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A Study on the Influence of Higher Secondary Subjects Scores on Engineering Performance

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ABSTRACT

This study aims to find the influence of the students' higher secondary marks in mathematics, physics and chemistry (MPC) on their performance in the engineering program. For this purpose, a sample of 173 students, studying in a private engineering college in Puducherry, were considered. Higher secondary MPC marks of students and their corresponding engineering marks were collected from the institution and statistical analyses were done. Chi square test was used to find the association between mathematics, physics and chemistry marks scored by these students and engineering performance. Also multiple regression test was used to analyze the degree of relationship between the three higher secondary subjects MPC and engineering performance. From the results of the statistical analysis logical conclusions were arrived at.

Keyword-- higher secondary marks, physics, chemistry, maths, engineering performance, private engineering college

I. INTRODUCTION

According to Geron (2011), there's an increasing demand both from tech companies and non-tech companies for highly-skilled engineers to create, build and maintain high quality systems at various levels from manufacturing to product design. A report from startup *Identified* shows just how in demand engineers are. People with engineering degrees on *Identified* havescores that are 1.2 times those of liberal arts majors with equivalent work experience, meaning they are more sought after for jobs. But even in non-technical fields, people with engineering degrees are more sought after than liberal arts majors with the same years of work experience. This situation is discussed with respect to the US. The same is true for India too. Parents tend to prefer engineering education for their children more than arts and science or medicine. The reasons for this may be various – engineering education is only four years after which their son or daughter can start earning and the opportunity to go abroad for higher studies or placement is bright. Many tech companies hire engineers who have been educated overseas. The U.S. H1-B Visa program was designed to bring talented "speciality occupations" such as engineers into the U.S. However the number of H1-Bs issued peaked in 2001 with 161,000 (Geron, 2011).

As the demand for engineers increase, engineering institutions become interested in admitting more students and getting them placed in good companies. This becomes easy for reputed engineering institutions. But for engineering colleges located in rural areas finding good students becomes a challenge. Most students have to settle for some private engineering college in their vicinity because the cut-off marks in the government colleges are pretty high (in most cases). It goes without saying, that the competition is tough to get into the few top private engineering colleges in any city (Katdare, 2015).Students who score low marks in higher secondary board exams join rural engineering college where seats remain vacant. This becomes a big challenge for such engineering institutes to produce good result from these students who have just scraped through their higher secondary exams. According to Banerjee and Muley (2008),a challenge facing engineering education in India is getting students excited and enthused in engineering. The focus of the curriculum / education system is on analysis and mathematical formulations. Students often do not appreciate the hands – on component of the engineering components / systems. The engineering course in India is one of the preferred choices for students who have scored high at the 10+2 level. The competition for the top institutions is intense with students spending a lot of time and money in coaching classes to get the added edge at the competitive entrance tests. This increasing demand for engineering has resulted in a mushrooming of a large number of engineering colleges in the country. Despite

this, the industry complains of an absence of trained quality engineers.

II. REVIEW OF LITERATURE

Banerjee and Muley (2008) suggest that the higher secondary stage is the launching pad from which the student is guided towards career choices, whether they imply university education or otherwise. By this time, the student's interests and aptitude have been largely determined, and mathematics education in these two years can help in sharpening his/her abilities. The most difficult curricular choice to be made at this stage relates to that between breadth and depth.

There should be more courses available which exploit some of the breadth of mathematics, to permit starting near the ground level, without a lot of repetition of topics that students have already heard, say Banerjee and Muley (2008).Many students have "no idea" what role mathematics will play in their future careers (Wood et al. 2011).

Most students view engineering education as further engagement in school science and mathematics (Brick house et al. 2000). "Some see mathematics as the gateway to engineering, paving the way for sound design; others see mathematics as a gatekeeper, denying entry to otherwise talented would - be engineers" (Winkel man 2009). Many third level engineering students struggle with the mathematics in their courses (James and High, 2008) and "it is now generally accepted that students entering the tertiary level suffer a lack of mathematical skills and no longer find mathematics to be an enjoyable subject. This decline in mathematical skills leads students to avoid overly analytical subjects in later years of degree programmes" (Irish Academy of Engineering 2004).

But the need to have excellent knowledge in mathematics is strongly felt when Derret. al (2012) says, 'Mathematical grounding is a prerequisite to understanding University mathematics. According to Duran et. al (2016), students who are interested in pursuing a degree in engineering should prepare themselves in the school level itself. Engineering programs are competitive and rigorous. Therefore, the students seeking an engineering career should plan their high school courses. They should study mathematics, physics, chemistry, drafting or mechanical drawing and computer science. De Pree (2004) in his book explains how physics is very important for engineering. He says, 'the connection of physics to engineering is more obvious. Engineers build structures, among other activities and these structures need to be able to withstand their own internal forces as well as these occasional forces that they may be subject to. A thorough understanding of forces is essential to engineers, who then add specialized understanding of the properties of materials to design objects and structures that can survive in the physical world. For these reasons and many others, a fundamental understanding of physics is useful to scientist in many disciplines and a basic physics course is generally required of future chemists, biologists and engineers.' This opinion of De Pree (2004) shows the importance of studying physics at the school level especially for students aspiring to become engineers.

Brown.L and Holme. T (2014), talk about the importance of studying chemistry. Students may often think that chemistry is unnecessary for an engineer except chemical engineers. But this is not so. According to Brown and Holme (2015), civil or environmental engineers working on environmental protection or remediation might spend a lot of time thinking about chemical reactions taking place in the water supply or the air. Much of modern electrical engineering relies on solid – state devices whose properties can be tailored by carefully controlling their chemical composition. Thus the importance of mathematics, physics and chemistry for potential engineers is undeniable.

However, an article in *The New Indian Express* by Ashmita Gupta (March, 2017), questions whether engineering students should study chemistry? The article said, 'a debate to do away with chemistry is on among Anna University professors. This was discussed in a panel meeting few months ago. But no decision has yet been made. But a section of professors strongly believe that basic sciences like physics and chemistry are fundamental to several engineering concepts. "One cannot study Mechanical Engineering without first learning about metal composition, thermal composition, oil composition, ignition and all the related principles that are applied in engineering. Strong fundamentals are necessary to understand these subjects," said Dr. A. Pandurangan, Head of Department of Chemistry, Anna University. A professor of Madras Institute of Technology, Chromepet, which also functions under Anna University, has a similar argument. "In Aeronautical Engineering, to learn about fuel, an understanding of basic Chemistry is essential. A student may not understand what a bio-fuel is if he has not studied Chemistry," the professor says on condition of anonymity. He says many students don't want to learn tough subjects like Chemistry since they are not interested in pursuing a career in their field of study, but take up a job in the IT industry. Due to such reasons, the university must not compromise on its syllabus, argues professors who oppose the move.

III. RESEARCH METHODOLOGY

A sample of 173 engineering students were selected at random from a private engineering college in Puducherry. Database of the students' marks in school board exams and their corresponding end semester exam marks in engineering program were collected from the college. These marks were used for analyzing the most influencing subject(s)on engineering performance. Also, the details

regarding the placed and not placed students were collected for analysis purpose. Statistical tools such as chi square and multiple regression were used.

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IV. RESULTS AND DISCUSSION

The following is the chi square test, to find the association between the mathematics, physics and chemistry subjects and the students' performance in engineering course along with the status of their placement.H_0: There is no association between the performance of students in HSC – Subjects (Mathematics, Physics and Chemistry) and their performance in Engineering Course and placement status.

TABLE 1
CHI SQUARE TABLE

SN	Performance in Engineering		Moderate	High	Total	χ^2	df	p value
1	Performance in Mathematics	Worst Poor	15	11	26	13.36	3	0.001*
		Good	5	12	17			
		Excellent	29	24	53			
			30	47	77			
Total			79	94	173			
2	Performance in Physics	Worst Poor	15	10	25	8.99	3	0.029*
		Good	5	12	17			
		Excellent	14	38	52			
			34	45	79			
Total			68	105	173			
3	Performance in Chemistry	Poor	12	31	43	3.873	2	0.1**
		Good	7	46	53			
		Excellent	20	57	77			
Total			39	134	173			
4	Placement Details		Placed	Not Placed	Total			
	Performance in Engineering	Worst Poor	18	7	25	0.776	3	0.9**
		Good	14	5	19			
		Excellent	41	11	52			
			61	16	77			
Total			134	39	173			

**Significant at 5% level. **Not significant*

From the above chi –square calculation, in table 1, it is seen that p value is less than 0.05 which implies that there is significant association between performance of students in HSC mathematics and their performance in engineering course. Also, chi square between HSC Physics and students' performance in engineering shows a significant association between HSC Physics and students' performance in engineering. Hence we reject the null hypothesis and conclude that the performance of students in HSC mathematics and physics influences their performance in engineering course to a great extent and the association did not happen by chance.

However, the association between HSC chemistry and performance in engineering does not show a significant association. Similarly, no significant association is found between performance in engineering course and students' placement. Thus, it may be inferred that HSC mathematics and physics score has high influence on the performance of students in engineering program whereas marks scored in chemistry does not affect the performance in engineering program significantly. Also, it is inferred that the performance of students in their engineering course alone cannot fetch placement for the students concerned but instead there are a series of factors other than mere engineering scores which are essential for a student to get placed. Below seen is table 2 showing regression analysis.

TABLE 2
REGRESSION ANALYSIS

Regression Statistics	
Multiple R	0.159995913
R Square	0.025598692
Adjusted R Square	0.008301628
Standard Error	1.067461144
Observations	173

The table 2 shows Multiple R as 0.1599. This value is called the multiple correlation value and the variables are seen to have low degree of positive correlation with each other. Also the R square value is found to be 0.026 and this can be interpreted as follows. 2.6% of the performance in engineering program is due to the HSC mathematics, physics and chemistry scores. The adjusted R square can be considered more reliable statistic as it takes into account the sample size. The standard error is the same as standard deviation and it measures the

variability of the actual Y values from the predicted Y values, and the Y values in the present study is the performance of students in the engineering program also called the dependent variable.

TABLE 3
ANOVA TABLE

	Df	*SS*	*MS*	*F*	*p*
Regression	3	5.0591	1.68635	1.4799	0.22181
Residual	169	192.571	1.13947		
Total	172	197.630			

Table 3 shows analysis of variance table indicating the insignificance of the regression using F test. The probability p is 0.222 which is high, and this indicatesthat there is a high probability that the above results have occurred randomly or by chance only. Therefore, it is inferred that the regression is insignificant. The degrees of freedom in the first column in table 3 affects the t stats, F test and adjusted R square. It takes into account the sample size, adjusting normal distributions with lower sample sizes that have fatter tails which increases the statistical probability of unlikely events.

TABLE 4
INTERCEPTS AND BETA

	Coeff	*Std Error*	*t Stat*	*P*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.027	0.648	1.6	0.1	-0.25	2.307	-0.25	2.307
Maths	-0.00	0.004	-0.3	0.7	-0.00	0.007	-0.00	0.007
Physics	0.008	0.005	1.7	0.08	-0.00	0.019	-0.00	0.019
Chem	-0.00	0.005	-0.2	0.88	-0.01	0.009	-0.01	0.009

Table 4 shows the t statistics and the corresponding p values for each of the independent variables or the X variables or the scores of mathematics, physics and chemistry. In all cases the p value is found to be high indicating no significant regression between each of the independent variables and the dependent variable (performance in engineering course).

V. CONCLUSION

From the above analyses it can be concluded that a significant relationship between each of the independent variables with the dependent variable is missing. In other words, the marks scored by students in their Higher Secondary Board exams does not have a significant effect on the performance of these students in their engineering program. There may be other factors influencing their marks and placement. Although the marks in mathematics, physics and chemistry are very important to help a candidate to gain entry into an engineering course, they don't seem to affect the performance in the engineering course as such.

Further research may be undertaken, considering various other factors which may seem important in affecting engineering performance. Also further research may be undertaken in the same area, considering an increased sample size to see if there is an effect on the engineering performance.

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