

A SUCCESSFUL INTERVENTION PROGRAM FOR ENGINEERING STUDENTS

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ABSTRACT

Further Differential Equations (MAT480) is a critical math course at the College of Engineering, Civil Engineering Studies, UiTM Cawangan Pulau Pinang. Unfortunately, during the October 2022-February 2023 semester, 30% of students failed this course. To address this, the "Boost Up Your Mathematical Skills Workshop (BMS)" was implemented for the March-August 2023 semester. The workshop sought to improve students' mathematical skills and boost students' confidence in the subject. In the March-August 2023 semester, 91% of students successfully passed the course, indicating improved outcomes. In order to sustain this positive trend, the intervention program was implemented for the second time for students during the October 2023 – February 2024 semester, involving 26 students and two lecturers as facilitators. In this article, the studies aim to analyse the result of the pretest and posttest to forecast the student's achievement in their final examination. If the forecast proves to be correct, then BMS will continue into upcoming semesters, enabling early performance assessment. Additional programs to raise performance can be implemented if the prognosis indicates a decline in student performance.

Keywords: *further differential equations, engineering students, intervention program, mathematical skills, academic performance.*

Introduction

The Further Differential Equations (MAT480) course is one of the crucial mathematics components for undergraduates in the Civil Engineering Studies at the College of Engineering, Universiti Teknologi MARA (UiTM), Cawangan Pulau Pinang. However, a notable concern emerged in the semester of October 2022–February 2023, with 30% of students facing challenges in succeeding (Kechil et al., 2023). To address this, the "Boost Up Your Mathematical Skills Workshop (BMS)" intervention program was introduced, influenced by the progress of Open Distance Learning (ODL) during the COVID-19 pandemic, as discussed by Kechil et al. (2020), Wan Mohammad et al. (2020), Mohd Mydin et al. (2020) and Abd Rahman et al. (2023). This BMS aimed to enhance students' mathematical skills through a comprehensive approach, resulting in improved academic performance, particularly in the MAT480 course. Notably, 91% of students successfully passed their final examinations in the March–August 2023 semester. Inspired by this achievement, the intervention program continued in an effort to improve student performance for the October 2023–February 2024 semester.

Literature Review

Generations Y and Z widely embrace computer technology and telecommunications (Wan Mohammad et al., 2017). Given the contemporary generation's proficiency and interest in the Internet of Things (IoT), traditional face-to-face learning becomes less pertinent (Aithal & Aithal, 2016). Consequently, a transition to blended learning is more fitting. To aid university students in their ongoing preparation throughout the course, the implementation of blended learning interventions is recommended. Additionally, the research done by Silvia et al. (2020) suggests that digital-based interventions have a positive impact on the mathematics achievement of students with mathematical difficulties. According to Higgins et al. (2019), technology interventions had a significant and favourable impact on students' mathematical achievement.

The use of video as a learning tool in blended learning environment is widely discussed by many researchers because it can create enthusiasm for learning (Kamariah, 2018), foster deeper learning (Mitra et al., 2010), and improve attitudes towards learning (Kinnari-Korpela, 2015; Rahmadani & Nurlaelah, 2019; Tan et al., 2020). For instance, Kinnari discovered that students were motivated to learn mathematics when brief video lectures were used. Due to the video's step-by-step solutions and explanations, they were able to better internalise and comprehend the mathematics material. Nevertheless, relying solely on technology for independent student study is inadequate. Merely watching videos without two-way communication should be discouraged. Prolonged solitary video viewing may lead to challenges in physiology, communication, and social skills for students (Kechil et al., 2021; Abdul Razak et al., 2021; Kechil et al., 2022).

Engaging in group discussions with peers is crucial to foster the enhancement of social and communication skills (Chung et al., 2016; Samter, 2003). The facilitator serves as a guide, ensuring that students stay on the correct path when comprehending each discussed topic (Hmelo-Silver & Barrows, 2006). This is also supported by group work, which allows learners to think analytically and critically, enhances their teamwork spirit, and fosters independent learning (Sofroniou & Poutos, 2016). Leveraging both peers and facilitators enables students to swiftly enhance their understanding of a variety of subjects, facilitated by their proficiency in self-directed learning with digital technology (Song, 2021).

Methodology

This intervention program ran for the first time in the March-August 2023 semester with the aim of enhancing engineering students' math skills for success in MAT480. It is divided into three weeks. Topics covered include differentiation, integration techniques, nonpolynomial vs. polynomial, series

and graph sketching. These topics correspond to the foundational areas of students' early calculus education. It was necessary for the students to recall all the fundamental mathematical concepts, rules, and procedures because they had forgotten the topics.

The intervention program, as depicted in Figure 1, involves three key components: self-monitoring studies, peers, and facilitators. Combining these elements is essential for success, especially in mathematics education. Self-monitoring studies empower students to take charge of their learning and cultivate self-directed skills. Peers contribute crucial support, encouragement and feedback, while facilitators, like instructors and tutors, act as guides and mentors for students.

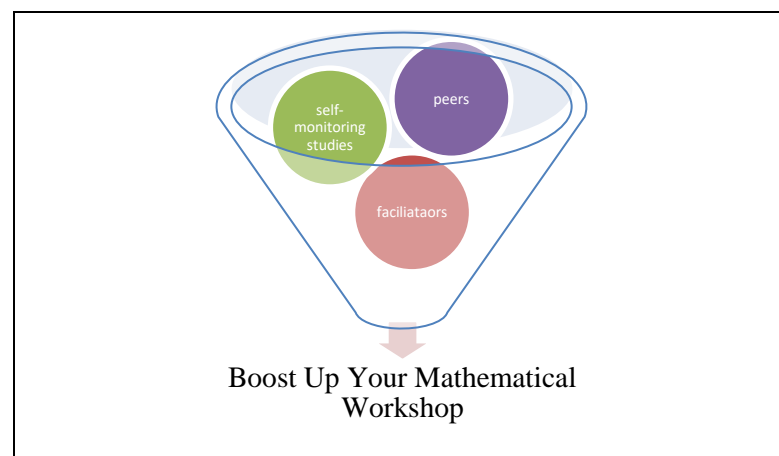


Figure 1: Three main elements in the intervention program

The success of this intervention is reflected in the results of the final exams of students, where 91% of students passed the MAT480 subject in the March-August 2023 semester. Therefore, this semester, this intervention program is being carried out for the second time. A total of 26 students from the October 2023-February 2024 semester were involved. Two lecturers with about 20 years of experience in the field of teaching mathematics for the subject of mathematical engineering were involved as facilitators.

The Figure 2 flowchart illustrates the intervention process. In the first week, students took a pretest to evaluate their understanding of prior topics, focusing on MAT480 relevance. In the second week, they watched instructional videos and engaged in group discussions. Students presented solutions to peers and facilitators in the final part of the second week, promoting two-way learning. The third week concluded with students taking a posttest to assess their progress in the program.

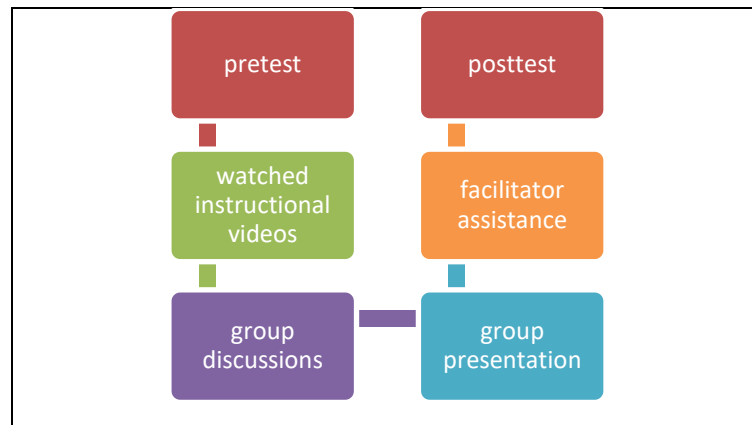


Figure 2: Flowchart of the intervention process

Result and Discussion

The data indicating an improved posttest score aligns with the high success rate of 91% in the final examination for the March-August 2023 semester. The positive trend in posttest scores reflects the effectiveness of the intervention program in enhancing students' mathematical skills. The majority of students scoring above 50% in the posttest experienced further improvement, contributing to the significant pass rate in the final examination. This suggests a correlation between the intervention program's impact on students' proficiency and their overall success in the MAT480 course, emphasizing the program's role in achieving favorable academic outcomes.

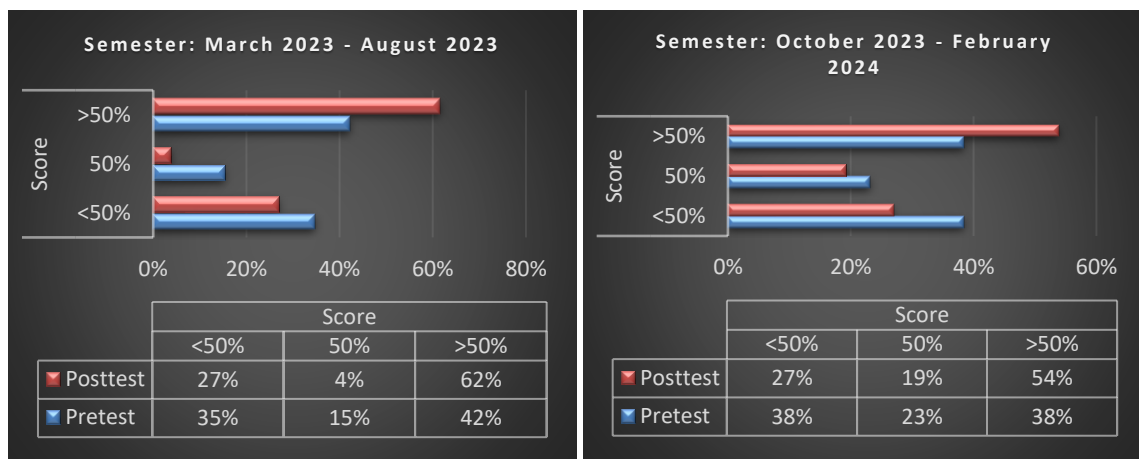


Figure 3: Score of pretest and posttest

Building upon the insights from the intervention program data in the March-August 2023 semester, the forecast for the October 2023-February 2024 semester is optimistic. In the pretest, 38% of students initially scored below 50%, suggesting a similar challenge as observed in the previous

semester. However, the positive trend seen in the March-August 2023 data, where posttest scores improved significantly, indicates potential improvement in the upcoming semester as well.

Similar to the March-August 2023 data, the majority of students with pretest scores above 50% in the October 2023-February 2024 semester are expected to experience improvement. The percentage of students scoring above 50% is forecast to rise from 38% in the pretest to 54% in the posttest, reflecting the effectiveness of the intervention program in enhancing mathematical skills.

Comparing both semesters, the forecast suggests a consistent positive impact on students' proficiency. The lessons learned from the March-August 2023 intervention program, especially in addressing challenges for students scoring below 50%, can be applied to further optimize outcomes in the upcoming semester. The parallel increase in posttest scores and the pass rate in the final examination observed in the March-August 2023 semester serves as a promising indicator for continued success in achieving favorable academic outcomes in the October 2023-February 2024 semester.

Conclusion

The BMS aimed to enhance students' mathematical abilities and boost their confidence as they progressed through the MAT480 course. The comprehensive three-week intervention program and its potential for improving the mathematical skills and overall academic performance of engineering students in MAT480 show the improvement of the students' results in their final examination. 91% of the students pass their final examination in the March–August 2023 examination. We anticipate the continuation of success for this intervention program into the October 2023– February 2024 semester, with students excelling in their academic endeavors during this period.

References:

- Abd Rahman, N. H., Kechil, R. & Abdul Razak, N. A. (2023). Extended study: Students' acceptance and preference in online-distance learning and teaching during pandemic-endemic. *AJTLHE*. Vol. 15, No. 1, 210-222.
- Abd Razak, N. A, Abd Rahman, N. H. & Kechil, R., (2021). The impact of open distance learning during covid-19 pandemic on social interaction among university students. *SIG – e-Learning@CS*, 71-76.
- Aithal, P. S., & Aithal, S. (2016). Impact of on-line education on higher education system. *International Journal of Engineering Research and Modern Education (IJERME)*, 1(1), 225-235.
- Chung, Y., Yoo, J., Kim, S. W., Lee, H., & Zeidler, D. L. (2016). Enhancing students' communication skills in the science classroom through socioscientific issues. *International Journal of Science and Mathematics Education*, 14, 1-27.

- Higgins, K., Huscroft-D'Angelo, J., & Crawford, L. (2019). Effects of technology in Mathematics on achievement, motivation, and attitude: A meta-analysis. *Journal of Educational Computing Research*, 57(2), 283-319, <https://doi.org/10.1177/0735633117748416>.
- Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-based Learning*, 1(1), 4.
- Kamariah, A. (2018). Using video as an authentic material in improving students writing ability. *International Journal of Humanities and Innovation (IJHI)*, 1(3), 184–199.
- Kinnari-Korpela, H. (2015). Using short video lectures to enhance mathematics learning-experiences on differential and integral calculus course for engineering students. *Informatics in Education-An International Journal*, 14(1), 69–83.
- Kechil, R., Mohd Mydin, A. & Wan Mohammad, W. A. (2020). Pendidikan jarak jauh terbuka (ODL): Adaptasi norma baharu dalam pembelajaran dan pengajaran. SIG: e-Learning@CS, 1(September 2020), 31–38. Retrieved on August 15, 2022, from <https://ir.uitm.edu.my/id/eprint/39810/1/39810.pdf>
- Kechil, R., Abd Rahman, N. H. & Abd Razak, N. A. (2021). Psychological impact of covid-19 on university students using open distance learning. SIG – e-Learning@CS, 77-85.
- Kechil, R., Abd Rahman, N. H. & Abd Razak, N. A. (2022). A Study on depression and anxiety among university students during ODL. *International Journal of Practices in Teaching and Learning*, 2, 1-7.
- Kechil, R., Syed Abdullah. S. S., Idris, N. A., Mazeni, N. A., Omar, M., Chew, Y. M. & Abdul Rahman, M. S. (2023). *Boost up your mathematical skills workshop: An intervention programme for engineering students*. SIG – e-Learning@CS, 13-18.
- Mitra, B., Lewin-Jones, J., Barrett, H., & Williamson, S. (2010). The use of video to enable deep learning. *Research in Post-Compulsory Education*, 15(4), 405–414.
- Mohd Mydin, A., Wan Mohammad, W. A. & Kechil, R. (2020). Online distance learning and online learning implementation to civil engineering student for subject CSC128. SIG – e-Learning@CS. 113-120.
- Rahmadani, S. I., & Nurlaelah, E. (2019). Video-based learning: Using technology to increase student mathematics learning results. In Proceedings of the 1st International Seminar STEMEIF (pp. 569-579).
- Samter, W. (2003). Friendship interaction skills across the life-span. In Handbook of communication and social interaction skills (pp. 655-702). Routledge.
- Silvia, B. V., Claudio, Z. C., Barbara, F., Leo, I., Gianmarco, A. & Daniela, L. (2020). Effectiveness of digital-based interventions for children with mathematical learning difficulties: A meta-analysis, *Computers & Education*, Volume 157, 103953, ISSN 0360-1315, <https://doi.org/10.1016/j.compedu.2020.103953>.
- Sofroniou, A., & Poutos, K. (2016). Investigating the effectiveness of group work in mathematics. *Education Sciences*, 6(3), 30.

- Song, B. K. (2021). E-portfolio implementation: Examining learners' perception of usefulness, self-directed learning process and value of learning. *Australasian Journal of Educational Technology*, 37(1), 68-81.
- Tan, S., Zou, L., & Wijaya, T. T. (2020). Using video learning to improve students' mathematical ability. *Journal of Didactic Mathematics*, 1(3), 117-126. <https://doi:10.34007/jdm.v1i3.364>
- Wan Mohammad, W. A., Mohd Mydin, A. & Kechil, R. (2020). UiTM Cawangan Pulau Pinang students readiness towards online teaching and learning. *SIG – e-Learning@CS*, 51-58.
- Wan Mohammad, W. A., Mohd Mydin, A., Kechil, R. & Libasin, Z. (2017). The impact of Blended Learning (BL) in UiTM Cawangan Pulau Pinang. *International Academic Research Journal of Social Science* 3(1) 239-244.