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Optimizing Differentiated Learning for Independence and Critical Thinking in Fifth Grade Student

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Abstract: This study aims to determine the effect of implementing differentiated learning based on learning styles on the improvement of student learning independence and critical thinking skills in science subjects, specifically on the topic of light, in grade V at SD Inpres 1 Inti Bantaya. This research is a quantitative study using a quasi-experimental method conducted on the entire population of grade V students at SD Inpres 1 Inti Bantaya for the 2023/2024 academic year, consisting of two classes with a total of 56 students. The results show that the application of differentiated learning based on learning styles has a positive impact on enhancing students' learning independence. This is evidenced by higher scores in the experimental class compared to the control class across five aspects of learning independence: initiative, self-confidence, responsibility, problem-solving, and self-control. Additionally, the results of the independent t-test indicate a significant difference between the average pretest and posttest scores of students' critical thinking skills in the experimental and control classes. The significance values for the pretest and posttest are 0.000 and 0.009, respectively, indicating that the use of differentiated learning based on learning styles can improve students' critical thinking skills. Based on these findings, it can be concluded that differentiated learning based on learning styles is effective in enhancing learning independence and critical thinking skills among students on the topic of light in grade V at SD Inpres 1 Inti Bantaya.
Keywords: Differentiated Learning, Independence, Critical Thinking, Grade V Students.

Optimalisasi Pembelajaran Diferensiasi untuk Kemandirian dan Berpikir Kritis pada Siswa Kelas V

Abstrak: Penelitian ini bertujuan untuk mengetahui pengaruh penerapan pembelajaran diferensiasi berdasarkan gaya belajar terhadap peningkatan kemandirian belajar dan keterampilan berpikir kritis siswa pada mata pelajaran IPA khususnya topik cahaya di kelas V SD Inpres 1 Inti Bantaya. Penelitian ini merupakan penelitian kuantitatif dengan metode eksperimen semu yang dilakukan terhadap seluruh populasi siswa kelas V SD Inpres 1 Inti Bantaya tahun pelajaran 2023/2024 yang terdiri dari dua kelas dengan jumlah siswa 56 orang. Hasil penelitian menunjukkan bahwa penerapan pembelajaran berdiferensiasi berdasarkan gaya belajar memberikan dampak positif terhadap peningkatan kemandirian belajar siswa. Hal ini dibuktikan dengan skor yang lebih tinggi pada kelas eksperimen dibandingkan kelas kontrol pada lima aspek kemandirian belajar: inisiatif, percaya diri, tanggung jawab, pemecahan masalah, dan pengendalian diri. Selain itu, hasil uji t independen menunjukkan adanya perbedaan yang signifikan antara rata-rata skor pretest dan posttest kemampuan berpikir kritis siswa pada kelas eksperimen dan kontrol. Nilai signifikansi pretest dan posttest masing-masing sebesar 0,000 dan 0,009 menunjukkan bahwa penggunaan pembelajaran berdiferensiasi berdasarkan gaya belajar dapat meningkatkan kemampuan berpikir kritis siswa. Berdasarkan temuan tersebut dapat disimpulkan bahwa pembelajaran yang dibedakan berdasarkan gaya belajar efektif dalam meningkatkan kemandirian belajar dan kemampuan berpikir kritis siswa pada topik cahaya di kelas V SD Inpres 1 Inti Bantaya.
Kata Kunci: Pembelajaran Diferensiasi, Kemandirian, Berpikir Kritis, Siswa Kelas V.

1. Intruduction

Education in Indonesia is currently facing the millennial era, where information can be easily accessed at the touch of a finger. The education sector is expected to adapt to this era, which requires critical thinking skills to be possessed by both teachers and students. Education and knowledge should not only equip students with information but also foster a scientific attitude toward knowledge,

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characterized by critical, logical, innovative, and consistent thinking, as well as the ability to adapt to global changes in line with rapid advancements in science and technology (Mulyasa, 2021).

The process of teaching science (IPA) in every educational unit should be conducted in an interactive, inspiring, enjoyable, challenging manner that motivates students to participate actively and provides sufficient space for initiative, creativity, and independence, in accordance with their talents, interests, and physical and psychological development (Suja, 2023). The science learning process that applies values by providing exemplary behavior (ing ngarso sung tulodo), fostering motivation (ing madyo mangun karso), and developing students' creativity in learning (tut wuri handayani) is part of the educational philosophy of Ki Hajar Dewantara, which advocates a system of "among," meaning that teachers should guide students to develop according to their inherent nature (Apriliyanti et al., 2021). In this regard, teachers play a crucial role in creating learning environments that empower students, enabling them to think freely and realize their potential, thus allowing them to grow and develop according to their nature.

The educational philosophy of Ki Hajar Dewantara aligns with the concept of differentiated learning (Herwina, 2021). Differentiated learning is an effort to tailor the classroom learning process to meet the individual learning needs of each student (Wahyuni, 2022). The adjustments referred to here relate to the interests, learning profiles, and readiness of students to achieve improved learning outcomes. Differentiated learning is also defined as a way to recognize and teach according to the different talents and learning styles of students (Bendriyanti et al., 2021). Teachers facilitate students according to their needs, as each student has different characteristics, and thus cannot be treated the same. Differentiated learning is not individualized learning; rather, it leans towards accommodating the strengths and learning needs of students through independent learning strategies.

According to Iskandar (2021), it was found that the implementation of education has not changed significantly, still applying a learning system that treats all children as if they are the same, without considering the diversity of their abilities. Teachers seem to teach as if there is only one student in a class, whereas in reality, a class typically consists of about 20-30 students who possess unique characteristics, abilities, and diverse learning experiences. As a result, students often feel bored and consequently lack good motivation to learn.

Learning styles are forms or efforts that are considered easy in managing and applying received information. This means that by understanding the learning styles of students, educators can guide them in learning according to their respective styles. Thus, the learning objectives of students can be effectively achieved through instruction that aligns with their learning styles (Minasari & Susanti, 2023). Learning styles refer to the ways individuals absorb and process information easily according to their abilities. The diverse learning styles of each student must be accommodated through differentiated learning. Iskandar (2021) argues that each person has different tendencies in absorbing information/learning. In this context, there are three learning styles commonly abbreviated as VAK: Visual, Auditory, and Kinesthetic.

In understanding information and learning in the classroom, one important attitude that students must possess is self-directed learning. Self-directed learning is a condition or behavior of students that easily demonstrates initiative during the learning process, the ability to solve their own problems, responsibility in completing their learning tasks, willingness to learn independently, confidence in completing assignments, and not requiring guidance from others to engage in learning activities (Laksana & Hadijah, 2019). Students with high self-directed learning tend to manage their learning activities easily, starting from preparation, execution, and even evaluation of the learning process (Aulia et al., 2019).

Students with self-directed learning are better able to learn both individually and in groups, showing courage in expressing their ideas as learners (Kurniawan et al., 2018). Conversely, students with low levels of self-directed learning tend to struggle to overcome obstacles in their learning process, while those with high levels of self-directed learning are more capable of addressing challenges during classroom learning (Syibli, 2018). Furthermore, students' self-directed learning becomes a significant factor influencing their learning outcomes; the more independent students are in their learning, the higher their learning achievements tend to be (Safitri & Pujiastuti, 2020). Indicators of self-directed learning include initiative, confidence, responsibility, problem-solving, and self-regulation. By fostering these attitudes, it is hoped that students can enhance their skills and

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knowledge in science to tackle real-life problems (Kurniasih et al., 2020).

Critical thinking is the ability to analyze situations based on facts and evidence to reach conclusions. Critical thinking also involves the ability to develop and articulate arguments from data to arrive at complex decisions or ideas (Agnafia, 2019). Critical thinking plays a crucial role in preparing students to solve problems, explain reasons, and evaluate information. Critical thinkers can analyze data or information systematically based on logic when investigating facts (Sumargono et al., 2013). According to Ennis (1996), indicators of critical thinking abilities include: (1) providing elementary clarification; (2) building basic skills; (3) making inferences; (4) providing advanced clarification; and (5) employing strategies and tactics.

In accordance with the characteristics of elementary school children and the nature of science learning, lessons should be designed around activities and oriented towards the environment to foster intrinsic motivation in students, allowing them to learn in engaging, enjoyable ways while thinking scientifically and critically. Related to this, teachers are expected to make changes in designing learning processes that align with students' characteristics, making learning enjoyable and enabling students to explore and discover concepts in the lessons. This aligns with the current curriculum as stated in Ministerial Regulation No. 41 of 2007, which emphasizes teachers as facilitators who enable students to achieve their learning objectives (Nasution, 2018).

According to Ministerial Regulation No. 41 of 2007, teachers are facilitators who support students in every learning activity. Differentiated learning is viewed as a means to enhance students' self-directed learning and critical thinking because in this model, teachers truly tailor instruction to students' abilities, based on their talents, interests, and learning profiles, allowing students to feel comfortable, confident, and capable of solving problems according to their understanding levels (Kusuma et al., 2023).

Practical reflections on the learning conducted at SD Inpres 1 Inti Bantaya indicate that the indicators of self-directed learning such as the desire to learn independently, initiative in self-study, belief in one's abilities, and responsibility for assigned tasks—are not yet evident. This is apparent when homework is assigned; most students complete their tasks at school by copying from friends, particularly in science subjects. Furthermore, indicators of critical thinking in science learning are still lacking, as evidenced by the low achievement of students in solving problems related to cognitive levels C4, C5, and C6. Therefore, the author applies differentiated learning based on learning styles to enhance students' self-directed learning and critical thinking.

Based on the background and theoretical elaboration above, the researcher has chosen the title " Optimizing Differentiated Learning for Independence and Critical Thinking in Fifth Grade Student." In accordance with the above title, the objectives of this study are to determine the effect of differentiated learning on enhancing students' learning independence in science, specifically on the topic of sound, in fifth grade at Inpres 1 Inti Bantaya Elementary School. Additionally, to investigate the impact of differentiated learning on students' critical thinking skills in science, particularly concerning the topic of sound, in fifth grade at Inpres 1 Inti Bantaya Elementary School.

2. Research Methods

The type of research is quantitative, using a quasi-experimental method. This design includes a control group but cannot fully control external variables that may affect the execution of the experiment (Sugiyono, 2015). The population in this study consists of all fifth-grade students at SD Inpres 1 Inti Bantaya for the 2023/2024 academic year, comprising 2 classes with a total of 56 students.

The sample in this study is the students of class VA as the experimental group, totaling 28 students, and class VB as the control group, also totaling 28 students. Thus, the total sample size for this research is 56 students. The sampling technique used is purposive sampling, which involves selecting two classes with relatively similar average scores.

The data source for this research is primary data collected directly by the researcher through pretests and posttests completed by the participants, as well as a learning independence questionnaire that has been prepared and validated by a team of validators appointed to assess the validity of the instruments prepared by the researcher, which will be administered to the participants.

3. Results and Discussion

Data on students' learning styles were obtained by scoring their answers from the learning style questionnaire. The scores for each learning style (visual, auditory, and kinesthetic) were then calculated. Subsequently, the scores among the three learning styles were compared.

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Based on the highest score, each student was classified as belonging to either the visual, auditory, or kinesthetic learning style. The results of the classification and descriptive analysis of students' learning styles based on their tendencies can be seen in Table 1.

Table 1. Results of Students' Learning Styles

No	Learning Style	**Number of Students**	**Presentage (%)**
1	Visual	8	28,57
2	Auditory	12	42,86
3	Kinesthetic	8	28,57
Total		**28**	**100**

Based on the classification in Table 1, it can be observed that there are 8 students, or 28.57%, who have a visual learning style, 12 students, or 42.86%, who have an auditory learning style, and 8 students, or 28.57%, who have a kinesthetic learning style.

The learning independence of the students was measured using a questionnaire. This questionnaire consists of several statements. The learning independence measured refers to 5 aspects: initiative, self-confidence, responsibility, problem-solving, and self-control. The results of the analysis of students' learning independence in the experimental and control classes can be seen in Table 2.

Table 2. Results of Students' Learning Independence

Measured Aspect	Eksperimentation	Control
Intiative	97,62	81
Self-Confidence	98,6	90
Responsibility	90	73,54
Problem solving	97,77	88,33
Self-Control	97	91,5

Based on the data in Table 2, it can be concluded that the learning independence of students in the experimental class has a higher score than that of the control class across all 5 measured aspects. This is evident from the data, where in the experimental class the score for the initiative aspect is 97.62, while the control class scored 81; for self-confidence, the experimental class scored 98.6 and the control class scored 90; for responsibility, the experimental class scored 90 and the control class 73.54; for problem-solving, the experimental class scored 97.77 and the control class 88.33; and for self-control, the experimental class scored 97 while the control class scored 91.5. This indicates that the use of differentiated learning based on learning styles has a positive impact on students' learning independence.

Critical thinking skills were measured using an essay test. The assessment of students' critical thinking skills was conducted before the learning process began, during the first meeting, and after the learning process, during the fifth meeting. The results of the critical thinking skills data for students in both the experimental and control classes can be seen in the prerequisite tests (normality test and homogeneity test) and hypothesis testing.

The normality test was conducted to determine whether the tested samples are normally distributed. The normality test used was the Kolmogorov-Smirnov test, assisted by SPSS version 25. The data from the normality test of students' critical thinking skills in the experimental and control classes can be seen in Table 3.

Table 3. Results of Normality Test for Pretest in Experimental and Control Classes

		Kontrol	Eksperimen
N		28	28
Normal Parameters[a,b]	Mean	64.6429	68.8571
	Std. Deviation	3.39077	2.63473
Most Extreme Differences	Absolute	.139	.132
	Positive	.139	.128
	Negative	-.125	-.132
Test Statistic		.139	.132
Asymp. Sig. (2-tailed)		.175[c]	.200[c,d]

Based on Table 3, the results of the normality test for the pretest of students' critical thinking skills in the experimental and control classes indicate that the pretest results for both classes have a significance value (sig.) > 0.05. This is evidenced by the pretest results of the experimental class, which obtained a sig. value of 0.200 > 0.05, and the sig. value for the control class, which is 0.175 > 0.05, meaning that both data sets are normally distributed.

Table 4. Results of Normality Test for Posttest in Experimental and Control Classes

		Kontrol	Eksperimen
N		28	28
Normal Parameters[a,b]	Mean	82.29	84.39
	Std. Deviation	2.878	2.961
Most Extreme Differences	Absolute	.139	.124
	Positive	.111	.124
	Negative	-.139	-.103
Test Statistic		.139	.124
Asymp. Sig. (2-tailed)		.177[c]	.200[c,d]

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Based on Table 4, the results of the normality test for the posttest of students' critical thinking skills in the experimental and control classes indicate that the posttest results for both classes have a significance value (sig.) > 0.05. This is evidenced by the posttest results of the experimental class, which obtained a sig. value of 0.200 > 0.05, and the sig. value for the control class, which is 0.177 > 0.05, meaning that both data sets are normally distributed.

Table 5. Results of Homogeneity Test for Pretest of Critical Thinking Skills

Levene Statistic	df1	df2	Sig.
3.614	1	54	.063

Based on Table 5, the results of the homogeneity test for the pretest of students' critical thinking skills in the experimental and control classes have a significance value (sig.) of 0.063. The homogeneity test for the pretest in both classes shows that the sig. value > 0.05. The pretest data for critical thinking skills in both classes has a sig. value of 0.584 > 0.05, indicating that the data is homogeneous and can proceed to hypothesis testing.

Table 6. Results of Homogeneity Test for Posttest of Critical Thinking Skills

Levene Statistic	df1	df2	Sig.
.189	1	54	.665

Based on Table 6, the results of the homogeneity test for the posttest of students' critical thinking skills in the experimental and control classes have a sig. value of 0.665. This indicates that the posttest results for both classes also have a sig. value > 0.05. The posttest data for critical thinking skills has a sig. value of 0.665 > 0.05, meaning the data is homogeneous and can proceed to hypothesis testing.

Hypothesis testing can be conducted once the prerequisite tests are satisfied. For data that is normally distributed and homogeneous, a parametric statistical test such as the t-test is used; if the data is not normally distributed or not homogeneous, a non-parametric test like the Mann Whitney U test is applied. Based on the prerequisite test results, the data obtained is normally distributed and homogeneous, so a t-test was performed. The results of the hypothesis test can be seen in the table below.

Based on Table 7, the results of the paired test for critical thinking skills in the experimental class show that the sig. (2-tailed) value is 0.000. The results from the pretest and posttest indicate that the sig. value obtained is 0.000 < 0.05, meaning there is a significant difference between the average pretest and posttest scores in the experimental class.

Table 7. Results of Paired Test for Critical Thinking Skills in the Experimental Class

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	sebelum- sesudah	-15.53571	3.41546	.64546	-16.86009	-14.21134	-24.069	27	.000

Table 8. Results of Paired Test for Critical Thinking Skills in the Control Class

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	sebelum- sesudah	-17.39286	5.09422	.96272	-19.36819	-15.41753	-18.066	27	.000

Based on Table 8, the results of the paired test for critical thinking skills in the control class show that the sig. (2-tailed) value is 0.000. The results from the pretest and posttest indicate that the sig. value is also < 0.05. The obtained sig. value of 0.000 < 0.05 means there is a significant difference between the average pretest and posttest scores in the control class.

Table 9. Results of Independent Test for Pretest of Critical Thinking Skills

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
hasil	Equal variances assumed	3.614	.063	-5.193	54	.000	-4.214	.812	-5.841	-2.587
	Equal variances not assumed			-5.193	50.894	.000	-4.214	.812	-5.844	-2.585

Based on Table 9, the results of the independent test for the pretest of students' critical thinking skills in the experimental and control classes show that the sig. (2-tailed) value is 0.000. The pretest results indicate that sig. < 0.05. This demonstrates that there is a significant difference in the average pretest scores between the experimental and control classes before the implementation of differentiated learning based on learning styles.

Table 10. Results of Independent Test for Posttest of Critical Thinking Skills

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
VAR00001	Equal variances assumed	.189	.665	-2.700	54	.009	-2.107	.780	-3.672	-.543
	Equal variances not assumed			-2.700	53.957	.009	-2.107	.780	-3.672	-.543

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Based on Table 10, the results of the independent test for the posttest of students' critical thinking skills in the experimental and control classes show that the sig. (2-tailed) value is 0.009. The posttest results indicate that sig. < 0.05, meaning there is a significant difference in the average posttest scores between the experimental and control classes after the use of differentiated learning based on learning styles. This can be seen in Table 11.

Table 11. Average Scores of Students' Critical Thinking Skills

Class	Preetest	Postest
Eksperimental	68,85	84,39
Control	64,64	82,29

The average score in the experimental class shows a significant improvement, with a pretest score of 68.85 and a posttest score of 84.39, while the control class had a pretest score of 64.64 and a posttest score of 82.29. This indicates that the critical thinking skills of students in the experimental class improved more than those in the control class. Additionally, the difference in posttest scores between the experimental and control classes is 2.10, suggesting that differentiated learning based on learning styles has a greater impact on students' critical thinking skills compared to problem-based learning models. This is in line with the research conducted by Sharma and Sahu (2013), which shows that differentiated learning not only improves academic outcomes but also contributes to the development of students' critical thinking skills. This study emphasizes the importance of adjusting teaching methods according to individual students' needs to achieve optimal results.

4. Conclusion and Recommendations

Based on the research results and discussions, the conclusions are as follows: The learning independence of students in the experimental class has higher scores than that of the control class across all 5 measured aspects. This is reflected in the data where the experimental class scored 97.62 in initiative compared to 81 in the control class; 98.6 in self-confidence vs. 90; 90 in responsibility vs. 73.54; 97.77 in problem-solving vs. 88.33; and 97 in self-control vs. 91.5. This indicates that the use of differentiated learning based on learning styles positively impacts students' learning independence. The results of the independent test for pretest critical thinking skills in both classes show that the sig. value is 0.000 < 0.05, indicating a difference in average pretest scores. The posttest independent test results also show a sig. value of 0.009 < 0.05, indicating a difference in average posttest scores. Therefore, it is concluded that differentiated learning based on learning styles can enhance students' critical thinking skills, as evidenced by the higher average scores in the experimental class compared to the control class.

Based on these findings, it is recommended that teachers implement differentiated learning based on learning styles in science subjects, while conducting thorough evaluations of the measured aspects of student abilities and skills. Additionally, for students or researchers interested in further studies, future research should consider using different variables to further explore the effectiveness of differentiated learning in various contexts.

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