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Impact of Foundation Academic Program on Mathematics 2 Achievement among Engineering Technology Students at PTSN

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Abstract. This study aims to analyse the impact of the Foundation Academic Program at Politeknik Tun Syed Nasir Syed Ismail (PTSN) improves student performance in the Mathematics 2 course among the second cohort of the Foundation Engineering Technology Program. Outcome-Based Education (OBE), a mentor-mentee method, and student centered learning principles form the foundation of the program's design. Descriptive analysis was used in a quantitative research design. Data from academic records (Continuous Assessment, Final Assessment, and overall course results) and a Google Forms questionnaire were used to gather information for the sample, which consisted of 91 students. The results showed that students had very high levels of program acceptability (M = 4.82, SD = 0.18962) and knowledge (M = 4.85, SD = 0.15375). Additionally, the Mathematics 2 course had a 100% pass rate, demonstrating participants' high academic achievement. All things considered, the findings show that the Foundation Academic Program significantly improved students' comprehension, acceptability, and academic achievement in Mathematics 2.

Keywords: Foundation Engineering Technology Program, Foundation Academic Program, Mathematics 2, Second Cohort, Mentor-Mentee

1. INTRODUCTION

Mathematics is a fundamental discipline that develops logical reasoning, strengthens problem-solving skills, and supports applications across technology, engineering, economics, medicine, and the arts [1]. Recognized as one of the most important subjects, it is taught at every level of education worldwide [2]. Despite its significance, the teaching and learning of mathematics have faced persistent challenges over the past two decades. In Malaysian universities, concerns are growing over students' performance in first-year mathematics courses, even among those who excelled in the Sijil Pelajaran Malaysia (SPM) examination. High SPM scores do not necessarily reflect mathematical aptitude, as many students struggle with reasoning, logic, and the ability to apply mathematical knowledge across disciplines. This disconnect highlights the need to strengthen the Malaysian Mathematics Curriculum to ensure students are mathematically literate and prepared for higher-level applications [3].

Mentorship programs have emerged as a potential intervention to address these challenges. Research shows that such programs improve academic performance, particularly for underachieving students, by boosting test scores, self-confidence, motivation, and problem-solving skills. Mentorship also reduces course failures, improves credit completion, and raises grade-point averages, thereby increasing the likelihood of college retention and completion [4]. Beyond academics, mentorship fosters social-emotional skills, career awareness, and resilience, contributing to both

personal and academic growth. In contradiction of this background, the present study examines the relationship between students' performance in SPM Mathematics and Additional Mathematics with their achievement in university-level mathematics, while also considering the role of mentorship programs in enhancing academic outcomes.

1.1 Problem Statement

Students' performance in tertiary-level mathematics courses is frequently thought to be significantly predicted by their prior performance in secondary-level mathematics, especially in the Sijil Pelajaran Malaysia (SPM) test. Higher education programs frequently employ SPM Mathematics results as a prerequisite, particularly in STEM (science, technology, engineering, and mathematics) disciplines. There is a small but favorable correlation between students' success in university-level mathematics courses and their SPM Mathematics grades, according to several research [5]. However, other research indicates that non-cognitive elements like self-efficacy, motivation, and math anxiety have a greater impact on kids' academic performance [6].

The goal of Malaysia's Foundation Programs is to increase access to engineering education, especially for students from backgrounds other than pure science. As a result, only a pass in SPM Mathematics is needed for admission, and Additional Mathematics is not required. As a result, some students start the program with weak mathematical foundations or no prior exposure to Additional Mathematics, which may have an impact on their confidence and capacity to handle mathematically demanding courses like Mathematics 2.

There is little empirical data on how structured academic intervention programs, like the Foundation Academic Program, help students from non-Pure Science backgrounds overcome deficiencies in mathematical preparedness, despite earlier research examining the relationship between SPM Mathematics performance and university-level mathematics achievement. Research on the overall effect of such programs on students' performance in Mathematics 2 as well as the precise program components that most strongly contribute to student success is particularly lacking.

Based on the identified gap, this study addresses the following research questions:

i) What is the impact of the Foundation Academic Program on students' achievement in Mathematics 2 among students of the Foundation in Engineering Technology at PTSN?
ii) Which element of the Foundation Academic Program contributes most significantly to students' achievement in Mathematics 2?

1.2 Objectives

The objectives of this study are to:

i) Evaluate the effectiveness of the Foundation Academic Program in enhancing students' achievement in Mathematics 2.
ii) Analyse the relationship between students' perceptions of the program and their Mathematics 2 achievement.
iii) Determine the key program elements that contribute most significantly to students' achievement in Mathematics 2.

2. LITERATURE REVIEW

Mentor mentee programs have been used extensively in educational settings as an intervention to improve students' academic performance, especially in subjects that require a lot of math. To foster both academic success and personal growth, a mentor mentee relationship often entails a more experienced person or peer offering advice and academic support to a less experienced learner [7]. Although several studies show that these programs have beneficial effects, the results vary depending on the situation.

Numerous studies have demonstrated the beneficial effects of peer mentorship on students' self-esteem, drive, and interest in their academics. For example, prior studies found that students who participated in peer mentoring felt more confident and less anxious because they could ask for help without worrying about being judged by peers or instructors [8]. Peer mentorship has been demonstrated to promote deeper conceptual knowledge in mathematics-related courses by giving students the freedom to ask questions and receive explanations catered to their learning style. Mentors also gain academically by teaching peers, which strengthens their subject-matter expertise [8].

Contrasting results, however, have also been documented. According to certain research, increases in students' self-assurance and drive do not necessarily result in appreciable improvements in their academic performance, especially when mentoring sessions don't have well-defined learning objectives or organized content. Some academics contend that mentor quality, training, and dedication are crucial to the success of mentor-mentee programs, with inadequately trained mentors making very little contribution to academic advancement. Additionally, several research primarily depend on students' self-reported impressions rather than objective academic results, which weakens the conclusions about real performance improvements.

The evidence is still conflicting when it comes to advanced mathematics and engineering courses. While some research indicates that students who participate in peer mentorship have quantifiable gains in their academic performance, other studies contend that the effect is small and varies depending on the students' past mathematics experience and preparedness for learning. This discrepancy suggests that mentor mentee programs might not be a one-size-fits-all answer and that structural and contextual aspects are critical in determining their efficacy.

3. RESEARCH METHODOLOGY

3.1 Research Design

The Foundation Academic Program, which ran from Week 10 to Week 17 of the semester, was created to improve students' performance in Mathematics 2. The program was based on student centred learning, backed by a mentor-mentee method, and in line with Outcome-Based Education (OBE) concepts. To support collaborative learning, resource sharing, and student involvement documentation, several digital learning systems were used, including Padlet, CIDOS, and MyLink.

Students were divided into three-person groups, each of which was led by a mentor. Exam problems from Engineering Mathematics 2 and Engineering Mathematics 3, which are taught at Malaysian polytechnics' Diploma in Engineering programs, served as the basis for the learning exercises. Despite differences in program level, these subjects were chosen as reference resources because their fundamental mathematical ideas aligned with the Mathematics 2 syllabuses.

A Mathematics Mentor Mentee Competition was held in Week 17 to assess students' general comprehension of the material and to honour those who showed exceptional performance and dedication during the program. Scores were combined and analysed in accordance with the preassigned groups to indicate collaborative learning outcomes, even though the competition was held on an individual basis.

The Padlet platform was used to distribute assignments during the weekly program. Each group had to work together to finish the assignments through in-person discussions. Discussion outputs were uploaded to Padlet after they were finished as proof of involvement. Every week, one group was chosen at random to present their discussion results in class to guarantee active participation and accountability. Lecturers were able to keep an eye on students' conceptual grasp thanks to these presentations, which also offered chances for quick feedback.

A quantitative method was used to analyse the data. Students' perceptions of their knowledge and program acceptability were analysed using descriptive statistics, such as mean and standard deviation. To investigate differences in Mathematics 2 accomplishment across certain program features (e.g., mentorship support, collaborative learning activities, and platform utilization), inferential analysis using one way ANOVA was utilized. The analysis section includes figures that show the program structure, student involvement, and accomplishment outcomes. These figures are labelled and referenced appropriately.

Table 1. Weekly Topic Breakdown

WEEK	TOPIC	ASSIGNMENT
WEEK 10	Session 1: Topic 1 - Indices and Logarithms	Students are required to complete the assignment given each week and upload their answers along with evidence to the Padlet platform provided by the course lecturer.
WEEK 11	Session 2: Topic 2 - Differentiation	
WEEK 12	Session 3: Topic 2 - Differentiation	
WEEK 13	Session 4: Topic 2 - Integration	
WEEK 14	Session 5: Topic 2 - Integration	
WEEK 15	Session 6: Topic 3 - Numerical Method	
WEEK 16	Session 7: Topic 3 - Numerical Method	
WEEK 17	Session 8: Topic 3 - Numerical Method	
	FINAL COMPETITION	
WEEK 18	PRIZE-GIVING CEREMONY	

The schedule of topics and assignments for the course, covers three main topics: Indices and Logarithms, Differentiation and Integration, and Numerical Method. The assignments are to be completed weekly and uploaded to the Padlet platform, culminating in a final competition in Week 17 and a prize giving ceremony in Week 18.

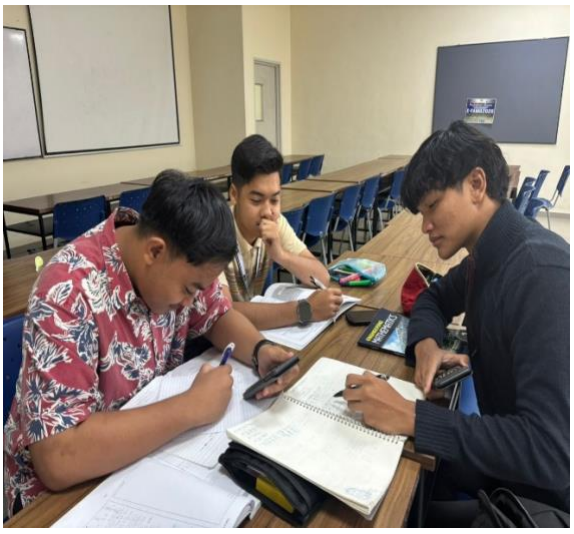


Figure 1-4. The pictures show that students have the flexibility to carry out this program at any time according to their own schedules

Figure 5-6. The picture shows the presentation of academic program awards that were given during the foundation students' appreciation ceremony.

3.1 Materials or Tools Used

The study involved 91 students from the Foundation in Engineering Technology program at PTSN for the 2024/2025 academic session. A questionnaire was distributed to the students after the program ended to collect the necessary data. The questionnaire consisted of three components: Section A (demographics), Section B (knowledge), and Section C (skills). The effectiveness of the program was measured using a 5-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5).

This study employed descriptive analysis and quantitative Pearson correlation research design. The correlational design is suitable because it allows for analysis of the level and direction of the relationship between two continuous variables without manipulating any conditions.

3.2 Data Collection Methods

The association between students' opinions of the Foundation Academic Program and their academic performance in Mathematics 2 was investigated in this study using a quantitative correlational design. All the students in the second cohort of Politeknik Tun Syed Nasir Syed Ismail's (PTSN) Foundation in Engineering Technology program made up the population. To guarantee complete representation and remove selection bias, census sampling was used to include all 91 students from FTV2A, FTV2B, and FTV2C.

With institutional consent, the i-HEP module of the Student Performance Management System (SPMP) provided academic accomplishment data, such as SPM Mathematics grades and Mathematics 2 performance. For analysis, the data were methodically documented.

After the program was finished, students were given a structured questionnaire via Google Forms to gauge their level of understanding and program acceptability. Content validity was established through expert review by experienced mathematics lecturers and foundation program coordinators.

Students' opinions of the program were summed up using descriptive statistics, such as mean and standard deviation. To investigate variations in Mathematics 2 achievement based on program components including mentorship support, cooperative group work, and usage of digital platforms, inferential analysis using one-way ANOVA was carried out. To investigate connections between students' perceptions (knowledge and acceptance) and their academic achievement, correlational analysis was used. With appropriate labelling and references to aid in comprehension, figures depicting the program's framework, participation procedure, and outcome measures were provided.

3.3 Analythical Technique

Mathematics 2 for the second cohort represents a revised and enhanced version of the course, which was refined collaboratively by lecturers from the Malaysian Technical University Network (MTUN). The revision was undertaken to ensure that the course content aligns more closely with the academic and professional needs of students enrolled in the Engineering Technology programme. Consequently, the updated Mathematics 2 syllabus places greater emphasis on Engineering Technology oriented mathematical applications, rather than abstract or theoretically intensive mathematical concepts.

Furthermore, the revised syllabus supports Outcome Based Education (OBE) principles by clearly mapping learning outcomes to programme outcomes and industry expectations. By focusing on applied mathematical competencies, the course aims to strengthen students' readiness for higher level coursework, improve their confidence in handling mathematically demanding subjects, and reduce the transition gap between foundation level studies and degree level engineering technology programmes.

During this phase of the study, descriptive statistical analysis was used as the analytical method. The distribution and consistency of the students' replies were summarized and interpreted using the mean, standard deviation, skewness, and kurtosis. This method was suitable since it checked the assumption of normalcy necessary for further inferential statistical analyses and gave a clear picture of participants' knowledge and skill levels.

4. RESULTS

Table 2. The table presents the mathematics 2 results

No.	Class	Number of students passed	Number of students failed
1.	FTV2A	31	0
2.	FTV2B	30	0
3.	FTV2C	30	0

Table 3. Level of students' knowledge after participating in the program

	SECTION B (KNOWLEDGE)	MEAN
B1	Learning sessions become more interesting when conducted in group activities.	4.89
B2	Learning sessions become more interesting and easier to understand when learning in groups.	5.00
B3	Learning sessions become more interesting and easier to understand when applying digital methods.	4.77
B4	I become more motivated when I can answer questions correctly.	4.81
B5	I am willing to help my friends understand mathematical concepts.	4.78
	Estimated Mean	4.85

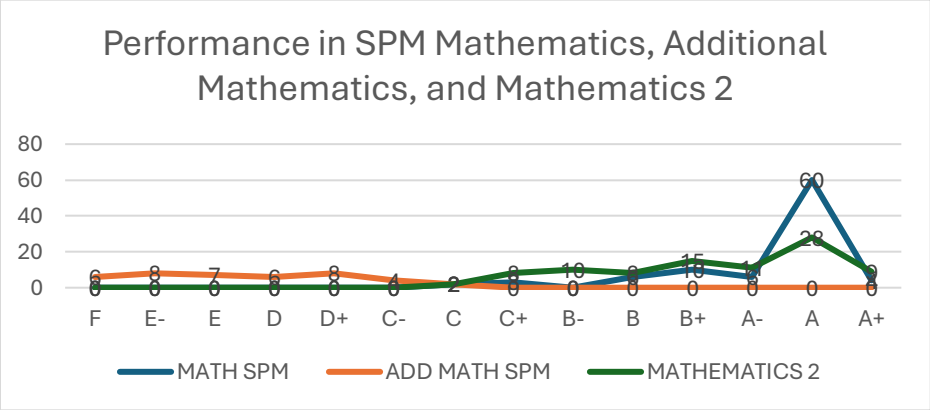
The knowledge level of students following their participation in the mentor-mentee program is shown in Table 2. The projected mean score of 4.85 shows a very high level of perceived expertise. Group learning emerged as the most influential factor (B2, M = 5.00), followed by group activities (B1, M = 4.89). All items had high mean values. These findings demonstrate the value of peer engagement and collaborative learning, which are essential components of the mentor-mentee approach.

Students' comprehension was also positively impacted by the employment of digital learning techniques (B3, M = 4.77), and a strong correlation between comprehension and confidence is suggested by higher motivation while successfully answering questions (B4, M = 4.81). Furthermore, the development of a helpful learning environment is reflected in students' eagerness to assist their peers (B5, M = 4.78). Overall, the findings show that the mentor-mentee program improved students' understanding, participation, and cooperative learning styles in Mathematics 2.

Table 4. Level of students' acceptance of the Foundation Academic Program

	SECTION C (ACCEPTANCE)	MEAN
C1	The implementation of the program is suitable for the allocated time.	4.78
C2	Knowledge can be enhanced after participating in the program.	4.84
C3	I am more confident and prepared to sit for the exam after participating in the program.	4.89
C4	I am more motivated to face the final exam after participating in the program.	4.77
C5	Overall, the program has been successfully implemented.	4.84
	Estimated Mean	4.82

The curriculum was well-received by pupils on all measured items, according to the results. With a mean score of 4.89, C3 ("I am more confident and prepared to sit for the exam after participating in the program") had the highest level of agreement from students, followed by C2 ("Knowledge can be enhanced after participating in the program") with a mean score of 4.84. The acceptance construct's overall estimated mean was 4.82, indicating a highly favourable opinion of the program's applicability, efficacy, and motivating influence. These results suggest that students not only thought the program was effective and well-structured, but they also reported feeling more motivated, confident, and prepared for exams.



Graph 1. Distribution of students' performance in SPM Mathematics, SPM Additional Mathematics, and Mathematics 2.

The usefulness of the mentor mentee program is further supported by comparing students' present achievement with their past academic performance. While students generally did well in SPM Mathematics, their performance in SPM Additional Mathematics was relatively worse, with most grades concentrated at the lower levels, as shown in Graph 1. Despite this, pupils showed a noticeable improvement in Mathematics 2, with most receiving B to A ratings. This development implies that students were able to overcome prior learning challenges and improve their conceptual comprehension and problem-solving abilities by structured instructional support and peer mentoring. The conclusion that the mentor-mentee approach is a successful intervention for improving academic achievement in difficult mathematics courses is supported by these results.

5. DISCUSSION

Table 5. Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
KNOWLDEGE	91	4.8505	.15375	-.770	.253	.073	.500
SKILLS	91	4.8220	.18962	-.784	.253	-.369	.500
Valid N (listwise)	91						

Descriptive statistics were calculated to examine students' levels of knowledge and skills following the implementation of the mentor-mentee program. As shown in Table 1, the mean score for **Knowledge** was **M = 4.85, SD = 0.15**, while the mean score for **Skills** was **M = 4.82, SD = 0.19**. Both means are close to the maximum point on the five-point Likert scale, indicating that participants generally reported high levels of knowledge and skills.

The distribution of scores for both variables met the assumptions of normality. Knowledge recorded a skewness of **–0.77 (SE = 0.25)** and kurtosis of **0.07 (SE = 0.50)**, while Skills recorded a skewness of **–0.78 (SE = 0.25)** and kurtosis of **–0.37 (SE = 0.50)**. These values fall within the acceptable range of ±1, suggesting that the data are approximately normally distributed.

Overall, the results suggest that the mentor mentee program contributed positively to enhancing students' knowledge and skills, with responses showing consistently high outcomes and low variability among participants.

6. CONCLUSION

The findings of this study clearly demonstrate that the mentor mentee approach significantly improved students' learning outcomes in Mathematics 2. The high mean scores recorded for both knowledge (M = 4.85) and abilities (M = 4.82) indicate that participants developed a strong understanding of mathematical concepts and were able to apply them effectively in problem-solving contexts. These results align with the program's original objectives, which emphasized peer collaboration and structured mentor guidance as key components of learning.

The relatively low standard deviations for both variables suggest minimal variation in participants' experiences, indicating that the program's benefits were consistently experienced across the cohort. This highlights the inclusivity and effectiveness of the mentor–mentee model, demonstrating its capacity to support a broad range of learners rather than only high-performing students. Furthermore, the normal distribution of the data, supported by acceptable skewness and kurtosis values, reinforces the reliability of the findings. The negative skewness observed for both knowledge and abilities reflect that most students rated their performance highly, suggesting increased confidence and mathematical competence following participation in the program.

Beyond academic achievement, the mentor mentee program contributed to the development of essential soft skills. Mentees became more confident in asking questions and engaging in collaborative learning, while mentors enhanced their communication, leadership, and instructional skills. These outcomes are consistent with prior research highlighting the cognitive and social benefits of peer mentorship in higher education. The program also fostered camaraderie and positive peer relationships, creating a supportive learning environment that is particularly valuable in challenging subjects such as mathematics.

From a policy and teaching perspective, the results support the integration of mentor mentee programs as a formal component of academic support strategies within higher education institutions. Educational policymakers and faculty administrators are encouraged to institutionalize peer mentoring initiatives, particularly for courses with historically high difficulty levels or failure rates. Lecturers may incorporate mentor–mentee sessions into tutorial structures or supplementary learning activities to enhance student engagement, understanding, and retention. Additionally, providing basic training for mentors in communication and instructional strategies could further strengthen the effectiveness of such programs.

In terms of future research directions, subsequent studies could examine the long-term impact of mentor mentee programs on academic performance, retention rates, and students' progression in mathematics related courses. Future research may also explore the application of the mentor mentee model in other disciplines, particularly in subjects commonly perceived as challenging, to assess its broader applicability. Comparative studies involving larger sample sizes, mixed-method approaches, or experimental designs could provide deeper insights into the mechanisms through which peer mentoring influences learning outcomes. Investigating mentors' perspectives and professional skill development may also offer valuable contributions to the literature on peer-assisted learning.

Overall, the mentor mentee program has proven to be an effective and holistic educational intervention, enhancing not only students' academic performance in Mathematics 2 but also their confidence, communication skills, and peer relationships. These findings strongly support the continued implementation and expansion of mentor–mentee initiatives within higher education.

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