before conducting the lesson, the teacher designed a teaching module containing a learning plan based on the Problem-Based Learning (PBL) model. Based on the observations conducted by the researcher, the teacher followed several steps outlined in the teaching module related to the syntax of the Problem-Based Learning model. The observation results for the implementation of the learning model are presented in the following table:

Table 1.Observation Results of the Implementation of the Problem-Based Learning Model

Indicators	Elements of Learning Model Characteristics			
	Reaction Principles	Social System	Support System	Instructional Impact
Problem Orientation	√	√	√	√
Organizing Students	√	√	√	-
Guiding Investigation	√	√	√	-
Developing and Presenting Work	√	√	-	√
Analyzing and Evaluating the Problem-Solving Process	√	√	√	√

The Problem-Based Learning (PBL) model includes specific syntaxes that teachers must implement, such as problem orientation, organizing, guiding investigations, developing and presenting solutions, and analyzing and evaluating the problem-solving process (Arends, 2012; Yoki Ariyana et al., 2018). Based on the observations, the teacher effectively implemented all the syntaxes of the PBL model.

From the research findings, the characteristic indicators of this learning model are divided into several aspects: compatibility, reaction principles, social system, support system, and instructional impact. In problem-based learning, the problem orientation phase is crucial, where the teacher presents contextual and relevant issues related to the students' lives. The problems discussed should stem from real-life challenges faced by students in their community or identified through dialogue with the teacher, books, or internet searches. The results reveal that presenting problems relevant to students' daily lives increases their interest and motivation in learning. As noted by Arends (2012), presenting real-world problems creates an engaging learning atmosphere, motivating students to seek solutions independently or in groups. The teacher successfully introduced compelling issues, making students perceive the problems as essential to analyze.

In this phase, the teacher also allows students to independently identify problems through questioning or self-directed research. Constructive responses from the teacher to students' questions and findings make students feel valued and encouraged to keep exploring solutions to the problems.

The interaction between teacher and students is notably strong during this phase, with both parties exchanging ideas and information, fostering a collaborative atmosphere. The learning process is supported by adequate resources, such as textbooks, the internet, and supplementary materials, enabling students to explore information. Consequently, students become more critical in addressing problems and actively engage in problem analysis. Problem-based learning positively impacts the development of students' critical and analytical thinking skills. Research by Mustari (2023) shows that problem-based learning enhances students' critical and analytical thinking, especially when integrated with locally relevant contexts. Similarly, Murni (2022) found that problem-based learning linked to cultural or local wisdom fosters greater student involvement and increases interest and motivation.

During the organizing phase, the teacher divides students into small groups to discuss the identified problems. In this phase, students collaborate in groups, share tasks, and solve problems collectively. Effective group organization supports productive discussions, with each group exploring problems from various perspectives. Research by Sari & Mahmud (2021) suggests that organizing groups improves students' collaboration skills, essential for joint problem-solving.

The teacher provides feedback to each group regarding their progress in completing tasks, ensuring that all students participate actively and that tasks are distributed fairly within the groups. This phase intensifies social interaction among students. Group collaboration becomes key to solving problems as students learn to work together and respect each other's opinions. A conducive classroom environment, along with supportive learning tools such as whiteboards, digital media, and adequate references, facilitates effective group interaction. Ultimately, group work helps students develop collaboration, communication, and critical thinking skills—important competencies for everyday life.

At this stage, students conduct an in-depth analysis of the problems, discussing their causes, impacts, and possible solutions within their groups. The investigation process in PBL encourages students to think critically by analyzing the presented issues. Recent studies by Azizah & Hadi (2023) highlight that during investigations, students actively seek solutions through group discussions and utilize various resources, such as books, the internet, and experimental tools, rather than passively receiving information. The teacher plays a crucial role in facilitating and guiding group discussions to align with learning objectives, providing clear instructions on the investigation steps students should follow. Feedback from the teacher on group discussions further enhances students' critical thinking. Group discussions serve as a platform for exchanging ideas, solving problems collaboratively, and developing social skills necessary for teamwork. Resources such as reference books, the internet, and experimental tools support students in their investigations, leading to improved instructional outcomes and sharper critical thinking skills. Students learn not just to accept information but also to ask critical questions about the issues they face.

After completing their investigations and discussions, students are tasked with developing a solution to the problem and presenting their findings. They are given time to discuss their experiments or analyses within their groups. The teacher monitors this process to ensure the solutions are effectively presented. This activity aligns with the learning objectives of fostering creativity and enabling students to formulate solutions to the problems they studied. The teacher provides feedback on the students' work, encouraging them to refine and improve their output before presenting it.

In this phase, students learn to present their group work to the class. Presentations require good speaking and communication skills and the ability to receive constructive feedback from peers. The teacher ensures students have access to necessary resources, such as presentation tools, whiteboards, and technology to support their presentations. This activity helps students develop public speaking skills and the ability to organize and convey information clearly and systematically.

The final stage is evaluation, where the teacher and students analyze the extent to which the discussed problems were resolved. The teacher asks evaluative questions to assess students' understanding of the material and the learning process. The evaluation also includes reflecting on students' experiences during the learning process and identifying follow-up steps. This phase aligns with the learning objectives of assessing students' understanding and providing constructive feedback for improvement. The teacher poses reflective questions, allowing students to self-assess their grasp of the concepts and processes. The evaluation creates a space for students to discuss their experiences in problem-solving and share insights with their peers. Research by Dwi (2022) indicates that reflection in problem-based learning enhances students' self-evaluation skills, improves understanding, and helps them address deficiencies in the problem-solving process. Evaluations are supported by teaching materials, visual aids, or digital media used throughout the learning process.

CONCLUSION

The application of the PBL model integrated with ethnoscience has proven to be effective in increasing student engagement and critical thinking skills. By connecting learning materials to local contexts and cultures that are closely related to students' life experiences, this model enables a deeper understanding of concepts. Problem-based learning, which emphasizes analysis and problem-solving, encourages students to actively think, analyze, and seek relevant solutions to the problems they face.

The learning process begins with a contextual problem orientation, followed by the organization of tasks into collaborative groups, and guided investigations that direct students to critically analyze data. Students are also given opportunities to develop and present their work, which strengthens their communication and creativity skills. Ultimately, the evaluation of the problem-solving process allows students to reflect on and assess their understanding of the material.

Overall, this study demonstrates that the ethnoscience-integrated PBL model is not only effective in enhancing students' critical thinking skills but also supports the development of 21st-century skills, such as creativity, collaboration, and communication. Learning that is relevant to students' real-life experiences and leverages local wisdom positively impacts their learning outcomes, particularly in IPAS subjects.

Based on these findings, the ethnoscience-integrated PBL model can be more broadly applied in schools to improve critical thinking skills across various subjects. Furthermore, it is essential for teachers to continuously develop approaches that link learning materials to local contexts to ensure greater student engagement and motivation in the learning process.

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