Academia Journal of Educational Research 5(10): 314-323, October 2017
DOI: 10.15413/ajer.2017.0113
ISSN 2315-7704

Academia Publishing

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Research Paper

The effects of scientific knowledge and attitudes towards first year engineering course performance

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Accepted 13th July, 2017

ABSTRACT

The interest in pursuing engineering degree is becoming unpopular. Factors such as insufficient mathematical and physics backgrounds, lack of exposure to the challenging nature of engineering profession and gender have been identified. In this paper, the effects of mathematics and physics performances during pre-university in relation to the grades obtained in first year engineering course at Universiti Tenaga Nasional was studied. A total of 60 first year students participated in this study. A survey form consisting of 10 questionnaires pertinent to study habits, grades obtained during pre-university, ultimate goal of taking the course, subject interest, expectation studying environment and towards lecturers was distributed. The results proved positive relationships between the pre-university courses and the first year engineering course performances.

Key words: Engineering, academic performance, linear relationship, study habit.

INTRODUCTION

Engineering students always have problem in applying the knowledge that they gained at university level in work place. Lack of writing, communication and negotiation skills lead to difficulty in problem solving. Real engineering world involves imagination and innovation and quite frequently they have to apply their own judgement to make quick and right decisions, rather than just do what they are told by the superior.

Principally, engineers do not just work with machines but the understanding of science and mathematics play an important role in handling various problems. An engineer must be multi-tasking, able to perform the work of a manager, supervisor and negotiator and at the same time address the safety precautions to ensure the workplace is conducive in order to maintain a sustainable society and environment. In general, given the importance of mathematics and physics for students' future lives, higher education systems need to ensure that students have both the interest and the motivation to continue learning in this area beyond university.

Interest in the subjects may also be affected by factors, such as admission points, social economic status, school background and university. Studies have shown that there is a correlation between pre-universities courses to the first year courses students enrolled at the university. The pre-universities courses include calculus, physics, chemistry and social science subjects. The interest in the first two subjects should be inculcated at the primary level and further enhanced at the secondary and university levels. Various scientific expedition programs are held and the participations from the students are encouraging.

LITERATURE REVIEW

The effect of mathematics and physics towards the performance in engineering course has been a topic of discussion until now. In one of the studies conducted by Imran et al. (2011), the relationships between the performances in mathematics and Physical Science

towards the performances in engineering courses were positive with the correlation coefficients, r = 0.86 and r = 0.75 respectively. The r values for both subjects vary slightly according to gender.

Fahmida et al. (2011), suggested ways of improving the inadequate mathematics competency that results in poor performance in engineering courses which include:

- Students must sit for mathematics placement test and understand the impact of the grade obtained;
- Students' self-perception on their capability and readiness to pursue the next level of mathematics or engineering courses;
- Revise the mathematics and science curriculum at high school or foundation levels to ensure a smooth shift into engineering program at the university level.

In addition, personal attitude towards learning such as absent from classes, lack of self-motivation, study habits and poor time management contributed towards student's performance (Ewe, 2014). Students prefer to enroll in classes where they could obtain good grades rather than taking elective courses pertinent to their majors. Student's avoidance in difficult courses may also lead to emotional stress and anxiety in pursuing higher level engineering courses (PISA, 2003).

The implementation of constructive teaching as a contrary will nurture critical thinking, create enthused and independent learners. A conducive classroom environment enables learners to involve actively in teaching and learning (Audrey Gray, 1997). Thus, the significance of constructive attitude of students enhances effective approaches towards learning and this critical problem could be overcome. This attitude enables the learner to construct the knowledge both individually and socially (Yudagul et al., 2012). Esme (2016) found that students in Turkey had negative attitude towards science. In addition, the use of different application of science and technology curriculum might lead to negative feelings about science. The implementing of cooperative learning strategy in class revealed a positive attitude towards learning in the first-year computer application technology class (Elsa et al., 2016).

Students make their own judgement about life through meaningful experience. Mathematics competency is a pre-requisite for further engineering courses and the curriculum for both mathematics and science subjects should be revised and improved. Therefore, it is our interest to study the effects of mathematics and physics knowledge together with students' attitude towards learning in relation to the performance in the selected Engineering course.

METHODOLOGY

A total of sixty (60) students enrolling in second semester participated in the survey. 46 students are from University Tenaga Nasional (UNITEN) foundation program while 14 are credit transfer students from various institutions. A survey form consisting of 10 questionnaires was distributed during week 9 after the common test. According to the survey form, students were required to rank factors affecting their performances in the first year engineering course and their expectation about the course. The questionnaires were constructed based on the following criteria: (i) Factors affecting students' performance; (ii) the importance of grade or knowledge obtained through the courses; (iii) factors to improve the performance and (iv) students expectation on teaching and learning environment and lecturers performances.

The data obtained was analyzed by using Statistical Package for the Social Sciences (SPSS) and Excel to determine whether there is a significant correlation between the grade obtained from the foundation program, namely Calculus and Physics to first year engineering course and Mechanics Statics.

The influence of other factors besides academic towards students' performance was also explored. Results and discussion based on the survey was summarized in the form of tables and graphs.

RESULTS AND DISCUSSION

Figures 1 to 4 represent the relationship (under simple linear regression) between the influence of calculus, physics, mechanics statics (MEMB123) mid-term test and final examination with the MEMB123 overall grade. Figures 5 to 7 shows the multiple linear regression performed on the data involving two categories, which are credit transfer students and Universiti Tenaga Nasional (UNITEN) foundation students. The results indicated that there were positive correlations between all the subjects to the MEMB123 overall grade. However, the correlation coefficients, r, vary slightly from one to another with the highest r value of 0.984 under multiple linear regression using test and final examination of MEMB123 for the prediction of the overall MEMB123 grade. The smallest r value of 0.687 under simple linear regression using physics as a predictor showed the existence of a moderate relationship.

In order to perform well in engineering courses, students should possess a strong mathematical background especially in calculus where in this study, the correlation between performance in calculus and MEMB123 overall grade gave r value of 0.809. Figures 8 and 9 represent the values of correlation coefficient r for the four predictors, final and mid-term mechanic static, calculus and physics. r values ranged from 0.687 to 0.917. It showed a moderate to strong relationship between predictors and MEMB123 overall grade. When the mid-term test and final examination of mechanic static were used to predict the overall performance, the credit transfer

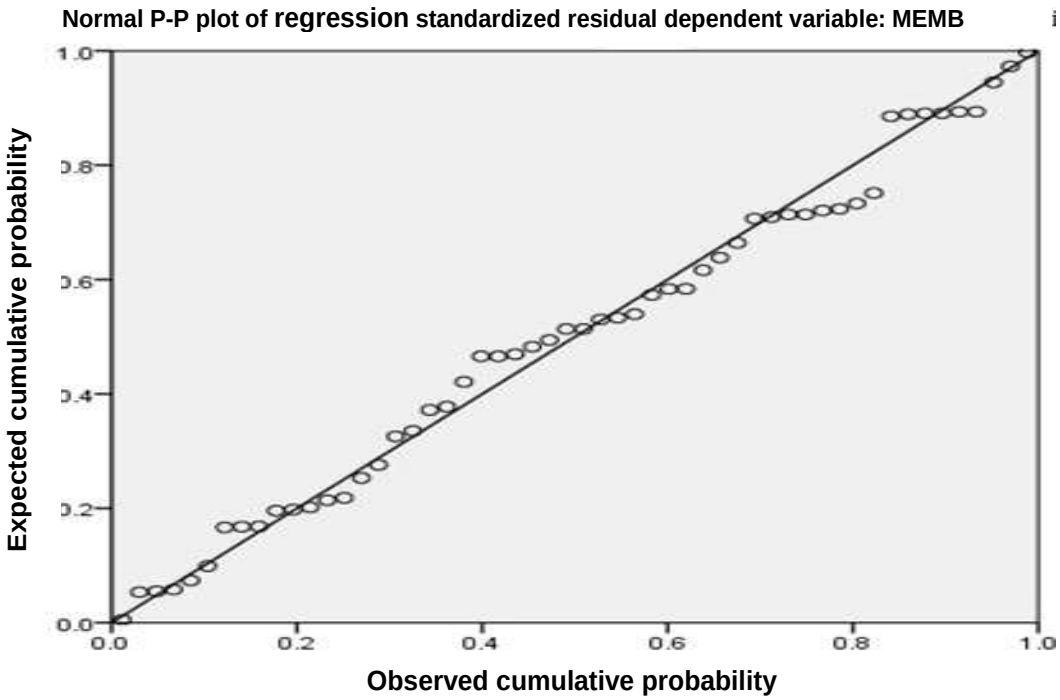

Figure 1: Expected cumulative probability vs. observed cumulative with calculus as a predictor.

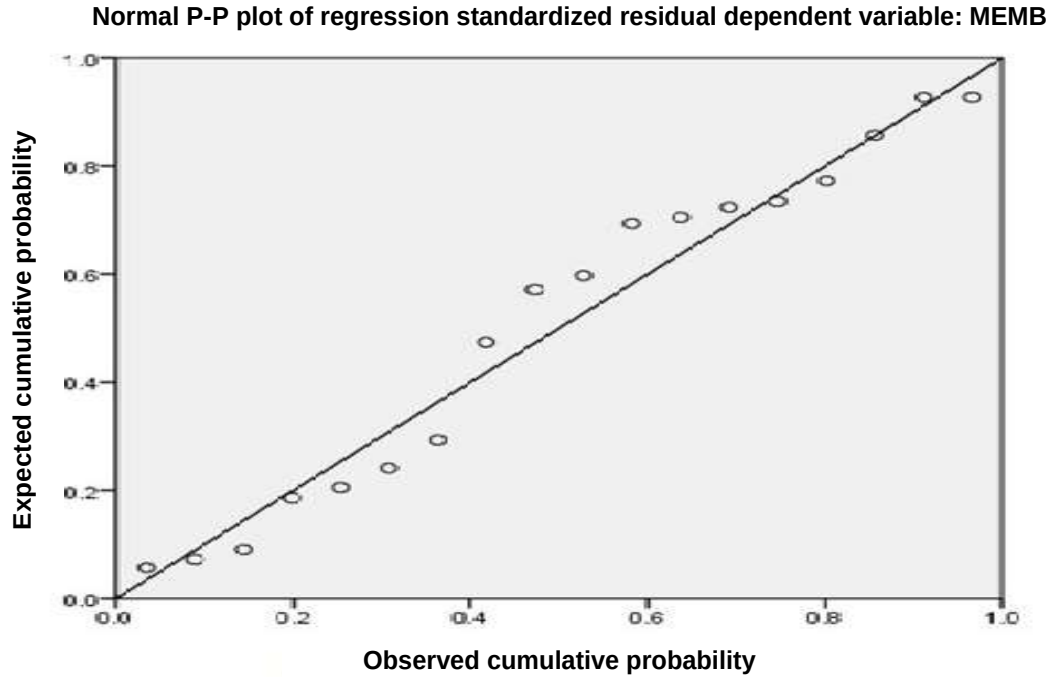

Figure 2: Expected cumulative probability vs. observed cumulative with physics as a predictor.

students' performance gave a significant relationship.

Tables 1 and 2 shows the best fitting line equations representing the correlation between calculus, physics, MEMB123 mid-term test and final examination to the overall MEMB123 grade derived..

Under multiple linear regressions different combinations were introduced. For UNITEN foundation students, calculus and physics, mid-term test and final examinations were separately used to predict the overall performance of MEMB123. However, for the credit

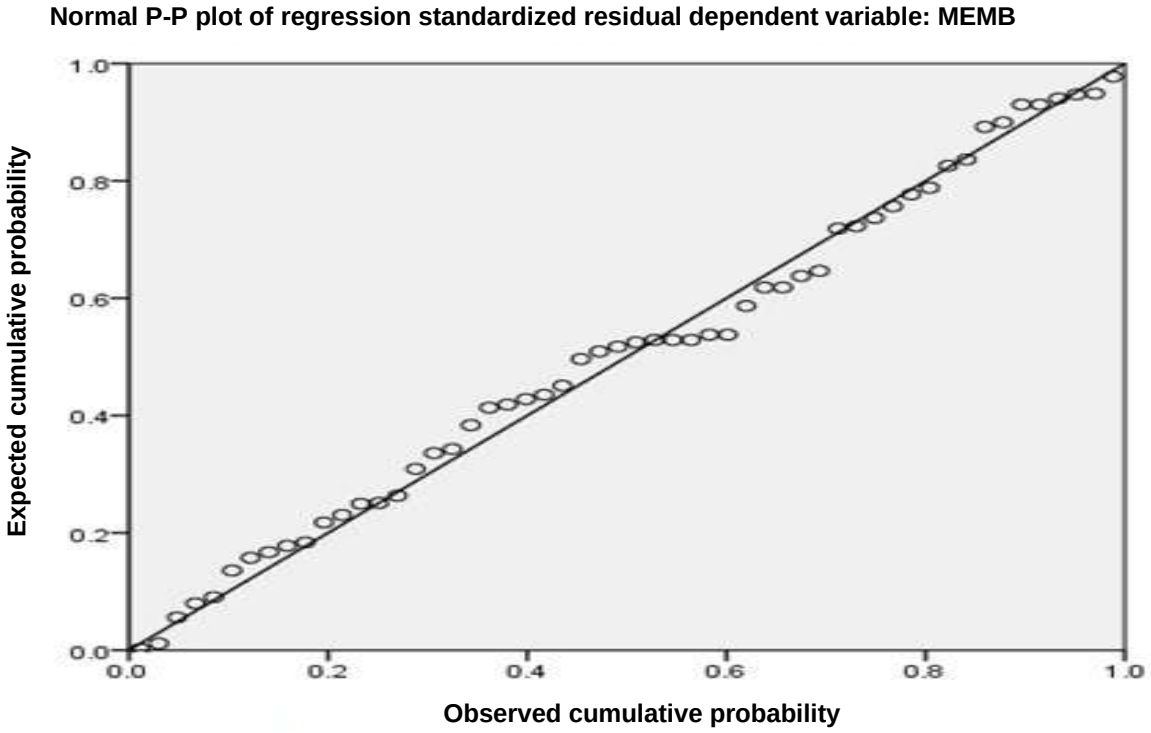

Figure 3: Expected cumulative probability vs. observed cumulative with MEMB123 mid-term test as a predictor.

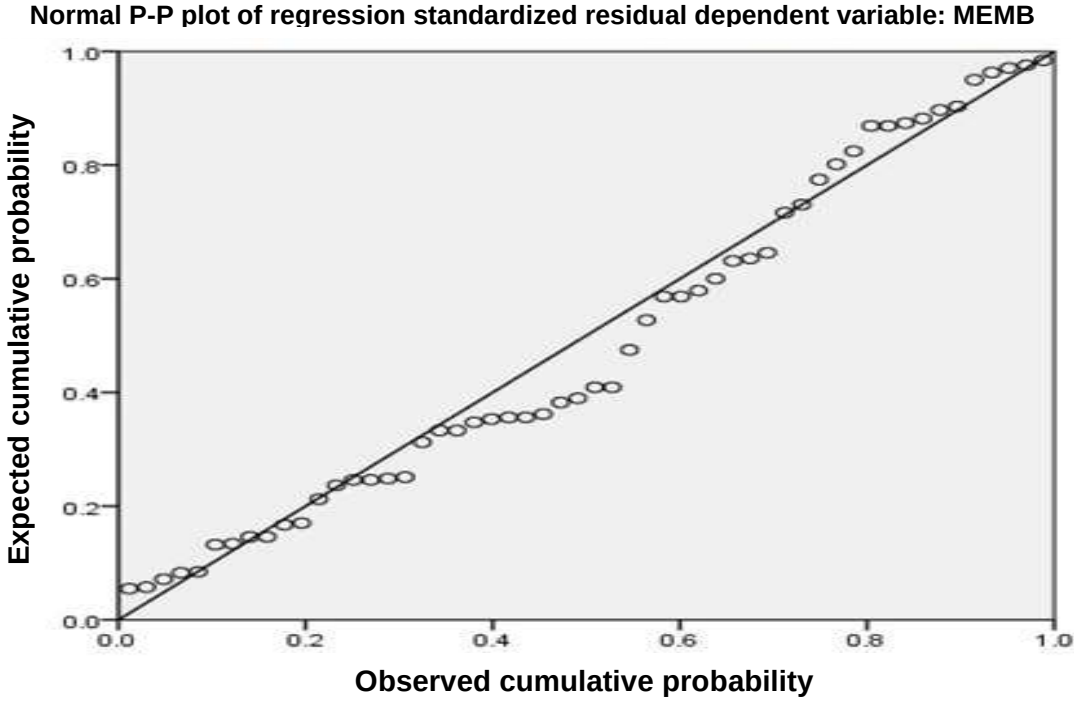

Figure 4: Expected cumulative probability vs. observed cumulative with MEMB123 final as a predictor.

transfer students only mid-term and final examinations were used in the analysis. The results of calculus and physics were not available for credit transfer students.

Figure 10 and Table 3 represent the distribution in percentages of students expectation towards academic excellence comprising of seven important factors from

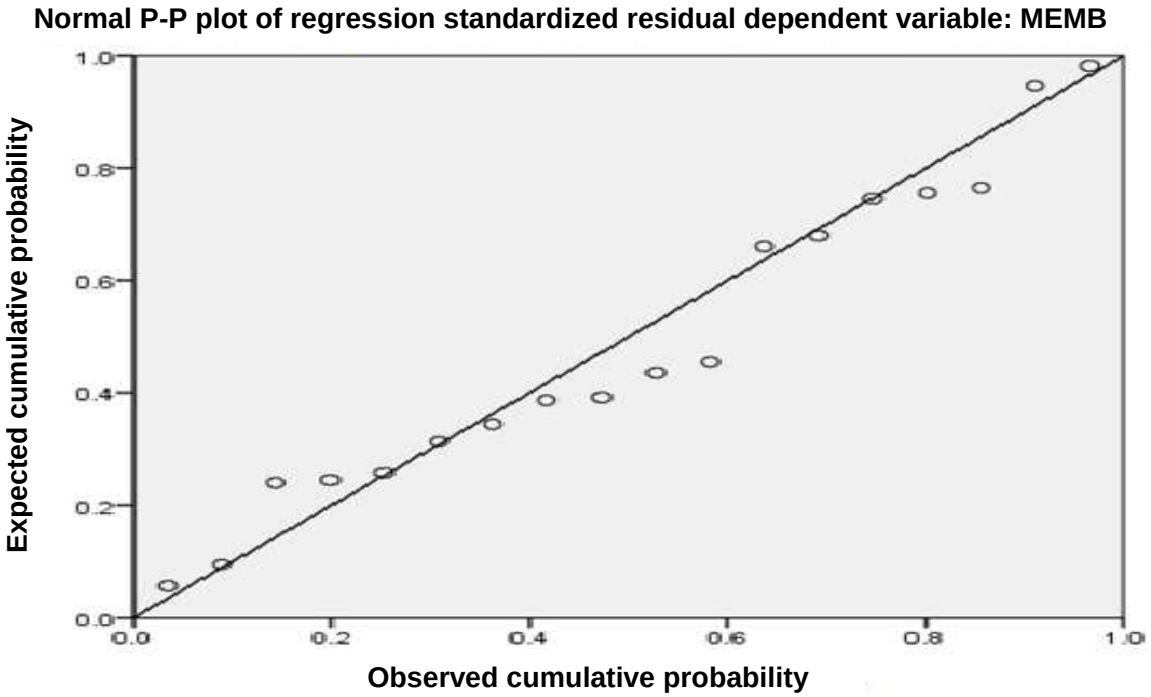

Figure 5: Expected cumulative probability vs. observed cumulative with calculus and physics as predictors.

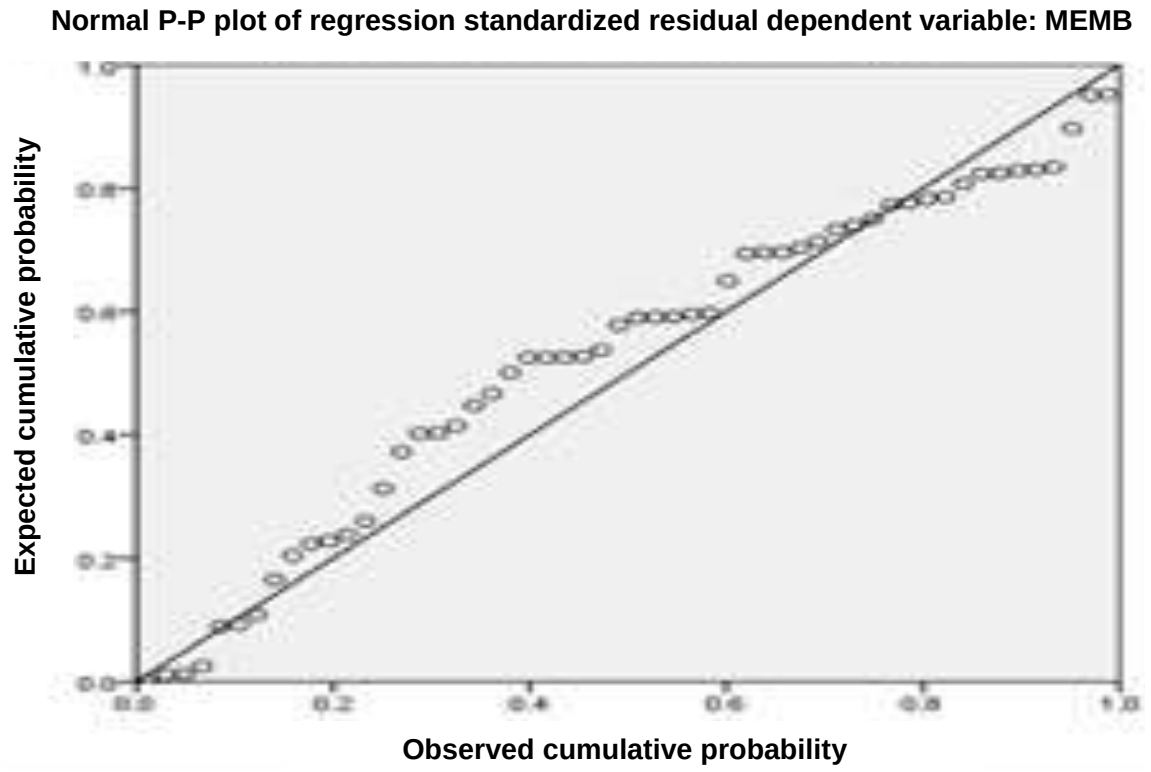

Figure 6: Expected cumulative probability vs. observed cumulative with MEMB123 mid-term test and final as predictors for UNITEN students.

study hard and focus in class to improve classroom environment and instructor expertise. Students believed that attitude problem plays significant role in their performance but not many of them were ready to change

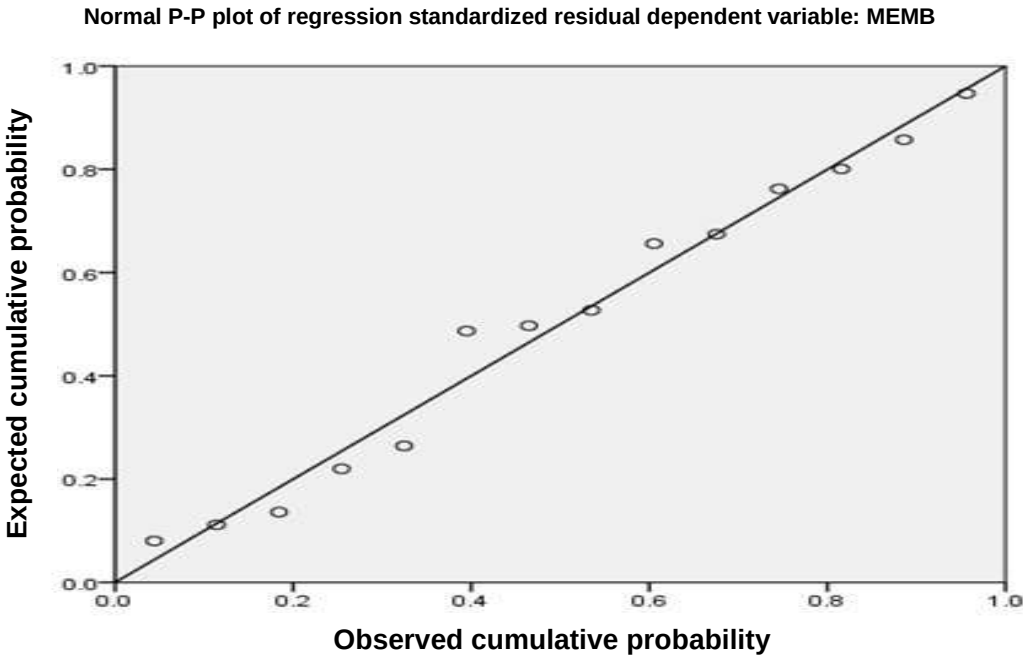

Figure 7: Expected cumulative probability vs. observed cumulative with memb123 mid-term test and final as predictors for credit transfer students.

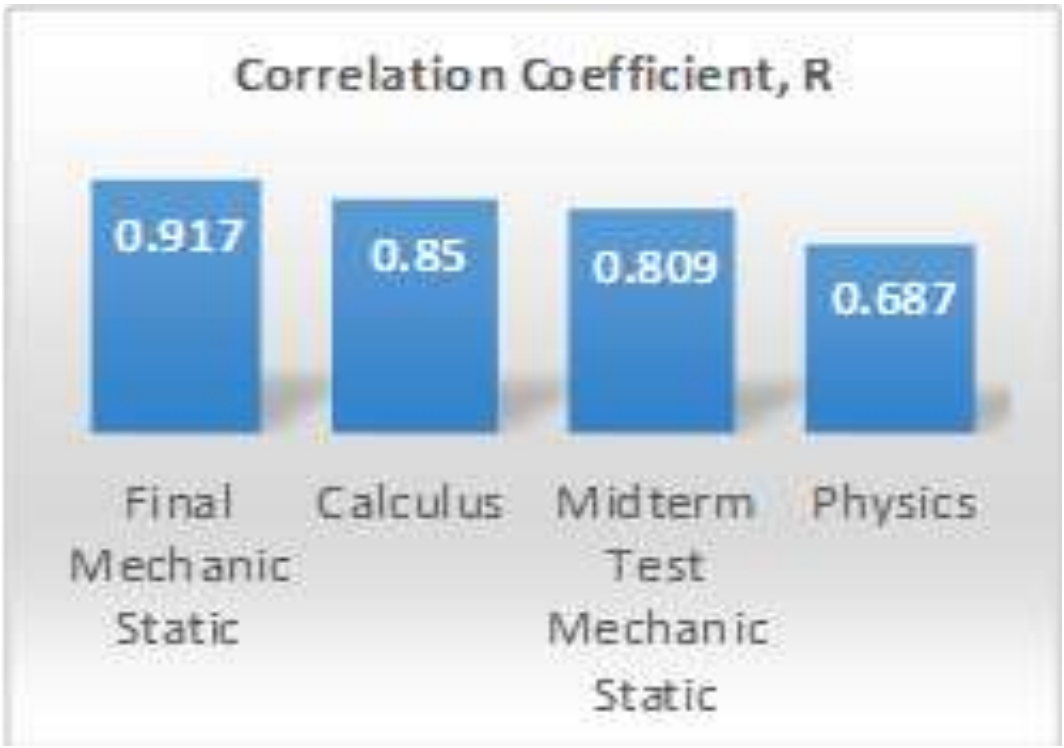

Figure 8: r values using four predictors under simple linear regression.

the attitude. Presently, most of the students are brought up in a comfortable environment, take things for granted and not prepared to take challenges in life. Easily satisfied with what they have and do not strive for excellent.

Students believed that they have to study hard (28%) and focus in class (28%) in order to perform well. Thus, skipping classes will result in poor performance. On the lecturers' side, taking attendance is necessity and delivers

Table 1: Simple linear regression with mechanic fluid (MEMB) as dependent variable, *y*.

S/No	Predictor (*x*)	Best fitting line equation
1	Calculus	$y = 0.723x + 21.925$
2	Physics	$y = 0.758x + 17.193$
3	MEMB Test	$y = 0.637x + 20.102$
4	MEMB Final	$y = 0.1.212x - 35.602$

Table 2: Multiple linear regression with mechanic fluid (MEMB) as dependent variable, *y*.

S/No	Predictors, x_1, x_2	Best fitting line equation
1	Calculus and Physics	$y = 0.575x_1 + 0.385x_2 + 4.796$
2	Test and Final (UNITEN)	$y = 0.309x_1 + 0.511x_2 + 20.746$
3	Test and Final (Credit Transfer)	$y = 0.253x_1 + 0.479x_2 + 27.882$

Figure 9: r values for credit transfer and UNITEN students under multiple linear regression.

more interesting and students-oriented presentation. On the other hand, to improve environment and instructor's expertise with 1.8% each showed the lowest percentage (Figure 10 and Table 3).

Figure 11 and Table 4 show the percentages of students' expectation on lecturer towards their excellence performance. Ten criteria were given, it can be seen that the highest expectation from students is to provide the answer or solution for tutorials (22.8%) whereas only 2.5% is strict. Strict teaching style tends to produce lower self-esteem students. Venicia (2017) found the importance of knowing the needs of the new generation of students

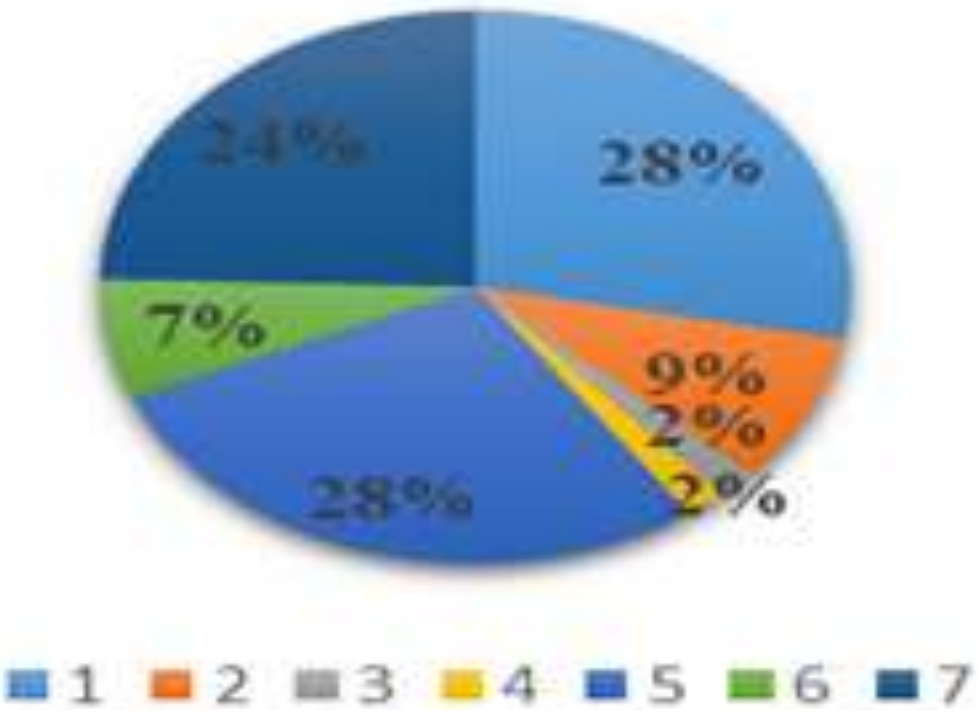

Figure 10: Distribution in percentages of students expectation towards academic excellence.

Table 3: Expectation towards academic excellence

S/No	Student's criteria	Percentage of students
1	study harder	28
2	solving past year questions	8.8
3	improve classroom environment	1.8
4	improve instructor expertise	1.8
5	focus in class	28
6	memorize equations	7
7	change attitude	24.5

that we have and also recommended new ways in which the students could be assisted and guided in the learning process.

Conclusion

It was observed in this study that both mathematics and physics background are essential in pursuing engineering courses. The correlation between mathematics and first year mechanic static course is more significant as compared to correlation between physics with coefficient correlation, $r = 0.85$. This is due to the fact that the calculus syllabus is quite detailed and comprehensive to prepare students for higher engineering courses. The teaching of mathematics and science that incorporate examples pertinent to engineering problems will increase student's interest in engineering courses. Students do believe that their attitudes toward learning such as study hard and focus in class play an important role. Student's expectation towards lecturers showed that they preferred easy and guided way of learning. Thus, teachers should use moderate methods and create interactive classroom activities which can enhance student's participation to improve student's performance in engineering courses. Lecturers, students and environments also seem to play an important role in determining the student performance.

ACKNOWLEDGMENT

The authors would like to thank those who participated in this survey and Universiti Tenaga Nasional (UNITEN) for supporting the research work.

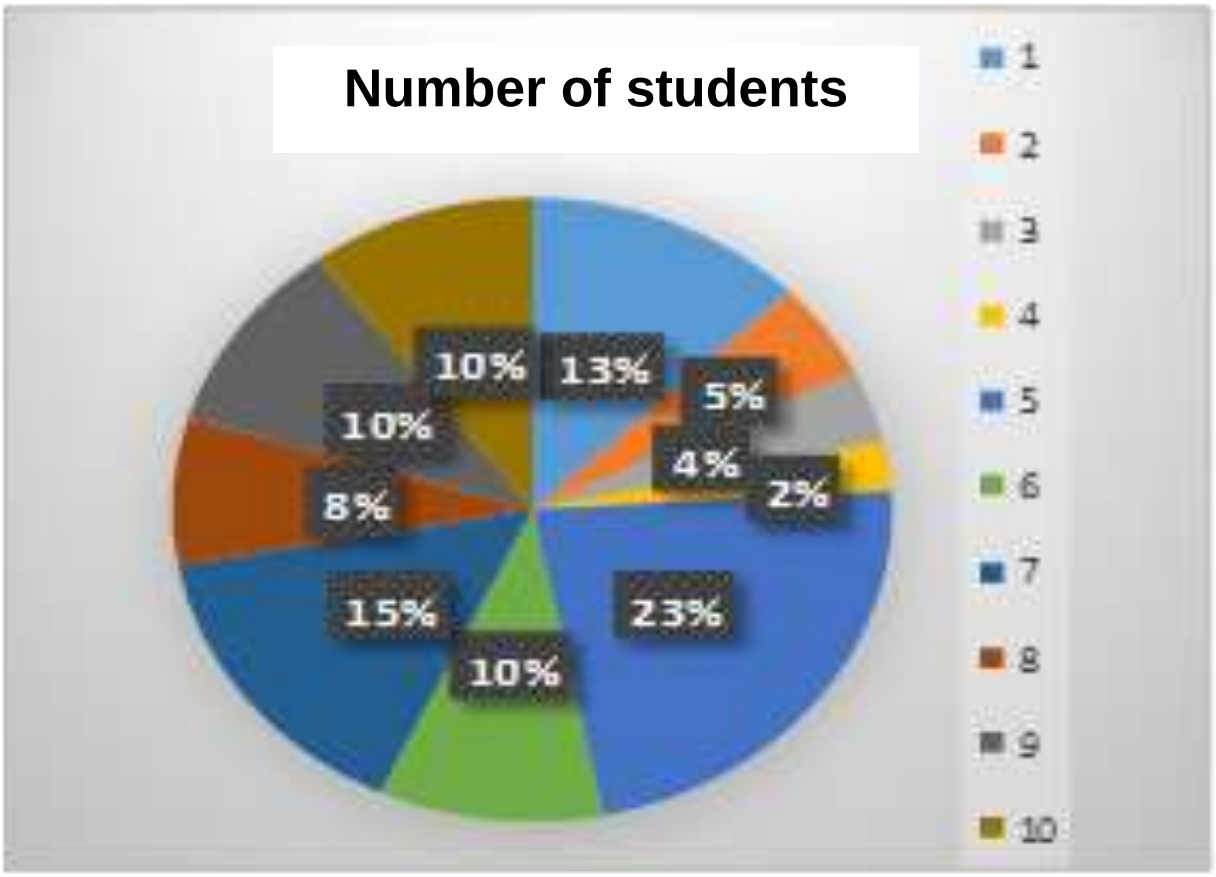

Figure 11: Percentages of students' expectation on lecturer towards their excellence performance.

Table 4: Expectations on lecturer toward academic achievement.

S/No	Lecturer's criteria	% of Students
1	Give more exercises	12.7
2	Don't take attendance	5.1
3	Change style of teaching	3.8
4	More strict	2.5
5	Provide answer for tutorials	22.8
6	provide lecture notes	10.1
7	give hints	15.1
8	change time of lectures	7.6
9	give special attention to student	10.1
10	teach in moderate speed	10.1

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Cite this article as:

Basaruddin F, Ewe LS (2017). The effects of scientific knowledge and attitudes towards first year engineering course performance. Acad. J. Educ. Res. 5(10): 314-323

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