Students' English language proficiency and its impact on the overall student's academic performance: An analysis and prediction using Neural Network Model

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Abstract – *English has become one of the most effective global medium of communication today. The significance of English is highly emphasized in many countries as it is now the medium of communication in international business and technology based trading industries. This paper present the results of an investigation that compares the performance in English courses of male and female students of a bachelor level engineering programme at the Faculty of Electrical Engineering, Universiti Teknologi MARA (UiTM), Malaysia. In addition, the research then investigates the impact of a student's English ability and capability on the overall engineering academic performance using Neural Network (NN) prediction model. The study was conducted on batches of students from two entries namely Matriculation and Diploma level intakes. Students performance was measured based on their Cumulative Grade Point Average (CGPA) upon graduation. We focus on the type of parameters used as input variables for the model using Artificial Neural Network (ANN) as the analysis and prediction tool. The outcomes of the study indicated that there appears to be a direct correlation between students' results for fundamental subjects and the final overall academic performance of graduating students. We also observed that English Language courses have no direct or little effects on the overall academic performance.*

Keywords – *Academic achievement, English, NN prediction, engineering fundamentals, Medium of instruction.*

1 Introduction

English language is now widely used and can be considered as one of the most effective medium of communication in international business and technology based industries. Malaysia has long recognised the importance of English and has placed various strategies in the education system to improve the standard of its citizen's English language capability. Institutions of higher learning (IHL) in Malaysia emphasized on the teaching of English in its endeavour to improve English proficiency of its students in line with the national education policy and system provided by the country's policy makers. University Teknologi MARA (UiTM) has also used English as its medium of instruction in the Bachelor of Engineering Program with the goal to produce students that are not only technically sound but are also proficient in English.

 This paper presents the results of a study that investigates whether a student's English language proficiency will have an impact on their overall academic performance. The hypothesis is: If a student's English language is poor, he will not be able to perform well in engineering fundamental subjects using English as the medium of instruction. He will have difficulty understanding the lecturer and reading reference books and doing assignment in English. The study attempts to investigate whether there is a correlation between the students' performance in the English courses (which is assumed to reflect their English capability) and the final overall academic results.

2 The need for English Language Proficiency

The importance of English has always been recognised in the South East Asia (ASEAN) region. Historically, Malaysia has been using English as the medium of instruction in many Universities. For example, in Universiti Teknologi MARA (UiTM), English has been the language used in all programs offered, whether Science and Technology based or the Social Science based. To be effective, it must be used right from students entry into any programs offered.[1]

C Hengsadeekul [2] pointed out that policy makers, language planners, educators and teachers in

Thailand are seriously addressing the importance of students proficiency in English, particularly in language skills. He suggested that students' perceptions must be included as one of major components, besides the implementers and adopters while crafting the policy on English. He concluded that Thai learners had relatively low English proficiency when compared to other developing countries like Malaysia, Singapore and Philippines. In his opinion, this is due to the fact that English teachers were mostly non-native English speakers, which consequently created non genuine interaction using English language in classrooms among students.

According to Zaaba Z [3], the Federation of Malaysian Manufacturers conducted a survey which concluded that poor ability to speak in English is among the main reasons for graduates' unsuccessful attempt to seek employment. The survey results also showed that relatively more graduates from overseas (who have better command of English) had secured places in public and private sectors compared to local graduates. This conclusive study has shown that English proficiency skills have been the extra determining factor for success in job interviews besides the students' outstanding performance at the universities.

Buniyamin [4] suggested that one of the reasons that engineers fail their Professional Engineer Interview conducted by the Institution of Engineers Malaysia is due to their poor communication skills and fundamental knowledge. She postulates that the inability to have in depth fundamental knowledge and poor written essay is due to low proficiency in English. Their fundamental knowledge is poor could be due to the fact that the medium of instruction in University is in English and at school level is in Malay, thus students may have difficulty understanding their university lecturer teaching fundamental subjects in English.

From many past research works, it can be concluded that good command of English depends on many factors. These include syllabus in learning-teaching process, students' interest and perception of its importance, influence of mother language, good surrounding and environment or opportunity that enable students to practise speaking English in daily lives [4-6].

3 English in Electrical Degree Program in UiTM

Bachelor of Electrical Engineering Degree Program in UiTM started in 1968 where Advanced Diploma was first offered and it was later upgraded to a two-tier degree system in 1976. It was renamed as Bachelor of Engineering (Honours) Electrical in 1996 [7]. Historically, English has been used as the medium of instruction in all courses right from day one of student registration at the faculty. Today, all the engineering courses are taught in English and the reference books are also in English. For example, English1 (Report Writing coded as BEL420) is introduced at semester three. English2 (Communication and Interpersonal skills coded as BEL499) is included in semester eight before graduation. Course BEL420 is meant to enable students to write formal report using appropriate language, to collect, interpret, and present data. With effective English teaching method, report writing skill may be improved at the end of the course. Course BEL499 is meant to enable students to design impressive resume, write effective job application letter, practice interpersonal communication and answer interview questions confidently [8]. The two English courses have been designed to also cover both theory and practical aspects, such as role play to make the course interesting and innovative.

Apart from English, a third language is offered to UiTM students, mainly as additional value to UiTM students. The languages offered include Mandarin, Japanese, German, French, Arabic and Korean. Each student must complete three levels of the chosen third language before he or she can complete the degree program. Following globalization trend, a third language will enable students to go even more internationally after graduation, competing with global market players in their specialised field of interest [9].

4 Methodologies

Live data of students from Matriculation and Diploma level intakes were compiled (in Excel format). The data included gender, student identity number, CGPA semester eight, areas (zones) of their hometowns, Grade Points scored in all courses attempted including English courses. The students were divided into five (5) zones namely Zone 1 for the East coast of West Malaysia, Zone 2 for Northern, Zone 3 for Central, Zone 4 for Southern

and lastly Zone 5 for East Malaysia (Sabah and Sarawak).   There were a total of 391 Matriculation students coming from July 2005, July 2006 and July 2007.   As for the Diploma, there were a total of 505 students that enrolled in Degree Program at semester three with credit exemptions in semester one and two. They enrolled in July 2006, July 2007 and July 2008 [10]. Fig. 1 below shows the intakes for Matriculation and Diploma students and Table 1 shows the classification of zone areas.
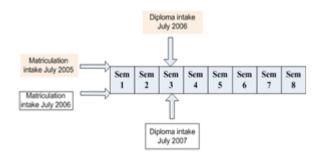

Fig. 1 Entry level into Degree Program [10]

Table1 Zones   Areas Classification

Zone 1	Kelantan, Terengganu, Pahang
Zone 2	Perlis, Kedah, Penang
Zone 3	Perak, Selangor, KL, NS
Zone 4	Melaka, Johor
Zone 5	Sabah, Sarawak

Engineering subjects such as Mathematics for Engineers, Circuit Theory, Electronics Fundamental and Signals and Systems are important fundamental subjects for foundation in Electrical Degree Program. Students must obtain good scores in fundamental subjects, which will later on be applied to solve engineering problems. These subjects become the pre-requisite to other higher courses along the path of the program. Those students with strong ability in their engineering fundamentals have little difficulties when they moved up the engineering ladder. On the other hand those students with medium ability are not able to complete the entire program within the specified time frame. As can be seen in [11], Arsad PM found that, they either graduate with minimum CGPA or extend another one or two semesters before completing the Degree Program.

Artificial Neural Network (ANN), by definition is a biological inspired intelligent technique that is generally made up from a number of highly connected processing elements (units or nodes) whose functionality is loosely based on animal neuron. We know today that the processing ability of the network is stored in the inter-unit connection strengths, or weights, obtained by process of adaptation to, or learning from a set of training pattern. In the past, ANN has been used to predict future events based on past historical data. Typically, ANN is widely used in prediction in automotive industries, banking, gas industries, aerospace industries and flood control.   We believe that it can also give benefit to academic industries, especially to predict student's performance.

Studying deeper into ANN, basically it consists of input, hidden and output layers. The number of nodes in hidden layers chosen depending on the designer and it is really a trial and error process of choosing the best value of Learning Rate and Momentum Rate for the model developed. The network is designed using the fastest technique with minimum error between targeted and predicted values. Usually, the more number of layers used, the more neurons there are in each layer and can produce a better network with minimum error rate between targeted and predicted. Thus, designing a neural network is a process of choosing the Learning Rate (0 -1) and the Momentum rate (0-1). The Learning Rate helps to accelerate the convergence of ANN training process while the Momentum Rate helps to accelerate the training process.   There are many techniques in ANN and in this study Lavenberg-Marquardt (LM) was chosen,   with two hidden layers and one output layer. The activation or transfer function used in hidden layers are Hyperbolic Tangent known as "logsig" while the output layer is mainly pure linear or "purelin".   The training will stop when Minimum Squared Error (MSE) is obtained, that is, the minimum error between targeted and predicted by NN model. There is only one output, which in our study, is the CGPA at semester eight. The NN model was built using the NN toolbox of the MATLAB software version

R2010a. The model was trained and tested with 391 data for Matriculation students.

In our earlier work, the model was developed and tested using Grade Points scored by students for courses at semester one to predict the final CGPA8. In the earlier study, it was found that there is a strong correlation between engineering fundamental subjects at semester one with the final CGPA [12]. In this paper, we used the same prediction model and tested it with sets of data collected whereby the courses include Signals and System 2, Mathematics 2, Digital System, Material Science, English 1 and English 2 as input variables

We used this model again with another set of data of Diploma students taking the same courses as Matriculation students. In both cases, the output is still CGPA8. The aim of our experiment is to see the correlation between engineering courses at semester three with English courses and without English courses with that of final students' performance.

5 Findings
5.1 Matriculation students
Based on the live data, there were 161 female students and 230 male students that formed the total number coming from three co-hort matriculation students for intakes in July 2005, July 2006 and July 2007. The achievement of English1 and English2 are as shown in Fig 2 and Fig 3 respectively.
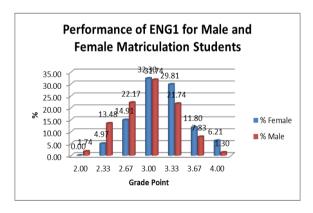

Fig 2 Performance of English 1 for Matriculation students

5.1.1 English Capability
Firstly, we would like to see whether English language has an impact on the performance of students in the final semester. Referring to Fig 2, it can be seen that female students performed better in terms of grade points scored for English 1.

There are obviously higher percentages of Grade Points (i.e. 3.00, 3.33, 3.67 and 4.00) for female students shown here. The Grade Point equivalent is described in Table 2 below. Next, we noted from Fig 3 that after a few semesters, male students have relatively improved compared to female students as shown with English2. In other words, male students performed better in communication skills. This is expected because from lecturers' observation the male students are more open and daring to speak out in public.

Table 2 Grade Point and Grade

Grade Point	Grade
4.00	A
3.67	A-
3.33	B+
3.00	B
2.67	B-
2.33	C+
2.00	C
1.67	C-
1.33	D+
1.00	D

5.1.2 English Capability Study based on Zones
Secondly, we conducted a study on English language and its impact based on Zones. We observed that by comparing performance results based on zones, those students from Sabah and Sarawak (Zone 5) performed better in both English courses. This is depicted in Fig 4 and Fig 5 where they scored higher Grade points i.e. 3.33, 3.67 and 4.00. Here, we argue that it is an acceptable fact that students from Zone 5 can speak and write English better due to the frequent use of English medium for communication right from primary schooling years since 1990. The environment in Zone 5 also helped them whereby every member of family including parents also speaks English in their daily-life
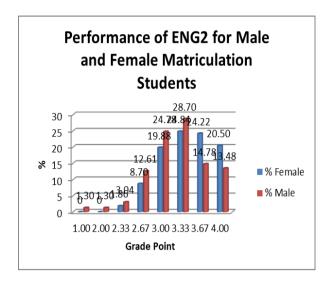
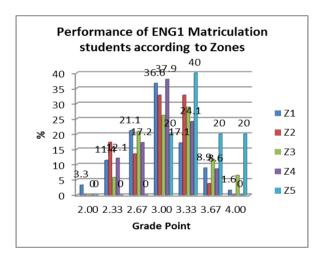Fig.3 Performance of English 2 of Matriculation students

Fig. 4 Performance of English 1 based on Zones

5.13 Impact on Overall Performance

Thirdly, we conducted a study to see how Grade points of English courses affect other electrical engineering courses. We do this by putting in as parameter input variables (English and other subjects together) and see the predicted outcome of the overall performance of students upon graduation using the NN Prediction model. We have three models, i) Model A which considers six inputs comprising of four Electrical courses and two English courses, ii) Model B which only considers the four fundamental electrical courses and iii) Model C which only considers English courses as inputs. The output of these three models remains the

same, namely CGPA8. We summarise the models with input and output parameters as shown in Table 3 while the NN configuration is as shown in Table 4 below.

Table 3 Input and Output parameters

Model	Input parameters	Output parameter
A	Digital Theory 1	CGPA8
	Material Science	
	Signals & Systems 2	
	Mathematics 2	
	English 1	
	English 2	
B	Digital Theory 1	CGPA8
	Material Science	
	Signals & Systems 2	
	Mathematics 2	
C	English 1	CGPA8
	English 2	

From Table 4.0, it can be seen that the Coefficient of Correlation, R for Model A is **0.92256** and Model B **0.92545** respectively. Model A includes both English courses while Model B only caters for the engineering courses. Our observation is that there is not much effect in the R values between the two models i.e. with engineering courses plus English compared to that of only engineering courses. As for the Mean Squared Error (MSE), there is a small increase in Model B which is **0.07969**. The best model is the one with minimum MSE which is confirmed in Model A. To verify further, we considered only English courses as inputs as in Model C. This time R is **0.5221** and MSE is **0.11742**. This implied that there is poor correlation between English courses and CGPA8 upon graduation. There is also an increase in the MSE for model C. The Model with R value of 80% is considered positive correlation.

Table 4 NN Configuration

Items	Model A	Model B	Model C
Network Configuration	'logsig', 'logsig', 'purelin' [17,35,1]	'logsig', 'logsig', 'purelin' [17,35,1]	'logsig', 'logsig', 'purelin' [17,35,1]
Learning Rate	0.6	0.6	0.6
Momentum Rate	0.95	0.95	0.95
Training Technique	Lavenberg-Marquardt (lm)	Lavenberg-Marquardt (lm)	Lavenberg-Marquardt (lm)
Training Goal	10^{-3}	10^{-3}	10^{-3}
Correlation Coefficient (R)	0.92256	0.92545	0.5221
Training Data	273	273	273
Testing Data	118	118	118
No of Input Variables	6	4	2
Mean Squared Error (MSE)	0.04375	0.07969	0.11742

In the following sub-section we describe how we repeated the same study again as described above for Diploma students, except zoning study

5.2 Diploma Students

The performances of English1 and English2 for the Diploma students are as shown in Fig 6 and 7. There were a total of 505 Diploma students joining the Program in July 2006, July 2007 and July 2008. There were 191 female students or 38 % of the total students and 314 male students

5.2.1 English Capability

Recall as before, we would like to see whether English language has an impact on the performance of students in the final semester. This time the outcome of the study, we observed a difference. There are a higher percentage of female Diploma students scoring Grade Points 2.67, 3.00, 3.33, 3.67 and 4.00 as depicted in Fig 6 for English 1. The male students improved when it comes to English 2 whereby there are a higher percentage of male students scoring Grade Point   2.67 and 3.67   as depicted in Fig 7.   As before the male students are more open and speak better in public than female

students. Then the Diploma students' data was tested using the NN model developed earlier. The data was again divided into 70% for training data and 30% for testing as in the Matriculation students before.
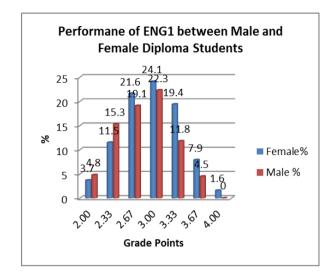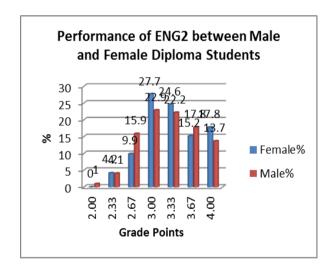

Fig. 6 Performance of English1 for Diploma Students

Fig. 7 Performance of English2 for Diploma students

5.2.2   Impact on Overall Performance

We also conducted a study to see how Grade points of English courses affect other electrical engineering courses amongst Diploma students. Again we can recall that there are three models, i) Model A which considers six inputs comprising of four Electrical courses and two English courses, ii) Model B which only considers the four fundamental electrical courses and iii) Model C which only considers English courses as inputs. This time we added Model D which combines all students together both Matriculation and Diploma, which makes up a total

of 896 students. The output of these four models remains the same, namely CGPA8.

Table 5 shows the network configuration for the Diploma students. Then the data was further divided into 70% for training and 30% for testing to confirm on English courses correlation with final CGPA8. From Table 5.0 it can seen that the Coefficient of Correlation for Model A (6 inputs) was **0.9776** while R for Model B (4 inputs) was **0.9044**. There is little difference in the value of R between Model A and Model B. The MSE were **0.05825** and **0.0400** respectively. As for Model C, with only English courses as inputs, R was **0.4989** with MSE **0.0806**. This implies that there a poor correlation between inputs and output namely CGPA8.

In order to confirm and verify the above correlation, all the students were combined together (both Matriculation and Diploma) to make a grand total of 896 students to form bigger data. This time around, the input variables were maintained with two English courses but the training data has been increased to 627 and testing data to 267 which is 70:30, named as Model D. It is found that R is **0.4518** and MSE **0.0786**. This is a poor correlation as far NN model is concerned which confirms the above correlation result. It is noted that the best model is the one with the highest R and minimum MSE.

Table 5 NN Configuration for Diploma Students

Items	Diploma Model A	Diploma Model B	Diploma Model C	Max Dip Combined Model D
Network Configuration	'logsig', 'logsig', 'purelin' [17,35,1]	'logsig', 'logsig', 'purelin' [17,35,1]	'logsig', 'logsig', 'purelin' [17,35,1]	'logsig', 'logsig', 'purelin' [17,35,1]
Learning Rate	0.6	0.6	0.6	0.6
Momentum Rate	0.95	0.95	0.95	0.95
Training Technique	Lavenberg-Marquardt (lm)	Lavenberg-Marquardt (lm)	Lavenberg-Marquardt (lm)	Lavenberg-Marquardt (lm)
Training Goal	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Correlation Coefficient (R)	**0.9776**	**0.9044**	**0.4989**	**0.4518**
Training Data	354	354	354	627
Testing Data	151	151	151	269
No of Input Variables	6	4	2	2
Mean Squared Error (MSE)	**0.05825**	**0.04**	**0.0806**	**0.0786**

The following figures show the comparison between Targeted and Predicted output based on tested data for cases for Matriculation and Diploma. (Model A, B, C, Combined model D)
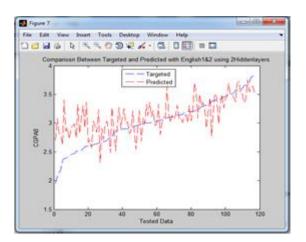

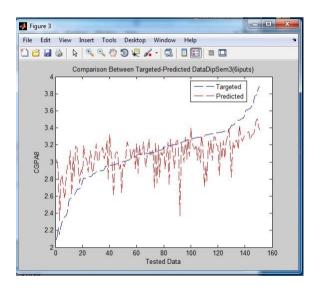Fig. 8 Comparison between Targeted and Predicted Matriculation Students (Model A)

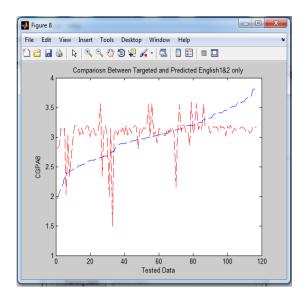Fig. 9   Comparison Between Targeted and Predicted 4 Inputs without English (model B).

Fig.10 Comparison between Targeted and Predicted Using English courses only. (Model C)

From Fig. 8 and 9 it can be seen that at lower CGPA8, the predicted is higher than the actual or targeted. On the higher hand, those students at higher CGPA8, the predicted is lower than the targeted value. This is true due to the fact that the total credit hours keep increasing as students move to higher semester in the program and the engineering courses tend to be more difficult and complicated. Students must stay focus and keep the study momentum from the very start until graduation. Those with low CGPA can be improved by strategic intervention by the lectures and academic advisors. In Fig. 10 there is poor correlation as R was **0.522** (Table 3).

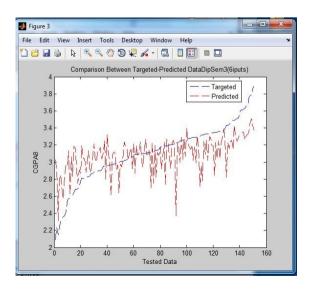The following figures will illustrate comparison between predicted and Targeted for the Diploma students.
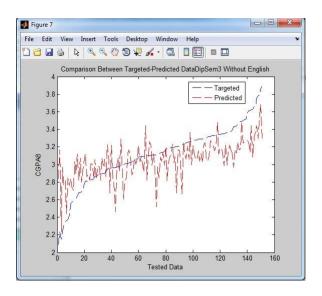

Fig.12 Comparison between Targeted and Predicted Diploma Students without English (Model B)

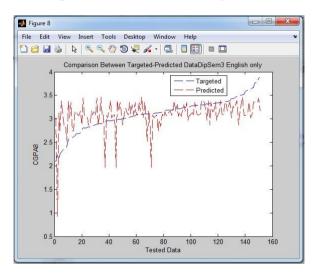Fig. 13 Comparison between Targeted and Predicted Diploma Students English only (Model C)

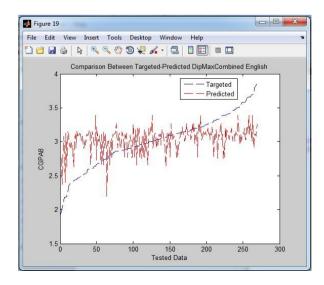Fig. 11 Comparison between Targeted and Predicted Diploma Students (Model A)

Fig. 14 Combined data MaxDip with English courses Only (Model D)

From Fig. 11 and 12 it can be seen that at lower CGPA8 the predicted is higher than the Targeted which is similar to finding for the Matriculation students. As for model C from Figure 13, whereby the inputs are merely English courses, there is a poor pattern between targeted and predicted. The Model D in Figure 14 was just the same as that of Model C with only English courses as input variables but the total data was a combination both Matriculation and Diploma students.

6.0 Discussion

Before closing it is worth to consider the following points. Throughout the paper, we have chosen CGPA as the performance measure, and it is also the criteria used by many employers to invite graduates for the first round of job interview. Other traits like leadership, effective communication, interpersonal skills, teamwork and critical thinking are also being assessed for the final job recruitment decision, and this is decided based on the performance of candidate during interview. For UiTM students, who have undergone Communication Skills course, this requirement becomes easy. On the management side, the University management must seek the best and effective methods of delivering English courses so that students have strong chances of success during interview sessions

7.0 Conclusion

In this paper we compared the performance achievement of English courses between male and female students. We then investigated the impact of English courses on the overall students' performance using Neural Network (NN) Prediction model. We also conducted predictions on intakes from two entries namely Matriculation and Diploma. Using the Prediction Model we have shown that students with strong fundamental engineering courses ability at the beginning of the Program will graduate with high CGPA. Though our intention is to see which one has a stronger effect on the final performance, and our prediction model has shown that engineering courses have greater impact on their final CGPA when compared with English courses. In other words, Report Writing and Communication and Interpersonal skills have little impact. This outcome is expected, because engineering courses are mostly based on calculation and problem based solving, and hence Report Writing and Communication and Interpersonal skills have relatively on effect on the final performance of the students.

The outcomes of the study indicated that there appears to be a direct correlation between students' results for fundamental subjects and the final overall academic performance of graduating students. We can safely conclude that English Language courses had little effects on the performance (final CGPA) but good English proficiency will help students during job interview session. Lecturers and academic advisors can use our NN prediction model, to do early and strategic intervention upon detection to alleviate the final CGPA upon graduation.

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