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The Effect of Learning Style Differentiated Learning on Learning Outcomes and Motivation of Grade IV Learners in Mathematics Subjects

Komarudin[1], Dya Ayu Agustiana Putri[1]
[1] Universitas Bhinneka PGRI, Tulungagung, Indonesia
Correspondence: komarudindinndin@gmail.com

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ABSTRACT

The uniqueness of each learner's learning style, whether visual, auditory, or kinesthetic, demands teacher attention. By fulfilling diverse learning needs, learners feel more valued, spurring learning outcomes and motivation. This research examines the impact of differentiated learning styles on IV-grade students' mathematics performance and motivation. An approach focused on quantifiable data utilizing a posttest-only control group design was employed in this study. A total of 31 learners, divided into control and experimental groups, were tested. Data were collected through administering tests and questionnaires. The findings of the study showed a striking difference. The control class had an average learning outcome of 66 and an average motivation of 65.1, while the experimental class achieved an average learning outcome of 92.5 and an average motivation of 86.1. The hypothesis analysis conducted using Jamovi 2.3.28 confirmed this difference, showing a p-value of < 0.001 in both multivariate tests (including Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root) and univariate tests with the same significance level. These findings suggest that differentiated learning enhances student outcomes and motivation.

Keyword:
Differentiated learning, learning outcome, motivation

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INTRODUCTION

Education is main foundation in human life which functions to develop the potential of students as the next generation of the nation (Putri, 2021). In the context of education, students are expected to develop themselves and achieve success through a quality learning process. The essence of education is not only limited to understanding the material, but includes the cultivation of thinking, emotional, and physical skills (Ana & Astutik, 2024). In 21st century education, there is an emphasis on developing skills that are relevant to global challenges and technological advances, which encourage innovation and creative thinking (Muliastrini, 2020). Therefore, the learning system must be learner-oriented so as to encourage their active participation and facilitate optimal understanding of the material.

Differentiated learning is an essential approach in education, particularly in addressing the varied learning needs of students. The variety of learning styles dominant in learners, namely visual, auditorial, and kinesthetic, demands differentiation in teaching (Nawati, Yulia, et al., 2023). Differentiated learning provides flexibility for teachers to adjust learning content, learning methods, and learning outputs according to the characteristics of each learner (Fitriyah & Bisri, 2023). Thus, learners' understanding of the material increases while fostering their active participation during learning activities. Considering learners' learning styles in educational activities, it is possible to create closeness to the material and ultimately increase their motivation and confidence.

Motivation plays a significant role in influencing learners' learning success. Observations in one of the elementary schools in Sendang Subdistrict, Tulungagung, showed that many students faced obstacles in understanding mathematical concepts, leading to low learning outcomes (Setiani et al.,

2022). Lack of interest and motivation to learn results in students tending to be inactive and less focused when learning. To overcome this, teachers need to design learning experiences that are interesting and challenging so as to arouse their motivation to be actively involved (Sungkono et al., 2024). By presenting interactive and varied learning experiences, learners' attention can increase and foster enthusiasm for learning.

It is important to recognize and address the varied educational requirements of students, as this should not be neglected. By attending to the individual needs of each learner, it can enhance their enthusiasm for the learning process (Syahputri et al., 2023). Differentiated learning responds to these needs by customizing materials, processes and products according to their individual characteristics (Istiqomah et al., 2024). In this way, learners' active participation in the learning process will increase as well as have a beneficial effect on enhancing their understanding of the material. In addition, fulfilling learners' needs can build a harmonious atmosphere between teachers and learners so that learning interactions become more positive.

This research aimed to examine the impact of learning style-based differentiated instruction on learning outcomes and motivation in mathematics. Gaining a thorough understanding of the connection among these three elements is anticipated to help develop more effective strategies for enhancing educational quality (Amalia & Siswanto, 2024). Learning that considers the learning style of each learner is anticipated to have a beneficial effect on their engagement during the learning process so that learning outcomes increase significantly. Thus, this research is anticipated to make a positive contribution to the advancement of learning practices in elementary schools, especially in mathematics subjects, and play a role in preparing a more competent young generation to answer the challenges of the times.

Overall, the application of differentiated learning that is customized to learners' learning styles can contribute to improving their learning outcomes and motivation levels. Research shows that paying attention to learners' diversity and meeting their needs makes learning more enjoyable and effective (Alfath et al., 2023; Hasibuan et al., 2024). Therefore, teachers should integrate differentiated learning strategies into classroom planning and activities. More than just pursuing high academic results, this effort also aims to establish an inclusive learning atmosphere that is conducive to their character development. It is hoped that this approach will empower learners to be more creative, active, innovative and independent in solving problems, as well as fostering strong motivation to achieve optimal learning outcomes.

LITERATURE REVIEW

Learning outcomes are achievements attained by students after participating in various learning activities, both inside and outside the classroom (in the surrounding environment), with the aim of bringing about changes in students' attitudes, knowledge, and skills (Amalia & Siswanto, 2024). Learning outcomes are grouped into three main domains, namely cognitive, affective, and psychomotor. The learning outcomes used in this study are those in the cognitive domain. According to Bloom's revised taxonomy (Astuti, 2021), the cognitive domain includes C1-C6, namely remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6).

The learning outcomes focused on in this study are cognitive domain learning outcomes. Cognitive domain assessment is designed to test the extent to which students understand basic concepts of knowledge, including learning materials as the main core. This domain predominantly involves mental activities or thinking (Rosyidi, 2020). The cognitive domain organizes thinking skills according to set goals. This enables individuals to internalize and implement theory in everyday practice.

Learning motivation is a condition in which students feel compelled to engage in an activity as an effort to achieve learning objectives. Motivation also greatly influences the learning process at school (Hafizhah et al., 2023). To measure students' learning motivation, instruments based on motivational aspects can be used. Keller (2016) proposed a learning motivation assessment model called ARCS, which consists of attention, relevance, confidence, and satisfaction.

Students will find it difficult to achieve their goals if they lack motivation to learn. This situation underscores the importance of educators in encouraging children's enthusiasm for learning. When students lack intrinsic motivation, extrinsic stimuli need to be provided as encouragement. Students who are motivated to learn can be identified by behavioral characteristics related to talent, interest, attention, and perseverance (Yuliana et al., 2023). Thus, efforts to increase learning motivation greatly influence students' academic success.

Differentiated learning is teaching that adapts the learning process to the uniqueness of each student, such as learning readiness, interests, and learning profiles. This strategy is important because each individual has differences in abilities, experiences, and learning styles (Fitriyana et al., 2024). Differentiated learning can be implemented through three aspects, namely differentiation of content, process, and product (Purba et al., 2021). Content differentiation refers to the material that will be taught by the teacher in class. Process differentiation refers to the concrete activities carried out by students in class. Product differentiation involves the design of final assignments by teachers to be completed by students (Kumalasari & Barriyah, 2024). Nawati, Kurniastuti, et al., (2023) states that learning styles are methods used by learners to absorb information based on their sensory preferences. Learning styles are grouped into three main categories, namely auditory (hearing), visual (sight), and kinesthetic (movement) learning styles. Differentiated learning styles is an approach that prioritizes the needs of learners by accommodating their learning preferences.

Research conducted by Amalia and Siswanto (2024) shows that differentiated learning has a significant effect on student learning outcomes when tailored to each student's learning style. This adjustment allows students to receive learning materials in the way that is most effective for them to absorb information, thereby improving their understanding and academic achievement. Furthermore, Hasibuan et al. (2024) add that differentiated instruction not only has a positive impact on learning outcomes but also contributes to increased student motivation. By adopting an approach that addresses individual needs and characteristics, students feel more valued and motivated to actively participate in the learning process. This finding is reinforced by Akhiruddin et al. (2024) who reveal that differentiated instruction can encourage learning motivation while improving students' academic performance. The implementation of this strategy can create a more inclusive and responsive learning environment, which ultimately builds students' self-confidence, increases active participation in class, and creates a more meaningful and effective learning atmosphere.

METHODOLOGY

Research Design

A quantitative approach utilizing a quasi-experimental approach was utilized in this research to evaluate the impact of a treatment on research results. According to Sugiyono (2011), a quasi-experiment entails comparing two groups: one that receives the treatment (experimental group) and another that does not receive the treatment (control group). A posttest-only control group design was chosen, where measurements were only taken after the treatment was given. With this design, researchers can compare the results of the two groups to determine the effectiveness of the treatment given. The study design is illustrated in Figure 1.

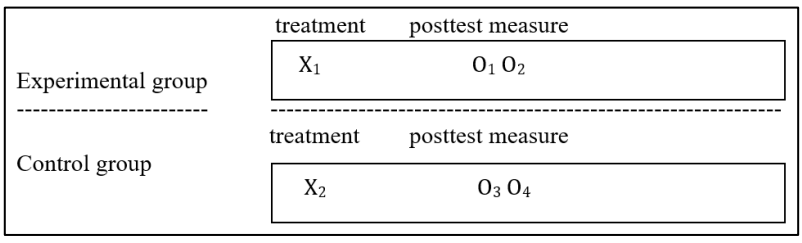


Figure 1. Research Design adopted from Sugiyono (2011)

This research includes two independent variables: differentiated learning based on learning styles (X1) in the experimental group and the use of conventional methods (X2) in the control group. Furthermore, there are two dependent variables, namely learning outcomes (Y1) and students' learning motivation (Y2). This research aimed to evaluate how differentiated learning affects the learning outcomes and motivation of IV grade students regarding the topic of length measurement in Mathematics.

Research Sample

This research was conducted in several elementary schools in Tulungagung Regency. Prior to the main study, an instrument trial was carried out to determine the validity and reliability of the research instruments, involving fifth-grade students from three elementary schools. The main study was then implemented in two parallel fourth-grade classes from different schools. Class IV A served as the experimental group, receiving instruction based on differentiated learning styles, while Class IV B functioned as the control group, receiving conventional instruction. The total number of participants was 31 students, consisting of 16 students in the experimental group and 15 students in the control group. Data collected from both groups were used to test the research hypothesis. A non-probability purposive sampling technique was employed, with school selection based on the similarity of instructional models used, ensuring consistency in the learning environment across both groups.

Data Collection

The research data were collected through two ways, namely tests and questionnaires. Assessments consisting of 20 multiple-choice questions on length measurement material were used to measure learning outcomes on cognitive aspects. Students' motivation was measured using a questionnaire consisting of 20 statements based on the development of motivational aspects, namely attention, relevace, confidence, and satifaction (Keller, 2016). The questionnaire assessment on each statement uses a Liket scale of 1-5.

This research instrument has been tested on 85 students through validity and reliability test procedures by utilizing Jamovi software version 2.3.28. Construct validity assessment using Exploratory Factor Analysis (EFA) approach was applied in this study to ensure that the instrument items accurately represent the theoretical constructs to be measured. The two main criteria in this test are the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO MSA) value must be greater than 0.05, and Bartlett's Test of Sphericity should yield a significant result with a p-value of less than 0.001. If both of these criteria are satisfied, as noted by (Retnawati, 2016), the instrument is deemed valid.

The level of consistency of the research instrument was also measured using the reliability test with the help of the Jamovi application version 2.3.28. The reliability results are shown by the Cronbach's Alpha coefficient with the coefficient value referring in Table 1.

Table 1. Cronbach's Alpha Coefficient

Cronbach's Alpha	Interpretation of *Cronbach's Alpha* Coefficient
0.00 – 0.49	Low
0.50 – 0.69	Medium
0.70 – 0.89	High
0.90 – 1.00	Very high

Source: Taherdoost (2016)

The reliability of the test instrument is expressed in the form of a coefficient number that is in the range of -1.00 to +1.00. A high reliability coefficient value implies that the instrument demonstrates good quality internal consistency in measuring the intended construct (Retnawati, 2016).

Data Analysis

The data analysis process was conducted in two main stages: prerequisite testing and hypothesis testing. To ensure the appropriateness of the data for further analysis, Jamovi software version 2.3.28 was utilized. As part of the prerequisite testing, a normality test was performed using the Shapiro-Wilk Multivariate Normality Test to determine whether the data followed a normal distribution. In

accordance with Sugiyono's (2011) criteria, the data are considered normally distributed if the p-value exceeds 0.05 ($p > 0.05$). Conversely, if the p-value is below 0.05 ($p < 0.05$), the data are deemed not normally distributed and therefore require nonparametric analysis or other appropriate statistical methods.

To determine whether the data follow a normal distribution, the following hypotheses were formulated:

H_0: The data have a normal distribution.

H_1: The data do not have a normal distribution.

To assess whether the variance of the samples used is homogeneous, a homogeneity test was conducted. Homogeneity of variance is a prerequisite in multivariate statistical analysis. This test employed Box's Test of Homogeneity of Covariance Matrices using the Jamovi application version 2.3.28. If the significance value (sig.) of the test results is greater than 0.05, the variances among groups are considered equal (homogeneous). Conversely, if the significance value is less than 0.05, the variances are deemed different (heterogeneous), leading to the following hypotheses:

H_0: The group variances are homogeneous.

H_1: The group variances are not homogeneous.

Subsequently, a MANOVA (Multivariate Analysis of Variance) was conducted with the assistance of Jamovi software version 2.3.28. MANOVA was used to examine whether there were significant differences between groups across two dependent variables—learning outcomes and motivation—based on learning style differentiated learning (Abiba et al., 2024). The analysis included both multivariate and univariate tests. The multivariate test yielded a significance value of $p < 0.001$, indicating a significant difference at the 0.05 level between the experimental and control groups. This result was obtained using several multivariate indicators: Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root. The corresponding hypotheses were:

Ho: Differentiated learning of learning styles does not significantly affect the learning outcomes and motivation of Grade IV elementary school students in mathematics.

Ha: Differentiated learning of learning styles has a significant effect on the learning outcomes and motivation of Grade IV elementary school students in mathematics.

Furthermore, the univariate tests also showed statistically significant results with $p < 0.001$ at the 0.05 significance level. The hypotheses for each dependent variable were as follows.

Ho_1: Differentiated learning styles do not have a significant effect on mathematics learning outcomes of Grade IV elementary students.

Ho_2: Differentiated learning styles do not have a significant effect on mathematics motivation of Grade IV elementary students.

Ha_1: Differentiated learning styles have a significant positive effect on mathematics learning outcomes of Grade IV elementary students.

Ha_2: Differentiated learning styles have a significant positive effect on mathematics motivation of Grade IV elementary students.

RESULTS

Data on Learning Outcomes and Motivation

This study involved IV grade students from two parallel classes, namely class IV A served as the experimental group (n=16), while class IV B functioned as the control group (n=15), so that the total number of participants was 31 students. The average achievement of learning outcomes and motivation levels of both groups are visualized in Figure 2.

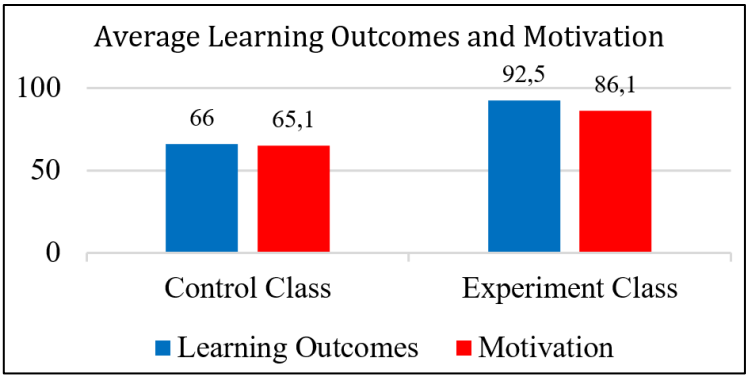


Figure 2. Data on Learning Outcomes and Motivation

The bar chart shows the difference between the control and experimental classes. The average learning outcome of the control class only obtained 66, while the experimental class obtained a higher number, namely 92.5 (blue colored bar). The same can be seen in learning motivation, where the control class obtained an average of 65.1, while the experimental class obtained 86.1 (red colored bars). This data comparison unequivocally shows the superiority of the experimental class in terms of learning outcomes and motivation. Therefore, it can be inferred that applying differentiated instruction based on learning styles has a positive impact on enhancing students' academic performance and motivation in mathematics.

Instrument Validity and Reliability Test

The research instruments, including test items and questionnaires, were evaluated for validity and reliability to determine the precision and consistency of the tools in measuring the intended concepts. The results of the instrument validity test are described in Table 2 and Table 3.

Table 2. Validity Test Results of Test Questions Instrument

χ^2	df	p
1049	190	< .001

Table 3. Validity Test Results of Questionnaire Instrument

χ^2	df	p
1049	190	< .001

The analysis results of Bartlett's Test of Sphericity for both instruments indicate a p-value of less than .001. According to Retnawati (2016), a p-value below 0.01 signifies that the sample size is adequate for conducting factor analysis.

The construct validity assessment for the test and questionnaire instruments, yielded KMO MSA values of 0.859 and 0.876, respectively. All items in these two instruments have values above 0.5, which according to Retnawati (2016) indicates that the data is adequate for factor analysis. In addition to KMO analysis, the number of factors in the instrument was analyzed through scree plot and Eigen value as presented in Figure 3 and Figure 4. The findings of the analysis results consistently show one steep point and a slope after that. This indicates that the items in the instrument contain only one main factor so that the instrument used has a valid construction for measuring learning outcomes and motivation.

Based on the results of the scree plot analysis, a sharp inflection point was observed, indicating that the instrument is characterized by a single dominant factor. This suggests that all items within the instrument—both test questions and questionnaire items—consistently measure a single underlying construct, namely learning outcomes and motivation. This finding is further supported by the Eigenvalue analysis, which reveals that only one factor has a substantially higher value compared to the others. Consequently, it can be concluded that the instrument demonstrates adequate structural

validity, qualifying it for use in this study. This one-dimensionality strengthens the internal consistency of the instrument and supports its relevance for measuring the intended constructs.

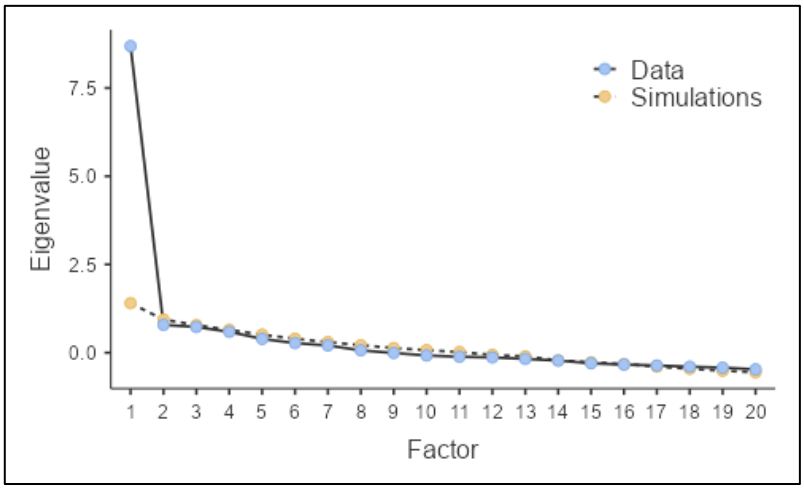


Figure 3. Scree Plot of Test Question Instrument

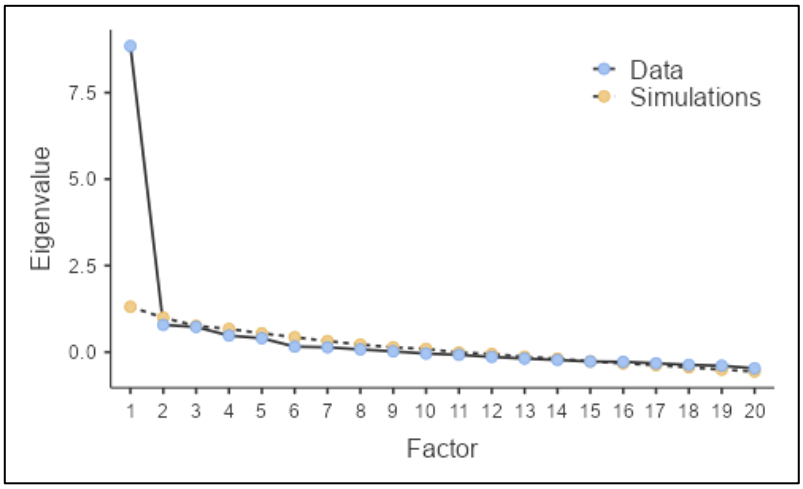


Figure 4. Scree Plot of Questionnaire Instrument

According to the findings of the Exploratory Factor Analysis (EFA) analysis, it can be inferred that the instrument consisting of test questions and questionnaires has met the criteria of construct validity, so it is feasible to use to measure learning outcomes variables and student motivation. The validity of the instrument is supported by empirical evidence which shows that the items in the instrument are able to represent the theoretical aspects measured consistently and accurately.

The reliability test conducted using the Jamovi application version 2.3.2 produced the results shown in Table 4 and Table 5.

Table 4. Results of the Test Question Instrument Reliability Test

	Cronbach's α
scale	0.934

Table 5. Results of the Questionnaire Instrument Reliability Test

	Cronbach's α
scale	0.940

The Cronbach's Alpha coefficient value of the test question instrument is 0.934 and the questionnaire instrument is 0.940. Based on Table 1, the determination of the classification level of the

Cronbach's Alpha coefficient shows that 0.934 and 0.940 are included in the very high reliability range. The analysis results suggest that the learning outcomes and motivation instruments have a very high level of reliability (Retnawati, 2016).

Item-rest correlation is used to determine the level of relationship between the score of each item in the instrument and the overall score. A positive correlation indicates that the item is relevant and represents the construct being measured, while a negative correlation indicates that the item needs to be revised or deleted (Wibowo & Kurniawan, 2020). Based on the analysis results, all items have a positive correlation value, ultimately this mean that the educational outcomes test instrument and learning motivation questionnaire used in this study are valid and reliable.

Normality Test

The initial stage of hypothesis testing is the implementation of prerequisite tests, which include normality and homogeneity tests. Based on the normality test, it was found that for the data are shown in the Table 6.

Table 6. Normality Test Results

W	p
0.941	0.089

Referring to the Shapiro-Wilk test results for multivariate normality, a value of 0.089 was obtained. Since this value is above the 0.05 significance threshold, the data aligns with a normal distribution. Therefore, the null hypothesis (Ho), which posits that This points to a normal distribution in the data, can be accepted. Additionally, the assumption of normality is further supported by the Q-Q Plot (Quantile-Quantile Plot). When the data points align closely with the diagonal reference line on the plot, it indicates it implies the data has a normal distribution. A visual representation of the Q-Q Plot is shown in the Figure 5.

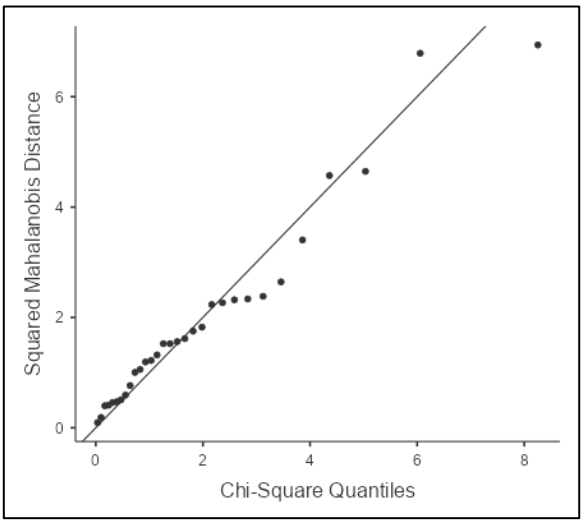


Figure 5. Q-Q Plot Graph

The Q-Q Plot graph demonstrates that the distribution of data points closely aligns with the diagonal line. This suggests that the research data is normally distributed.

Homogenity Test

The Table 7 presents the results of the homogeneity test conducted on the research data. This test was carried out to determine whether the variance between groups was equal, which is a critical assumption in multivariate statistical analysis. The outcome of this test serves as a basis for deciding whether parametric or non-parametric methods should be applied in the subsequent hypothesis testing stages.

Table 7. Homogenity Test Results

χ^2	df	p
6.87	3	0.076

Table 7 shows the results of Box's Test of Homogeneity of Covariance Matrices, which indicated a p-value of 0.076. As this value exceeds the 0.05 significance threshold, the null hypothesis (H_0), which assumes equal variances across groups, is not rejected. In conjunction with the previously confirmed normality of the data, this result suggests that the data meet the assumptions required for parametric statistical analysis. Since both the normality and homogeneity assumptions were satisfied, further analysis was appropriately conducted using parametric methods.

Hypothesis Test

MANOVA test was performed to evaluate the hypothesis. The testing process was conducted using the Jamovi application version 2.3.28. The results can be seen in the Table 8.

Table 8. Hypothesis test results on the Multivariate Test

		value	F	df1	df2	p
Class	Pillai's Trace	0.830	68.4	2	28	< .001
	Wilks' Lambda	0.170	68.4	2	28	< .001
	Hotelling's Trace	4.89	68.4	2	28	< .001
	Roy's Largest Root	4.89	68.4	2	28	< .001

The results of the multivariate analysis revealed a significance value of $p < 0.001$ across all indicators, indicating a substantial effect on the dependent variables. Consequently, the alternative hypothesis (H_a) is accepted, confirming that learning style-based differentiated instruction has a significant impact on students' academic performance and motivation. This supports the notion that adapting instruction to match individual learning styles enhances overall learning effectiveness. To further explore the specific effects on each variable, a univariate analysis is conducted and discussed in the Table 9.

Table 9. Hypothesis Test Results on Univariate Tests

	Dependent Variable	Sum of Squares	df	Mean Square	F	p
Class	Learning Outcome	5437	1	5436.8	97.9	< .001
	Motivation	3433	1	3433.2	45.1	< .001
Residuals	Learning Outcome	1610	29	55.5		
	Motivation	2209	29	76.2		

Based on the univariate test results, the significance value of $p < 0.001$ was obtained, indicating that the first (Ha_1) and second (Ha_2) alternative hypotheses are accepted. That is, differentiated learning based on learning styles has a significant impact on learning outcomes and students' motivation. Acceptance of Ha1 proves that tailoring learning methods to each individual's learning style significantly improves their learning outcomes, while acceptance of Ha_2 proves that this approach is also effective in fostering learning motivation through a more personalized and enjoyable learning experience. These findings confirm that strategies that take into account individual differences, particularly learning styles, are effective in enhancing the quality of education in elementary schools.

DISCUSSION

Differentiated learning based on learning styles is an innovative teaching approach that emphasizes adapting the learning methods to the characteristics of each learner, especially in grade IV mathematics subjects. Research by Choirina et al. (2024) shows that when teachers adjust teaching methods based on each learner's learning style, there is an increase in knowledge and understanding in mathematics material. Amalia and Siswanto (2024) adds that this approach is an effective innovation to improve learning outcomes, while Latifah (2023) emphasizes the importance of fostering an inclusive and responsive learning environment that adapts to diverse learning styles. In the context of

mathematics learning, learners use images and videos (visual), actively engage in activities such as measuring objects around them (kinesthetic), and listen to explanations and audio (auditory). Considering the variety of learning styles is believed to increase their participation level which directly contributes to the improvement of learning outcomes.

A learning style-based differentiated learning approach can be understood as a strategy aimed at tailoring the learning experience to accommodate the diverse learning styles that students are interested in. This approach shows a significant effect on increasing learners' learning motivation, especially at the grade IV elementary school level (Sahputri & Ilmi, 2024). Learning motivation, defined as the internal force that drives individuals to be passionate about learning, can be enhanced through meaningful learning experiences provided by differentiated learning. Differentiated learning can enhance this motivation through the provision of meaningful and relevant learning experiences.

One form of implementation is to give learners the freedom to choose a way of learning that suits their style, whether auditory, visual or kinesthetic. In addition, providing constructive feedback and relevant tasks also contribute to increasing learning motivation (Santhika & Jayantika, 2023). The diversity of learner characteristics, such as preference for learning videos or practice questions, suggests that interaction with the real world through the material being studied is an effective way to increase motivation (Faiz et al., 2022; Handiyani & Muhtar, 2022). Furthermore, Demir (2021) explained that differentiated learning provides opportunities for learners to play an active role in the whole learning process. Activities such as brainstorming, discussion, internet information search, drama, self-study, and flexible group work are examples of strategies that can be applied in this model. This approach is considered effective because it provides a variety of methods that are relevant to each individual's learning style and needs, something that is not found in conventional learning.

Differentiated learning is a teaching strategy designed to tailor personalizing the learning experience to suit the needs, interests, and learning styles of individual learners. This strategy has been shown to have a significant impact on improving learning outcomes and motivation of students at the elementary school level, especially in grade IV students (Istiqomah et al., 2024). The customization of materials, processes and products allows teachers to design learning in accordance with the readiness of students, create an atmosphere that supports understanding of the material and encourages creativity and independence in solving problems. Learning certainly becomes more challenging for learners' curiosity, responsiveness to the support for students with special needs will also improve, and teachers' preparedness in the learning process will also enhance and can even increase learner motivation (Marlina et al., 2023). Akhiruddin et al. (2024) and Hasibuan et al. (2024) revealed that the application of differentiated learning can foster learning motivation, encourage children to actively participate, and build self-confidence. In the context of learning mathematics, differentiation strategies are very effective when combined with the use of media relevant to children's varied learning styles. This helps improve understanding of abstract concepts through a more concrete and visual approach (Aprima & Sari, 2022). By providing opportunities to actively participate, ask questions, and express opinions, differentiated learning can facilitate the diversity of individual characteristics and strengthen the role of learners as subjects in learning. This opinion is corroborated by AM et al. (2023) that differentiated learning emphasizes the importance of recognizing individual differences, both considering readiness, interests, and learning profiles. This creates a learning experience that matches the background of children's interests, makes learning more challenging, and is able to encourage active involvement of students. Teachers can also provide more targeted and constructive feedback. Differentiated learning, which takes into account the individual traits and needs of each student, has been shown to enhance their motivation, participation, comprehension, and academic abilities. In turn, this method supports the improvement of overall learning performance.

CONCLUSION

This study aimed to examine the effects of differentiated learning styles on learning outcomes and motivation in fourth-grade mathematics. Learning style differences are unique characteristics

inherent in each student, requiring teachers to provide greater attention through the implementation of differentiated instruction. The findings of this study indicate that differentiated learning styles positively influence both learning outcomes and student motivation. When students' learning needs are met according to their preferred styles, they feel acknowledged and supported, which fosters enthusiasm and active participation in learning activities. This heightened engagement, in turn, contributes to improved learning outcomes and increased motivation.

This study has several limitations. First, it focused solely on students' cognitive learning outcomes, while observations during the study revealed notable changes in students' attitudes, such as increased willingness to participate and learn. This suggests that differentiated learning styles may also impact the affective and psychomotor domains, which were not examined in this research. Second, the sample size was limited to one class of 31 students, which restricts the generalizability of the findings. Future studies should include larger and more diverse samples and evaluate cognitive, affective, and psychomotor outcomes to provide a more comprehensive understanding of the influence of differentiated learning styles across various dimensions of student development.

The results of this study carry significant implications for instructional practices, especially in primary education. Recognizing and accommodating students' diverse learning styles can help teachers create more inclusive, engaging, and student-centered classrooms. When students feel that their individual needs are respected and addressed, they are more likely to develop positive attitudes toward learning, maintain high levels of motivation, and achieve better academic results. Therefore, differentiated instruction should be regarded as an essential approach to enhancing teaching effectiveness and supporting the holistic development of students.

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