

Exploring Factors Contributing to Weak Math Skills in Saudi Engineering Undergraduate Students and their Influence on the Students' Study Achievements

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Abstract: Education is currently one of the most important development aspects in Saudi Arabia. The government of Saudi Arabia under the instruction of the custodian of the two Holy Mosques King Abdullah Al-Saud, has allocated enormous budgets for citizens education within the kingdom and abroad. The number of Saudi universities has increased dramatically from 10 universities in the year 2000 to 42 universities in the year 2021 (30 Governmental Universities and 12 Private Universities) plus 13 separated Governmental and Private colleges and 7 Military colleges. For engineering colleges in Saudi universities, math represents one of the most important basis of engineering studies. Students need to be versed in this subject to be able to master any engineering discipline. Although math is taught to all Saudi students starting from elementary school, several academic staff and students acknowledge the weakness among students in this subject, specifically noticeable at college stage. Furthermore, they recognize the implications of this weakness on the study of most engineering courses. This study aims to explore factors contributing to weak math skills in Saudi engineering undergraduate students and their influencing on the students' study achievements. It considers the Engineering College – Rabigh Branch – King AbdulAziz University as a case study for this research work.

Keywords: Math; Engineering Studies; Student's Achievement; Survey; Skills

1. Introduction

Mathematics is the study of topics such as quantity (numbers) [1], structure [2], space [1], and change [3, 4, 5]. There is a range of views among mathematicians and philosophers as to the exact scope and definition of mathematics [6, 7]. Gauss referred to mathematics as "the Queen of the Sciences." [8]

Engineering mathematics is a branch of applied mathematics concerning mathematical methods and techniques that are typically used in engineering and industry. Along with fields like engineering physics and engineering geology (both of which may belong in the wider category engineering science), engineering mathematics is an interdisciplinary subject motivated by engineers' needs both for practical, theoretical and other considerations out with their specialization, and to deal with constraints to be effective in their work [9].

Mathematics science is considered as one of the most basic science for the Engineering studies. Therefore, the students' level of this science is playing an important role in the students' Engineering studies achievements.

Previous studies focused on studying the effect of some factors on the academic performance such as teaching Style, Mathematical skills, self-concept and assessment methods etc [10-19].

Some researches purpose was to investigate the relationship between Mathematical proficiency measured by the

Mathematical Grade Point Average (GPA) that the student obtained from secondary school and academic achievement as measured by the student's GPA from the examination in the first semester [19-26]. Some other researches considered self-concept, which is a personality development to have a strong effect on the academic performance [27].

Zhang et al., [28] found that graduation in engineering depends mainly upon Math level and was positively correlated with graduation rates.

Erdogan et al., [29] tried to find solutions to student problems, the authors concluded that education based on web positively affect the academic achievement improvement.

Loo and Choy [30] studied the relationship between academic performance of students at engineering colleges and sources of self-efficacy. The study revealed that self-efficacy sources, mathematics achievement scores as well as cumulative GPA were correlated. Suggestions were offered to help curriculum developers to improve students' engineering academic performance. Yi et al., [31] studied the relation between learning behavior and content based academic improvement. The Students' academic achievements were found to be highly related with their learning styles.

Tella [32] investigated the effect of self-motivation on academic achievement of students and intended learning outcomes in the courses of mathematics. The results revealed that difference in gender is very important

Volume 10 Issue 4, April 2021

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(significant) when effect of self-motivation on academic score (achievement) was compared in male and female students. Also other results indicated big difference when degree of self-motivation was taken as a primary variable on academic score in mathematics courses.

2. Objectives

This research objective is focusing mainly on:

- Determine the relationship between students' academic achievements and their level in mathematics.
- Determine to what extent some factors such as high school, province, academic level, and age can explain the variability in students' academic achievements.
- Discuss the main problems faced by the students before and during their study in the University.
- Determine the relationship between the problems faced by students and some governing factors as, curriculum, mother tongue of Faculty staff etc.
- Investigate to what extent the students' academic performance is affected by oral presentations and using the original textbooks.
- Determine to what extent the students' level in mathematics affect their answer and final grades.
- Reach recommendations to avoid the problems faced by the students and shed light on the means, which can be used to improve the level of students in math.

3. Methodology

Engineering studies depend mainly on Mathematics and Physics as basic sciences. Therefore, the students' level of this science is playing an important role in the students' Engineering studies achievements. In this study, we shall focus on the students' Math level as a factor affecting the students' Engineering studies achievements. In addition, Engineering studies at faculty of Engineering - Rabigh are mainly using English language in teaching and literatures. Therefore, the students' English language level is considered also as one of the factors affecting the students' engineering studies achievements in math subject.

In this study, we shall try to find out to which extend the students' levels of the Math is affecting in the Students' Engineering studies achievements. Not all the students have the same environments of previous studies or have the same attitudes or the motivation to study. Some factors may have influencing on the students' Math levels in the pre-university stage such as Age, Region, and Type of school. In addition, some other factors may effect on their Math levels like credit hours that they achieved during their university studies and the academic department that they are studying in.

To prove the hypothesis and find out the reasons of the weakness of the students' Math levels throughout their studies, a survey on the students at faculty of Engineering - Rabigh will be done using a well-designed questioner. The questioner has categorized the students according to the age, region, type of school, achieved credit hours, and department. To be more accurate, the survey subjected to

three stages, the pre-university studies, the first university preparatory year, and the academic university studies.

4. The Survey's Questions

No.	Question	1	2	3	4	5
Pre-university schooling						
1	I had difficulties with pre-university mathematics.					
2	My grades in mathematics reflect my true level.					
3	Solving a large number of applied exercises in mathematics has to do with improving the level of					
Preparatory year phase						
1	I had difficulties with mathematics at university.					
2	The math courses I studied in the preparatory year were enough to prepare me for engineering school.					
3	The content of the math courses was appropriate to preparatory for engineering school.					
4	The way mathematics courses were taught was appropriate to take advantage of the contents and applications of the course.					
5	I've worked hard to improve my math level to get a degree in engineering.					
The study stage at the Faculty of Engineering						
1	The difficulties I face in mathematics are based on the difficulty of the content of courses.					
2	The difficulties I face in mathematics have to do with the faculty's mother tongue.					
3	I find it best to teach and explain the mathematics course in English.					
4	My level of mathematics has an impact on my participation in the discussions and the delivery inside the lecture					
5	My level of mathematics has an impact on my education in laboratories and analysis of results.					
6	My level of mathematics has an impact on my level in other courses.					
7	I'm interested in improving my math level.					
8	I use sophisticated software to solve issues.					
9	I always try to see modern programs that are used to solve complex math issues.					
10	I always get in touch with the professor of subject to explain some of the difficulty and become that I'm facing in mathematics.					
11	My level of mathematics improved during my university studies.					

5. Results and Data Analysis

Reliability test

Cutoff points for Cronbach's alpha values as follows:

- $\alpha \geq 0.9$ Excellent

- $0.7 \leq \alpha < 0.9$ Good
- $0.6 \leq \alpha < 0.7$ Acceptable
- $0.5 \leq \alpha < 0.6$ Poor
- $\alpha < 0.5$ Unacceptable

Reliability Statistics	
Cronbach's Alpha	N of Items
.780	25

Study Sample

Variable	Selection	Frequency	Percent
Age	18-20	21	16.7
	21-23	94	74.6
	23+	11	8.7
	Total	126	100
School	Government	109	86.5
	Private	17	13.5
	Total	126	100
Hr. passed	27 or less	2	1.6
	28-55	9	7.1
	56-88	29	23.0
	89-122	56	44.4
	123-155	30	23.8
	Total	126	100
Province	Middle	9	7.1
	Western	95	75.4
	Eastern	10	7.9
	Northern	5	4.0
	Southern	7	5.6
Total	126	100	
English level	Weak	16	12.7
	Middle	81	64.3
	Excellent	29	23.0
	Total	126	100
Major	MEN	29	23.0
	CEN	22	17.5
	EEN	45	35.7
	IEN	12	9.5
	CHEN	10	7.9
	New	8	6.3
Total	126	100	

Descriptive analysis

Variable	N	Mean	Std. Deviation
BUQ1	126	3.2778	1.40649
BUQ2	126	2.4444	1.33000
BUQ3	126	1.6984	.91450
PRPQ1	126	2.2222	1.25149
PRPQ2	126	2.2857	1.13742
PRPQ3	126	2.2143	1.07038
PRPQ4	126	2.8810	1.41764
PRPQ5	126	1.7698	.89588
UQ1	126	2.3968	1.03599
UQ2	126	2.7222	1.23054
UQ3	126	2.7778	1.30775
UQ4	126	2.4841	1.07133
UQ5	126	2.2143	.98474
UQ6	126	2.2222	1.04222
UQ7	126	2.0000	.88544
UQ8	126	2.6905	1.20972
UQ9	126	2.7937	1.29193
UQ10	126	2.6349	1.19735
UQ11	126	2.1905	1.06369

One-Way ANOVA test

Age VS Question

ANOVA

		Sig.
UQ1	Between Groups	.003
	Within Groups	
	Total	

Post-Hoc (Tukey)

Variable	Age (I)	Age (J)	Mean Difference (I-J)	Std. Error	Sig.
UQ1	18-20	21-23	.21023	.24052	.658
		23+	-.88745*	.37088	.048
	21-23	18-20	-.21023	.24052	.658
		23+	-1.09768*	.31754	.002
	23+	18-20	.88745*	.37088	.048
		21-23	1.09768*	.31754	.002

School VS Question

ANOVA

		Sig.
BUQ2	Between Groups	.014
	Within Groups	
	Total	
BUQ3	Between Groups	.042
	Within Groups	
	Total	
PRPQ2	Between Groups	.010
	Within Groups	
	Total	
PRPQ3	Between Groups	.011
	Within Groups	
	Total	
PRPQ4	Between Groups	.009
	Within Groups	
	Total	
PRPQ5	Between Groups	.021
	Within Groups	
	Total	
UQ2	Between Groups	.002
	Within Groups	
	Total	

Post-Hoc (Tukey)

Not required, as only two groups are available under this variable.

- Hr. Pass VS Question
No significance were found between group variables
- Province VS Question
No significance were found between group variables
- English level VS Question

ANOVA

		Sig.
BUQ2	Between Groups	.007
	Within Groups	
	Total	
PRPQ1	Between Groups	.004
	Within Groups	
	Total	
PRPQ3	Between Groups	.003
	Within Groups	
	Total	
PRPQ4	Between Groups	.002
	Within Groups	

	Total	
UQ1	Between Groups	.001
	Within Groups	
	Total	
UQ7	Between Groups	.009
	Within Groups	
	Total	

Post-Hoc (Tukey)

Variable	Age (I)	Age (J)	Mean Difference (I-J)	Std. Error	Sig.
BUQ2	Middle	Weak	.31636	.35215	.642
		Excellent	.89825*	.27855	.005
	Excellent	Weak	-.58190	.40086	.318
		Middle	-.89825*	.27855	.005
PRPQ1	Weak	Middle	-.49846	.32971	.289
		Excellent	-1.20259*	.37532	.005
	Middle	Weak	.49846	.32971	.289
		Excellent	-.70413*	.26080	.021
	Excellent	Weak	1.20259*	.37532	.005
		Middle	.70413*	.26080	.021
PRPQ3	Weak	Middle	.72762*	.28180	.029
		Excellent	1.10991*	.32078	.002
	Middle	Weak	-.72762*	.28180	.029
		Excellent	-.38229	.22291	.204
	Excellent	Weak	-1.10991*	.32078	.002
		Middle	-.38229	.22291	.204
PRPQ4	Weak	Middle	.47531	.37198	.410
		Excellent	1.36207*	.42344	.005
	Middle	Weak	-.47531	.37198	.410
		Excellent	.88676*	.29424	.009
	Excellent	Weak	-1.36207*	.42344	.005
		Middle	-.88676*	.29424	.009
UQ1	Weak	Middle	-.50849	.27017	.148
		Excellent	-1.11853*	.30754	.001
	Middle	Weak	.50849	.27017	.148
		Excellent	-.61005*	.21370	.014
	Excellent	Weak	1.11853*	.30754	.001
		Middle	.61005*	.21370	.014
UQ7	Middle	Weak	.36034	.23512	.279
		Excellent	.55215*	.18597	.010
	Excellent	Weak	-.19181	.26764	.754
		Middle	-.55215*	.18597	.010

Major VS Question

ANOVA

		Sig.
PRPQ3	Between Groups	.022
	Within Groups	
	Total	
PRPQ5	Between Groups	.023
	Within Groups	
	Total	
UQ11	Between Groups	.000
	Within Groups	
	Total	

Post-Hoc (Tukey)

Variable	Age (I)	Age (J)	Mean Difference (I-J)	Std. Error	Sig.	
PRPQ3	IEN	MEN	.93103	.35521	.100	
		CEN	.72727	.37138	.372	
		EEN	.84444	.33622	.129	
		CHEN	1.50000*	.44310	.012	
		New	.37500	.47235	.968	
	CHEN	MEN	-.56897	.37950	.665	
		CEN	-.77273	.39468	.373	
		EEN	-.65556	.36179	.462	
		IEN	-1.50000*	.44310	.012	
		New	-1.12500	.49088	.206	
PRPQ5	EEN	MEN	.34253	.20639	.561	
		CEN	.29394	.22548	.783	
		IEN	.65000	.28160	.199	
		CHEN	.96667*	.30301	.022	
	CHEN	MEN	-.62414	.31785	.369	
		CEN	-.67273	.33056	.329	
		EEN	-.96667*	.30301	.022	
		IEN	-.31667	.37112	.957	
	UQ11	MEN	New	-.52500	.41113	.797
			CEN	-.21787	.27835	.970
			EEN	-.35019	.23444	.669
			CHEN	-.12759	.23444	.999
		CEN	New	-1.29741*	.39317	.016
			MEN	.21787	.27835	.970
EEN			-.13232	.25612	.995	
IEN			-1.12121*	.35331	.023	
EEN		CHEN	.34545	.37548	.941	
		New	-1.07955	.40647	.092	
	MEN	.35019	.23444	.669		
	CEN	.13232	.25612	.995		
IEN	IEN	-.98889*	.31986	.029		
	CHEN	.47778	.34419	.734		
	New	-.94722	.37775	.130		
	MEN	1.33908*	.33793	.002		
CHEN	CEN	1.12121*	.35331	.023		
	EEN	.98889*	.31986	.029		
	CHEN	1.46667*	.42154	.009		
	New	.04167	.44937	1.000		
New	MEN	-.12759	.36104	.999		
	CEN	-.34545	.37548	.941		
	EEN	-.47778	.34419	.734		
	IEN	-1.46667*	.42154	.009		
New	New	-1.42500*	.46700	.033		
	MEN	1.29741*	.39317	.016		
	CEN	1.07955	.40647	.092		
	EEN	.94722	.37775	.130		
CHEN	IEN	-.04167	.44937	1.000		
	CHEN	1.42500*	.46700	.033		

6. Conclusion

Mathematical level of the students has a major effect on the students' achievements in Engineering studies. The students' weakness in the mathematics due to, mainly, the weak achievements in the pre-university stage which lead to unfollow the level of the preparatory studies for the university consequently in the university stage. Also, the math courses in the University stage do not take into account such weakness to make the students ready for higher level of math. The region of the students has no significant effect on

their math level which shows that the same materials and teaching strategies are applied. Hour pass also has no significant effect. Private schools have the lead in math level which is natural because of the strict rolls in the private sectors. Major field of study has minor effect in the math achievements. English language level has major effect in understanding the math due to the natural of teaching environmental and the references books which are in English languages. It is recommended to rise the students' achievements in math studies, and consequently in the engineering studies, better teaching strategies in the pre-university stage must be applied. Also, the admission rolls of the engineering students must include a certain math and English language level to be accepted.

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