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Implementing Problem-Based Learning with Differentiated Learning Styles to Improve Higher-Order Thinking Skills

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Abstract

This research was conducted to improve high-order thinking skills (HOTS) of tenth-grade students through the application of Problem-Based Learning (PBL) combined with differentiated learning based on learning styles. The background of the research shows that most students are still at a low level of thinking and have difficulty analyzing, evaluating, and solving complex problems. The purpose of the research is to improve HOTS, participation, and learning outcomes by adapting the learning process to visual, auditory, and kinesthetic learning styles. The research used a Classroom Action Research (CAR) design with two cycles. The participants were 19 students. The research instruments included HOTS tests (essays C4–C6), activity observation sheets, discussion assessment sheets, and interviews. The procedures in each cycle included planning, action, observation, and reflection. In the first cycle, learning was designed based on PBL syntax and media based on learning styles. Student activity increased, but some students—especially those with auditory and kinesthetic learning styles—still had difficulty solving HOTS problems. Significant improvements occurred in the second cycle after strategy adjustments: 84% of students were able to solve HOTS problems based on analysis and logic, 89% were active in discussions, and more than 80% achieved the Minimum Completion Criteria (KKM). The study concluded that PBL combined with differentiated learning is effective, efficient, and capable of improving HOTS, participation, and student learning independence.

Keywords: *PBL, Differentiated Learning, Higher Order Thinking.*

1. Introduction

Problem-Based Learning (PBL) is a learning approach that places real-world problems as the basis of the learning process to improve students' critical thinking skills, learning motivation, and conceptual understanding. According to (I. M. C. Wibawa, N. W. Rati, B. R. Werang, 2024) the application of PBL-based interactive videos can increase science learning motivation in elementary school students because it encourages active involvement in solving problems and constructing knowledge independently. Furthermore, Jannah & Saifuddin (2024) (Na'imatul Jannah, 2024) found that the application of problem-based blended learning significantly improved high school students' critical thinking skills through a combination of collaborative online and face-to-face learning. Meanwhile, (Tasya Arsyada, Paramita Cahyaningrum Kuswandi, 2025) emphasized that the development of Google Sites-based learning media with a differentiated PBL model effectively increased learning interest and understanding of biodiversity concepts because it provided an interactive learning experience that suited students' learning styles. Thus, PBL has been proven effective in developing 21st-century skills such as critical thinking, collaboration, and independent learning in students. PBL is a student-centered learning approach that encourages them to conduct research, integrate theory and practice, and apply knowledge to solve real problems(Savery, 2006).

Problem-Based Learning (PBL) is an innovative approach designed to enhance students' problem-solving thinking skills through structured group collaboration. This approach provides students with the opportunity to explore problems in depth, stimulate critical thinking, and encourage continuous skill development. This model focuses centers on students as the center focal point of learning. In practice, PBL consists of five main stages: (1) identifying problems, (2) organizing learning activities, (3) guiding the investigation process, either independently or in groups, (4) presenting findings, and (5) conducting analysis and evaluation(Suryani et al., 2023). In this case, the teacher acts as a facilitator, while students are the main leading who are directed to be more independent and active in solving problems during the learning process(Eneng Mardiana & Sofyan Iskandar, 2024). (Sukmaningthias et al., 2024)Emphasized that diagnostic assessment can help teachers identify students' problem-solving abilities based on learning interests, so that problem-based approaches can be more targeted.

The Problem-Based Learning model provides the conditions to improve students' critical thinking and analytical skills in solving complex real-life problems, thereby fostering a culture of critical thinking(Notalia, 2023). The application of differentiated learning makes students feel cared for, valued, and challenged to learn, which is certainly in line with learning strategies that adapt to students' diverse learning needs(Sastra Wijaya, Mohammad Syarif Sumantri, 2022).

Differentiated learning is an effort to adapt the educational process in schools to meet the unique needs of each student. Differentiated learning is an effort to tailor the classroom learning process to meet the individual learning needs of each student. By implementing a variety of methods and strategies, teachers can provide learning experiences tailored to students' readiness, interests, and learning styles, ensuring that each individual receives the appropriate support(Ainiyah Melani Firdaus, 2022). This concept emerged in response to the differences in learning needs of each individual. This aligns with Kihajar Dewantara's philosophy, which emphasizes that the goal of education is to guide all children's potential so they can achieve the highest possible safety and happiness, both as individuals and as members of society(Nur Intang, Elpisah, 2025).

Differentiated learning shows significant potential for success because it is based on key principles that include an understanding of student diversity, their readiness, interests, and learning profiles, all of which contribute to ensuring that each learner receives a learning experience tailored to their needs(Almujab, 2023). This approach is proactive, emphasizes quality over quantity, and focuses on assesment and evaluation. Furthermore, it applies variations in learning products, processes, and content, is learner-oriented, combines classical, group, and individual learning methods, and is flexible. ccording to(Naibaho, 2023), differentiated learning aims to meet, serve, and acknowledge the diversity of students in learning according to their readiness, interests, and learning preferences, so that it can improve students' understanding of learning. In line with this, (Sastra Wijaya, Mohammad Syarif Sumantri, 2022)In addition, the research results show that the application of differentiated learning is able to increase student motivation and learning outcomes because teachers can adjust learning strategies and media according to the individual needs of students.

Visual learning style is often defined as a learning method that involves observation or seeing. Children with this learning style rely heavily on their sense of sight to comprehend information. They are typically drawn to colors, shapes, and moving images, thus preferring materials in the form of written instructions, photos, videos, films, charts, illustrations, or infographics. Visualizations such as pictures and diagrams in textbooks also provide significant benefits. Conversely, the auditory learning style emphasizes hearing. Students with this learning style rely more on their sense of hearing to receive and comprehend information. They are typically more attracted to sounds and words and find it easier to understand lessons through verbal explanations, oral directions, speaking activities, and group discussions. Kinesthetic, the kinesthetic learning style is often defined as learning through movement. Students with this learning style tend to involve more of their bodies in the learning process. Kinesthetic learning styles prefer to learn through physical activity and direct experience, because bodily involvement in learning strengthens memory and concrete understanding of concepts(Ignatia Ari Sayekti, Dewa Gede Bambang Erawan, 2025). (Laili et al., 2024)Study also used a similar approach to group students based on visual, auditory, and kinesthetic learning styles before analyzing differences in mathematical reflective thinking abilities.

Differentiated learning is an approach or perspective in teaching instructional approach that aims to create an effective learning process by providing various methods for understanding new information.

This approach is designed to reach all students in the class, who have different learning styles and abilities. This strategy includes variations in how to acquire material, process, and develop understanding and reasoning about ideas, and produce learning products and different forms of assessment. Thus, each student has the opportunity to learn optimally according to their potential and needs. This approach not only gives students the freedom to learn in the way that best suits them but also encourages the development of higher-order thinking skills (HOTS), such as the ability to analyze, evaluate, and design solutions(Tasya Arsyada, Paramita Cahyaningrum Kuswandi, 2025).

Higher-order thinking skills are cognitive abilities students need to face the challenges of the 21st century. Modern education emphasizes the importance of students' ability to formulate problems, gather information from various sources, and collaborate to find solutions. Therefore, collaboration and higher-order thinking skills are essential. One form of higher-order thinking is divergent thinking, the ability to generate which involves generating diverse ideas by comparing diverse and contrasting information. Students who thinking will be more skilled at dealing with better equipped to handle the various diverse challenges of 21st-century life.

Developing divergent thinking skills can be achieved through the implementation of various learning strategies in schools. However, currently, there is a significant gap in students' abilities to achieve high levels of analysis, evaluation, and creativity. Many students still struggle with critical and creative thinking, potentially hindering their ability to solve complex problems(Muliatmika et al., 2024). Learning styles that support these abilities emphasize real-world contexts and social interactions, but the approaches applied are often ineffective. A contextual approach helps students observe, understand, and evaluate information more objectively. One promising example of a contextual approach is problem-based learning (PBL). In this model, the teacher acts as a facilitator, while students are encouraged to learn independently. PBL is increasingly used as a primary tool to address various learning challenges in the classroom, although obstacles remain in developing students' higher-order thinking skills.

Based on observations at a private vocational high school in Jember, it was observed that most students in grade 10 still demonstrated lower-order thinking skills, such as memorizing information or answering questions directly without further analysis. When given tasks that required in-depth understanding, reasoning, or problem-solving, students tended to experience confusion and difficulty developing critical and creative ideas. This indicates suggests that higher-order thinking skills, such as the ability to analyze, evaluate, and create, still require development through learning that emphasize exploration, open discussion, and in-depth reflection on the material, for example, through the PBL model combined with differentiated learning(Komarayanti, 2023).

Based on the background description, this study aims to improve enhance the higher-order thinking skills of tenth-grade students at a private school in Jember through by applying the PBL model combined in conjunction with differentiated learning based on tailored to students' learning. This research is expected to create a more inclusive and participatory learning process, while simultaneously also improving overall student learning outcomes overall.

2. Method

Classroom action research (CAR) is part of the role and responsibility of teachers to developing scientific abilities and improve the quality reflective activities(Annury, 2018). This research serves as an important essential tool that is inseparable from integral to teachers' efforts to overcome various problems challenges that the learning process. Furthermore, classroom action research also serves as a form of self-evaluation of the learning process that teachers have implemented.

This classroom action research aims to develop students' higher-order thinking skills, particularly in the topic of probability enumeration. The research study was conducted at a private vocational high school in Jember, involving 19 10th-grade students known to experience challenges in critical thinking skills. The material used in this study covered probability enumeration in mathematics. The research success criteria are presented in Table 1.

Table 1. Student Success Benchmark

No.	Success Indocators	Criteria	Target	Data Collection Technique

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1.	Improving students' high-level thinking skills	Students are able to answer questions based on analysis and logic	75% of students completed	essay test
2.	Active involvement in learning	Students participate in discussions and express their opinions.	80% of students are involved	Observation and interviews
3.	Improvement of individual evaluation results	Minimum evaluation value according to KKM	75% of students achieved the KKM	essay test
4.	Ability to work on HOTS (Higher Order Thinking Skills) questions	Students are able to solve questions at level C4 and above	70% of students succeeded	essay test

This classroom action research was conducted through two cycles adjusted to the level of student learning achievement, and the termination criteria were determined when the success indicators had been achieved. According to(Suryaningrum et al., 2023), each cycle consists of four stages: (1) planning, (2) implementation, (3) observation, and (4) reflection. In the planning stage, the researcher prepared a learning plan. Then, implementation and observation were carried out simultaneously during the learning process. The final stage is reflection, which aims to review and evaluate the learning implementation in order to make improvements in the next cycle.

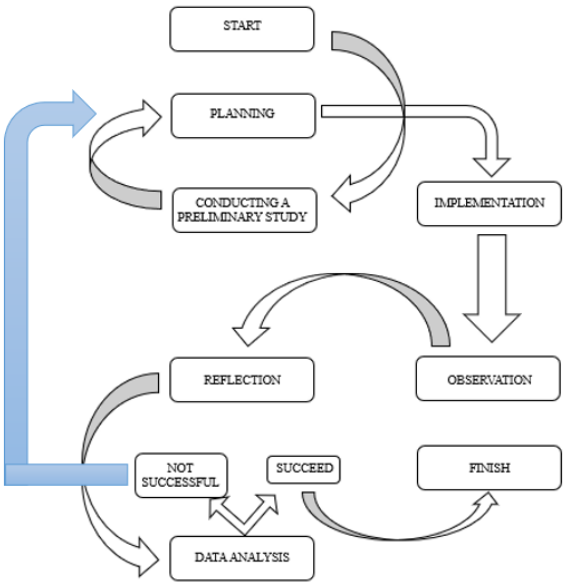

Figure 1. Research Design Flowchart

Classroom Action Research begins with an initial stage, namely conducting a preliminary study to identify any problems in the learning process that need to be addressed. This preliminary study is was conducted through initial classroom observations and interviews. Based on the results of this study, educators develop an action plan that includes objectives, materials, media, learning strategies, and evaluation instruments. The next stage is implementation, namely, carrying out the learning process according to the predetermined action plan. At this stage, the PBL learning model is applied first to identify each student's learning style, which will is then be integrated into the PBL implementation. After identifying students' abilities and learning styles, they are given assigned problems to solve according to that align with their respective learning styles. Students with a kinesthetic learning style are given media in the form of text or writing, students with an auditory learning style use audio

recordings, while. In contrast students with an audiovisual learning style receive media in the form of videos.

During the implementation of CAR, an observer records and collects data related to the learning process and outcomes. This observation aims to assess the success of the implemented actions and student responses. Following the observation, the educator conducts a reflection to evaluate the effectiveness of the actions and identify any obstacles that arose during the process. Data obtained from the observations and reflections are then systematically analyzed to determine the extent to which problems have been resolved and learning objectives achieved. If the analysis results show significant improvement, the research is declared complete. However, if the problems issues have not been optimally resolved, the educator can proceed to the next cycle with a refined action plan(Widayati, 2008).

3. Results and Discussion

The application of the Problem-Based Learning (PBL) model, combined with differentiated learning, to 10th-grade students at a private vocational school in Jember was motivated by their low higher-order thinking skills. Initial observations showed revealed that students were only able to memorize material and answer questions directly, but lacked the skills necessary to develop critical thinking, such as including analyzing, evaluating, and designing solutions. This condition indicates that most students are still at a lower-order thinking level (Lower Order Thinking Skills) and require a more exploratory and challenging learning approach. Similar findings were discussed by(Savery, 2006), who noted that PBL emerged to overcome traditional lecture-based learning which often fails to foster deep analytical reasoning.

This issue underscores highlights the importance of using adopting a learning approach that can increase promotes active student engagement while simultaneously fostering cultivating higher-order thinking skills. Therefore, the PBL learning model was chosen, combined with differentiated learning strategies tailored to students' learning styles. The collaboration of these two approaches is expected to create a more interactive, adaptive, and in-depth learning process, while also providing students with the opportunity to learn the material using the methods that are most appropriate and effective for them.

PBL is a learning model that focuses on students by stimulating them to participate in learning activities and solve problems given, creating an interesting learning environment(Saiful Fajar Dwi Ananda, 2022). The PBL model was chosen because it emphasizes contextual problem solving, collaborative discussion, and active exploration of ideas by students. In its implementation, this model is combined with differentiated learning strategies based on tailored to various learning styles, namely including audiovisual, auditory, and kinesthetic. This combination is expected to create a more inclusive and effective learning process that can adapt to the differences in learning styles of each student, thereby optimizing the development of higher-order thinking skills(Atikah et al., 2024).

Research data were analyzed through a process of information reduction obtained from student worksheet scores in each cycle, learning observations, and interviews. The pre-cycle implementation began with observation activities and student ability tests, which aimed to determine their initial conditions. Based on initial observations, it was found that the majority of students showed a tendency to think at a lower level. This was characterized by a dominant ability to memorize and answer questions directly without demonstrating in-depth understanding. When faced with questions that require analytical, evaluation evaluative, or creative skills (level levels C4 and above in Bloom's Taxonomy), many students experienced difficulties. They tended to be confused, passive in discussions, and less able to develop ideas critically and creatively.

After conducting a preliminary study and observing students, educators then develop an action plan that includes material objectives, media, and activities based on PBL syntax and the needs of students' learning styles. In the planning stage, educators must establish a well-structured learning environment. After compiling the learning plan, educators carry out cycle one by starting with a learning style test on students. The results of the test conducted from on 19 students were obtained, where 7 students use visual learning styles, seven students use auditory learning styles, and five students use kinesthetic learning styles.

After students' learning styles were identified, they were then grouped based on their dominant learning style, and the curriculum was adjusted based on accordingly to utilize appropriate media and

teaching methods. Students with visual learning styles were facilitated through the use of images, videos, and diagrams; auditory students were guided through discussions and verbal explanations; while kinesthetic students learned through direct practice and educational games. As a result, the level of student engagement in the learning process increased significantly compared to before. In the first cycle, students were given questions based on the PBL learning model combined with each student's their individual learning style styles. This finding is consistent with the research results of (Taufiqur Rahman, n.d.), where students showed increased motivation and active participation in the problem-based learning process.

However, at the end of the first cycle, it was revealed that the majority of students, especially those with auditory and kinesthetic learning styles, still faced continued to face difficulties in optimally completing higher-order thinking questions. This finding also shows that students are not yet accustomed to working on PBL-based questions with a differentiated learning approach. However, their scores improved compared to the initial ability test. This proves that learning that adapts to students' learning styles is more effective. As explained by(Chantika et al., 2024), differentiated education is an approach taken by teachers to adapt adjust the learning process to the needs, preferences, and learning styles of each student in a flexible and individual individualized manner. Although there has been improvement, the second cycle must still be carried out with greater emphasis on student learning styles and PBL learning.

In the second cycle, learning followed the same pattern as in the first cycle. However, in this phase, a stronger emphasis was placed on the PBL model, which is based on differentiated learning, with a primary focus on student learning styles. Differentiated learning enhances the effectiveness of PBL because it can be tailored to each student's readiness, learning style, and motivation. By understanding different learning styles such as visual, auditory, and kinesthetic, teachers can design activities that are more relevant and engaging for students, thus facilitating more effective learning. After strategic improvements were made during this cycle, student learning outcomes showed significant improvement. 84% of students successfully answered higher-order thinking questions requiring analysis and logic, 89% actively participated in discussions, and more than 80% achieved scores above the Minimum Completion Criteria (KKM). These achievements demonstrate that problem-based learning, tailored to individual learning styles, not only deepens students' understanding of the material but also increases their confidence in critically communicating ideas and solutions. In line with this, there is an influence of differentiated learning strategies through the PBL model on students(Sitorus et al., 2023). Practical implications for teachers include designing group assignments that address students' diverse learning styles, such as dividing groups based on learning styles to support each member. Furthermore, the materials used should be varied, including visual and audio resources and hands-on activities, to ensure they are engaging for all students. Teachers should also develop clear assessment rubrics that reflect the various aspects of expected higher-order thinking skills, such as analysis, evaluation, and collaboration. These adjustments can make learning more effective and inclusive, supporting the development of each student's competencies.

4. Conclusion

The Problem-Based Learning (PBL) model has been proven effective in developing higher-order thinking skills by encouraging students to identify problems, design solutions, and evaluate alternatives. When PBL is combined with differentiated learning, this integration achieves a more holistic learning objective. This approach not only facilitates collaboration, communication, and creativity, but also helps students understand complex concepts according to their individual learning styles. Research shows that this combination can enhance higher-order thinking skills and foster student independence in learning.

However, implementing this strategy certainly faces challenges. Teachers need to take the time to understand each student's learning style and design materials that meet their diverse needs. Challenges often arise include complex planning, dynamic classroom management, and the need for diverse learning media. With careful planning, strong collaboration between teachers, and the use of learning technology, these obstacles can be effectively overcome. Overall, this research shows that implementing PBL integrated with a differentiated approach significantly improves students' higher-order thinking skills, while fostering self-confidence and collaborative skills, and creating a more active,

motivating, and engaging learning environment. Therefore, this approach is highly recommended to be applied more widely at various levels of education as a solution to develop higher-order thinking skills among students.

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