International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 05, 2020
ISSN: 1475-7192

Significance of SPM Additional Mathematics and Physics toward Engineering Diploma Student's Performance at PPD Space

Sahnius Usman, Norhaslinda Harun, Nurul Aini Bani,
Hazilah Mad Kaidi, Siti Armiza Mohd Aris, Siti Zura A. Jalil and
Mohd Nabil Muhtazaruddin

Abstract--- *Additional Mathematics and Physics are among SPM subjects that have great influence on engineering. The continuity of these two subjects can be seen in the courses offered each semester in the Engineering Diploma Program at PPD, SPACE. Students' ability to master the knowledge of Additional Mathematics and Physics greatly helps in decision making while continuing their study at PPD, SPACE. This is agreement with the aim of the Engineering Department to produce students with the Cumulative Grade Point Average (CGPA) of over 3.00 to enable them to continue with bachelor study as well as competing in job market. The results suggest that students' performance in engineering programs depends on the SPM results they have obtained. It is possible that students who scored A and B have higher CGPA compared to those with C for Additional Mathematics and Physics. Between these two SPM subjects, a study will be conducted to see which subject has higher impact onto students' performance*.

Keywords--- *Additional Mathematics, Physics, Academic Performance, Cumulative Grade Point Average (CGPA) and Diploma Engineering Students.*

I. INTRODUCTION

A diploma program is one of the pathways for students to pursue their undergraduate study post matriculation and Higher School Certificate or Sijil Tinggi Pelajaran Malaysia (STPM). Center for Diploma Studies, School of Professional and Continuing Education ((PPD SPACE), offers 5 Diploma Programs in engineering; Diploma in Electrical Engineering (Power) (DDWK), Diploma in Electronic Engineering (DDWE), Diploma in Electrical Engineering (Mechatronics) (DDWB), Diploma in Civil Engineering (DDWA) and Diploma in Mechanical Engineering (DDWJ). Apart from polytechnics and UiTM, PPD SPACE is another preferred choice for SPM holders to pursue their study in Diploma Engineering Programs since this center is located in the heart of Kuala Lumpur. In addition, UTM's reputation as a premier university in engineering studies is also a contributing factor for PPD SPACE to be the first choice.

The curriculum designed for each diploma engineering program is a continuation of the Additional Mathematics and Physics at SPM level, therefore, only students who take both subjects can apply for the engineering program at

Sahnius Usman, Senior Lecturer, PPD, SPACE, Universiti Teknologi Malaysia, Malaysia.
Norhaslinda Harun, Senior Lecturer, PPD, SPACE, Universiti Teknologi Malaysia, Malaysia.
Nurul Aini Bani, Senior Lecturer, Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia, Malaysia.
Hazilah Mad Kaidi, Senior Lecturer, Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia, Malaysia.
Siti Armiza Mohd Aris, Senior Lecturer, Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia, Malaysia.
Siti Zura A. Jalil, Senior Lecturer, Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia, Malaysia.
Mohd Nabil Muhtazaruddin, Senior Lecturer, Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia, Malaysia.

DOI: 10.37200/IJPR/V24I5/PR2020233
Received: 14 Mar 2020 | Revised: 30 Mar 2020 | Accepted: 06 Apr 2020

PPD SPACE. The admission requirement for the Diploma Engineering Program is that student must at least achieve credits for six subjects which are Bahasa Melayu, English, Mathematics, Additional Mathematics, Physics and any other SPM elective subject [1].

Research works have discovered that mathematics skills and mastery have an impact on students [4]. Although not many studies have been conducted on Mathematics decisions before entering university, there are several studies related to Mathematics subjects at university and related to the performance of engineering students [6]. A study conducted by [6] found that Level 1 and Level 2 Mathematics during the 1st year of study at Moratuwa University, Sri Lanka, influenced student achievement in the subjects of Level 2 Engineering, Bachelor of Chemical Engineering and Process Engineering. A study by [5] found that the pretest conducted in the first semester of engineering study at Faculty of Engineering and Built Environment (FKAB), UKM had a significant impact on the Linear Algebra course. The first year students are required to sit for a diagnostic test which is called a pre-test that contains all basic mathematics questions and the purpose of this test is to examine the level of understanding among the first year students toward the basic knowledge of mathematics that they have learnt during pre-university and secondary school. This test is performed at the beginning of the first semester each year or each academic session. There are total of six mathematic courses that are compulsory for the students to take as their faculty subject throughout their years of studies: Linear Algebra, Vector Calculus, Ordinary Differential Equation, Engineering Statistics, Statistics and Numerical Method (for engineering students Electrical and Electronics only) and Complex Analysis (for Electrical and Electronics engineering students only).

A study by [4] have concluded that there is a strong relationship between SPM grades for the subjects of Additional Mathematics, Physics, Chemistry and Biology with engineering students' performance at INTI Penang International College. In this study, student performance was assessed using cumulative average (CAVG). Physics Grade is the highest correlation factor for student achievement while Extra Mathematics has higher correlation factor than Mathematics.

A study conducted by [7] found that SPM Additional Mathematics is one of the strongest influences of high-failure rate for four different mathematics course marks, MAT133, MAT183, MAT192 and MAT293 for Diploma students in UiTM Sarawak.

The data collected from Heads of Program and the Academic Affairs Division (HEA) and were the final examination reports of the Mathematics courses from semester January-May 2004 to semester January-May 2007, and the data were analyzed using SPSS. The finding showed that students having learned only SPM Mathematics would not enough mathematical background for studying high level mathematics at university level.

A study of entry qualification effect on the academic performance of university diploma students has been carried by [8]. The study involved comparison of two entry qualifications; SPM and certificate, and found a significant difference. Data of academic performance (CGPA) and completion time (total semester graduate) from total of 264 students from Diploma of Engineering Technology in Quality Engineering (DQE) and Diploma in Industrial Logistics (DIL) of UniKL MITEC has been analyzed using SPSS. All students are from cohort of September 2008 until January 2011. Studies conducted by [3] among polytechnic students have found that SPM

DOI: 10.37200/IJPR/V24I5/PR2020233
Received: 14 Mar 2020 | Revised: 30 Mar 2020 | Accepted: 06 Apr 2020

student' decisions on Mathematics subjects influence student performance on Mechanical Structures subjects for students pursuing civil engineering

II. RESEARCH OBJECTIVES

The main objective of the study is to investigate the relationship between students' achievement in SPM Additional Mathematics and Physics with students' achievement in pursuing diploma in engineering programs at PPD SPACE, UTM.

III. METHODOLOGY

This study employs quantitative research approach. Statistical analysis of numerical data was done to deduct a conclusion in explaining the issue studied. A total of 483 engineering students from Year 1 to Year 3 were involved in this study and they were divided into each group of their year of study accordingly. The study was conducted using students' SPM results for Additional Mathematics and Physics as well as their CGPA for Semester 2 20182019. Data was analyzed using SPSS version 16 involving ANOVA and factorial ANOVA. In this study, ANOVA was performed to study the equality of mean for students' academic performance in the term of their CGPA. SPSS software program (SPSS 16) was used to perform the statistical analysis. Assumptions were made for conducting the ANOVA. These were: (i) approximately similar group size, (ii) independently observations and (iii) approximately normal distribution of dependent variable. To study the effect of Physics and Additional Mathematics grade toward academic performance, factorial ANOVA was performed. Assumptions were made in conducting the factorial ANOVA, which included: (i) approximately normal distribution of dependent variable, (ii) equal variances, and (iii) independently observations for each group. A significant level of p-value < 0.05 was considered to be statistically significant with 95 per cent of confidence level in comparing mean between the groups and the width of 95 per cent confidence interval (CI).

IV. RESULTS AND DISCUSSION

A total of 483 engineering students' data has been used in this study. In analysing the equality of mean for academic performance, the students were divided into 3 groups which were Group A involved students who had A+, A, and A–. Whereas, Group B involved students who had B+, B, and B– and Group C involved students who had C+, C, and C– in Additional Mathematics and Physics in SPM. Table 1 shows the number of students for each group for Additional Mathematics and Physics. Figure 1 (a) and (b) show the number of students based on year distribution for Group A, Group B and Group C for Additional Mathematics and Physics respectively.

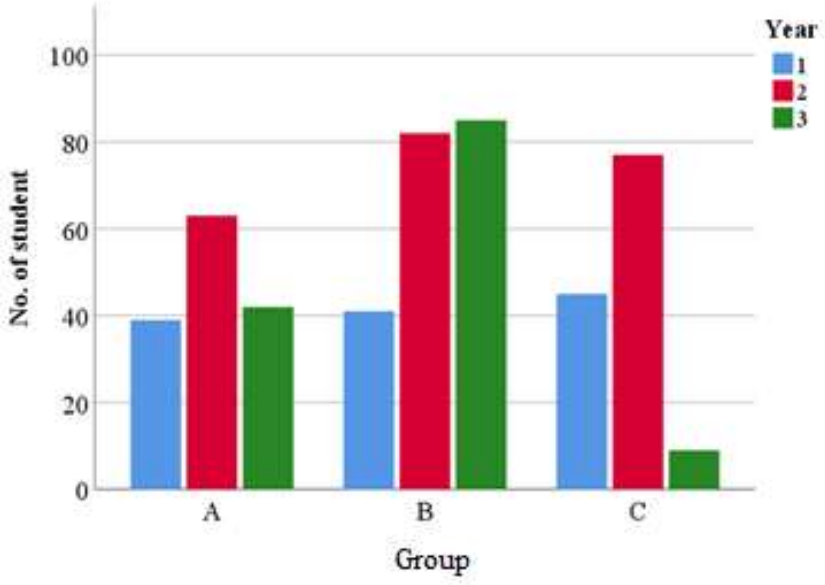
Table 1: Number of Student for Each Group for Additional Mathematics and Physics

	Group		
	A	**B**	**C**
Addmath	144	208	131
Physics	158	249	76

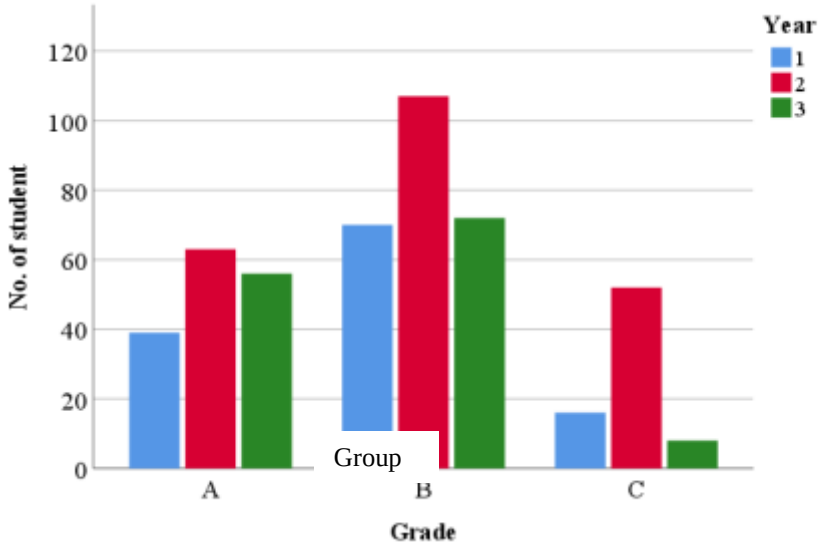
For Additional Mathematics, it shows that there was a statistically significant difference of students' academic performance (CGPA) between Group A, Group B and Group C, $F=13.159$, $p<0.001$. Based on the post hoc test, the result shows that students in Group A of Additional Mathematics had significantly higher CGPA than those in

DOI: 10.37200/IJPR/V24I5/PR2020233
Received: 14 Mar 2020 | Revised: 30 Mar 2020 | Accepted: 06 Apr 2020

Group B and Group C. Similar to Physics, it shows that there was a statistically significant difference of students' academic performance between Group A, Group B and Group C, F= 34.645, p<0.001. According to the post hoc test, the result shows that students in Group A of Physics had significantly higher CGPA than those in Group B and Group C. Based on Table 2, the mean of CGPA for Group A is statistically higher than students with Group B and Group C.



(a)



(b)

Figure 1: Distribution of Student based on Year of Study for (a) Additional Mathematics and b) Physics

DOI: 10.37200/IJPR/V24I5/PR2020233
Received: 14 Mar 2020 | Revised: 30 Mar 2020 | Accepted: 06 Apr 2020

Table 2: Mean and Standard Deviation of CGPA for Each Group of Additional Mathematics and Physics

	SPM Group Grade						p-value
	A		B		C		
	Mean	SD	Mean	SD	Mean	SD	
Addmath	3.536	0.366	3.352	0.351	3.124	0.457	<0.001
Physics	3.518	0.374	3.318	0.399	3.073	0.391	<0.001

Based on Table 3, there is a significant main effect for the Additional Mathematics grades, F (2, 474) = 8.212, p<0.001, partial eta2 = 0.033. Similar to Physics grades, there is a significant main effect towards students' academic performance, F (2, 474) = 6.968, p<0.001, partial eta2 = 0.029. In contrast, there is no significant interaction between the effects of Additional Mathematics grades and Physics grades on students' academic performance, F(4, 474) = 0.632, p = 0.64. According to Figure 2, for those who in Group A in Additional Mathematics during SPM have higher academic performance than those with Group B and Group C. Students with Group A in SPM Physics have better academic performance than those in group B and group C regardless of grade Additional Mathematics. Thus, it can be said that both subject's grades and not their combination can affect the student's academic performance during their diploma study.

Table 3: Two Way ANOVA for CGPA as a Function of Additional Mathematics and Physics Grades

Variable	df	Mean Square	F	η^2	eta	p-value
CGPA						
Addmath grades	2	1.184	8.212	0.033	0.18	<0.001
Physics grades	2	1.004	6.968	0.029	0.17	0.001
Addmath*physics	4	0.091	0.832	0.005	0.07	0.640
Error	474	0.144				

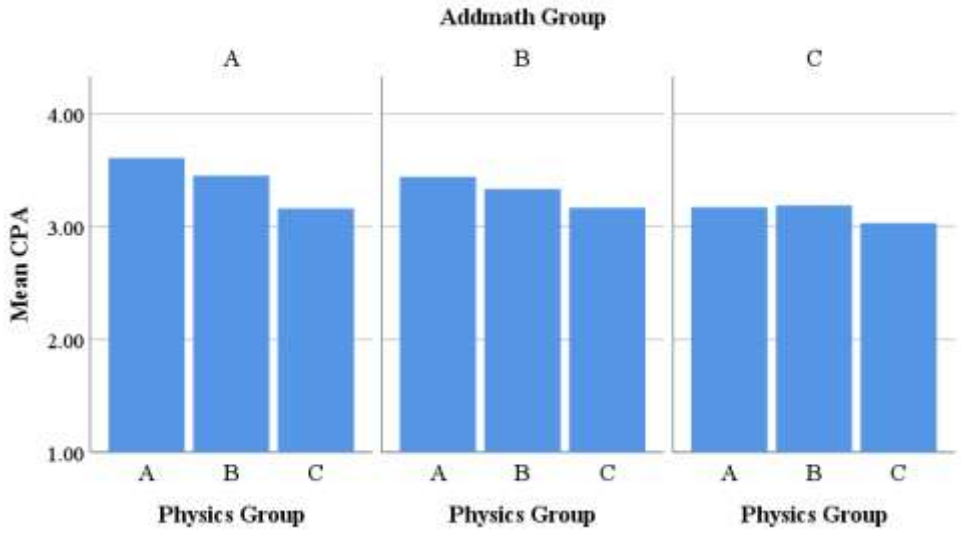


Figure 2: Mean CGPA for Each Group of Physics Referring to Group of Additional Mathematics

Statistical analysis has been done to identify the relationship between SPM grades and academic performance among PPD SPACE engineering students in studying in the diploma program.

Analyses have been conducted for SPM Additional Mathematics and Physics and for each subject, students were

DOI: 10.37200/IJPR/V24I5/PR2020233
Received: 14 Mar 2020 | Revised: 30 Mar 2020 | Accepted: 06 Apr 2020

divided into three groups which were Group a, Group B and Group C. According to the findings, there was a statistically significant difference in students' academic performance (CGPA) between Group A, Group B and Group C for both SPM subjects. The findings show that group A for both SPM subjects, has higher CGPA performance than Group B and Group C as supported by [4].

This might be due to the close relationship between courses offered in the Engineering Program and Additional Mathematics and Physics. It also shows that courses offered in the Engineering Program are extension of Additional Mathematics and Physics. Therefore, a strong fundamental knowledge on both subjects benefits the students.

Based on Table 2, the mean score of CGPA for all groups in Additional Mathematics is higher than those groups in Physics. This shows that Additional Mathematics has more impact onto students' academic performance. The mean score of CGPA gradually decreases and this means that there is a possibility for students who had D grade in Additional Mathematics to achieve CGPA of 3.00. Table 3 demonstrates that there is no significant association between the effects of Additional Mathematics grades and Physics grades onto students' academic performance. This suggests the entry requirement can be revised; students who have Group C in Additional Mathematics and Physics in SPM can be considered to enroll in the Engineering Programs.

V. CONCLUSION

In a nutshell, this study discovers that students who scored A grade in Additional Mathematics and Physics in SPM have better academic performance in the Engineering Programs at PPD SPACE, UTM. However, those who had C grade for Additional Mathematics show similar CGPA performance to those from all categories of grades for Physics.

ACKNOWLEDGEMENT

The authors would like to express gratitude to the Ministry of Education, Malaysia, Universiti Teknologi Malaysia and UTMSPACE for funding this project (Vot. No. Q.K130000.3556.06G43, Vot. No. SP-PDF1901)

Source of Funding: Research Grant Scheme (Vot. No. Q.K130000.3556.06G43), (Vot. No. SP-PDF1901).

Conflict of Interest: NIL

Ethical Clearance: NIL

REFERENCES

[1] PPD, SPACE online available from https://www4.utmspace.edu.my/centre-for-diploma-studies
[2] Siti Aisyah Zakaria, Syafawati Ab. Saad and Nor Hizamiyani Abdul Azziz, Performance of Undergraduate Engineering Students in Mathematics According to Gender, *AIP Conference Proceedings*, 1750 (04002), pp. 1-5, 2016.
[3] Amran Ab. Ghani and Rozlini Mohamed, The Effect of Entry Requirement for Civil Engineering Performance, *Journal of Science and Technology*, Vol. 9, No. 4, pp. 44-49, 2017.
[4] H. T. Adele, Kam, P.C. Ch'ng, Predicting Academic Performance of Engineering Diploma Students, *Proceedings of the 2nd International Conference of Teaching and Learning (ICTL)*, 2009.
[5] Arzilah Ismail, Zulkifli Mohd Nopiah, Izamarlina Asshaari, Haliza Othman, Norngainy Mohd Tawil and Azami Zaharim, Mathematical Performance of Engineering Students in Universiti Kebangsaan Malaysia (UKM), *Procedia-Social and Behavioral Sciences*, Vol. 60, pp. 206-211, 2012.

DOI: 10.37200/IJPR/V24I5/PR2020233
Received: 14 Mar 2020 | Revised: 30 Mar 2020 | Accepted: 06 Apr 2020

[6] K.A.D.S.A. Nanayakkara and T.S.G Peiris, Identifying the Influence of Mathematics on Academic Performance of Engineering Students, *Moratuwa Engineering Research Conference (MERCon),* pp. 247-252, 2017.

[7] Tang Howe Eng, Voon Li Li and Nor Hazizah Julaihi, A Case Study of 'High-Failure Rate' Mathematics Courses and its' Contributing Factors on UiTM Sarawak Diploma Students, *Conference on Scientific and Social Research (CSSR 08'09),* 14-15 March 2009.

[8] Rohana Yusof, Hawa Tamat, The Effect of Entry Qualification on The Academic Performance of University Diploma Students: A Comparative Study Between Sijil Pelajaran Malaysia or Malaysian Examination Certificate (GCE O Level Equivalence) and Certificate Entry Qualification, *International Conference on Education, Social Sciences and Humanities (SOCIOINT15),* June 2015.

DOI: 10.37200/IJPR/V24I5/PR2020233
Received: 14 Mar 2020 | Revised: 30 Mar 2020 | Accepted: 06 Apr 2020