JPPIPA 11(10) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

The Effect of Differentiated Learning Approach and Motivation on the Learning Outcomes (Science) of Grade V Students in Elementary School

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Received: August 11, 2025
Revised: September 24, 2025
Accepted: October 30, 2025
Published: October 30, 2025

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DOI: 10.29303/jppipa.v11i10.12382

Abstract: This study aims to determine the effect of differentiated learning approaches on science learning outcomes of grade V elementary school students reviewed from the level of learning motivation. The method used is a quasi-experiment with the Nonequivalent Control Group Design. The main instruments in this study are learning outcome tests and learning motivation questionnaires. The results of the Independent Sample T-Test showed that the differentiated learning approach had a significant effect on improving science learning outcomes, with a significance value of 0.000 (< 0.05). Highly motivated students who participated in differentiated learning showed an increase in learning outcomes with an average difference of 14.64, while students with low motivation experienced a greater increase with an average difference of 21,818. Interaction analysis using the Two-Way ANOVA test showed a significant interaction between the learning approach and the level of learning motivation (Sig. = 0.020 < 0.05). These findings show that the effectiveness of differentiated learning approaches is influenced by the level of learning motivation of students. Overall, differentiated learning has been proven to be effective and inclusive in improving science learning outcomes by adapting the learning process to students' readiness, interests, and learning styles.

Keywords: Differentiated Learning; Elementary School; Learning Outcomes; Motivation; Science

Introduction

Education in Indonesia has experienced significant developments in recent years, particularly in the teaching methods used in elementary schools. Basic education plays a crucial role in developing students' basic knowledge and skills, including in the field of natural science (science). The primary objective of science subjects at the elementary school level is to foster students' understanding of the natural environment and the natural phenomena they encounter every day. However, despite this crucial objective, students' science learning outcomes in Indonesia remain relatively low. Based on data from the Program for International Student Assessment (PISA) from 2003 to 2021, Indonesia's average science learning outcomes are below the average of 23 other countries. This indicates that education in Indonesia still needs improvement to keep up with other countries. These low science learning outcomes can be influenced by various factors, both internal and external (Primastami & Insani, 2024). Internal factors such as students' intelligence, interest, and attention, as well as their motivation to learn and physical condition, can influence their learning outcomes. Meanwhile, external factors include the methods, models, and approaches used by teachers in teaching. According Ding (2022); Salim et al. (2024), one of the causes of low science learning outcomes is the use of approaches that are not varied or not suited to student characteristics, resulting in students being passive in the

How to Cite:
Salman, R. R. (2025). The Effect of Differentiated Learning Approach and Motivation on the Learning Outcomes (Science) of Grade V Students in Elementary School. *Jurnal Penelitian Pendidikan IPA*, *11*(10), 159–165. https://doi.org/10.29303/jppipa.v11i10.12382

learning process. This also aligns with the findings of Akhiruddin et al. (2024); Tetep & Dahlena (2021), who stated that a less varied learning approach can cause students to feel bored and less motivated to learn.

Preliminary research conducted in several elementary schools in Ampek Nagari District, Agam Regency also indicated a similar problem. A November 2024 survey at SDN Gugus 02 found that the average daily test scores of fifth-grade students were below the Minimum Passing Criteria (KKM), especially in science. Daily test scores at several schools showed low scores, for example, SDN 20 Lubuk Alung with an average of 46.6, SDN 13 Lubuk Alung with 68.41, and SDN 15 Pudung with 55. Furthermore, the teaching methods used by teachers tended to focus on conventional approaches, such as lectures, which made the learning process less effective and led to students being more passive in learning. This indicates that the approach used in teaching does not pay attention to the needs and characteristics of students. Low student motivation is also a significant factor influencing poor science learning outcomes. According to Chand (2025); Schildkamp et al. (2020), low science learning outcomes are caused by inappropriate approaches used by teachers, where teachers primarily act as sources of information and do not actively involve students in learning. Hidayah et al. (2025); Singun (2025), also revealed that low science learning outcomes are due to suboptimal and less varied approaches used by teachers. This finding is reinforced by Ramdhani et al. (2024); Suardin et al. (2023), who explain that low learning outcomes are caused by students' lack of attention to learning, low student motivation, and inadequate implementation of the educational process.

Based on the problems identified in the science learning process in these schools, changes in the teaching approach are needed. One solution to address this problem is to implement a Differentiated Learning (LDL) approach. This approach allows students to learn according to their individual abilities, interests, and needs. Kholidah et al. (2024); Stollman et al. (2021), state that Differentiated Learning is an approach that provides students with opportunities to learn in ways that suit their learning styles and interests, preventing frustration and failure in their learning experience. This aligns with Anyichie & Butler (2023); Levy-Feldman (2025) opinion, which states that PBD aims to meet the diverse learning needs of each student in the classroom. The Differentiated Learning approach can also increase student motivation. Maulidia & Prafitasari (2023) states that with this approach, learning activities can be tailored to students' readiness, interests, and learning styles, so students feel more engaged and motivated in learning. This approach can create a more conducive learning environment, which in turn can improve student learning outcomes. This is supported by research conducted by Crawford et al. (2024); Guo et al. (2020), which showed that the implementation of PBD has a positive impact on learning outcomes, motivation, activeness, student engagement, and higher-order thinking skills such as critical and creative thinking.

The application of a Differentiated Learning Approach in fifth-grade elementary school science instruction is highly relevant, particularly for the topic of food chains in ecosystems. This material involves understanding the basic concepts of the roles of producers, consumers, and decomposers in ecosystems. In this regard, Differentiated Learning Approaches (PDAs) can be used to vary the delivery method, tailored to students' learning styles and interests. In line with research conducted by Novalia et al. (2025); Zhang & Ma (2023), the use of PBD based on learning styles can increase student motivation in science learning, compared to traditional lecture-focused learning approaches. Given the urgency of this issue and support from various existing studies, researchers are interested in further examining the influence of Differentiated Learning Approaches and learning motivation on fifth-grade elementary school students' science learning outcomes. This research is expected to contribute to improving science learning in elementary schools by providing an approach more tailored to students' characteristics and needs, as well as increasing their motivation and learning outcomes.

Therefore, the purpose of this study is to determine the influence of Differentiated Learning Approaches and learning motivation on fifth-grade elementary school students' science learning outcomes. It is hoped that the results of this study can provide broader insight into the importance of using a varied approach based on student characteristics, as well as provide recommendations for teachers to improve the quality of science learning in elementary schools.

Method

This study employed a quantitative method with a quasi-experimental design, which aims to measure the effect of a particular treatment on other variables under controlled conditions. According to Braga et al. (2025); Hippel et al. (2025), a quasi-experiment allows researchers to test hypotheses about the effects of a treatment even though they cannot fully control all variables that might influence the outcome. In this study, a quasi-experiment was implemented by providing a differentiated learning approach to the experimental group, while the control group received a conventional learning approach in the form of a lecture. This aligns

that quasi-experiments are used when it is difficult to obtain a fully controlled control group. The research design used was a 2x2 factorial, which tested two independent variables: learning approach (differentiated vs. conventional) and learning motivation (high vs. low). This design allowed researchers to evaluate not only the influence of each variable, but also the interaction between the two variables on student learning outcomes. As explained by Sugiyono (2019), a 2x2 factorial design is well-suited for examining the effects of multiple interacting independent variables, which is crucial for identifying the influence of more complex factors on student learning outcomes.

For data collection, this study used two main instruments: a motivation questionnaire to measure students' learning motivation and a written multiple-choice test to measure their science learning outcomes. The motivation questionnaire used in this study was adapted from indicators relevant to learning motivation theory, as described by Li et al. (2025). The written test was pre-tested to ensure its validity and reliability, with results indicating a valid and reliable instrument for measuring student learning outcomes. This instrument was then used to collect data before and after the treatment, namely the pretest and posttest. Data analysis was conducted using inferential statistical techniques, beginning with normality and homogeneity tests to ensure that the data obtained from both groups were normally distributed and had equal variance. Normality testing was performed using the Kolmogorov-Smirnov test, and homogeneity testing was performed using the Levene test, both using SPSS 16.0 software (Andrade, 2024). After meeting the assumptions of normality and homogeneity, a t-test (independent samples t-test) was used to see significant differences between the experimental and control groups. To test the interaction between learning approaches and learning motivation on learning outcomes, a two-way ANOVA test was used. As explained by Garofalo et al. (2022), a two-way ANOVA test allows researchers to test the effect of two independent variables and their interaction on the dependent variable.

Result and Discussion

This research was conducted in fifth-grade students at SDN 20 Lubuk Alung, consisting of two classes: Class VA with 21 students as the experimental group and Class VB with 21 students as the control group. The purpose of this study was to determine the effect of a differentiated learning approach and learning motivation on science learning outcomes. Data collected included the results of the science pretest and posttest as well as the grouping of students' learning motivation in both sample classes. The grouping of learning motivation was carried out to separate students with high and low learning motivation, which was then analyzed to determine its effect on learning outcomes. As part of the data collection, before being given the differentiated learning approach, students in the experimental group first completed a questionnaire to measure their level of learning motivation. The data obtained from the questionnaire were analyzed using the learning motivation assessment criteria proposed by (Bushuven et al., 2022; Sauri et al., 2022). Based on the results of this questionnaire analysis, students were grouped into two categories of learning motivation: high and low, which served as the basis for further student grouping in the study.

This study aims to examine the effect of a differentiated learning approach on the science learning outcomes of fifth-grade elementary school students, taking into account their level of learning motivation. Data collection was conducted using a learning motivation questionnaire (Sewang & Mustapa, 2022) and learning achievement tests (pretest and posttest). The study subjects consisted of two groups: an experimental group using a differentiated learning approach and a control group using a conventional approach. The results of the learning motivation classification showed that the experimental group consisted of 11 students with low learning motivation and 10 students with high learning motivation. Meanwhile, the control group consisted of 14 students with low learning motivation and 7 students with high learning motivation. This indicates a fairly balanced proportion of learning motivation in both groups, providing a basis for further analysis.

Figure 1. PISA results from 2003 to 2021

Analysis of learning outcomes showed a significant improvement in the experimental group after the

differentiated learning treatment. Before the treatment, only three students in the experimental group achieved learning completion. However, after the treatment, all students (100%) achieved completion, both in the high and low motivation categories. This contrasted with the control group, where only three students completed the learning before the treatment, and after conventional learning, this increased to eight students, most of whom were in the high motivation category. Results of normality and homogeneity tests indicated that the data in both groups were normally distributed and homogeneous, allowing for further analysis using parametric statistical tests. An Independent Sample T-Test on the posttest data revealed a significant difference between the learning outcomes of the experimental and control groups, with a significance value (Sig. 2-tailed) of 0.000 (<0.05). This indicates that the differentiated learning approach significantly impacted students' science learning outcomes (Armayanti et al., 2025; Subandiyah et al., 2025).

Further analysis was conducted on the groups based on their learning motivation levels. For highly motivated students, the T-test results indicated a significant effect of the differentiated approach on learning outcomes, with a significance value of 0.000 and an average difference of 14.643 points. Meanwhile, for low-motivated students, the differentiated approach also had a significant effect, with a significance value of 0.000 and a larger average difference of 21.818 points. This indicates that the differentiated learning approach is more effective in helping low-motivated students improve their learning outcomes than the conventional approach (Maryanti & Sartono, 2024). The results of the Two-Way ANOVA revealed a significant interaction between the learning approach and the level of learning motivation on science learning outcomes, with a significance value of 0.020 (<0.05). This indicates that the effectiveness of the learning approach on learning outcomes depends not only on the method used but is also significantly influenced by the students' level of learning motivation. This means that the differentiated approach tends to be more adaptive and responsive to the learning needs of students with varying motivations (Rincon-Flores et al., 2024; Westbroek et al., 2020).

Overall, these findings confirm that a differentiated learning approach can significantly improve learning outcomes for students with both high and low learning motivation. Furthermore, this approach narrows the gap in learning achievement that often arises due to differences in motivation levels. Therefore, teachers are advised to implement learning strategies that accommodate the differences in students' needs, interests, and learning readiness (Melesse & Belay, 2022; Muhtadi et al., 2024). The practical implication of this research is the need for training and mentoring for teachers in optimally implementing differentiated learning in the classroom (Darling-Hammond et al., 2020; Langelaan et al., 2024; Oktoma et al., 2025). Furthermore, initial grouping based on learning motivation can be used as a strategy to design more targeted learning interventions. This will lead to more equitable achievement of learning objectives and significant improvement in learning outcomes, particularly in subjects like science, which require conceptual understanding and logical application (Kreijkes & Greatorex, 2024; Mafarja et al., 2023).

Conclusion

Differentiated learning significantly improves science learning outcomes (Food Chain topic) in fifth grade elementary school students. This is evidenced by the T-test significance value of 0.000 (<0.05). This approach is not only statistically effective, but also increases enthusiasm and active engagement. Specific Impact Based on Motivation: High Motivation: Improved results (mean difference = 14.643); Low Motivation: Greater impact (mean difference = 21.818), indicating the ability of this approach to overcome the challenge of low motivation; Two-Way ANOVA test (Sig. = 0.020) confirmed a significant interaction between differentiated learning and motivation levels.; Overall, differentiated learning is an effective, applicable, and inclusive strategy, in line with the Independent Curriculum, and worthy of widespread implementation in elementary schools.

Acknowledgments
Thanks to all parties who have supported the implementation of this research. I hope this research can be useful.

Author Contributions
Conceptualization; methodology.; validation; formal analysis; investigation; resources; data curation; writing—original draft preparation; writing—review and editing.; visualization: R. R. S. All authors have read and agreed to the published version of the manuscript.

Funding
The research and writing of this article were funded by personal funds.

Conflicts of Interest
The researchers funded this research independently.

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