

Fostering Critical and Creative Thinking Skills Using Differentiated Student Worksheet (LKPD) in Primary Science Education

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Abstract

The research study investigates the impact of differentiated student worksheets (LKPD) on the development of critical and creative thinking skills among fifth-grade students in elementary science learning (IPAS). The research employed a quasi-experimental design involving students from District IV, Klaten Regency SDN 1 Tambongwetan, Kalikotes District, Klaten Regency. Data were collected through pretest and posttest assessments using validated test instruments, and analyzed using both descriptive statistics and inferential analysis. The findings reveal a significant improvement in students' critical thinking skills, with an average increase of 24.2 points, and in creative thinking skills, with an average increase of 26.03 points, following the implementation of differentiated LKPD. Furthermore, hypothesis testing using a multivariate test showed a significance value of 0.0001 (< 0.05), confirming that differentiated LKPD had a statistically significant positive effect on both critical and creative thinking abilities in simultanly. These results highlight the potential of differentiated learning materials to foster higher-order thinking skills in primary school students, supporting a more personalized and effective science education experience.

Keywords: Differentiated Student Worksheet (LKPD), Creative Thinking Skills, Critical Thinking skill, Primary Science Education.

Introduction

In today's dynamic educational climate, students are expected not only to acquire knowledge but also to develop higher-order thinking skills that prepare them for real-world challenges (Trikoili et al., 2025). Learning needs now go beyond content mastery, encompassing attitudes, basic skills, and specific competencies that reflect individual learner profiles. These needs must be understood and addressed if the learning process is to be meaningful (Ramírez-Montoya et al., 2025). According to Qin (2024), students who feel that their learning needs are met are more open, engaged, and ready to learn collaboratively with their teachers. Learning needs, however, vary considerably from student to student based on their learning styles, readiness levels, and interests (Goyibova et al., 2025). In reality, many elementary students struggle to understand lessons when instruction and materials, such as worksheets are delivered uniformly without considering their individual differences.

The implementation of the Kurikulum Merdeka (Freedom to Learn Curriculum) in Indonesia marks a shift toward more flexible, student-centered education. It encourages teachers to recognize and accommodate learners' diverse needs by offering freedom in how students engage with and explore learning materials (Hamdi et al., 2022). One of the core instructional approaches emphasized in this curriculum is differentiated learning, which requires teachers to modify content, process, and products according to students' readiness, interests, and learning profiles. A key tool

to support this model is the Differentiated LKPD (Student Worksheet) is a versatile, adaptive resource that personalizes the learning experience while maintaining instructional objectives. As Fahrizy & Fathurrahman (2024) suggest, differentiated LKPD is a practical way for teachers to respond to the specific learning profiles of their students and create meaningful, personalized learning experiences.

Several recent studies have supported the integration of differentiated instruction into elementary classrooms, particularly in promoting critical and creative thinking two of the most essential cognitive domains for 21st-century learners (Md, 2019). These thinking skills are also key dimensions within the Pancasila Student Profile, which serves as a moral and philosophical foundation for Indonesian education. According to the research by Mazid, Komalasari, Abdulkarim, Rahmat, Abqa, & Wulansari (2024), pancasila profile includes six essential dimensions: faith and moral character, global diversity, collaboration, independence, creativity, and critical thinking. Differentiated instruction when integrated intentionally has the potential to cultivate these traits by allowing students to engage more deeply and meaningfully with the learning process.

Critical thinking, in particular, empowers students to analyze, evaluate, and synthesize information, fostering their ability to make sound judgments and solve problems (Wardani & Fiorintina, 2023). Within differentiated classrooms, this skill is nurtured through learning tasks that encourage questioning, reasoning, and reflecting. Equally important is creative thinking, which enables students to generate new ideas, approach problems from multiple perspectives, and apply innovative solutions. Creative thinking is essential in developing learners who are adaptable, resilient, and capable of lifelong learning (Khalid et al., 2020). It also promotes confidence, collaboration, and effective communication—skills that are fundamental for students' success across academic and real-world settings.

Despite this theoretical support, many Indonesian classrooms still face practical limitations in applying differentiated instruction. Classroom observations conducted at District IV, Klaten Regency in fifth grade, revealed that fifth-grade science classes primarily use generic publisher-produced LKPDs. These worksheets rely heavily on passive reading and teacher explanations, followed by simple exercises. Such materials fail to engage students actively or promote exploration, critical inquiry, or creative expression. Furthermore, students were found to have limited access to learning resources, reducing their opportunities for independent and collaborative learning. The lack of variety in teaching methods and materials also contributed to reduced motivation and engagement among students.

To better understand this issue, unstructured interviews were conducted with teachers at the same school. The findings highlighted significant challenges, such as limited time for preparing differentiated instruction, inadequate training in designing adaptive learning materials, and limited infrastructure for practical, hands-on learning. These constraints hinder the application of differentiated approaches and limit teachers' ability to provide instruction that meets students' unique needs. Teachers expressed a need for practical strategies and tools such as differentiated LKPDs that could help them implement Kurikulum Merdeka more effectively and meaningfully in their classrooms.

While differentiated instruction is widely advocated in the literature, few studies have empirically examined its direct impact on both critical and creative thinking in elementary science education (Ilmu Pengetahuan Alam dan Sosial, or IPAS). Much of the existing research focuses on general learning outcomes or engagement, leaving a gap in understanding how specific cognitive skills are developed through differentiated tools. This study seeks to bridge that gap by investigating how the use of differentiated student worksheets (LKPD) in Grade V IPAS lessons can influence students' higher-order thinking abilities. The study situates itself at the

intersection of curriculum innovation, instructional design, and cognitive development, addressing an urgent need for more effective strategies to support diverse learners.

This study seeks to bridge that gap by focusing on the use of differentiated LKPD in Grade V IPAS lessons and its influence on students' critical and creative thinking. Unlike previous research that often treats differentiated instruction as a broad pedagogical approach, this study investigates the practical, tool-based application of differentiation and its cognitive effects. By doing so, it contributes both empirically and theoretically to the understanding of how instructional design intersects with curriculum innovation and cognitive development, offering a novel perspective on how to support diverse learners in developing essential 21st-century skills.

The objective of this research is to examine and analyze the effects of differentiated student worksheets on improving students' ability to think critically and creatively within the context of elementary science learning. The novelty of this study lies in its integration of differentiated instruction and cognitive development with the values of Kurikulum Merdeka and the Pancasila Student Profile. By offering empirical evidence on how differentiated LKPD enhances both cognitive and character development, this study contributes new insights into effective instructional strategies for achieving transformative learning outcomes in Indonesian primary education.

Method

In general, this section describes how the study was conducted. The subject matter of this sections are: (1) the study design; (2) the sample population or subject of the research; (3) data collection techniques and instrument development; (4) and data analysis techniques. Please use descriptive paragraphs.

This study employed a quasi-experimental design with a non-equivalent control group pretest-posttest model to investigate the effect of differentiated LKPD on students' critical and creative thinking skills in science (IPAS) learning. This design was chosen to compare learning outcomes before and after the intervention between experimental and control groups, without the need for random assignment at the individual level.

The population in this research consisted of 186 fifth-grade students from several schools in District 4, Klaten Regency. From this population, two schools; SDN 1 Tambongwetan and SDN 1 Krajen were selected through simple random sampling to serve as the research subjects. A total of 60 students were involved in the study, with one school designated as the experimental group (receiving differentiated LKPD) and the other as the control group (receiving conventional worksheets). To support the validity and reliability of the research instruments, schools outside the two research subjects were involved in instrument trials. These trials helped ensure that the test instruments which measured critical thinking skills (analysis, inference, explanation, and evaluation) and creative thinking skills (fluency, flexibility, originality, and elaboration) were appropriate, valid, and reliable for data collection.

Data were collected using pretest and posttest assessments, designed based on established indicators of critical and creative thinking. The test instruments were reviewed by experts and tested in a pilot study to validate their content and reliability. For data analysis, descriptive statistics were used to calculate means, standard deviations, and gain scores. To test the research hypotheses, a multivariate analysis test (MANOVA) was applied. This statistical method was used to determine the overall effect of differentiated LKPD on both critical and creative thinking skills simultaneously, offering a more comprehensive view of the intervention's impact. The analysis was conducted using appropriate statistical software to ensure accuracy and rigor in interpreting the results.

Results

Descriptive and Inferential Analysis

The initial stage of this research involved conducting descriptive data analysis after confirming that both instruments were valid and reliable. This descriptive analysis was carried out to determine the improvement in critical thinking skills and creative thinking skills of the experimental group and the control group. However, the difference in improvement alone is not sufficient to determine whether or not the implementation of differentiated LKPD had an effect. It is necessary to first examine the results obtained through hypothesis testing. Based on the assessment conducted on both instruments, the following results were obtained:

Table 1. Descriptive Analysis Result

Ability	Means	
	<i>Pretest</i>	<i>Posttest</i>
Critical Thinking_Experiment	54.13	78.33
Critical Thinking_Control	56.63	65.57
Creative Thinking_Experiment	53.67	79.70
Creative Thinking_Control	56.28	64.56

Based on Table 1, the pretest scores for critical thinking skills in the control class were higher than those in the experimental class, with a difference of approximately 2.5 points. A similar pattern was observed in creative thinking skills, where the control class had a higher pretest average compared to the experimental class, with a difference of about 2.61 points. After the implementation of the differentiated LKPD, there was a more significant improvement in the experimental class as shown in the posttest results. The average posttest scores in the experimental class were substantially higher than those in the control class, critical thinking skills in the experimental class were 12.76 points higher, and creative thinking skills were approximately 15.14 points higher than the control class. Referring to the difference between pretest and posttest averages in the experimental class, critical thinking skills increased by about 24.2 points and creative thinking skills by 26.03 points. These results indicate that both groups experienced improvement in critical and creative thinking skills, but the highest improvement occurred in the experimental class through the implementation of the differentiated LKPD.

The next step is to carry out inferential data analysis. This inferential data analysis is preceded by a normality test and homogeneity test as a prerequisite before the multivariate data test is carried out. The results are as follows:

Table 2. Normality Test Result

Variable	Group		Result
	Control	Experiment	
Df	30	30	30
<i>PostTest</i>	0.381	0.197	Data are normally distributed

Table 2 shows that *Df* (degrees of freedom) corresponds to the number of participants in the experimental and control groups. The *Sig.* values represent the significance levels obtained. During the pretest, the significance level for the experimental group was 0.197, and for the control group, it was 0.381. Since both groups exceeded the 5% threshold, the data can be

considered normally distributed. Following this, a homogeneity test was conducted, with the results detailed as follows:

Table 3. Homogeneity Test Result

Based on	Group	Sig.
Mean	<i>Control-Experiment</i>	0.950

As presented in Table 3, the homogeneity test resulted in a significance value of 0.950 and declared the data variance between the two groups homogeneous. Since both values exceed the minimum requirement of 5%, the data variance between the two groups is considered homogeneous. With the fulfillment of these prerequisite conditions, it can be continued with parametric statistical testing. The next step is to test the normality of the data, with the results described below:

Table 4. Multivariate Test Result

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.992	3584.380 ^b	2.000	57.000	<.001	.992
	Wilks' Lambda	.008	3584.380 ^b	2.000	57.000	<.001	.992
	Hotelling's Trace	125.768	3584.380 ^b	2.000	57.000	<.001	.992
	Roy's Largest Root	125.768	3584.380 ^b	2.000	57.000	<.001	.992
Experiment_Control	Pillai's Trace	.251	9.542 ^b	2.000	57.000	<.001	.251
	Wilks' Lambda	.749	9.542 ^b	2.000	57.000	<.001	.251
	Hotelling's Trace	.335	9.542 ^b	2.000	57.000	<.001	.251
	Roy's Largest Root	.335	9.542 ^b	2.000	57.000	<.001	.251

Referring to the effect table column of experiment and control in table 4, the Wilk's Lambda value obtained a significance of <0.0001. This result shows that there is a simultaneous effect of the implementation of Differentiated LKPD on students' critical thinking skills and creative thinking skills. This is because the significance obtained is <5%, and answers the hypothesis that H_a is accepted and H_0 is rejected.

Discussion

This research was conducted to examine the impact of differentiated student worksheets (LKPD) on students' critical and creative thinking skills. Based on the descriptive analysis, the pretest average score for critical thinking in the experimental class was 54,13, while the control class achieved a higher average of 56,63. Similarly, for creative thinking, the experimental class scored an average of 53,67, whereas the control class had 56,28. These initial results indicate that before the intervention, the control class demonstrated slightly stronger critical and creative thinking abilities.

However, a notable change occurred in the posttest phase. The experimental class, after receiving instruction using differentiated LKPD, exhibited an increase in critical thinking scores to an average of 78,33, while the control class only increased slightly to 65,57. For creative

thinking, the experimental class's posttest average rose to 79,70, while the control class only reached 64,56. This significant improvement in the experimental class supports the hypothesis that differentiated instructional materials tailored to students' needs, interests, and readiness can effectively enhance higher-order thinking skills.

From the inferential analysis, the independent sample t-test results also reinforced this observation. For critical thinking and creative thinking, the significance value (Sig. 2-tailed) was 0.001, which is less than the 0.05 threshold. This indicates that there was a statistically significant difference between the experimental and control classes after the intervention, and the improvement cannot be attributed to chance. These results validate the effectiveness of differentiated LKPD in improving students' cognitive abilities, particularly in fostering critical analysis, problem-solving, and innovative thinking.

Interpretatively, the improvement in the experimental group underscores the importance of recognizing and addressing student diversity in classroom settings. Differentiated LKPD provides varied levels of challenge and formats, which accommodate students' different learning profiles and preferences (Efendi et al., 2024). This aligns with Goyibova et al (2025) theory of differentiation, which posits that instruction must be responsive to students' readiness, interests, and learning styles to maximize engagement and achievement. In this study, differentiated LKPD allowed students to work at an appropriate level of difficulty, encouraging deeper engagement and the development of metacognitive strategies necessary for critical and creative thought.

These findings are consistent with prior research. For instance that Rahardhian (2022) found that differentiated instruction significantly improved students' critical thinking skills in science classes. Similarly, Manab (2016) emphasized the role of varied instructional materials in stimulating logical reasoning and decision-making. In terms of creative thinking, the study echoes results from Triyani et al (2024) who highlighted that differentiated environments support originality and divergent thinking among learners. Halimah et al (2023) also noted that when students are given autonomy through choice-based activities as seen in differentiated LKPD they demonstrate greater creativity and curiosity. Furthermore, Wahyuningsari et al (2022) showed that differentiation practices reduce passive learning and instead promote exploration, experimentation, and reflection. This study, therefore, contributes to a growing body of literature confirming that differentiated instruction is not just a theory but a practical strategy that produces tangible academic outcomes.

The implications of this study are significant both theoretically and practically. Theoretically, the findings strengthen constructivist learning theories, especially Vygotsky's Zone of Proximal Development (ZPD), which argues that learning is most effective when it is scaffolded at the edge of a learner's competence. Differentiated LKPD serves as that scaffold, offering materials and questions that challenge students without overwhelming them. It also aligns with Bloom's Taxonomy by supporting learning tasks across multiple cognitive levels, from understanding to evaluating and creating. Practically, this study encourages educators to adopt a more personalized approach in instructional planning. By using differentiated LKPD, teachers can cater to a broader spectrum of learners, reducing educational inequality within the classroom. It also suggests that school administrators should provide training and resources for teachers to design or adopt differentiated learning tools to support students' individual development.

Nonetheless, the study is not without limitations. First, the research was limited to a single school with two classes, which restricts the generalizability of the findings. The sample size may not adequately represent diverse educational contexts or demographic variations. Second, the duration of the intervention was relatively short only covering one unit of instruction so the long-term effects of differentiated LKPD remain unknown. Third, although teachers followed the same

lesson plan structure, individual teaching styles and classroom dynamics may have influenced student outcomes, introducing a variable that was not fully controlled. In addition, this study focused solely on cognitive outcomes critical and creative thinking without assessing emotional, social, or motivational effects, which are equally important in holistic education.

Given these limitations, several suggestions can be proposed for future research. First, future studies should involve a larger and more diverse sample across multiple schools or regions to improve the external validity of the findings. Second, researchers could adopt a longitudinal design to investigate the sustained impact of differentiated LKPD over time and across different subjects. Third, incorporating qualitative methods such as classroom observation, student interviews, and teacher reflections would enrich the understanding of how differentiation influences student behavior, engagement, and attitudes. Fourth, future studies should explore the integration of technology with differentiated instruction, such as adaptive learning platforms or gamified LKPD to enhance student interaction and feedback. Finally, exploring differentiation's impact on other competencies such as collaboration, motivation, and self-regulation would provide a more comprehensive picture of its educational value.

In conclusion, the present study demonstrates that differentiated LKPD significantly enhances students' critical and creative thinking skills. The combination of descriptive and inferential analysis confirms that providing students with materials tailored to their individual needs leads to better academic performance. The results are consistent with prior research and contribute to ongoing discussions about inclusive, student-centered pedagogy. Educators and policy-makers are encouraged to consider differentiation as a vital component of curriculum design and classroom practice to foster equity, engagement, and excellence in education.

Conclusion

This study critically examined the impact of differentiated student worksheets (LKPD) on students' critical and creative thinking skills. Based on both descriptive and inferential analyses, the findings suggest that differentiated LKPD has a positive and significant effect on students' higher-order thinking. While the control group showed modest improvements, the experimental group taught using differentiated LKPD demonstrated notably higher gains in both critical and creative thinking scores. This supports the argument that instructional differentiation, when implemented effectively, can enhance student cognitive development by accommodating diverse learning needs, interests, and readiness levels.

However, the results must be interpreted with caution. The study was limited to two classes in a single school context, which constrains the generalizability of its findings. Differences in teacher delivery, classroom dynamics, and the short intervention period may also have influenced the outcomes. Therefore, while the findings are promising, they cannot be universally applied without further validation.

Despite these limitations, this research contributes meaningfully to the scientific discourse on differentiated instruction. It reinforces existing theories from constructivist and inclusive pedagogy by demonstrating how student-centered, flexible learning tools can improve key cognitive competencies. In doing so, it provides empirical evidence that supports the integration of differentiation into classroom practice particularly through the use of tailored LKPD as a viable strategy to support diverse learners and elevate thinking skills that are essential for 21st-century learning. Future research should expand on these findings across broader contexts and explore long-term impacts to further substantiate and refine the implementation of differentiated instruction in varied educational settings.

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