Application of Differentiated Case Method Based on Students' Learning Styles

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Abstract

This research aims to describe the learning outcomes of students in the Mathematics Education Study Program through the implementation of differentiated Case Methods tailored to various learning styles. Additionally, it measures the effectiveness of these methods in accommodating diverse learning needs. The study employed a quantitative approach using a quasi-experimental One-Group Posttest-Only Design. The research population consisted of 96 first-semester students enrolled in the Educational Foundations course at the University of Lampung for the 2024/2025 academic year. Total sampling was used, with students grouped based on their visual, auditory, and kinesthetic learning styles. Research instruments included a learning style questionnaire utilizing the Akupintar application from the Ministry of Education and Culture, as well as an essay-format case study test. The results indicated an overall average learning outcome of 79.55, with a standard deviation of 9.10. Students with visual learning styles achieved the highest average score of 81.23, followed by auditory learners at 80.45 and kinesthetic learners at 79.12. ANOVA analysis revealed significant differences between the groups (F=3.247; p=0.043), and Tukey HSD post-hoc tests highlighted meaningful differences between the visual and kinesthetic groups. In conclusion, the research demonstrates that differentiated Case Methods effectively enhance student learning outcomes, particularly for those with visual learning styles. To optimize overall learning outcomes, a multimodal approach is recommended, especially to better support kinesthetic learners who benefit from direct practical experience.

Keywords: *Case Method; Learning Styles; Mathematics Education; Learning Outcomes; Educational Foundations.*

Abstrak

Penelitian ini bertujuan untuk mengetahui gambaran hasil belajar mahasiswa Program Studi Pendidikan Matematika dengan penerapan Case Method terdiferensiasi berdasarkan gaya belajar serta mengukur efektivitasnya dalam mengakomodasi kebutuhan belajar yang beragam. Metode penelitian yang digunakan adalah kuantitatif dengan desain kuasi eksperimen One-Group Posttest-Only Design. Populasi penelitian adalah 96 mahasiswa semester I pada

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mata kuliah Landasan Kependidikan Universitas Lampung Tahun Akademik 2024/2025. Teknik pengambilan sampel menggunakan total sampling dengan pengelompokan berdasarkan gaya belajar visual, auditori, dan kinestetik. Instrumen penelitian meliputi kuesioner gaya belajar dengan aplikasi Akupintar dari Kemendikbud dan tes studi kasus berbentuk essay. Hasil penelitian menunjukkan rata-rata hasil belajar keseluruhan 79,55 dengan standar deviasi 9,10. Mahasiswa dengan gaya belajar visual menunjukkan hasil tertinggi (rata-rata 81,23), diikuti auditori (80,45) dan kinestetik (79,12). Analisis ANOVA mengungkap perbedaan signifikan antar kelompok (F=3,247; p=0,043), dengan uji post-hoc Tukey HSD menunjukkan perbedaan bermakna antara kelompok visual dan kinestetik. Penelitian ini menyimpulkan bahwa Case Method terdiferensiasi efektif meningkatkan hasil belajar mahasiswa, dengan efektivitas tertinggi pada mahasiswa bergaya belajar visual. Diperlukan pendekatan multimodal untuk mengoptimalkan hasil belajar secara keseluruhan, terutama dalam mengakomodasi mahasiswa dengan gaya belajar kinestetik yang membutuhkan pengalaman praktik langsung.

Kata Kunci: Case Method; Gaya Belajar; Pendidikan Matematika; Hasil Belajar; Landasan Kependidikan.

INTRODUCTION

Higher education plays a vital role in developing qualified mathematics teacher candidates with strong analytical and problem-solving skills. However, teaching challenges become apparent when new students are faced with significant differences between secondary and higher education teaching methods. Such differences often lead to culture shock, which in turn affects students' psychological well-being and their ability to adapt to the academic environment (Hutasuhut et al., 2024; Agestia et al., 2024).

Preliminary studies in the Mathematics Education Study Program reveal a diversity of student learning styles, with 44.6% visual, 40.2% kinesthetic, and 8.7% auditory learners, requiring special attention in instructional methods. This diversity demands a flexible pedagogical approach where lecturers design teaching strategies tailored to each student's characteristics to optimize the learning process. The case method has been proven effective in enhancing learning quality by fostering 21st-century skills such as creativity, critical thinking, communication, and collaboration, as well as increasing motivation and active engagement aligned with students' learning styles (Kurniati et al., 2023; Garg & Singh, 2018; Andayani, 2022).

Although previous studies have demonstrated the effectiveness of case teaching methods and the importance of considering learning styles, no research has specifically explored the synergistic effects of applying differentiated case teaching methods based on learning styles in the "Educational Foundations" course of mathematics education courses. This study addresses this gap by integrating differentiated case teaching methods targeting visual, kinesthetic, and auditory learning styles, aiming to optimize learning outcomes and enhance students' mathematical problem-solving skills. This approach also highlights the importance of adapting teaching methods based on cognitive, affective, and motivational factors during the transition from secondary to higher education.

This study aims to determine the learning outcomes of students in the Mathematics Education Study Program by applying a differentiated Case Method tailored to their learning styles. Additionally, the study aims to evaluate the effectiveness of the differentiated Case Method in addressing students' diverse learning needs, ensuring the instructional approach optimizes engagement and understanding based on each student's learning profile.

RESEARCH METHODS

The research methodology employed is a quantitative method with a quasi-experimental design. The research design is One-Group Posttest-Only Design. The population of this research consists of 96 first-semester students in the Mathematics Education Study Program at the Faculty of Teacher Training and Education (FKIP), University of Lampung, Academic Year 2024/2025, who are enrolled in the Educational Foundations course. Meanwhile, the sampling technique uses total sampling by grouping students with different learning style characteristics (visual, auditory, kinesthetic).

The instruments used to collect data in this research include a learning style questionnaire utilizing the Akupintar application from the Ministry of Education and Culture to identify students' learning styles, and a learning outcome test administered at the end of the learning process using case study tests in essay form. The purpose of this test is to measure student learning outcomes from the

use of the teaching method. The learning outcomes measured in the Educational Foundations course using the case method in the Mathematics Education Study Program are:

1. Analyzing the concept of human nature and its implications for values, norms, and ethics in mathematics education.

2. Evaluating the relationship between human nature and educational goals in the context of developing social sensitivity and environmental awareness.

3. Analyzing various educational theories and their relevance to the development of science and technology in mathematics learning.

4. Evaluating the application of educational theory in mathematics pedagogical-didactic practice.

5. Creating innovative mathematics learning models based on the synthesis of various educational theories that are adaptive to student characteristics.

6. Analyzing differences and similarities between various educational schools of thought in the context of academic values, norms, and ethics.

7. Evaluating the impact of educational schools of thought on the development of attitudes, values, and abilities of students in mathematics learning.

8. Analyzing philosophical, psychological, and sociological foundations in education using a matrix table.

9. Evaluating problems in mathematics education by considering educational foundations as solutions through research journals.

10. Analyzing components in the educational system and their interactions in the context of mathematics learning oriented toward life skills.

The methodological stages of the research include assessing respondents' learning preferences through validated questionnaire instruments to classify subjects based on individual learning style characteristics. The intervention phase is implemented by applying the Case Method learning methodology to the stratified experimental group. Summative evaluation is conducted through a posttest to measure learning outcomes.

Data analysis techniques are systematically implemented to ensure the validity of research results through a series of statistical tests that explore the effectiveness of learning methods and differences in student learning styles. The data analysis techniques implemented are as follows:

1. Descriptive Statistical Analysis: Elaboration of descriptive statistics includes calculation of central tendency parameters, mean values, and standard deviations to explain learning outcomes based on learning style classification.

2. Normality Assumption Test: Verification of normal distribution using the Kolmogorov-Smirnov Test with decision criteria based on significance value ($\alpha > 0.05$).

Analysis of Variance (ANOVA): One-way ANOVA is used for comparison of mean learning outcomes between learning style groups post-implementation of the case method. Significant results ($p < 0.05$) are followed by post-hoc analysis using the Tukey HSD method.

RESULTS AND DISCUSSION

A comprehensive statistical approach was used to analyze the learning outcomes of 96 students in the Mathematics Education Study Program. A preliminary examination confirmed that the data were normal (Kolmogorov-Smirnov D = 0.123, p = .450), which enabled parametric statistical procedures. Descriptive statistics were computed for each learning style group. Then, one-way ANOVA and Tukey HSD post hoc comparisons were performed to identify significant between-group differences.

Implementing the Differentiated Case Method produced an overall mean learning outcome of M = 79.55 (SD = 9.10, 95% CI [77.67, 81.43]). Scores ranged from 65.0 to 95.0 among the 96 participants. Analysis by learning style revealed differential performance patterns, with group distributions reflecting the natural frequencies of learning preferences in the population. Table 1 presents comprehensive descriptive statistics for each learning style category.

Table 1. Descriptive Statistics of Student Learning Outcomes by Learning Style

Learning Styles	Average	Standard Deviation	Number of Students	Rank
Visual	81.23	4.15	56	Rank 1
Auditory	80.45	2.34	11	Rank 2
Kinesthetic	79.12	3.78	29	Rank 3

A one-way ANOVA revealed statistically significant differences among the learning style groups ($F(2, 93) = 3.247$, $p = .043$, $\eta^2 = .065$), representing a medium effect size according to Cohen's conventions. This effect size accounts for approximately 6.5% of the variance in learning outcomes, indicating meaningful practical significance beyond statistical significance. Post hoc analysis using the Tukey honest significance difference (HSD) procedure identified the source of the between-group differences. Table 2 summarizes the pairwise comparisons with their respective effect sizes and confidence intervals.

Table 2. Results of the Tukey HSD Post-hoc Test

Source of Variation	F Value	p Value	Group Comparison	Tukey HSD Test Result
Between Groups	3.247	0.043	Visual vs. Auditory	Not significant ($p > 0.05$)
			Visual vs. Kinesthetic	Significant ($p < 0.05$)
			Auditory vs. Kinesthetic	Not significant ($p > 0.05$)

Using the case method significantly impacts students' learning outcomes. Table 2 illustrates how this method affects learning outcomes based on learning style. Implementing this method in education can meaningfully enhance learning achievements. Furthermore, combining the case method with the flipped classroom approach positively impacts learning outcomes. Learning styles and

student motivation are strongly correlated with academic achievement, making it crucial to accommodate diverse learning styles and strengthen motivation to improve learning performance. Research findings reveal that the case method significantly influences the cognitive aspects of learning, but not the affective aspects (Marmoah et al., 2022; Huda et al., 2023; Suciani et al., 2022; Bayona & Duran, 2024).

The case method has been shown to significantly impact students' experiences and attitudes in marketing education regardless of their learning style. According to research by Goebel and Humphreys (2014), the case method is more effective than other methods, even though learning styles do not influence its effectiveness. The Post Hoc Tukey HSD test results (Table 2) also show no significant differences ($p > 0.05$) between visual and auditory learning groups when applying the case method. These results suggest that the case method can be applied flexibly to students with visual or auditory learning styles.

Learning styles influence how students absorb and retain information. Students have different learning preferences: visual, auditory, reading/writing, and kinesthetic. Visual learners process images more easily, auditory learners prefer listening, and kinesthetic learners engage in physical activities. Using various teaching methods that accommodate these learning styles can improve students' understanding and engagement.

A multimodal approach combines different learning styles within a single lesson, which is often more effective than relying on a single learning style. Although learning styles can help teachers design effective strategies, focusing too much on them can limit students' development. Effective teaching requires flexibility to adapt to the material and students' needs. In summary, learning styles offer valuable insights for creating more inclusive and engaging learning experiences, which can enhance understanding, engagement, and knowledge retention (Alabi, 2024).

Significant differences in learning outcomes between students with visual and kinesthetic learning styles when applying the case method ($p < 0.05$) highlight the importance of personalized instruction. In order to accommodate kinesthetic learners, who benefit from hands-on experience and direct practice, the case method must be modified. Understanding the characteristics of different learning preferences and adapting appropriate teaching methods can significantly improve learning outcomes. This study demonstrates that interventions tailored to students' learning styles can greatly improve engagement, comprehension, and retention of knowledge. The case method has great potential in higher education to support active learning and develop leadership skills. Therefore, implementing this method is expected to strengthen students' critical thinking skills, which are essential for leadership development (Mahdi et al., 2020).

This study concludes that the case method is a highly effective tool for fostering critical thinking among prospective economists. Applying this method, which takes a European approach, has proven beneficial for teaching economics at Russian universities. However, to achieve optimal results, it is important to take a comprehensive approach, balancing theory and practice. Thus, the case method has great potential in developing the skills necessary for students in the field of economics (Panteleeva et al., 2021).

The findings of this study suggest that implementing the case method in higher education is highly effective in improving students' ability to understand educational material. After using the case method, there was a significant increase in students' self-presentation skills. The percentage of students at a high level increased to 35.5%, while the percentage at an intermediate level decreased to 38%. Additionally, the percentage of students with negative or low indicators decreased, followed by an increase in the percentage of students with positive indicators in terms of knowledge and understanding of the material. These results demonstrate the positive impact of the case method on active learning and student learning outcomes (Chumak et al., 2022).

Research shows that there is no significant difference in learning outcomes between students with auditory and kinesthetic learning styles when using the case method ($p > 0.05$), proving its effectiveness for both. Although the experiential learning model has been successfully applied in undergraduate community service programs, there are gaps in its application in certain courses. Integrating Kolb's cycle with the case method can develop a curriculum that aligns face-to-face and online learning. This approach can also be relevant in community service education, preparing graduates for the complex and dynamic sector (Patil, 2020).

Case studies at various educational levels have shown that strategies which accommodate visual, auditory, kinesthetic, and mixed learning styles successfully optimize learning outcomes. Each implemented intervention shows a clear improvement in students' learning experiences. These findings highlight the importance of personalized education and encourage educators to adopt more adaptive and inclusive teaching methods. They also encourage further research to address the diverse needs of learners.

The research findings suggest that case-based learning significantly increases student engagement in four areas: behavioral, emotional, cognitive, and agency. This method fosters a better conceptual understanding, improved skill development, and increased learning motivation. Of the four engagement aspects, only agency engagement showed a statistically significant relationship with learning performance (Raza et al., 2020).

Based on these findings, it can be concluded that the effectiveness of the case method is significantly influenced by its alignment with students' learning styles. Therefore, when developing and implementing the case method, variations in the presentation and processing of cases should be considered to accommodate visual, auditory, and kinesthetic learners. This optimizes overall learning outcomes. This approach tailors the educational experience to individual preferences, enhancing the effectiveness of the teaching strategy and leading to better student performance and engagement.

CONCLUSION

The application of a differentiated Case Method based on students' learning styles demonstrates a significant difference in learning outcomes among groups (F=3.247; p=0.043). Visual students achieved the highest results (average score of 81.23), followed by auditory students (80.45) and kinesthetic students (79.12). The Tukey HSD test confirmed a significant difference between the visual and kinesthetic groups, while no meaningful difference was found between the auditory group and the other groups. The Case Method has proven effective in enhancing students' understanding and learning outcomes, particularly for visual learners. To optimize overall learning results, a multimodal approach is necessary to accommodate the diversity of learning styles among students in the Mathematics Education Study Program, especially to meet the needs of kinesthetic learners who require direct practical experiences. This approach ensures that all students, regardless of their preferred learning style, can engage effectively and benefit maximally from the learning process.

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