The Relationship of English Proficiency and Mathematics Achievement

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Abstract: - The study aims to investigate the relationship between English proficiency and mathematics achievement. The sample of study is taken from a population of students from Faculty of Science & Technology (FST), UKM (n = 118) taking into account grades and English proficiency test. Chi square analyses conducted to test the significance of the relationship between two variables. Analysis of variance (ANOVA) was used to examine differences in mathematics achievement English proficiency. The results showed that good mastering of English is needed to nurture and understand mathematics subject to achieve excellent results. Furthermore, low English proficiency resulted in students experiencing a shortage in mathematics learning and obtained a lower grade in a mathematics course.

Key-Words:- English proficiency, mathematics, teaching and learning, performance, thinking process, native language, ESL students

1 Introduction

1.1 History of education
In the days of British rule, the Malay school system developed by the English only provided the Malay population with their spelling, writing, and mathematics skills, as well as health knowledge. Education provided did not have the potential to be extended because it was not recognized to be accepted as a basis for further studies into secondary school. Thus a series of revised education policy was done before the era of independence until after independence. In 1970 an educational reform has occurred with the implementation of Language Transition Program. The purpose of this program was to unite Malaysians of multi-races using the Malay language. Based on this program, all languages of instruction in English schools were converted in stages from English language (EL) to Malay, while Chinese and Tamil national-type primary schools could maintain two languages but should follow the syllabus set by the Ministry of Education. In 1982, all schools in Malaysia used Malay language as the medium of instruction [1].

In 2003 educational reform occurred again where the language of instruction of Science and Mathematics subjects changed from the Malay language into EL. Although the language of instruction for Malaysia was the Malay language but the education reform was done on the basis of EL is seen as an international language. Mohini et al. [2] showed that the reasons for the education reform are Malaysia is heading towards internationalization, increased competition in the labour market, increased training of EL usage in the context of international business as well as increased in the number of foreign students in local universities in Malaysia.

1.2 Problems of Science and Mathematics Education around the World
The problem of teaching science and mathematics in EL was also faced by most countries around the world. This problem was caused by globalization and migration, where the population of underdeveloped countries, whose mother tongue was not EL, migrated to developed countries whose medium of instruction is English. Many countries around the world affected by this setback for example the United States [3,4,5,6,7,8,10], New Zealand [11,12], Australia [13] and England [14]. Thus a lot of researches were done [3,4,5,6,7,8,9,10,11,12,13,14] including studies by the
International Study Centre, the Trends in International Mathematics and Science Study (TIM2008) [15].

1.3 Teaching and Learning of Science and Mathematics in English (PPSMI)

Issues of learning mathematics and science in EL covers the problem of the use of vocabulary in problem solving problem, especially the process of transforming the EL into mathematical expressions [16], and discussions of mathematics in the classroom [12,17]. Students with low English proficiency will experience problems from lower to higher level, while students who are good in EL may have a problem only in the discussion of mathematics in the classroom. Usually low-level mathematical problem involves only the first and second year courses at the university, while the discussion of high-level mathematics courses occur in the third and fourth years. Third and fourth year courses are very much involved with mathematical proof, conjecture based on logic and reasoning to arrive at the conclusion, and the ability to generate thoughts on knowledge and theories learned in year one and two. With a lack of proficiency in the EL, these students will experience a shortage in learning mathematics. Research by Neville-Barton & Barton [11] has shown that students who use EL as a second language (ESL) experienced 10-15% deficiency in learning mathematics due to lack of proficiency in EL.

There are some studies that show ESL students are facing problems in learning Mathematics, both in primary and secondary schools. Almost every developed and emerging countries found a decline in Mathematics results [6,11]; reduction in mathematics achievement because of the difficulty of understanding the text in the first year of undergraduate programs compared with the native students [18]; ESL students bear 10 to 15% deficiency in learning mathematics due to the language and the problem gets worse for students with low English proficiency [11,19]. Four of the five studies show that the ESL students do not realize the extent of their learning difficulties [11]; mathematical vocabulary depends on English proficiency and native language; and problem solving is the most difficult element for the ESL [11].

In Malaysia, the PPSMI was implemented in 2003, starting in Year 1 (seven years old), Form 1 (thirteen years old) and Lower Six (eighteen years old), although teachers and students are not proficient in English [20]. This was a big change in the country's education system with particular challenges to teachers and students [21]. In 2007/2008 school session, the Ministry of Higher Education declared that all university candidates are required to fulfil additional entrance qualification to the university, by taking the Malaysian University English Test (MUET), with the lowest band is one and the highest of that is six. Thus MUET becomes a measurement of EL competency.

Therefore, this paper aims to look at students’ achievements in mathematics which are assessed based on grades obtained in a mathematics course and its relationship to EL proficiency.

2 METHODS

2.1 Subject

The study was undertaken on students from the Faculty of Science & Technology (FST), Universiti Kebangsaan Malaysia (UKM), who were specializing in Biology and Environmental Sciences fields. A total of 118 students taking a STQM1823 course were the subject of study. These students have learned mathematics in EL since 2006 in high schools. All of the students have taken the MUET examination, with the lowest band is two and the highest of that is five.

2.2 Research Instrument

Data were obtained from the assessment of STQM1823 course. The examination questions are given in two languages, Malay and English languages. There are four subjective questions given in the test with different difficulty levels. Students are evaluated based on overall performance in the course and competency of English from the MUET band is studied. The assessment includes mid-semester and final examinations, quizzes, projects, and tutorials. During the assessment, students are given the freedom to choose and use the Malay language and EL in solving problems.

2.3 Statistical Analysis

In this study, data was analyzed using descriptive statistics which includes mean, standard deviation, frequency, percentages and cross tabulation. Chi square analyses conducted to test the significance of the relationship between two variables. Analysis of variance (ANOVA) was used to examine differences.
in mathematics achievement scores across different MUET band.

3 RESULTS

3.1 Mathematics Achievement relationship with MUET Results

Majority of the students lie in a moderate English proficiency with band three and four of 43% and 37%, respectively. About 10% of the students are both in low and high bands, Table 1.

Table 1. Percentage of students with MUET band respectively

<table>
<thead>
<tr>
<th>MUET band</th>
<th>Number of students</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>9.3</td>
</tr>
<tr>
<td>3</td>
<td>51</td>
<td>43.2</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>37.3</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>10.2</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Analysis of variance (ANOVA) was used to test the relationship between English proficiency, which is assessed through MUET and student achievement in a mathematics course which is measured by grades and scores. The results show that the effect of MUET results on student achievement were significant (p-value 0.034, F = 2.995). Since MUET results are found to affect the achievement of students, further analysis using Tukey HSD Multiple Comparison Test and LSD were conducted to determine the most influenced MUET band in student achievement scores, Table 2. The analysis showed that students with band 5 are the highest achievers and significantly different with students who earned MUET band 2 (p-value = 0.026), band 3 (p-value = 0.005), and band 4 (p-value = 0.04).

Table 2 is a cross tabulation results of MUET1 (Band 1 to 6) versus grade category, namely the Excellent (grade A and A-), Good (B + and B), the Fair (grade of B-, C + and C) and Poor (C- and below). The result showed that English proficiency affected student achievement with a significant p-value of 0.044.

Results in Table 3 showed dependency exists between MUET band with student’s grade achievement. Students with low MUET achievement, with band 2 and 3 failed to excel in a mathematics course where 5% of the students from band 2 obtained a poor grade and almost 40% of band 3 obtained fair and poor grades.

Based on Table 4, it was found that the p-value for dependence testing of MUET2, MUET category (low, moderate and good) versus grade student achievement (excellent, good, fair and poor) is 0.027. A significant p-value indicated that MUET results have a significant relationship with grade achievement. Cross tabulation in Table 4 showed that for the moderate MUET category, the percentages number of student increased for lower grade category.

The performance of students in a mathematics course is compared with the English competency measured through MUET results. The findings showed that, in general, the English competency affected student performance in a mathematics subject.

Table 2. Tukey and LSD Multiple Comparison Tests

<table>
<thead>
<tr>
<th>(I)</th>
<th>(J)</th>
<th>Mean Difference (I-J)</th>
<th>Standard Error</th>
<th>Sig.</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUET</td>
<td>MUET</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tukey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSD</td>
<td>2</td>
<td>3</td>
<td>-0.22193</td>
<td>4.56503</td>
<td>1</td>
<td>-12.126</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
<td>-3.63848</td>
<td>4.63976</td>
<td>0.861</td>
<td>-15.7375</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>-12.96212</td>
<td>5.732</td>
<td>0.113</td>
<td>-27.9093</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>0.22193</td>
<td>4.56503</td>
<td>1</td>
<td>-11.6822</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>-3.41655</td>
<td>2.84298</td>
<td>0.627</td>
<td>-10.8301</td>
</tr>
</tbody>
</table>
### Table 3. Cross tabulation of MUET1 and grade

<table>
<thead>
<tr>
<th>Grade Category</th>
<th>MUET band</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>5 (4.3)</td>
<td>6 (5.1)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1 (0.08)</td>
<td>7 (6.0)</td>
<td>20 (17.1)</td>
<td>23 (19.7)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>5 (4.3)</td>
<td>4 (3.4)</td>
<td>15 (12.8)</td>
<td>19 (16.2)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4 (3.4)</td>
<td>2 (1.7)</td>
<td>4 (3.4)</td>
<td>2 (1.7)</td>
</tr>
</tbody>
</table>

### Table 4. Cross tabulation of MUET2 and grade

<table>
<thead>
<tr>
<th>Grade Category</th>
<th>MUET Band Category</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poor (band 2)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>5 (4.3)</td>
<td>6 (5.1)</td>
</tr>
<tr>
<td></td>
<td>Moderate (band 3 &amp; 4)</td>
<td>6 (5.1)</td>
<td>11 (9.4)</td>
<td>35 (29.9)</td>
<td>42 (35.9)</td>
</tr>
<tr>
<td></td>
<td>Good (band 5)</td>
<td>4 (3.4)</td>
<td>2 (1.7)</td>
<td>4 (3.4)</td>
<td>2 (1.7)</td>
</tr>
</tbody>
</table>

### 4 Discussions

This study has shown that English competency affected student’s achievement in a mathematics course at the university level. Furthermore, students in a lower English proficiency group showed a negative relationship with mathematics achievement, where the percentage of students with poor grades increased,
Table 3. The findings showed that the mean performance of band 5 group shows a very good performance. This means that students must have a good competency in EL to nurture and understand mathematics at their best when teaching and learning of mathematics is done using a second language, EL.

Lack of English proficiency in mathematics learning creates a lack of attention to the use of symbols, representations of objects and mathematical operations. Dubinsky [22] states formalism in mathematics learning is able to produce meaning. Formalism means a representation of objects and mathematical operations such as the use of symbols and diagrams, while meaning refers to various factors in the individual understanding. Failure to paying attention to symbols, representations of objects and mathematical operations cause dropouts in learning mathematics or a shortage to absorb mathematical knowledge due to the learning of mathematics in a language that is less competent.

Good English proficiency also shows a direct proportion to the development of cognitive skills. Good mastery in EL provides excellent performance while less competence in EL makes learning mathematics difficult thus student performs poorly in mathematics course. Although mathematics is considered to be a subject that does not require as much use of language because mathematics often uses symbols, but the skills to understand, build conceptual and blending information requires thinking in a language that is well understood. Usually the language of thought is the mother tongue of the students. Clarkson [23] found that ESL students tend to translate their learning problem into their native language because the thought process becomes easier in their native language which simplifies the semantics process. Translation act as an agent to maintain concentration in the learning process for a long enough duration so that meaning and understanding of the materials are achieved. On the other hand, learning in the second language causes students to lose some information in the thinking process because it is difficult to be stored in the short-term memory. By doing the thinking in the native language, the concept of learning will be easy to understand because communication networks in reading, recalling, and relating information are better than that of using a second language. This explanation is relevant in the TIMSS2008 report which shows the achievements of Mathematics and Science students who used their mother tongue for teaching and learning, on average, are higher than those who study the subject in a second language [15].

5 Conclusion
The main objective of this research is to study the performance of students' in mathematics course in relation to English proficiency through MUET results. A dependency test between mathematics achievement and English proficiency shows that good mastering of English is needed to nurture and understand of mathematics to achieve excellent results. Furthermore, low English proficiency resulted in students experiencing a shortage in mathematics learning and obtained a lower grade in mathematics. Mathematics is a natural language involving certain vocabulary, syntax, logic and reasoning. The skills to understand the mathematical language need to be learned in the native language and the mother tongue is also a precursor to excellence in learning mathematics using a second language.

References:
California Association for Bilingual Education in Anaheim, California.


