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# THE RELATIONSHIPS BETWEEN HIGH SCHOOL MATHEMATICS AND PRE-CALCULUS PERFORMANCE IN UNIVERSITY

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## ABSTRACT

Pre-Calculus is an introductory calculus course compulsory for most program under science and technology cluster in UiTM. In UiTM Perak Branch, Tapah Campus alone, 4 programs are required to undertaken Pre-Calculus during their first semester. Even so, previous exam results showed students' achievement in the Pre-Calculus course is still moderate and unsatisfactory. This study believed that students who take Additional Mathematics subject during secondary school can understand and perform better in Pre-Calculus compare to other students who were not. Therefore, this study aims to examine the relationship between Mathematics subject's achievement during secondary school with Pre-Calculus performance in UiTM. Descriptive analysis and Pearson correlation was used to identify the relationship among three courses which are Mathematics, Additional Mathematics and Pre-Calculus using SPSS. The findings showed that there were significant correlations between the three courses; mathematics at SPM level with Pre-Calculus (correlation, $r = 0.416$, p-value $= 0.003 < 0.05$), Additional Mathematics and Pre-Calculus ($r = 0.385$, $p = 0.007 < 0.05$) and mathematics with Additional Mathematics ($r = 0.591$, $p = 0.000 < 0.05$). Overall, the finding depicted the achievement of mathematics will help student's performance in Pre-Calculus.

**Keywords:** Additional Mathematics; Mathematics; Pre-Calculus.

## 1. INTRODUCTION

Mathematics performance has received a lot of attention in education, from the beginning of primary education to higher institution of advanced mathematics. Mathematics ability perceived students' cognitive level that they can be placed in science and technology cluster program such as Engineering, Medical, Mathematical Science and many more. In Malaysia, Mathematics is compulsory for all upper secondary students while Additional Mathematics is taken by students from pure science and sub-science streams. Additional Mathematics syllabus is different from the Mathematics syllabus, as it covers more in-depth and complex topics such as Algebra and Calculus. According to [6], undergraduates who took Engineering, Physics and Mathematics as their field of studies may find that the knowledge and understanding in Additional Mathematics are very helpful. Factors that affect students' performance was study to improve the students' results. The entrance requirements for diploma in Computer Science student must credits in Mathematics while Additional Mathematics is not compulsory. Therefore, Mathematics and Additional Mathematics play a role in shaping the factors that affect Pre - Calculus result.

The importance of students to conquer mathematical skills is no deception. Mathematical skills and knowledge will bring student to their utmost potential which means the ground works of developing the skills is extremely important. It is often said that students who achieve good grades in Mathematics and has Additional Mathematics will have strong mathematical skills to have better understanding in higher institution mathematics. Students' achievement in Modern Mathematics is significantly correlated with their results in Engineering Mathematics 2 at diploma level. They noted that students who obtain good results in Mathematics able to understand and perform better in Mathematics course at diploma level [8].

In UiTM, Pre-Calculus is a course that include four chapter which are coordinate, graphs and lines, functions, system of equations and equalities and trigonometric. It became a major concern as it is an early assessment of Mathematics before they take calculus for diploma students. This study conducted a preliminary analysis to observe a significant relationship of Mathematics and Additional Mathematics to performance in Pre-Calculus. The study hopefully will disclose the cause of underperformance in Pre-Calculus and initiate quick action to improve performance of the students in the future.

## 2. LITERATURE REVIEW

Many studies have been conducted to investigate various factors that affect student's academic performance in mathematical-based subjects at pre-university and university level. Demographic, financial, prior education and current education are among the significant factors that affect the academic performance [2, 3, 7, 8]. A study on two cohorts of science stream students at a Matriculation college showed that the most important factors that affect the academic performance of students are prior education, followed by demographic and current education. The most significant factor of prior education is SPM grade in Mathematics. The financial factors (such as family income) were not significantly affecting the students' performance [2].

A study on 2442 students from different Engineering Department at Polytechnic Sultan Mizan Zainal Abidin found that there was a significant positive correlation between the achievement of Mathematics during secondary schools with the achievement of Engineering Mathematics 2 in polytechnics and it also proved that Additional Mathematics is one of the mediums for student's excellent in Engineering Mathematics 2 at polytechnics [7].

In a different study, the effect of students' behavior (self-effort and personal attitude) and students' preference (lectures' attitude and class size) on students' academic performance in Calculus subjects has also been studied on 608 diploma students from Diploma in Mathematical Science and Diploma in Computer Science, Universiti Teknologi MARA (UiTM) Johor branch, Segamat Campus. The results show that the only factor that is related to the students' performance in Calculus is students' self-effort [3].

## 3. METHODOLOGY

This study took a sample of 48 first semester students from the Diploma in Computer Science at UiTM Perak Branch, Tapah Campus who enrolled in Pre-Calculus course during the September 2018 – January 2019 session. Respondent consists of 24 male students and 24 female students. The data used are the SPM result in Mathematics and Additional Mathematics, and final exam score in Pre-Calculus. That primary data gathered from the academic records. These data were then analyzed using Microsoft Excel 2013 and SPSS.

In analysis section, percentage (%) was calculated by finding the frequency according to the grade for each subject using Microsoft Excel 2013 in order to measure the highest percentage grade. The data then execute and analyses through IBM SPSS version 22 based on respondent grade point median for each subject. Pearson Correlation test is used to examine the relationship

between Mathematics, Additional Mathematics and Pre-Calculus. Two competing hypotheses such as the null hypothesis ($H_0$) and the alternative hypothesis ($H_1$) defined as follow:

$H_0$: There is no relationship between Additional Mathematics and Mathematics at SPM level with Pre – Calculus.

$H_1$: There is a relationship between Additional Mathematics and Mathematics at SPM level with Pre – Calculus.

The null hypotheses of these test are rejected when the p-value ≤ significant value ($\alpha$) = 0.05 [8]. It means that there was a relationship between Mathematics and Additional Mathematics with Pre-Calculus. The detail interpretation of the relationship is explained in result and discussion where the null hypothesis was tested at 0.05 level of significance.

## 4. RESULTS AND DISCUSSION

Table 1 shows students results in Mathematics, Additional Mathematics and Pre-Calculus. Mostly student scored grade A in Mathematics by 60.42% and grade C+ (31.25%) for the Additional Mathematics. For Pre-Calculus, most student obtained grade B+ (22.92%). These give the highest percentage of mathematics performances for the three subjects. The grading range of Mathematics result was from A+ to B and only a few students obtained a C+ and C grade. While the range of Additional Mathematics (SPM) result was from C+ to F and only a few students score B above. Range result in Pre-Calculus are in between A and C. Only a few students score A+, D+ and E in Pre-Calculus.

**Table 1.** Percentage of Mathematics result performance.

| Grade | Mathematics (%) | Add. Math (%) | Pre-Calculus (%) |
|---|---|---|---|
| A+ | 12.50 | 0.00 | 2.08 |
| A | 60.42 | 0.00 | 16.67 |
| A- | 8.33 | 0.00 | 16.67 |
| B+ | 2.08 | 0.00 | 22.92 |
| B | 8.33 | 8.33 | 12.50 |
| B- | 0.00 | 0.00 | 16.67 |
| C+ | 2.08 | 31.25 | 4.17 |
| C | 6.25 | 12.50 | 4.17 |
| C- | 0.00 | 0.00 | 0.00 |
| D+ | 0.00 | 0.00 | 2.08 |
| D | 0.00 | 29.17 | 0.00 |

| | | | |
|---|---|---|---|
| E | 0.00 | 12.50 | 2.08 |
| E- | 0.00 | 0.00 | 0.00 |
| F | 0.00 | 6.25 | 0.00 |

Table 2 describes Pearson correlation analysis to identify the relationship between Mathematics and Pre-Calculus, Additional Mathematics and Pre-Calculus and Mathematics and Additional Mathematics. The findings showed that there were a significant correlation between the three courses i.e. the Mathematics at SPM level with Pre-Calculus ($r = 0.416$, $p = 0.003 < 0.05$), Additional Mathematics at SPM level and Pre-Calculus ($r = 0.385$, $p = 0.007 < 0.05$) and Mathematics SPM level with Additional Mathematics ($r = 0.591$, $p = 0.000 < 0.05$).

**Table 2.** Data analysis using Pearson correlation

| | | Mathematics | Additional Mathematics | Pre-Calculus |
|---|---|---|---|---|
| Mathematics | Pearson Correlation | 1 | .591** | .416** |
| | Sig. (2-tailed) | | .000 | .003 |
| | N | 48 | 48 | 48 |
| Additional Mathematics | Pearson Correlation | .591** | 1 | .385** |
| | Sig. (2-tailed) | .000 | | .007 |
| | N | 48 | 48 | 48 |
| Pre-Calculus | Pearson Correlation | .416** | .385** | 1 |
| | Sig. (2-tailed) | .003 | .007 | |
| | N | 48 | 48 | 48 |

** Correlation is significant at the 0.01 level (2-tailed)

From the above table, the determinant of correlation is calculated. The value of the relationship between Mathematics and Pre-Calculus is 0.1731, Additional Mathematics and Pre-Calculus is 0.1482 and the Mathematics and Additional Mathematics is 0.3493.

This means 17.31 percent of students are able to maintain the achievement of Mathematics with Pre-Calculus, 14.82 percent of students showed a significant relationship between the achievement of Mathematics and Additional Mathematics, 34.93 percent of students are able to maintain mathematical achievement with Pre- Calculus.

## 5. CONCLUSION

The results presented that there is a relationship between prior Mathematics performances with Pre-Calculus achievement at diploma level. Students who obtained good SPM results in Mathematics and Additional Mathematics will have better understanding and hence able to perform in Pre-Calculus. This study took a preliminary study of small group in advance of furthering to bigger and in-depth study. As conclusion, it is an advantage for students who have a strong prior Mathematics background to obtain good grades in Mathematics courses at diploma compare to other students who contended their calculus courses first time during their first semester in diploma.

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