Available online at www.ispacs.com/metr
Volume 2014, Year 2014 Article ID metr-00048, 11 Pages
doi:10.5899/2014/metr-00048
Research Article

Students' English Language Abilities in Solving Mathematics Word Problems

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Abstract
Previous local research findings have found that students are generally weak in solving mathematics word problems especially in problems that required skills in choosing the various mathematical techniques they have learned in previous years. Too often, students see the knowledge taught by teachers as mathematical procedures and they failed to apply the importance of such knowledge to their daily lives. This research investigated two main areas, namely students' performance in solving mathematics word problems and the relationship between English competency and the ability to do mathematics. A total of 78 Year 9 students from four secondary schools participated in this study. The findings revealed that the time or period spent in school does not determine students' ability in mathematics but rather a strong foundation in basic mathematics is a factor that contributes to a better performance in the subject. Furthermore, the English competency does not influence students' performance in doing mathematics word problems significantly. It was proven that students does not require good English to do Mathematics word problems questions with less than 40 words (those categorised as 'Not Wordy' and 'Average Wordy' questions).

Keywords: English competency, language, mathematics word problems, secondary students' performance, Brunei Darussalam.

1 Introduction

One of the most significant experiences that a teacher will remember during a teaching career is when a result of an examination is published. Students performance can be seen from the grades they obtained and at the same time teachers will also be 'measured' by the same result. The ability of the teacher to teach is often reflected from the grades obtained by his or her students [18]. Teachers will then be expected to write up a report commenting on the result, highlighting the strengths and weaknesses of the overall performance of the school. The number of failures often exceeded the number of passes in mathematics regardless of

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any level of examination. Some are unable to solve the computational aspects of mathematics and some are unable to understand the questions being asked and this led to poor performance in mathematics. In Brunei Darussalam (hereafter referred to as Brunei), English is a second language but the medium language of instruction, including mathematics subject, in schools, is English. Previous local researchers such as Saman (2000) [12] investigated Year 6 students' understanding of mathematics word problems involving multiplication and division. From his findings, he found that the Year 6 students considered mathematics word problems to be one of the most difficult parts in mathematics especially when it involved multiplication and division in comparison to addition and subtraction problems. One of the questions asked in his research was "*I have 3 cakes to be shared equally between six people. How much cake will each person get?*" Only 13.8% of the participants gave the correct response, however 38.5% solved this as $6 \div 3 = 2$. Furthermore, Saman also reported that 29% of his sample students were having difficulties in level II error that is the Comprehension error of the Newman Error Analysis. This is similar to the findings found by Raimah (2001) [7], where 29% of her Year 6 student samples were having difficulties in the same level. In addition, 49% of Saman's sample students were having difficulties in level III error that is the Transformation error and fewer in Raimah's study (27%). It appears that students are weak in solving mathematics word problems especially problems that requires skills in choosing the various mathematical techniques they have learned in previous years. Students often see the knowledge taught by teachers as mathematical procedures by failing to apply the importance of such knowledge in daily life. Teachers on the other hand, put less emphasis on understanding but more focus on finishing the syllabus as reported by Rosney (2008) [9] and Sakdiah (2008) [11]. Teachers will formulate strategies in order to help their students. Several earlier researches had taken interests on similar topics yet none had actually linked the relationship between English competency and mathematics performance.

2 Related Literature

According to Orton (2004) [6], a mathematics word problem is a question that requires the application of mathematics knowledge in order to reach a solution. However it first requires extraction of information from a given sentences. Gurung (2003) [2] on the other hand defined mathematics word problems as "problems expressed in sentences and solved by expressing them structurally and solving them using basic operations" (p. 1). In addition, Hadion (1990) [3] defined mathematics word problem as "a mathematical verbal problems in written form that includes percentages symbol (%), and other mathematical symbols such as +, -, ÷, ×" (Hadion, 1990, p. 4). From the three definitions here, we concluded that mathematics word problems refers to mathematical questions expressed in sentences and it requires precise understandings over the questions in order to know what mathematical concepts is needed to solve it. Students learn arithmetic in the early years of schooling [1]. Addition, subtraction, multiplication and division are taught and rehearsed extensively. For some years the mathematics questions asked to students is limited to question that is expressed in mathematical symbols and often teachers exposed students with techniques to solve them. These early exposures give students the impressions that mathematics can be conquered by memorising of steps and procedures. The existence of *how many* in the question may also lead to the use of keywords (or cue words) approach. Veloo (1994) [17], Sainah (1998) [10], Saman (2000) [12], Raimah (2001) [7] and Timah (2006) [15] suggested that students employ the key words approach in solving the question. Students skimmed through the sentences and try to find key words which alerted them on the operations to be used. This approach shows there were less thinking process amongst students in attempting the questions. The keywords strategy in which students are expected to scan for one word and this one word becomes the 'sign' in deciding what procedures to be used in solving the mathematics word problems had also posed problems [14]. Different researches (Gurung, 2003 [2]; Raimah, 2001 [7]; Saman, 2000 [12]) found that students were unable to perform well in mathematics word problems that are presented in the English language. It is typical to encounter a person who performs better in computational

mathematics compared with mathematics word problems. However, Rasidah (1997) [8] in her research investigating the performance of Year 7 students in solving mathematics word problems in English and Malay reported that there exists no significant difference in students' performance whether the students are to be tested in English or Malay. In fact she found that, students preferred to attempt the Malay questions in using their English understandings as they learnt it in English. Another research investigating the difficulties encountered by primary 5 and 6 pupils done by Yusof (2003) [19] reported that pupils made more mistakes in comprehension and transformation errors and not because of language. She further recommended that teachers should develop intervention strategies to aid students, whom English is not the first language, in solving mathematics word problems. Timah (2006) [15] utilised model-drawing or box-diagram as a strategy in solving the mathematics word problems. She reported that this strategy improved students' understandings, as it clarified the complexities and the semantic structure of the mathematics word problems. The issues in the teaching and learning of mathematics in a second language had become an issue in most countries. Leung (2005) [4] found that in the 1999 video study majority of the teachers in East Asian countries (focusing on Hong Kong and Japan) expressed their teaching in mathematical language and symbols set in the context unfamiliar to their students. The same view is shared by Toom (2000) [16], where he believed that students should be taught with problems which people solve in everyday life.

3 Methodology

3.1. Logic of the Research

In this research, the focus is on mathematics word problems tested using a test. The English part of the research is the command of English possessed by the Year 9 students and this is based on the readily available results obtained from the school that participated in this study. That is the results from past examination and assessments taken by the students. In addition to students, word problems cannot be separated from language, lessons were also observed in order to find ways how a teacher communicated with his or her students. Moreover, further investigations were made on the use of different teaching resources so that influences other than teachers will also be discussed.

3.2. Research Design

This research sought to find out the relationships between language and the ability to perform well in mathematics. In order to find these relationships, the main research questions investigated are given below.

- What is the level of performance of Year 9 students in solving mathematics word problems?
- What is the correlation between English competency and the ability to solve mathematics word problems?

The approach to data collection and analyses are both qualitative and quantitative in design. It utilized statistical information gathered from the research instruments (test, interviews and students questionnaires). This research aimed to establish the correlations between English language ability and the ability to solve mathematics word problems. In addition, this research may also provide any useful evidence to the debate in the importance of teaching mathematics in English and to use the Malay language when necessary.

3.3. Participants

Brunei is a country that practices the Malay Islamic Monarchy concept or the *Melayu Islam Beraja.* The country is divided into four districts, namely, Brunei Muara, Tutong, Belait and Temburong. The population of Brunei is approximately 390 000 people and majority are Malays. Malay language is the official language in the country but English language is also widely used. The Education System in Brunei can be divided into two major areas, the conventional schooling system and the Islamic religious schooling system. In the conventional schooling system, students will undergo primary, secondary and pre-university

levels. It is also compulsory for all Muslim children from the age of 7 to 13 years of age to attend Islamic religious schools on top of attending their conventional schooling. According to the schools and institutional statistics provided by the Ministry of Education of Brunei (Ministry of Education, 2007) [5], there were a total of 13500 students (approximately 5% of the total Brunei population) in Year 9, at the time of study. Consequently, the participants involved in this study consisted of Year 9 students studying in four of the government schools in Brunei. All the schools are located within approximately 20 km from the capital city of Brunei, Bandar Seri Begawan which is located in the Brunei Muara district. Furthermore, only one class of Year 9 from each four schools were selected to participate in this research. The selection of this classroom is purposive and convenience in nature. The authors purposely targeted the Year 9 students as the sample for this study and all the schools were within easy access to the authors. Meanwhile, the age distribution of the participants indicated that majority (44.9%) of the students are at the age between 14 and 15 years old. The education system act in Brunei made it compulsory for all children to be in school, starting from the age of six years old in which they will be in primary school starting with Year 1 until they reached 15 years old where they will be in Year 11 of the secondary schooling. Therefore, as the students reached Year 9, they would have been in schools for approximately ten years. The community of Brunei consists of different races where the dominant race is Malay. However, in this research the Malays are separated into two. Namely, the 'Malay', consisting of the pure Malay community and the 'Indigenous Group' consisting of the 'Ibans', 'Dusuns' and the 'Muruts'. Meanwhile, other communities are grouped into the ‘Chinese’ and ‘Other’. According to the race distribution of students in the sample, the dominant race is Malay (17, 18, 18 and 18 in Schools A, B, C and D respectively. And there were only 4 Chinese students in School D, one student from the indigenous groupings in each schools B and C and one from the 'Other' category. For participants who are from the non-Malay categories, English may be their third or even fourth spoken language. Table 1 shows that all the schools involved in this research are mixed gendered schools. In total, 78 students were involved in this research study.

Table 1: Gender of students in the sample

	School A		School B		School C		School D		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Male	8	47.1	10	52.6	6	31.6	11	47.8	35	44.9
Female	9	52.9	9	47.4	13	68.4	12	52.2	43	55.1
Total	17	100	19	100	19	100	23	100	78	100

3.4. Instrumentation

Several instruments were used in the data collection. Students command in English used during the comparison is based on the marks given by their schools. It can either be a grade from the, at the time of study, Penilaian Menengah Bawah (PMB) examination or Students Progress Assessment (SPA) depending on the cohorts of the Year 9. The test item consisted of 14 word questions and grouped into Not Wordy question (Question with number of words less than 30 words); Average wordy question (Question with number of words in the range of 31-40 words); and Wordy question (Question with number of words more than 41 words). Questionnaires were also distributed for the students (adapted from Shahrill (2009) [13]), the mathematics subject teachers (adapted from the Trends in International Mathematics and Science or TIMSS in 2007) and schools (adapted from the Programme for International Student Assessment or PISA in 2006), and classroom observations and interviews were gathered as well.

3.5. Data Collection and Data Analysis Methods

Permission to conduct the study was granted by the Ministry of Education who oversees mainly all the government and most of the non-government schools in the nation. Before the implementation of the main study, an initial 15 word questions in the test were piloted to a different class of 20 students. The test items

reliability was determined in terms of its internal consistency and the Cronbach alpha reliability was found to be 0.65. One of the test items were found to be more suitable if calculators were allowed, but since calculators were not allowed during the test, the item was then omitted. In the main study, the collection of English test marks and the administration of the test items and the questionnaires (students, mathematics subject teachers and schools) took about two weeks. Subsequently, another three weeks for the classroom observations and interviewing process. In analysing the data, for the first research question, simple descriptive statistics, in the form of frequency and percentages, is used to represent the findings. Meanwhile for the second research question, the Pearson's Correlation technique had been utilised to find the existence of correlation between the two variables (the command of English and the ability to solve mathematics word problems).

4 Findings

All the 78 students were given the test items consisted of 14 mathematics word problem questions carrying 28 marks. However, none was able to respond correctly to all the questions. Figure 1 shows the histogram and normal curve of the marks obtained by students in the test. The minimum mark obtained by students in the test is zero and the highest is 26 marks. The mean mark is 10.42 and the standard deviation is 6.38. In addition the distribution of students in their performance in the mathematics word problems is skewed to the left indicating that majority of the students were performing less than half of the full mark.

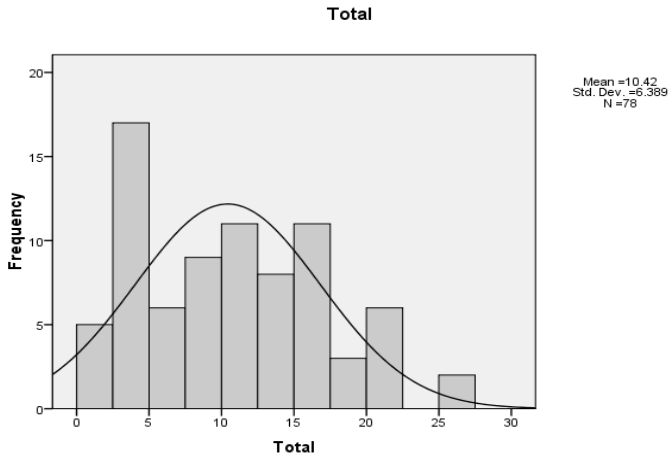

Figure 1: Total marks obtained by students in the mathematics word problems

Table 2 below shows the range of marks obtained by each of the four schools. The highest marks obtained by students in this research was obtained by a student from school B and the lowest marks was from school D. In addition, eight students obtained marks in the top 90th percentile (20-26 marks or 71%-93%) and from the eight, seven were from school B. Meanwhile, five students were in the lowest 10th percentile (0-2 marks or 0%-7%) and all are from school D.

Table 2: Range of marks according to school

School	Minimum Marks (%)	Maximum Marks (%)
School A	3 (10.7%)	21 (75%)
School B	8 (28.6%)	26 (92.9%)
School C	3 (10.7%)	18 (64.3%)
School D	0 (0%)	16 (57.1%)

A one-way ANOVA in Table 3 shows there is a significant different on the performance of students in the mathematics word problems according to school at $p<.05$ level for the three conditions [$F(3,74)=12.5$, $p=.000$]. Therefore with $p<.05$ post hoc test is possible to be used in further investigate the performance of Year 9 students according to school.

Table 3: Analysis of variance for total marks and percentage marks of the four schools

		Sum of Squares	df	Mean Square	F	Sig.
Total Marks	Between Groups	1059.29	3	353.09	12.54	0.000
	Within Groups	2083.74	74	28.15		
	Total	3143.03	77			
Percentage Marks	Between Groups	13511.38	3	4503.79	12.54	0.000
	Within Groups	26578.38	74	359.16		
	Total	40089.77	77			

Based on the results in Table 4, at 0.05 level of significance students from school B performed better in the mathematics word problems compared with the other three schools. This can be concluded from the mean difference of 5.52, 5.73 and 10.08 when compared with school A, school C and school D respectively. In addition, school A performed better compared to school C and school D with mean difference of 0.2 and 4.55 respectively. Meanwhile school C performed better compared to school D with mean difference of 4.35.

Table 4: Multiple comparison analysis of the total marks for the four schools

(I) School	(J) School	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
School A	School C	0.2	1.77	1.00	-4.86	5.28
	School D	4.55	1.69	0.074	-0.3	9.41
	School B	-5.52*	1.77	0.027	-10.6	-0.46
School C	School A	-0.2	1.77	1.00	-5.28	4.86
	School D	4.35	1.64	0.081	-0.36	9.06
	School B	-5.73*	1.72	0.015	-10.66	-0.81
School D	School A	-4.55	1.69	0.074	-9.41	0.3
	School C	-4.35	1.64	0.081	-9.06	0.36
	School B	-10.08*	1.64	0.00	-14.79	-5.38
School B	School A	5.52*	1.77	0.027	0.46	10.6
	School C	5.73*	1.72	0.015	0.81	10.66
	School D	10.08*	1.64	0.00	5.38	14.79
* The mean difference is significant at the 0.05 level						

In reference to Table 5 below, school B is in a group different from the other three schools. The mean of school B differs significantly from the means of school A, school C and school D. In summary a one-way unrelated analysis of variance showed an overall significant effect for the type of school [$F(3,74)=12.5$, $p=.000$]. Scheffe's ranges found that that school B differed from school A ($p=0.027$), school C ($p=0.015$) and school D ($p=0.000$). Therefore, students from School B performed better compared with students from the other three schools in the mathematics word problems administered for this research.

Table 5: Scheffe homogeneous subsets

School		Subset for alpha = 0.05	
	N	1	2
School D	23	5.91	
School C	19	10.26	
School A	17	10.47	
School B	19		16
Sig.		0.07	1.00

The performances of the students according to the number of words in the question are presented in Table 6. Overall, students from school B performed better in comparison to the other three schools. Students from school B had a mean higher in all the three classifications when compared to the overall means and also with the means of the other three schools. It should also be noted here that school B is one of the elite schools in the nation and thus considered as one of the high-performing schools. Students are admitted into this school based on their national Year 6 examination results. In contrast, as shown from the results in Table 6, students from school D performed lower, in all the three type of questions, when compared with other schools. school D is considered one of the low-performing schools in Brunei. In conclusion, the level of performance of Year 9 students in doing mathematics word problems set for this research is alarming. More than half (50 out of 78 students or 64%) of the students obtained marks less than 50% of the possible full marks in the test items. Students from school B performed the best followed by students from school A, school C and school D. school A, school B and school C performed higher than the overall mean in a Not Wordy question. Meanwhile in an Average Wordy question school A and school B performed higher than the overall mean. Lastly, in a Wordy Question, school A, school C and school D performed lower than the overall mean.

Table 6: Performance of students according to the number of words

Type of Question	School A		School B		School C		School D		Total	
	M	SD	M	SD	M	SD	M	SD	M	SD
Not Wordy Question	4.24	2.11	5.47	2.09	3.68	2.03	1.65	1.87	3.64	2.45
Average Wordy Question	4.76	2.99	7.79	3.82	5.21	3.05	3.52	2.86	5.24	3.51
Wordy Question	1.47	1.55	2.84	1.38	1.37	1.34	0.91	1.27	1.62	1.54
Note: Not wordy question (Question with number of words less than 30 words); Average wordy question (Question with number of words in the range of 31-40 words); and Wordy question (Question with number of words more than 41 words).										

The reporting on the correlation between English competency and the ability to solve mathematics word questions will first be shown using a cross tabulation between the grades of English and mathematics grades. Table 7 shows the correlation between the performance of students in doing the mathematics word problems and their English ability. The results from Table 7 indicated that more than 65% of the students obtained a Grade F in the mathematics word problems yet they managed to obtain a higher grade (Grade A, Grade B, Grade C and Grade D) in English. In terms of direct correlation, it is a correlation manifested only in Grade B, Grade C and Grade E.

Table 7: Cross tabulation between English and mathematics grades

		English Grade						Total
		F	E	D	C	B	A	
Mathematics Grade	F	0	0	1	16	29	5	51
	E	0	1	0	4	5	1	11
	D	0	0	0	1	2	0	3
	C	0	0	0	1	3	1	5
	B	0	0	0	0	5	1	6
	A	0	0	0	0	2	0	2
Total		0	1	1	22	46	8	78

The main aim of this research was to correlate English and mathematics. During the analyses, an interesting correlation manifested between English competency and the ability to solve mathematics word problems. The results in Table 6 shows that the correlations between English competency and the ability to solve mathematics word problems according to number of words shows positive correlations, however, in this research all correlations were proven to be weak. Nevertheless, the results in Table 8 reported there is statistically significant value (p = 0.04) on the correlation between English competency and the ability to do Wordy question. In other words, students must be very good in their English in order to solve Wordy questions but not necessarily in Not Wordy and Average Wordy questions.

Table 8: English competency versus number of words

		Not Wordy Question	Average Wordy Question	Wordy Question
English Grade	Pearson Correlation	0.03	0.05	0.22*
	Sig. (2-tailed)	0.73	0.62	0.04
	N	78	78	78
*Correlation is significant at the 0.05 level (2-tailed) **Correlation is significant at the 0.01 level (2-tailed)				

5 Discussions and Conclusion

The overall findings from this study revealed that the performance of Year 9 students from school B which was better compared to the other three schools. The main reason for the difference in performance may be caused by the practices done by the school. In school B, enrolment is very strict. Students must first obtain an excellent result, in all the subjects in their primary school in order to enrol in this school. As mentioned by Baroudi (2006) [1], students rehearsed basic algorithms in primary schooling and this knowledge became the foundation that they will bring in their future mathematics undertakings. For this reason, it can be assumed that the students in school B possessed a steady background on basic mathematics. Therefore, with this in mind, it can be concluded that a good mathematics foundation is necessary in order to perform well in mathematics word problems. Toom (2000) [16] and Timah (2006) [15] reported the importance of manipulative when teaching students mathematics as this can help students to solve the mathematics word problems. The interviews done for this research found that teaching aids do help students in doing mathematics word problems. Students were observed moving to the higher level of Newman word problems solving stage. The interviews also suggested that with the practice of teacher-centred method, understandings were not promoted. In fact, other methods of teaching are needed. It was also found in the research that students did not require good command of English to answer Not Wordy and Average Wordy questions. Only in Wordy question good command of English is required. Yet, in this research, students' performances were still alarming. Therefore, findings by Saman (2000) [12] that stated students who can do computational tests but not mathematics word problems does not stand in the results and findings of this research. This again shows that basic mathematics is important. Data from the

interviews had shown that the use of teaching aids also showed quite a significant improvement. Despite the limited number of students involved in the interview, findings from it remain important. Just by showing a diagram, the students were able to complete the question correctly. With the current emphases on the use of technology in teaching and learning, an IT competent teacher will encounter fewer problems, and thus have an advantage for his or her teaching. The correlations also showed that command of English is not the reason why students were unable to solve mathematics word problems. But it is due to the mathematics itself. In this research it clearly showed that there existed only weak correlation between the command of English and the ability to solve Not Wordy mathematics word problems. At time of the research, all level of schooling, with the exceptions of preschools, mathematics is taught in English in Brunei. This scenario does not mean that the students in Brunei will be at a disadvantage because English in not the first language. In fact, this research discovered that there exist only weak relationship between English competency and the ability to solve mathematics word problems. Nonetheless it can be taken as a challenge that will and can create competitive Bruneian students. The beliefs that students must have good English to solve mathematics questions have proven to be wrong by this research. Interestingly, this research found that good English is only necessary to solve Wordy questions. This shows that, all students should at least be able to solve mathematics word problems which are Not Wordy or Average Wordy. On the contrary this does not happen in Brunei. Maybe, the reason is not on language but perhaps it is actually the teaching and learning that needs to be modified. The fact that time spent in school has no impact on students' performance is also interesting. All this while teachers believed it is important to complete the syllabus on time. But this research had shown that time is not the determinant factor but a good foundation in mathematics is. There are several limitations to this research.

- Only one class of Year 9 from each four schools participated in this research. The selection of this classroom is purposive and convenience in nature. Therefore the findings of this research are the representations of the four schools only. Hence it cannot be used to generalise the overall Year 9 students in Brunei.
- For this research, the students were categorised according to groupings based on the performance obtained by students from previous assessments administered by their respective schools. Students were considered to have a good command of English if they obtained grade A or B in the assessments, having an average command of English if they obtained grade C and D in the assessments and with poor command of English if they obtained grade E and F in the assessments. Since the grading classification was taken from one school source, this may impose inequality because the weighting of grades will be different between schools.
- The assumption that all students in this research use English as their second language, regardless of their ethnicity. Thus ignoring the possibilities that some may be first user of English language.
- Students ability in mathematics are tested using the mathematics word problems. The performance of students in the test items should not be used to measure students' performance in mathematics as a whole.

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