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IMPLEMENTATION OF INQUIRY-BASED DIFFERENTIATED LEARNING IN IMPROVING STUDENTS' CRITICAL THINKING SKILLS

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Abstract

The development of critical thinking skills is one of the learning objectives applied in the Merdeka Curriculum through the Pancasila student profile. However, the implementation of the Merdeka Curriculum that meets the students' needs has not been fully developed in each school. Therefore, one effort that can be used to address this issue is by implementing differentiated learning based on inquiry learning. This research aims to determine the effect of implementing differentiated learning based on inquiry learning on improving students' critical thinking skills. The research design uses a mixed methods approach. The population in this study includes all 10th-grade students (Class X.E) at SMA Negeri 2 Woha. Using cluster random sampling, two classes were selected as the research sample, with each class consisting of 23 students, divided into an experimental group and a control group. Data collection techniques include test sheets and interviews. Quantitative data analysis was obtained from the test results using the N-Gain and Wilcoxon tests, while qualitative data analysis was obtained from the interview results. The findings show that in the experimental class, 26,2% of students achieved the highest improvement in critical thinking skills, whereas in the control class, 34,8% of students did not experience any improvement in critical thinking skills. In conclusion, there was an improvement in both critical thinking skills and mathematics learning outcomes as a result of implementing differentiated learning based on inquiry learning in the experimental class compared to the control class.

Keywords: differentiated learning, inquiry-based learning, critical thinking skills, Merdeka Curriculum, 21st-century skills

Abstrak

Pengembangan keterampilan berpikir kritis merupakan salah satu tujuan pembelajaran yang diterapkan dalam Kurikulum Merdeka melalui profil siswa Pancasila. Namun, pelaksanaan Kurikulum Merdeka yang sesuai dengan kebutuhan siswa belum sepenuhnya terwujud di setiap sekolah. Salah satu upaya untuk mengatasi masalah ini adalah dengan menerapkan pembelajaran berdiferensiasi berbasis inquiry learning. Penelitian ini bertujuan untuk menentukan pengaruh penerapan pembelajaran berdiferensiasi berbasis inquiry learning terhadap peningkatan keterampilan berpikir kritis siswa. Desain penelitian menggunakan pendekatan campuran (mixed methods). Populasi dalam studi ini mencakup seluruh siswa kelas 10 (Kelas X.E) di SMA Negeri 2 Woha. Dengan menggunakan teknik pengambilan sampel acak kluster, dua kelas dipilih sebagai sampel penelitian, masing-masing terdiri dari 23 siswa, yang dibagi menjadi kelompok eksperimen dan kelompok kontrol. Teknik pengumpulan data meliputi lembar tes dan wawancara (kuisioner). Analisis data kuantitatif diperoleh dari hasil tes menggunakan uji N-Gain dan uji Wilcoxon, sementara analisis data kualitatif didapat dari hasil wawancara (kuisioner). Temuan menunjukkan bahwa pada kelas eksperimen, 26,2% siswa mencapai peningkatan tertinggi dalam keterampilan berpikir kritis, sedangkan pada kelas kontrol, 34,8% siswa tidak mengalami peningkatan dalam keterampilan berpikir kritis. Kesimpulannya, terdapat peningkatan baik dalam keterampilan berpikir kritis maupun hasil belajar matematika sebagai hasil penerapan pembelajaran berdiferensiasi berbasis inquiry learning di kelas eksperimen dibandingkan dengan kelas kontrol.

Kata kunci: pembelajaran berdiferensiasi, pembelajaran berbasis inkuiri, keterampilan berpikir kritis, Kurikulum Merdeka, keterampilan abad ke-21

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INTRODUCTION

The government stipulates learning skills/outcomes in the curriculum, but they are used as a path that leads Indonesian children to their destination. In the independent curriculum, educational units must design a curriculum by adjusting the characteristics of the school and the needs of the teaching unit. Learning that implements the independent curriculum focuses on essential materials and the development of students' character and abilities. The development of student's abilities is required to have science and technology skills (Suryaningsih et al., 2023). These skills are in the 21st century, namely *creativity, critical thinking, communication, and collaboration* (Kivunja, 2015). Demands The era is the foundation that requires education to form and develop innovation and creativity (Ramdani & Suryaningsih, 2023). Developing innovative and creative learning, especially in mathematics learning, needs to implement the current curriculum in the education unit. However, the education unit has not implemented learning that is tailored to the needs of students in each school.

One of the efforts to realize an independent curriculum is by implementing differentiated learning (Hasibuan & Ningsih, 2023; Hidayat et al., 2023; Jumiarti et al., 2024; Sulaiman et al., 2024; Triyanti et al., 2024). Differentiated learning has been known in Indonesia since the first teacher education program was held in 2020. Differentiated learning is an effort to combine differences to obtain information, make ideas, and convey the results that students have learned. Planning learning by taking into account the characteristics of students is hereinafter called differentiated learning (Mahmudah et al., 2023). Differentiated learning is learning that accommodates the needs of each individual to gain learning experience and mastery of the concepts learned (Evendi et al., 2023). Interest-based differentiated learning provides students with opportunities to learn as they wish and helps them learn efficiently (Solikhin et al., 2023). Differentiated learning contains the differentiation of content, processes, and products.

Differentiated learning strategies need to be applied to learning models that can improve 21st-century skills, one of which is *inquiry learning*. Inquiry learning is when students do not get learning concepts/materials directly, but each student is required to be active in questions and answers to stimulate their curiosity and be able to think critically mathematically. Type *inquiry learning* is an activity design that encourages all students' ability

to learn to search, analyze critically, analytically, logically, and systematically so that students are confidently able to formulate their findings (Kartika & Rakhmawati, 2022). Stages of *inquiry learning* namely orientation, conceptualization, investigation, conclusion, and discussion (Pedaste et al., 2015). Meanwhile, the stages of the learning model *inquiry learning* loading orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses, and formulating conclusions (Amini et al., 2020). Implementation of learning stages *inquiry learning* can guide students to think critically and find their concepts from learning.

Critical thinking is a reflective thinking skill based on reason and is focused on determining what is believed and done. Critical thinking skills need to be taught to junior and senior high school students (Changwong et al., 2018). The reason is that the critical thinking skills indicator involves students' ability to collect, evaluate information, analyze, synthesize, and make decisions (Yazidah et al., 2020). Critical thinking is the skill of understanding interpreting and having alternative solutions to problems (Salahuddin & Ramdani, 2021). Critical thinking skills have meaning when a person can recognize differences so that they can conclude the problem correctly, use various supporting information to solve problems, and be able to find relevant information (Patandung, 2023). Therefore, to make learning more effective, it is important to carry out differentiated learning that has a positive impact and can improve students' critical thinking skills (Kamarulzaman et al., 2022; Nahdhiah & Suciptaningsih, 2024).

The importance of effective learning in the mathematics education process does not align with the reality observed in the field. The causative factor of the results of the study in the previous research is that students tend to memorize material and formulas rather than understand the concepts (Arif et al., 2020), students have difficulty working on description questions, difficulty asking questions, and giving reasons in answering questions (Suriati et al., 2021). In addition, teachers in the learning process usually do not pay attention to the needs of students when teaching because they teach according to the characteristics and learning styles they want (Laia et al., 2022). This finding aligns with the initial research regarding the real challenges at SMA Negeri 2 Woha. The observation results indicate that when students' engagement in mathematics learning is low, the evaluation questions remain at the level of Lower Order Thinking Skills (LOTS), and the learning approach continues to be

Teacher-Centered Learning. This is evident from the teacher's activities, which are largely focused on delivering content in a lecture-style format.

The above problem factors indirectly have an impact on the low grades of students and the ineffective learning process. Therefore, the solution is to pay attention to the different characteristics and learning styles of each student so that students are more active in investigating a problem and are used to thinking. Based on this, the researcher wants to research to find out how the impact of the implementation of inquiry-based differentiated learning in improving students' critical thinking skills.

METHODS

This study uses the *Mixed Methods design through* the concurrent mixed methods *approach* (a combination of quantitative and qualitative research) to answer questions related to the influence of the implementation of inquiry-based differentiated learning in improving students' critical thinking skills. The following flowchart shows the design stages of the Mixed Methods research used in this study:

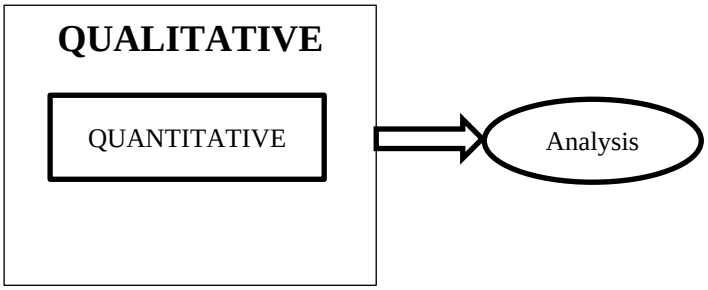

Figure 1. Research Design Flow Chart *Mixed Methods* (Creswell, 2010)

This research was conducted at SMA Negeri 2 Woha, a school that is representative of this research because of the involvement of students in new learning models or the diversity of student abilities. The research population included a total of 46 students from class X.E at SMA Negeri 2 Woha. Cluster random sampling was used to divide the students into two groups: the experimental class (X.E1) and the control class (X.E2), with 23 students assigned to each group. This division ensured a balanced and representative sample for comparing the effects of the inquiry-based differentiated learning method on critical thinking skills. Data was collected using two primary instruments: test sheets and interviews. The test sheets,

comprising descriptive questions, were designed to evaluate students' critical thinking skills. Additionally, semi-structured interviews were conducted with 5 students to gain deeper insights into their perspectives on the applied inquiry-based differentiated learning method. This approach ensured a comprehensive understanding of both the quantitative and qualitative aspects of the study. Both instruments were validated by a team of experts. Quantitative data were analyzed using the N-Gain test to measure improvements in critical thinking skills and the Wilcoxon Test to test for significant differences between groups. Qualitative data were analyzed based on the results of the interviews.

Table 1. Question Instruments based on Critical Thinking Skills Components

Cognitive Processes	Question Number
Understand	1
Apply	1
Analyze	1
Evaluate	1
Created	1
Total	**5**

RESULTS AND DISCUSSION

The results showed a striking difference between the control class and the experimental class in improving students' critical thinking skills. In the control class, of the 23 students who participated, none of the students experienced a high improvement in critical thinking skills. Only 1 student (4.3%) showed improvement at a moderate level, while 14 students (60.9%) experienced an improvement at a low level. The rest, namely 8 students (34.8%), showed no improvement at all in their critical thinking skills. In contrast, in the experimental class, which also consisted of 23 students, more positive results were seen. A total of 6 students (26.2%) experienced an increase at a high level, while 12 students (52.1%) showed an increase at a moderate level, and 5 students (21.7%) experienced an increase at a low level. There were no students in the experimental class who did not experience improvement.

This improvement was measured using the N-Gain, which describes how much students' critical thinking skills changed before and after learning. Figure 2 presents the

results of the N-Gain calculation between the control class (KK) and the experimental class (KE).

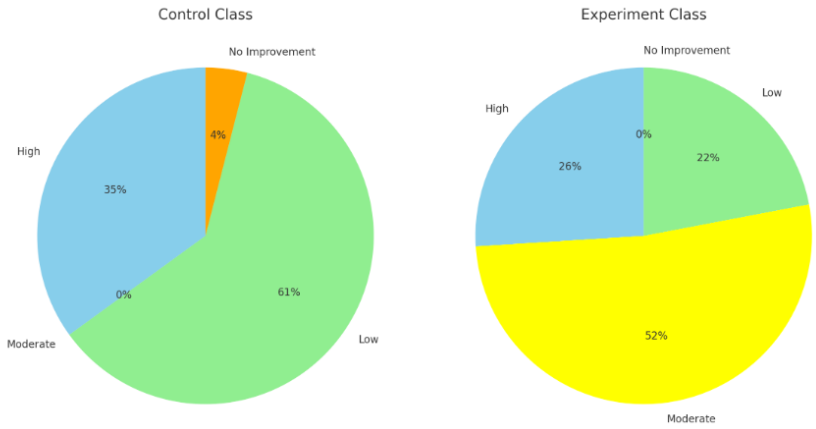

Figure 2. Results of Students' Critical Thinking Skills

Figure 2 shows the distribution of critical thinking skill improvement between the control class and the experimental class. In the experimental class, as many as 26.2% of students experienced a high improvement in critical thinking, 52.1% experienced a moderate increase, and 21.7% experienced a low increase. Meanwhile, in the control class, no students showed high improvement; Only 4.3% of students were in the moderate improvement category, 60.9% in the low category, and 34.8% did not experience any improvement at all.

These findings show that the implementation of differentiated learning is based on *inquiry learning* able to provide a significant improvement in students' critical thinking skills. This approach allows students to be more active in arguing, problem-solving, and enthusiastic during learning activities. This improvement was more pronounced in the experimental class compared to the control class, which used conventional learning methods. This progress aligns with the findings of previous studies. Kamarulzaman et al. (2022) and Nahdhiah & Suciptaningsih (2024) state that differentiated learning is more effective and has a positive impact on developing thinking and problem-solving skills in students. In addition, this learning not only focuses on memorization but also provides students with the opportunity to interpret the questions in their language, so that they better understand the concepts being taught. Purnamasari et al. (2024) found that students who had already grasped the formula could solve the problems given. Similarly, Nurwalidainismawati (2022) emphasized that direct student involvement is a key factor in their learning success.

It is also important to note that students in the control class who do not show improvement may be due to a more passive learning method and less stimulation to them to think critically. It underscores the importance of student-centered learning to develop deeper thinking skills.

Students' Perspectives on Differentiated Learning

The results of interviews with students provide a more in-depth picture of students' critical thinking skills on various indicators. This interview is used to support quantitative results and explain more about students' ability to differentiate learning. The following are the results of the interview analysis presented in Table 2.

Table 2. Results of Interview Analysis

Critical Thinking Skills Indicator	Results of Interviews with Students
Understand	Most students can understand the intent of the question, explaining the scope of each item correctly and in detail.
Apply	Students were able to apply the data presentation procedure, but 1 out of 5 students had difficulty in applying instructions in the questions.
Analyze	Most students can analyze the problem, but almost all students have difficulty understanding the number 5. They are confused about the meaning of the problem and are not thorough in solving it.
Evaluate	Students understand the presentation of single data, but some are confused in presenting group data such as determining the frequency and other forms of presentation.
Created	Students enthusiastically designed data presentation diagrams in groups.

From the interviews, it was revealed that students who participated in differentiated learning showed varying critical thinking skills on each indicator. Most students can understand the problems well and can apply the concepts learned, although some students have difficulty following more complex instructions, especially those related to problem analysis and group data presentation.

The results of these interviews support the findings of previous research. Arfiana & Wijaya (2018) and Wulandari & Warmi (2022) stated that math problems can not only help students develop critical thinking skills but can also support them in solving problems in the context of daily life. This is also emphasized by Karim (2015) states that a person is said to have critical thinking skills if they show the characteristics of critical thinking indicators, such as understanding, analyzing, and evaluating information effectively.

However, the interview also revealed several obstacles in the development of critical thinking skills. Some students still show dependence on sample questions that have been given previously and difficulties in dealing with questions with different formats. In line with this, Faiziyah & Priyambodho (2022) highlight the lack of practice and motivation of students in trying to solve more challenging problems as one of the obstacles in the development of critical thinking skills. Students tend to stick to familiar patterns, so they become confused when faced with questions that require a more creative and analytical approach.

Thus, although inquiry-based differentiated learning has been proven to be able to improve students' critical thinking skills, efforts are still needed to provide more diverse exercises and encourage students to be more courageous in exploring various forms of problems. This strategy will help students become more flexible and adaptive in solving problems that require critical thinking and problem-solving.

Implementation of Differentiated Learning Based on Inquiry Learning

To evaluate the influence of differentiated learning methods on mathematics learning outcomes, statistical analysis is carried out as presented in Table 3 below:

Table 3. Mathematics Learning Outcomes Using Differentiated Learning Methods

		N	Mean Rank	Sum of Ranks
Postest Eksperiment- Pretest Eksperiment	Negative Ranks	0[a]	.00	.00
	Positive Ranks	23[b]	12.00	276.00
	Ties	0[c]		
	Total	23		
Postest Control - Pretest Control	Negative Ranks	2[d]	5.75	11.50
	Positive Ranks	15[e]	9.43	141.50
	Ties	6[f]		
	Total	23		

Symbols used in the table (a, experimental posttest < experimental pretest; b, experimental posttest > experimental pretest; c, experimental posttest = experimental pretest; d, control posttest < control pretest; e, control posttest > control pretest).

Based on Table 3 above, it can be seen that there is no decrease in the value of mathematics learning outcomes in the experimental class between the pre-test and the post-test, which is indicated by a negative difference of 0. This shows that all 23 students in the experimental class experienced an improvement in their learning outcomes, with an average rating of 12.00. In contrast, in the control class, two students showed a decrease in their

learning outcomes between the pre-test and post-test, with an average rating of 5.75. However, 15 students in the control class showed positive improvement, with an average rating of 9.43. This discovery aligns with research by Rijal et al. (2025) which shows that differentiated learning significantly improves math outcomes by tailoring instruction to student needs. In addition, learning approaches that are differentiated by learning style have also been proven to be effective, improving students' problem-solving skills and critical-thinking skills (Partika HN et al., 2024; Lestari et al., 2024).

The conclusion of this data shows that there is a significant difference in learning outcomes between the experimental and control groups before and after the implementation of differentiated learning. This indicates that this learning method has a positive effect on the mathematics learning outcomes of students in the experimental group.

CONCLUSION

The analysis of the pre-test and post-test results from both the experimental and control classes at SMA Negeri 2 Woha reveals a significant difference in student outcomes. In the experimental class, all 23 students showed score improvement (positive ranks), with a total sum of ranks of 276.00. In contrast, the control class saw 15 students demonstrate score improvement (positive ranks) with a sum of ranks of 141.50, while 6 students showed no change (ties) and 2 students experienced a decline in scores (negative ranks). This notable improvement in the experimental group underscores the effectiveness of the inquiry-based differentiated learning method in enhancing critical thinking skills and overall learning outcomes, in comparison to traditional teaching methods.

The results indicate that differentiated learning based on inquiry learning significantly improves students' critical thinking skills, particularly in mathematics learning outcomes at SMA Negeri 2 Woha. By tailoring learning strategies to meet individual student needs, this approach enhances students' conceptual understanding and problem-solving abilities. Statistical evidence supports that differentiated learning is more effective in fostering cognitive development and critical thinking compared to conventional methods.

Overall, this study underscores the importance of implementing differentiated learning to improve student outcomes, especially in mathematics, emphasizing both academic success and critical thinking development.

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