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Achievement in college mathematics: past effect analysis

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ABSTRACT

Investing in education is imperative in this knowledge based economy to sustain a competitive edge. As we are aware, the higher education level is a significant factor for a long term economic growth. To ensure students' are well equipped with the foundation for a higher level, a proper transition from primary right up to tertiary is crucial. In retrospect, poor achievement in higher learning institution has been an invariable issue and has drawn the attention of the higher learning institution, especially in numerical subjects like the College Mathematics. Although research of the higher learning institution places emphasis on classroom intervention to enhance students' achievement, a study in the phenomenon from the perspective of course setting of the high school level mathematics education as reason behind poor performance in college is also vital. The aim of this study was to investigate the influence of students' performance in high school Mathematics on students' academic performance in College Mathematics. The respondents of this study were the students from a private college. This study revealed that performance in high school Mathematics has an association with student's performance in College Mathematics, while gender and medium of study act as moderators.

Introduction

Mathematics helps nurture the mind to reason and organized problems into simple, clear and logical steps. The smooth progression from on level of learning to another depends on the vigor and foundation of knowledge gained from the first level. As of late, there has been a concern regarding the students' performance, especially the weaker ones, in the higher learning institutions focusing on Mathematics. Consequently, many methods had been adopted to cater for these students by the teachers. Crawford, Gordon, Nicholas and Prosser (1998) found that the prior conception of the nature of the subject ultimately lead to improvement in the quality of students learning outcome in the higher learning institution.

A study by Bamforth, Robinson, Croft and Crawford (2007) revealed that the level of preparedness of students for the mathematical demand of their courses offered in the higher learning institutions seems to be deteriorating. This leads to students being unaware of the disparity between skills and expected tertiary requirements (Farran (2007)). A strong foundation in Mathematics will allow students to grasp knowledge at a faster pace. Sanoff (2006) found that one of the problems faced by academicians in the higher learning institutions is that they have to backtrack and polish students' basics before proceeding with the substance of the higher learning syllabus. This eats into the time allocated thus limiting the subject content delivery. In order to eradicate this problem, the knowledge from High school level must be hefty.

McDonald (2008) indicated that students with low grades at high school subjects tend to have corresponding low grades in their tertiary education and vice versa. This is consistent with the study done by Fan, Li and Niess (1998) who found that a low college entrance examination scores has a significant correlation in the performance in college studies. College entrance examination is an indicator of the knowledge gained in high school level. Students' foundation in mathematics is essential for a smooth progression and a high quality performance in the higher learning institutions as it will provide them with sufficient skills when they venture in their respective career path.

College Mathematics is one of the core subjects in the most tertiary level education. As such, this study aims to examine whether the grades for high school mathematics would serve as a predictor for the mathematics' achievement at college level. Once the association is statistically proven, it is believed that teaching strategies which take the diverse backgrounds of students into consideration would help to achieve better results. On the same token, this study also examines the influence of gender and Advanced mathematics on the mathematics' achievement at college level.

This study aims to answer the following questions:

1. Does students' achievement in college level mathematics depends on their high school mathematics grades?
2. Is there a difference in the performance of high school mathematics between students who had completed the advance mathematics and those who had not?
3. Does gender influence the performance of mathematics at both high school and college level?
4. Does the language used to teach mathematics at high school level influence the performance of students in their college level mathematics?

Method

The participants included in this study were a sample of 1028 students (492 males and 536 females). The participants were selected on the basis of availability of their academic records for both College mathematics and High School Mathematics examinations results. A number of students (857 students) took advanced mathematics in High school as an optional subject. Students who completed their high school

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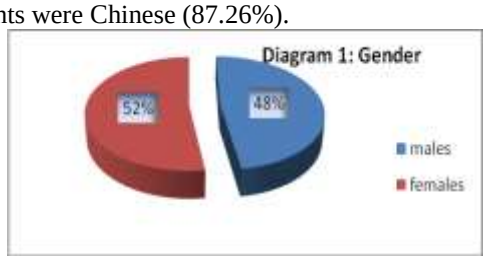
mathematics and Advanced mathematics in the English medium represented 26.3% (270 students) of the participants of this survey while the rest did it in Bahasa Malaysia. The Statistical Package for the Social Sciences (SPSS) was used for data analysis.

Findings

There were a total of 1028 respondents of which 492 (48%) were males and 536 (52%) were females. The majority of the respondents were Chinese (87.26%).



The grade distributions of these respondents were as given in Table 1. Almost 84% of the respondents took advanced mathematics in high school and 11.6% of them failed the paper. As for High School Mathematics, 96.3% passed the paper. On the other hand, almost 1/3 of the respondents failed College Mathematics. To further analyze these results, a cross tabulation was done as shown in Table 1.

A significant association between College mathematics and High School Mathematics has been established as shown in Table 2. An examination of the cross-tabulation between the two variables below resulted in the findings that HD (High Distinction) and D (Distinction) achievers are mostly made up of those who obtained grade A for High School Mathematics (41.73%). The strength or degree of association between College mathematics and High School Mathematics was found to be moderate at C = 0.551.

College mathematics' grades were significantly associated with whether or not students had taken advanced mathematics at high school level. The cross tabulation in Table 3 indicated that students who had completed the Advanced mathematics at high school tended to do better than those who had not done the same subject.

The Pearson Chi-Square results, as shown in table 4, indicated that there exist a significant association between gender and the performance of students in both High School Mathematics and Advanced mathematics. The findings also showed that there are more female than male who scored A1 in both Modern and Advanced mathematics. The strength of association between gender and any of the two mathematics subjects is about 0.2.

The result of the t-test in Table 5 showed that College mathematics results differ by gender. The mean score for males and females are significantly different (p = 0.001) which indicates that females perform better in College mathematics as compared to the males.

Results from Table 6 established a significant association between the language used to teach mathematics at high school level and the performance of College mathematics. The findings showed that most participants of this study learned mathematics in Bahasa Malaysia at the high school level (73.7%). However, the performance of those students who learned high school mathematics in English medium fared better than those who learned the same subjects in Bahasa Malaysia. Specifically, 24.9% of those who was taught in Bahasa Malaysia obtained HD for College Mathematics as compare to 34.1% of those who learned through English.

Discussion

The findings from this study identify several factors that were significantly related to the grades performance in mathematics. First, the High School Mathematics and Advanced mathematics grades were associated to the performance of College mathematics. The results are consistent with similar studies which found that academic background influences students' future achievement in the nature of the subject matter that they are studying. (Fan et al. 1998; House, 2000; Smith and Schumacher, 2005) The finding suggested that students who enrolled in the program with a certain level of knowledge in advance mathematics tended to perform better in College mathematics due to some similarities in the syllabus covered.

Second, for both high school and college level mathematics, the performance of female students was better than male students. Gender differences in Mathematics achievements have been widely studied. While this study found significant differences in the performance of females and males in high school as well as college mathematics, many other similar studies reported conflicting findings. (House, 2000; Thompson, 2001; Tsui, 2007) These studies have attributed gender differences in mathematics to social and environmental factors that position a different expectation for males and females.

Third, the medium used to deliver the mathematics subject at high school level is found to be related to students' achievement in the College mathematics. Students who learnt the high school mathematics in English medium achieved better grades than those who learnt the same subject in Bahasa Malaysia. One reasonable explanation for this is that students who learnt mathematics in English medium were able to understand a particular mathematical problem better because they were more familiar with the mathematical terms and language used as compared to their peers who learnt it in Bahasa Malaysia. So, this study suggested that language could be a contributing factor for students not being able to perform in college level mathematics.

Students who did not do well for their school mathematics are generally those who believed that mathematics is unimportant, and are likely to avoid the study of mathematics. It is these students who struggle at college level as they suddenly realize how important mathematics is for their chosen course. These students often have a very low confidence in their mathematical abilities which extends as far as them saying 'we can't do mathematics!' Due to this, the main emphasis of teaching has to be diverted from teaching the mathematics concepts to giving students the confidence in their mathematical skills. It is thus important to design mathematical lessons that will result positive experience and emphasizes that everyone makes mistakes.

Identifying the shortcoming of the high school in preparing students sufficiently for the progression into the higher learning institutions should be looked into. This must start from the stem of the problem, which is the lower and higher secondary. Considering English to be the choice of language in schools would ensure a smooth learning process among students. Thus, creating marketable students with wider job scope to seek into once graduate.

The present study has several limitations. This study was based on the high school grades instead of the raw scores. If the raw scores were made available, a more rigorous study could have been carried out to examine the predictive ability of the high school mathematics grades. The change of medium from

Bahasa Malaysia to English involved a change in the syllabus of high school mathematics, which was not taken into consideration in this study. Therefore, future research should be conducted to determine if similar results can be found if the changes in syllabus are considered.

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Table 1: Grades distribution (%) for High School Mathematics, Advanced mathematics and College Mathematics

High School Level	Sample Size	A (75-100)	B (65-74)	C (50-64)	D (40-49)	E (30-39)	G (less than 29)
High School Mathematics	1028	70.4	16.2	9.6	3	0.7	0
Advanced mathematics	857	38.6	21.2	20.5	8.1	8.4	3.2
College Level	Sample Size	HD (80-100)	D (70-79)	C (60-69)	P (50-59)	F (less than 50)	-
College Mathematics	1028	27.3	16.1	12.3	14	30.3	-

Table 2: Results of the Chi-Square Test between College mathematics and High School Mathematics

		College Mathematics Grade					
		HD	**D**	**C**	**P**	**F**	**Total**
High School Math	A1	263	141	76	63	65	608
	A2	12	13	21	24	46	116
	B3	3	3	11	24	43	84
	B4	0	6	10	16	51	83
	C5	1	3	4	9	35	52
	C6	1	0	2	5	39	47
	D7	0	0	1	3	27	31
	E8	1	0	1	0	5	7
Total		281	166	126	144	311	1028

ChiSq = 448.78, df = 28, p = 0.0001, C = 0.551

Table 3: Results of the Chi-Square Test between College Mathematics and students who had/had not taken the advanced mathematics

	College Mathematics Grade					Total
	HD	**D**	**C**	**P**	**F**	
Had not taken Advanced mathematics	4	11	20	27	109	171
Had taken Advanced mathematics	277	155	106	117	202	857
Total	281	166	126	144	311	1028

ChiSq = 135.434, df = 4, p = 0.0001, C = 0.341

Table 4: Result of Chi-Square Test between High School Mathematics, Advanced mathematics and Gender

High School Mathematics				Advanced mathematics		
	Male	Female	Total	Male	Female	Total
A1	246	362	608	73	154	227
A2	59	57	116	44	60	104
B3	48	36	84	34	52	86
B4	49	34	83	49	47	96
C5	43	9	52	57	50	107
C6	29	18	47	35	34	69
D7	13	18	31	40	29	69
E8	5	2	7	51	21	72
G9	0	0	0	22	5	27
Total	492	536	1028	405	452	857
Chisq = 51.7, df = 7, p = 0.0001, C = 0.219				Chisq = 58.881, df = 9, p = 0.0001, C = 0.233		

Table 5: Results of independent t-test on Gender and College mathematics results

Gender		N	Mean	Std. Dev.	t	df	p-value
College mathematics Result	Male	492	56.13	24.329	-7.20	1026	0.001
	Female	536	66.41	21.458			

Table 6: Results of the Chi-Square Test between College mathematics and students who had/had not learnt mathematics in English at the high school level

		College Mathematics Grade					Total
		HD	D	C	P	F	
Language	learnt Math in Bahasa Malaysia	189	125	94	106	244	758
	learnt Math in English	92	41	32	38	67	270
Total		281	166	126	144	311	1028

Chisq = 9.924, df = 4, p = 0.042, C = 0.098