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FIS STUDENTS' PERFORMANCE IN MATHEMATICS: COMPARISON BETWEEN SPM ADDITIONAL MATHEMATICS AND FIRST SEMESTER EXAM

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ABSTRACT

Mathematics teaching and learning encounter quite a big problem, especially at the tertiary level. The main concern always surrounds the students' achievement in the subject matter. Students' performance during the first semester of the foundation programme is reflected by the students' mathematical background prior to the admittance into the university. The study was carried out among 62 students that enrolled in the foundation in science programme in UCTS. Each student is given a pre-test at the beginning of the semester. The pre-test consisted of 10 mathematical questions which students have learnt before. From the results, 61% of these students failed. However, looking into their Sijil Pelajaran Malaysia (SPM) additional mathematics results, the majority of them getting a (24%). These students also took FIS1114 mathematics I during the first semester. At the end of the semester, the result of their FIS1114 mathematics I course was insignificant where the majority of the students failed and obtained pass grade which is below C+. The performance of these three mathematics results was being compared and studied.

Keywords: Mathematics, Additional Mathematics, pre-test, foundation programme, Student performance comparison.

INTRODUCTION

Mathematics is an essential subject that must be learned by most students starting from lower until higher education. Students understanding on basic knowledge of mathematics during primary and secondary school will be applied by them at the university. In the university level, most programs of study require Mathematics, as the ability to master mathematical skills is an important indicator of potential for students' success in all levels of academic endeavours. However, in schools and universities, we are seeing a declining number of Malaysian students taking science and mathematics. Academy of Science Malaysia reported there is less enrollment of science students in STEM studies, both at the higher secondary and tertiary levels. This problem is worrying as the nation will face a human capital shortage in the science field. One of the root cause leads to this declining trend is the fear of STEM subjects for being too tough and only meant for the good-result-students.

Research shows that students hold remarkable perceptions regarding the knowledge of mathematics and science from the secondary school, which can influence considerably on the achievement of the mathematics courses at the university. It is undeniable that students' prior knowledge and academic achievement which result from students' prior cognitive mathematical ability influence very strongly in their mathematics achievement. Therefore, students who came to university with a poor grade in Mathematics will have difficulty to master the subject even when they are facing easy topics within the subject.

Under Foundation in Science programme in School of Foundation Studies, University College of Technology Sarawak (UCTS), there are three mathematics courses that are

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compulsory for the students to take throughout one year of foundation programme. The courses are FIS1114 Mathematics I, FIS1124 Mathematics II and FIS1134 Mathematics III. The content of each course is shown in Table 1 below.

Table 1: Percentage of Mathematics result performance

Course	Content
FIS1114 Mathematics I	• Matrices (2x2) • Sequence and Series • Function and Graphs • Algebra
FIS1124 Mathematics II	• Differentiation • Integration • Trigonometry and its Application • Matrices (3x3) • Statistics
FIS1134 Mathematics III	• Vectors • Complex Number • Differential Equations • Taylor Series and Maclaurin Series • Numerical Methods

The aim of this study is to compare the performance of students in mathematics courses throughout their one year of foundation programme. Past years' results showed a high failure rate of mathematics courses. In order to improve the academic achievement of FIS students, this research serves as the starting effort to identify the problems and therefore find a solution to improve it.

LITERATURE REVIEW

The literature is designed to identify factors that exert some influence on students' performance in Mathematics subject. Among the factors identified as factors to the academic achievement are the prior academic achievement during secondary schools and strategies taken for students' improvement in Mathematics learning.

Prior academic achievement

Of all the constructs in the cognitive domain, the one considered the strongest predictor of academic success is the prior academic achievement which strongly influences students' mathematical ability. It is also reported that lack of basic skills and knowledge in Mathematics was one of the three major reasons for engineering students at the Norwegian University of Science and Technology to fail their Calculus course. Concisely, most high achievers in secondary Mathematics education did well in Calculus. A series of studies done on University of Technology Malaysia (UTM) students indicated that those who performed poorly in the first year Basic Mathematics and Basic Calculus examinations usually belong to the group that scores poorly in SPM Additional Mathematics or did not take the subject at all.

Strategies Taken for Students' Improvement in Mathematics Learning

Researchers and academicians everywhere around the world are implementing various strategies to address students' poor performance in Mathematics. In Singapore, a group of researcher from Nanyang Technological University [10] had suggested improvements on

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curriculum and teaching strategies, use of technology, infusing thinking and creativity, and provision of training as solutions to improve Calculus and Mathematics education. It is reported of students' development in Mathematical understanding through investigation and exploration tasks in the classroom by using a specific teaching unit which he had constructed. It is recommended that in order to help students to succeed in 'high-failure rate' Mathematics courses, the lecturers and the students should cooperate to overcome the arising problems which might prevent the students to succeed.

RESEARCH METHODOLOGY

This study started with the collection of relevant information to investigate students' mathematics performance in SPM (Sijil Pelajaran Malaysia) examination, pre-test and first semester FIS1114 Mathematics I exam. The population was targeted to the first semester Foundation in Science students in University College of Technology Sarawak which consists of 63 students enrolled in semester 1, 2018/2019 academic year.

The data were collected from both secondary and university sources. Data on students' secondary school were obtained from the student's past record. The students were asked to key in their results into a student's database system. Meanwhile, the pre-test was given to students at the beginning of the semester, upon entering into the foundation programme. There are many ways to evaluate the teaching and learning process. Pre-tests can also be used as a way to measure the depth of understanding of prerequisite materials [3]. The results of the pre-test can be used as an indicator to gauge students' ability to cope with all mathematical courses offered during the foundation programme as well as engineering technology courses at the degree level. The test consisted of 10 questions written in English and took approximately 45 minutes to complete. The questions were a combination of topics like basic algebra, trigonometry, and basic calculus.

The results for SPM mathematics were taken from Additional Mathematics exam, which a compulsory subject is taken by all science streaming SPM candidates and had the strongest influence on the course marks as compared to SPM Modern Mathematics grades [6]. FIS1114 Mathematics I course on the other hand is the first out of three compulsory mathematics courses offered in the Foundation in Science programme. The main course contents cover topics like algebra, sequence and series, matrices and functions. The course is taught for 14 weeks of instructions with a breakdown of 28 hours of lectures and 28 hours tutorials. The course work consists of 2 assignments worth 30%, mid-semester test worths 20% and final exam worths 50%, in which altogether make up to a total of 100% of the course marks. The results used in this study was the final exam results, which is the 100% total, obtained from the university database system.

Results were analysed and compared quantitatively using percentage based on the students' performance in these three mathematical results.

RESEARCH FINDINGS

This study revealed that there is a significant difference in the performance of the students for the three mathematics results. The overall results of mathematics achievements are shown in Table 2 below.

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Table 2: Percentage of Mathematics result performance

Grade	SPM (%)	Pre-Test (%)	FIS1114 (%)
A+	4.84	1.61	0.00
A	24.19	0.00	8.06
A-	12.9	0.00	1.61
B+	14.52	1.61	9.68
B	9.68	3.23	12.9
B-	0.00	6.45	9.68
C+	9.68	6.45	19.35
C	8.06	19.35	17.74
F	16.13	61.29	20.97

As shown in Table 2 above, the highest percentage of mathematics performances for three different categories are an A grade for the SPM Additional Mathematics exam (24.19%), an E grade for the pre-test (61.29%) and an F grade for FIS1114 Mathematics I (20.97%). Based on the SPM result, we can conclude that students' prior knowledge of mathematics during secondary school is very good. It is expected that the results for pre-test showed otherwise as approximately 61% of the students failed this test (F grade). However, FIS1114 Mathematics I course still showing a passing rate above 70% although approximately 21% of the students failed (F grade).

One of the reasons why these results turned out the way they were, perhaps, the nature of the SPM exam is that the two years duration of mathematics learnt during Form Four and Form Five will be tested at the end of the two years of study. During this period, students had enough time to fully understand the subject matter and would be able to make good preparation for the SPM examination.

After the SPM examination, there were approximately five months long break before the students enrolled in the foundation programme. The pre-test was carried out to see their mathematics competency in answering fundamental mathematics questions that they had learnt before. As expected, the majority of them failed the test, that is, 61% obtained F grade. It is due to the majority of the students had forgotten what they had learnt before, even though the majority obtained A in the SPM Additional Mathematics examination.

As for FIS1114 Mathematics I, the results is not normal especially for students that are going to enter an engineering degree programme although the passing rate is above 70%. This course runs for 14 weeks with two assignments and one midterm test to help the students master the subject matter prior to the final examination. The breakdown assessments for the course is 50% coursework and 50% final examination. By the time the students sat for the final examination, the knowledge of what they have been taught should not be forgotten. According to the feedback given by the lecturer, the students showed less effort and considered tutorial is unimportant. Sometimes, students paid insufficient attention during class.

Figure 1 and Figure 2 shows the histogram and a line graph of the mathematics performance in three categories respectively. The patterns show a very significant abnormality in both pre-test and FIS1114 Mathematics I where the graph is skewed to the left.

The results also show a very significant difference between the SPM Additional Mathematics, pre-test and FIS1114 Mathematics I results. Most of the students obtained an F grade in their pre-test as well as FIS1114 Mathematics I and it contradicted to their SPM

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results. In SPM Additional Mathematics, most of them obtained A grade. One of the reasons was that the students were trained to answer a lot of past years' SPM questions for a few months, right before the SPM examination. Their minds and memory were not being interfered by other stuff which might cause the recollection of memories of what recently taught would gone [5], right before the examination.

Figure 1: Histogram for mathematics performance comparison between SPM Additional Mathematics, pre-test, and FIS1114 Mathematics I

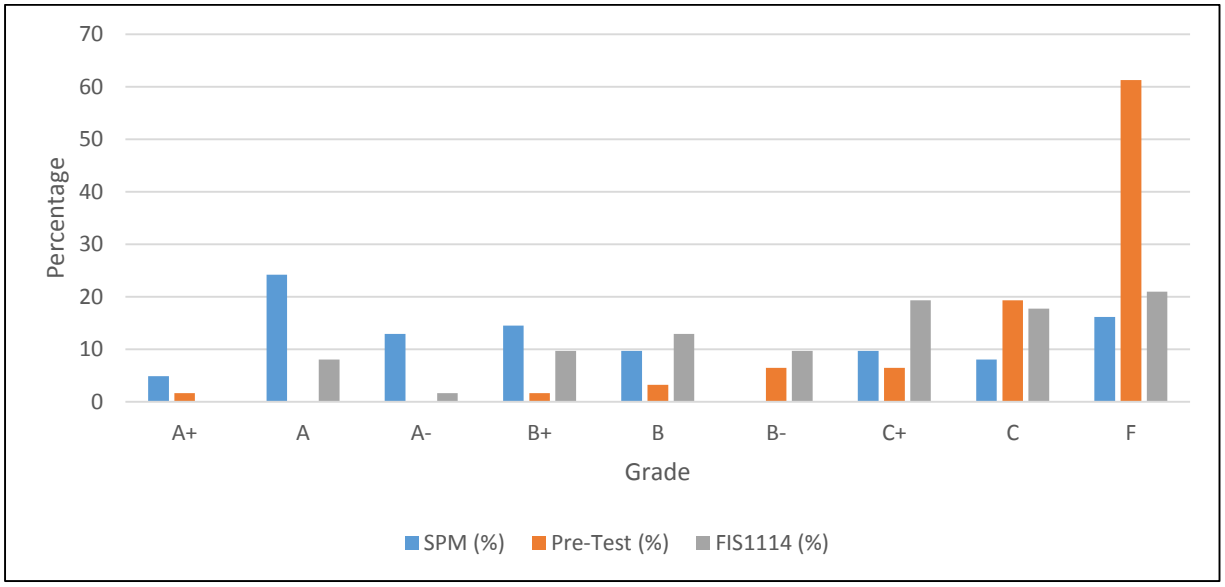
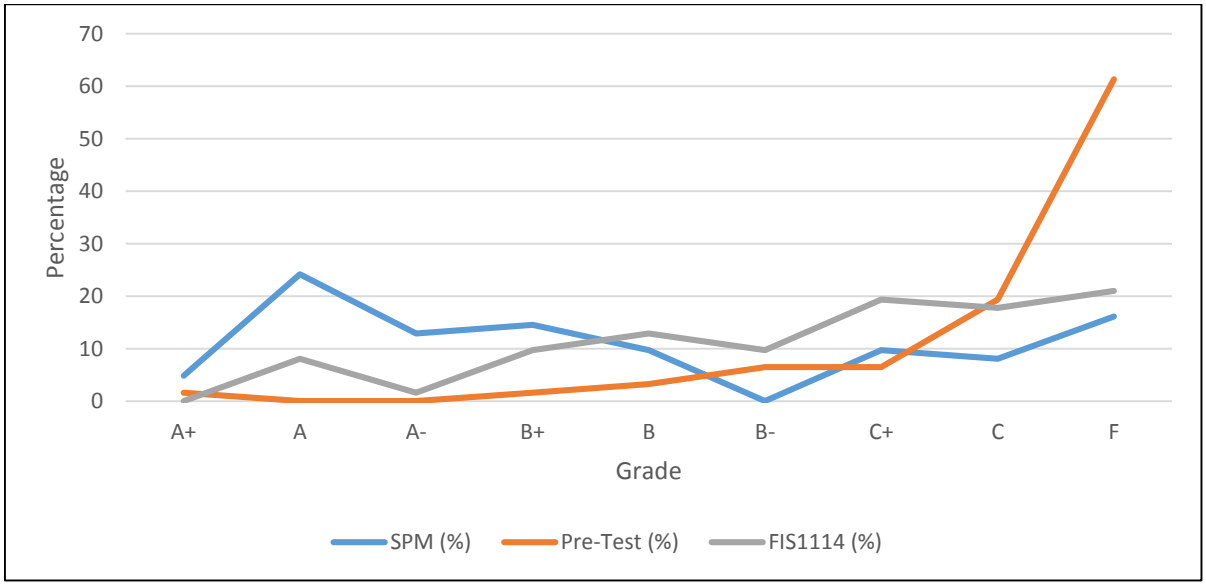


Figure 2: Line graph for mathematics performance comparison between SPM Additional Mathematics, pre-test and FIS1114 Mathematics I



The pre-test was given to students upon entering the foundation programme which after students had quite a long break in between. The main reason why the majority of the students failed the pre-test is due to the loss of short term memory of the mathematical knowledge learnt before. However, the performance results of FIS1114 Mathematics I was alarming. The results

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obtained at the end of the semester should show improvement as the students were started to learn again, doing all the assignments and tutorial questions before sitting for the final examination. The process was similar to the students' preparation before sitting for SPM. Thus, most of the mathematics educators at the tertiary level have always questioned the validity and the reliability of the SPM results.

Table 3: Mean and standard deviation of mathematics performance

	SPM	Pre-Test	FIS1114
Mean	2.80	0.92	2.16
Standard deviation	1.38	1.21	1.24

Table 3 represents the mean and standard deviation of mathematics achievements based on SPM Additional Mathematics, pre-test and FIS1114 Mathematics I examination results. These mean and standard deviation were calculated based on the grade point score for every grade in the grading system as shown in Table 4 below. From Table 3, the mean for SPM Additional Mathematics, pre-test, and FIS1114 Mathematics I examination results was 2.80, 0.92 and 2.16 respectively. For SPM Additional Mathematics results, the mean score reflected the majority of students obtained a range of B- to B grade, which is credit. The mean score of pre-test results suggested that the majority of the students failed this test because the value of the mean score would reflect F grade which is less than 2.00.

Meanwhile, the mean score of FIS1114 Mathematics I examination results suggested that the range of grade is barely C which is just passing.

Table 4: Grading system used in Foundation in Science programme of UCTS

Mark	Grade	Point Value	Status
90 – 100	A+	4.00	Excellent
80 – 89	A	4.00	
75 – 79	A-	3.67	
70 – 74	B+	3.33	Credit
65 – 69	B	3.00	
60 – 64	B-	2.67	
55 – 59	C+	2.33	Pass
50 – 54	C	2.00	
0 – 49	F	0.00	Fail

CONCLUSION AND RECOMMENDATIONS

In this paper, we just analysed and compared the data from SPM Additional Mathematics, pre-test and FIS1124 Mathematics I. The conclusion at this stage of the study is still varied and inconclusive to make any conclusion on the performance of the students and the factors influencing the performance. Further investigation and data collecting are needed, especially examination grades from FIS1124 Mathematics II and FIS1134 Mathematics III that may enhance the findings of this study. These two courses will be offered in the next two semesters. The results of this study highlight the fact that most of the students are still weak in the certain topics in FIS1114 Mathematics I. Improvement plan such as to conduct remedial mathematics course was offered to students apart from encouraging students to spend more time to do tutorial questions provided.

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