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Analysing Factors Contributing the Failure Rate in an Ordinary Differential Equations Course Using the Fuzzy TOPSIS: A Case of Undergraduate Students at UiTM Perlis Branch

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ABSTRACT

High failure rates in the Ordinary Differential Equations (MAT522) course at UiTM Perlis Branch are a major concern for students in the Bachelor of Science (Hons.) Management Mathematics (CS248) and Bachelor of Science (Hons.) Physics (AS203) programmes. This study aims to analyse the factors contributing to this failure rate and rank them using the Fuzzy TOPSIS. Three factors were examined: poor study habits, negative peer influence, and external distractions. These were assessed based on four criteria: lack of understanding, insufficient practice, fear of mathematics, and lack of self-confidence. Data were collected via questionnaires from lecturers who taught MAT522, serving as decision-makers. The findings revealed that external distraction is the most significant factor impacting the students' performance in MAT522, followed by negative peer influence and poor study habits, with the closeness coefficient of 0.884, 0.564, and 0.053 respectively. These findings emphasise the need for strategies to raise the students' awareness of distraction's impact and improve self-control in the digital era.

Keywords: Fuzzy TOPSIS, mathematics performance, ordinary differential equations, undergraduate students

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INTRODUCTION

Ordinary Differential Equations (MAT522) is a core course for the undergraduate students in the Bachelor of Science (Hons.) Management Mathematics (CS248) and Bachelor of Science (Hons.) Physics (AS203) programmes at Universiti Teknologi MARA (UiTM). Students in these programmes typically have a strong background in mathematics from their

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matriculation or diploma studies. Based on the UiTM student admission portal, students must hold a diploma in statistics, actuarial science or mathematical sciences with a minimum GPA of 2.50. For matriculation graduates, eligibility requires a grade of C+ in two (2) mathematics subjects and a GPA of 2.50. As outlined in the UiTM study plan, students must pass Calculus 1 (MAT421) and Calculus II (MAT441) before enrolling in MAT522.

A significant failure rate among CS248 and AS203 students in MAT522 at UiTM Perlis was observed over two consecutive semesters: October 2022-February 2023 and March-July 2023. In the October 2022-February 2023 semester, 59% of CS248 students and 47% of AS203 students failed MAT522. While, in March=July 2023 semester, the failure rates were 23% for CS248 students and 38% for AS203 students. Previous studies reported that high failure rate in mathematics courses are poor study habits (Fitrianti & Riyana, 2020), negative peer influence (Xu et al., 2023), and external distractions (Pérez-Juárez et al., 2023). The main reasons for the poor performance in MAT522 at UiTM Perlis have not been fully investigated.

This study examines and ranks the factors influencing the failure rate of MAT522 among CS248 and AS203 students at UiTM Perlis using the Fuzzy TOPSIS. Given the involvement of expert opinions in systematically rank the factors, the Fuzzy TOPSIS is the most suitable method for handling uncertainty and ensuring a comprehensive analysis (Do, 2024). Identifying these factors can lead to personalised learning experiences, helping students overcome challenges, and graduate on time. Additionally, it allows UiTM Perlis to maintain high educational standards and its academic reputation.

MATERIALS AND METHODS

This study involved three experienced MAT522 lecturers from UiTM Perlis as decision-makers to assess the failure rate of MAT522. Four decision criteria: lack of understanding, insufficient practice, fear of mathematics, and lack of self-confidence were evaluated against three factors: poor study habits, negative peer influence, and external distractions. Data were collected through questionnaires using linguistic variables and analysed using the Fuzzy TOPSIS method. The Microsoft Excel was used to rank the factors, identifying the most significant contributors to student failure.

RESULTS AND DISCUSSION

This study identifies external distractions as the leading cause of MAT522 failure among UiTM Perlis students, followed by negative peer influence and poor study habits, with the closeness coefficients of 0.884, 0.564, and 0.053 respectively.

The findings of this study align with previous research emphasising that external distractions, such as social media and financial constraints, significantly hinder the students' focus and academic performance. While technology enhances learning, excessive use can

become a major distraction. This corresponds with Pérez-Juárez et al. (2023) and Liao and Wu (2022), who found that frequent smartphone and social media usage negatively impact the students' academic success. However, Martens et al. (2024) argued that phone usage during study sessions does not directly affect grades, instead emphasising the role of university quality and cultural attitudes. The differing findings may be due to this study's focus solely on students who failed MAT522.

CONCLUSION

This study examined the high failure rates in MAT522 at UiTM Perlis and ranked the contributing factors using the Fuzzy TOPSIS method. The analysis identified external distraction as the most significant factor affecting the students' performance. These findings highlight the need for strategies to raise awareness of the negative impact of distractions and enhance the students' self-control in the digital era. Future research should consider additional factors like the students' backgrounds and socio-economic status for a more detailed analysis. Future research could explore the impact of tutoring programmes and study workshops on mathematics achievement. Expanding the study to other UiTM campuses would enhance the validity and generalisability of the findings. Additionally, applying this research to other high-failure mathematics courses at both degree and diploma levels could help develop comprehensive strategies to reduce failure rates and improve academic success.

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