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Implementation of Differentiated Learning in the Independent Curriculum for Fifth-Grade Science at SDN 31 Kampung Caniago, Agam Regency

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Abstract: This study examines the effect of differentiated learning within the Independent Curriculum on students' mastery of science content and creative thinking skills in Grade V at SDN 31 Kampung Caniago, Agam Regency. The research was motivated by the need for student-centered instruction that accommodates diverse learning needs and supports 21st-century competencies. A quantitative descriptive method with a one-shot case study design was employed. The sample consisted of 27 students selected through purposive sampling. Data were collected using observation and documentation, supported by a performance assessment instrument based on five indicators of creative thinking: fluency, flexibility, originality, elaboration, and evaluation. Data were analyzed using percentage scores and N-gain. The results showed that students' mastery of science content reached a high level, with the highest achievement in the topic Properties and Changes of Matter (88%) and the lowest in the Solar System (75%). Creative thinking skills also improved, as indicated by an increase in N-gain from 0.63 during the preparation phase to 0.72 during the presentation phase. These findings demonstrate that differentiated learning effectively enhances both content mastery and creative thinking in elementary science learning.

Keywords: Differentiated learning; Elementary school; Independent curriculum; Science

Introduction

The rapid development of the 21st-century education system demands a learning approach that is adaptive, inclusive, and student-centered. Education today must respond to the diverse needs, interests, and the learning readiness of students (Dewi & Arifin, 2024; Dhivya et al., 2023). In line with this, the Indonesian government introduced the Merdeka Curriculum (Munte, 2022), which focuses on student autonomy and differentiated instruction to promote meaningful learning experiences for every individual (Choudhary et al., 2022; Setiawan & Suwandi, 2022).

Differentiated learning is an instructional strategy that adapts content, process, product, and learning environment to meet the unique characteristics of students (Assirri, 2025; Kafabihi et al., 2024; Nursyaidah et al., 2023). This approach encourages teachers to recognize and respond to the diversity in students' learning profiles, readiness levels, and interests. It allows students to learn at their own pace, using strategies that work best for them (Fadila et al., 2025; Rahmawati et al., 2025).

In practice, however, the implementation of differentiated learning in many Indonesian schools remains limited. Observations conducted at SDN 31 Kampung Caniago, Agam Regency, particularly in Grade V Science lessons, reveal that most learning activities are still teacher-centered and uniform. This condition may hinder students' ability to fully engage and understand scientific concepts, especially those who require different forms of instruction or additional support.

Science as a subject is closely related to observation, experimentation, and analysis (Amalia &

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Ratnaningrum, 2025; Imran et al., 2020). It plays a vital role in developing students' critical thinking and problem-solving abilities. When instruction is not tailored to accommodate different learning needs, students who need extra guidance or greater challenges may not reach their full academic potential (Octaviana et al., 2025).

Moreover, science education in primary schools should foster curiosity and exploration through real-life contexts (Januar et al., 2025). The Merdeka Curriculum offers flexibility for teachers to design contextual learning based on students' environments and daily experiences (Syamsiar et al., 2023). This is an opportunity to implement differentiated learning to improve students' scientific literacy and inquiry skills (Susanti et al., 2023; Syamsiar et al., 2023).

Currently, the Science learning process often relies heavily on textbooks and one-size-fits-all assignments (Ni'mah et al., 2024; Mukhibat, 2023). There is minimal variation in tasks or activities provided for students with different learning needs. As a result, student engagement and deeper understanding are frequently lacking, and many students become passive participants in the learning process (Rizki & Fahkrunisa, 2022; Suciningsih et al., 2024).

The availability of learning resources and teacher readiness are also major challenges in implementing differentiated instruction (Himmah, 2025; Efendi & Suastra, 2023). Many teachers are still adjusting to the new paradigm of the Merdeka Curriculum, and some lack adequate training in planning differentiated activities effectively (Anisa, 2022; Jalil, 2025). This gap contributes to the limited practice of student-centered strategies in the classroom.

Nevertheless, differentiated learning can be integrated gradually, especially in science learning, by designing varied tasks such as group experiments, guided observations, and inquiry-based projects (Qolbiyah et al., 2022; Ruaya et al., 2022). These activities can cater to different learning styles—visual, auditory, kinesthetic—and promote a more engaging and inclusive classroom environment.

Science education should not only focus on the acquisition of facts but also encourage students to investigate phenomena, ask questions, and formulate explanations (Ummah & Mustika, 2024; Latifah et al., 2023). By applying differentiated instruction, teachers can guide students to become active learners who are capable of thinking critically and creatively. This aligns with the broader goal of the Merdeka Curriculum to develop independent and lifelong learners (Putri et al., 2023; Wanti & Chastanti, 2023).

Based on the background and problems mentioned above, this study aims to examine the implementation of differentiated learning in science instruction under the Merdeka Curriculum for Grade V students at SDN 31 Kampung Caniago. The research focuses on identifying the types of differentiation used, the challenges encountered by teachers, and the impact on students' engagement, understanding, and scientific thinking skills.

Method

This study was designed as a quantitative descriptive research using a quasi-experimental method with a one-shot case study design, in which a single group of students received a differentiated learning treatment and the results were observed afterward (Creswell, 2016; Sugiyono, 2019). The study was conducted in August 2025 at SDN 31 Kampung Caniago, Agam Regency, in the Grade V Science classroom, as part of the implementation of the Merdeka Curriculum.

The research sample was determined through purposive sampling, involving 27 fifth-grade students selected based on their active participation in science learning and teacher recommendations (Cleland & Durning, 2023). The treatment involved implementing differentiated learning strategies based on students' readiness, learning profiles, and interests. The implementation was carried out over four meetings through varied teaching methods such as tiered assignments, learning stations, and flexible grouping.

The data collection was focused on evaluating students' performance and learning outcomes using performance assessments and creative thinking skill rubrics. The performance assessment focused on students' ability to explore, explain, and apply science concepts through differentiated tasks. Assessment criteria were adapted from Purwanto et al. (2020) and involved calculating the achievement percentage with the following formula.

$$\mathrm{NP} = \frac{\mathrm{R}}{\mathrm{S}} \times 100 \quad (1)$$

Where:
NP = Expected Value
R = Total student/group score
NS = Maximum score

The average score was matched against the scoring criteria for interpretation. In addition to performance assessment, students' creative thinking skills were measured using a rubric modified from Rozasqonain et al. (2025) which included five indicators: fluency, flexibility, originality, elaboration, and evaluation. Each indicator was scored using a Likert scale from 1 (low) to 5 (high).

The research procedure began with a preliminary observation and interview with classroom teachers to identify students' learning needs, profiles, and

preferences. Based on the data gathered, differentiated learning plans and instruments were developed, including worksheets, observation sheets, and the creative thinking rubric. Students engaged in science activities tailored to their zones of proximal development and completed tasks reflecting varied complexity and formats.

During implementation, observations were conducted at three stages: the preparation and task orientation stage; the learning activity and group performance stage; and the presentation of findings and reflection stage.

Data on student performance and creativity were collected using a closed-ended observation instrument, and creative thinking skills were analyzed using the N-Gain formula (Sundayana, 2020) as follows.

$$N_{Gain} = \frac{N_A - N_B}{N_{MAX} - N_A} \quad (2)$$

Where:
NA = Initial score
NB = Final score
NMAX = Ideal maximum score

Table 1. Creative thinking skills assessment rubric

Factor	Criteria	Rubric	Score
Fluency	Ability to give correct and clear answers.	Correct and clearly explained answer.	5
		Correct answer but lacks clear explanation.	3
		Incorrect or irrelevant answer.	1
Flexibility	Ability to present varied answers from different perspectives.	Varied and accurate responses with different points of view.	5
		Varied responses but with less accurate logic.	3
		Repetitive or limited perspective with inaccurate logic.	1
Originality	Ability to generate ideas independently with personal insight.	Unique and original responses showing personal thinking.	5
		Somewhat original but influenced by external/common ideas.	3
		Copied, common, or unoriginal ideas.	1
Elaboration	Ability to express and develop ideas in detail.	Well-developed, detailed, and clear explanation	5
		Some elaboration present, but lacks depth or clarity.	3
		Little or no elaboration, vague or underdeveloped response.	1
Evaluation	Ability to conclude based on data and observation.	Accurate conclusions supported by data/observation.	5
		Correct conclusions but lacks full support from data or clear reasoning.	3

Result and Discussion

This study was conducted to determine the implementation of differentiated learning in the Independent Curriculum in science learning for Grade V at SDN 31 Kampung Caniago, Agam Regency. The study focused on students' mastery of science material and the improvement of creativity skills during the learning process. The results showed that students had a good level of mastery of science material with variations in mastery in each topic. In addition, there was a significant increase in students' creativity skills as measured by the N-gain score at three stages of learning, namely preparation, implementation, and presentation of learning outcomes.

Table 2. Percentage of mastery of science learning materials for grade V students

Learning materials	Mastery Percentage (%)
Properties and Changes in the Form of Objects	88
Energy Sources and Their Utilization	85
Living Things and Their Environment	82
Style and Its Changes	79
Solar System	75

Based on the data obtained in Table 2, students' mastery of science material showed quite satisfactory results. Of the five main topics tested, the highest mastery was in the material on Properties and Changes in the Form of Objects with a percentage of 88%. This indicates that students are able to understand the basic concepts of physical changes in matter well. The topic of Energy Sources and Their Utilization also received high mastery of 85%, indicating students' awareness of the importance of energy sources in everyday life. In the material on Living Things and Their Environment, mastery of 82% indicates that students are beginning to understand the interactions between living things and their environment. The material on Forces and Their Changes received 79% mastery, slightly lower, which may be due to its more abstract concept so that a more contextual teaching approach is needed. Finally, the material on the Solar System had the lowest percentage of mastery at 75%, indicating that this topic may require more interesting teaching methods or more effective visual aids to improve students' understanding.

In addition to mastery of the material, this study also measured the development of students' creativity skills during science learning. Creativity assessment is carried out using the N-gain score on five aspects of creativity, namely fluency (fluency of thinking),

flexibility (flexibility of thinking), originality (originality of ideas), elaboration (ability to develop ideas), and evaluation (ability to evaluate). The assessment is carried out at three stages of learning, namely the preparation stage, implementation, and presentation of learning outcomes.

Table 3. Results of student creativity performance assessment based on N-Gain score at each stage

Learning Stage	Fluency	Flexibility	Originality	Elaboration	Evaluation	N-Gain
Preparation	0.62	0.60	0.65	0.63	0.64	0.63
Implementation	0.67	0.66	0.68	0.66	0.69	0.67
Presentation	0.72	0.70	0.71	0.73	0.75	0.72

Each aspect of creativity also experienced consistent improvement. For example, the fluency aspect increased from 0.62 at the preparation stage to 0.72 at the presentation stage, indicating that students were increasingly fluent in providing correct and clear answers. The flexibility and originality aspects also showed an increase, indicating that students were able to provide varied and original answers with different perspectives during the learning process. The elaboration aspect related to the ability to develop ideas into more detail and clarity also increased, showing students' ability to gradually deepen science concepts. Finally, the evaluation aspect showing students' ability to draw conclusions based on data and observations increased significantly, especially at the presentation stage, indicating that students were able to think critically and reflectively about their learning outcomes.

Overall, the results of this study prove that the implementation of differentiated learning in the Merdeka Curriculum at SDN 31 Kampung Caniago has succeeded in increasing students' mastery of science material and creativity abilities in a sustainable manner. This learning model is able to facilitate various learning styles of students and provide space for them to develop their creative potential optimally in the science learning process.

The implementation of differentiated learning in the Independent Curriculum has been proven to be able to improve the mastery of science material in Grade V students of SDN 31 Kampung Caniago. This is reflected in the high percentage of material mastery, ranging from 75 to 88%. Differentiated learning strategies provide opportunities for teachers to adjust learning materials, processes, and products to student characteristics, such as their interests, learning readiness, and learning profiles (WHO, 2023; Armayanti et al., 2025; Istiyati et al., 2024). With this approach, students can better understand the material because they receive learning according to their individual learning styles and needs.

In addition to improving mastery of the material, differentiated learning also significantly contributes to the development of students' creative thinking skills. The N-gain results show an increase in the aspects of fluency, flexibility, originality, elaboration, and evaluation that are consistent at each stage of learning. Research by Hidayati & Eriyanti (2023) and Saleh et al. (2024) shows that a learning approach that provides students with space for exploration and choice can stimulate creative thinking skills because they are trained to generate new ideas (Buntu et al., 2025; Latifah et al., 2023), view problems from various perspectives, and develop unusual solutions to the problems they face.

The science learning structure implemented in three stages—preparation, implementation, and presentation—contributes to the activation of students' creative potential (Muhab et al., 2024; Pratiwi & Tyas, 2025). In the preparation stage, students begin to recognize problems and formulate work steps. During implementation, they test ideas and observe the results. The presentation of results is the peak of the expression of creative ideas. According to Amalia & Ratnaningrum (2025) and Yantoro et al. (2023), a systematic learning process that provides students with the opportunity to reflect, evaluate, and present their results encourages the improvement of 21st-century skills, especially creativity and communication.

This finding is in line with the objectives of the Independent Curriculum which emphasizes strengthening the Pancasila Student Profile, especially in the dimensions of creativity, independence, and critical reasoning (Haloho et al., 2025). Differentiated learning encourages the growth of these characters by giving students space to make their own learning decisions, convey ideas originally, and draw conclusions based on data. Based on this, student-centered learning is the main key in forming students who are complete in terms of competence and character in the digital era (Dalila et al., 2022; Prihandono et al., 2023).

Thus, it can be concluded that differentiated learning in the Independent Curriculum provides a significant contribution to improving the mastery of science material and developing creative thinking skills of fifth-grade students of SDN 31 Kampung Caniago. This improvement occurs because of the adaptive and responsive learning approach to student diversity, as well as the arrangement of learning stages that encourage exploration and reflection. This model can be an effective alternative learning strategy in

strengthening 21st-century skills and shaping student character according to the Pancasila Student Profile.

Conclusion

Based on the results of the data analysis, it can be concluded that the application of differentiated learning in the Independent Curriculum has a positive impact on students' mastery of the material and the development of creative thinking skills. The high percentage of mastery of science material shows that this approach is able to adjust the learning process to the needs and characteristics of students individually. In addition, the N-gain score for each creative thinking indicator—fluency, flexibility, originality, elaboration, and evaluation—has experienced a consistent increase at every stage of learning, from preparation to presentation. Thus, differentiated learning not only improves cognitive learning outcomes, but also develops students' affective dimensions and high-level thinking skills, which are in line with the objectives of the Independent Curriculum and the Pancasila Student Profile. This model is worthy of being recommended as an innovative learning strategy in elementary schools, especially in science subjects, because it is able to provide space for students to think independently, creatively, and critically in the learning process. For further development, teachers need to be given training to be able to design systematic and sustainable differentiated learning.

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