Effect of English Language Comprehension on Achievement in Engineering Mathematics

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Abstract

This paper presents results of a study that investigates the effects of English language comprehension on the achievement in engineering Mathematics. The population of the study was the entire year one and two (National Diploma I and II) students of Waziri Umaru Federal Polytechnic, Birnin Kebbi, Nigeria (n<700). A sample of two hundred and eighty seven (287) students was selected using simple random sampling. Pearson correlation, paired samples t-test and Independent sample t-test were used to analyze data using SPSS version 20.0. The results obtained indicated a significant difference exists between word-based problems and wordless problems in engineering mathematics. It was also revealed that the medium of instruction influence the attainment of instructional objectives in mathematics. No significant relationship was observed between English language comprehension and performance in non worded problems in engineering mathematics. Although the mathematical ability and numerical manipulative skills of the students seems not to be affected by English language comprehension, the results showed a strong positive correlation between English language comprehension and engineering mathematics word problems.

Key Words: English Language Comprehension, Mathematics Achievement, Word Problems, Non worded Problems.

Introduction

English as a second language to most Nigerian students, occupy a critical position in Nigerian educational system as prescribed medium of instruction. Therefore, a good communication skill in English language is inevitable for students to meet up the abstract nature of most mathematical concepts. Many research findings revealed that the linguistic problem is one of the major factors contributing to low performance of students in mathematics. Two situations can be explained in the language nature of mathematics. First, is a situation where a student learns mathematics in his first language (mother tongue). This situation may not be totally free from language issues due to the fact that mathematics terminologies do not find place readily in most mother tongues in Nigeria. The second situation is where a student learns mathematics through a foreign language (second language) medium. Here, the common impediment is that, learners of mathematics are not likely to ask for explanation of words in mathematics class. Therefore, they manage to get the general gist of the information without proper understanding of every word. Clearly, the general gist may not be enough for understanding the mathematical concepts. Osafahenti (1993). Many students fail simply because they don't understand several words used in mathematics examination papers. Backhouse (1999).

Gillam et al (2016) reviewed the effects of language impairments with respect to mathematical ability. Many problems were highlighted in regard to students with language impairments in mathematics class. These include; inability to initiate conversation in the classroom, failure to ask questions and inability to realize when they have misunderstood information. These problems clearly interfere with the process of teaching and learning mathematics. At least four linguistic competencies are required for mathematics learner to be able to construct, store and retrieve a mathematical schema. These are; reading comprehension, proficiency in vocabularies and syntax forms with different meanings in mathematics and general contexts, ability to switch between usage of words in mathematics and general contexts, knowledge of symbols and formal language used to solve mathematics problems. Research have

shown that specific language impairment in children can be an impediment to acquisition of some mathematical skills such as spoken number sequence, calculation, place value principle etc. However, the logical principles of simple arithmetic may not be affected by the impairment. Donlan et al (2007).

One can argue that mathematics is a language of its own with unique vocabularies, phrases, symbols and peculiar reading comprehension method. The language of mathematics is a source of difficulty and sometimes confusion. Mathematics terminologies are often complex and the words used in it are enriched with meaning that are completely at variance from their normal meaning or usage Gillam (2016). For example, *root, similar, power, ring, odd* etc have a different sense from their usual meaning when used in mathematics. Language problem is one of the major factors contributing towards the poor performance of many students in mathematics especially those who are bilingual and multilingual. Therefore, it is not out of point to infer from previous researches that a student with good level in English language will stand a chance of a very good performance in mathematics. Recca and Lasaten (2016). A research by Laurito et al (2016) gave a similar conclusion that the students' performance in geometry can be influenced by comprehension skills and mathematical ability.

Mathematics problem solving strategy is very essential in mathematics. And mathematics problem solving requires some level of proficiency in English vocabulary and reading comprehension skills Orosco (2014). Mathematics performance improves with English language reading proficiency. A wide gap in mathematics achievement was found to exist between English language learners and students who spoke English language as their primary language Beal et al (2010), Tuohimaa et al (2008), Ramos et al (2015), Walkington et al (2015). Linguistic complexity is a very strong impediment to mathematics word problem solving for English language learners. It was observed that students performed better in mathematics word problems written in easier language compared to the same problem written with advanced grammatical complexity. Barbu and Beal (2010). Basol et al (2011) confirmed a positive correlation in English language reading comprehension and mathematics word problem. Fuchs et al (2017) described language text comprehension as a significant and strong predictor of performances of students in word problem solving assessments. The language issue in mathematics is more pronounced for second language learners in mathematics word problems. A significant difference exists between the performances in mathematics word problems of first language learners and second language learners. However, there is no significant difference between the first language learners and second language learners in the wordless problems. Trakulphadetkrai (2018). Correlation was found to exist between reading comprehension and students' success in mathematics and science for secondary school students. Reading comprehension can also affect the performance in mathematics and science positively or negatively. Akbasli et al (2016).

Varied research findings on the relationship between language comprehension and achievement in mathematics found no relationship between the two variables. Imam et al (2013) examined the association of English language comprehension and achievement in mathematics. Their findings revealed no significant correlation between reading comprehension and mathematics performance.

Background of the study

There are many researches to examine the link between language comprehension and achievement in mathematics with conflicting results. Imam et al (2013). In Nigeria, there are agitations for the use of local language as a medium of instruction in our educational institutions. Ali (2002). The relationship between English language and performance in mathematics at tertiary level of our educational institutions is of interest to researchers in order to clarify the necessity for the use of local language as a medium of instruction and this forms the basis of the present study.

Research questions

The present study seeks to answer the following research questions;

i. Is there significant relationship between English language comprehension and achievement in engineering mathematics?
ii. Is there any significant difference in the performance of students in mathematics worded problems and non worded problems?
iii. Is there any significant relationship between English language comprehension and performance in non worded mathematics problems?
iv. Is there any significant relationship between English language comprehension and performance in worded mathematics problems?

Methodology

The population of this study was the entire year one and two (National Diploma I and II) students of Waziri Umaru Federal Polytechnic, Birnin Kebbi, Nigeria (n<700). A sample of two hundred and eighty seven (287) students was selected using simple random sampling. Three questionnaires were used for the data collection. Listening comprehension problem scale (LCPS) was administered first to measure English comprehension ability of the respondents. LCPS (α=0.862) is a fifteen item scale designed to measure second language learners' listening comprehension problems for undergraduate students. Zhang and Zhang (2011).The instrument uses a five points Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). English language comprehension is calculated by adding the individual scores for all the items whose possible score ranges from 15 to 75. Higher score on the LCPS shows high English language comprehension and lower score represents low English language comprehension. Examples of the items include;

I do not understand the intended message of the entire text.
I do not understand the intended message of some parts.
I am confused about the key ideas in the text.
I do not understand the long sentences.
I do not understand a word with more than one meaning
I neglect the next part when thinking about meaning

The mathematics word problem questionnaire (WPQ) and non worded problem questionnaire (NWPQ) consist of ten items each extracted from semester examinations past question papers. Non worded questionnaire was administered a week before the worded problem questionnaire which was a worded version of the non worded questionnaire. Each question on WPQ and NWPQ attracts a maximum of 10 marks when answered correctly. Thus the maximum score of WPQ and NWPQ is 100 marks each and the minimum mark obtainable is zero.

Results

SPSS version 20 was used to analyze the data. Four factors from the research questions were analyzed as follows;

i. Relationship between English language comprehension and achievement in engineering mathematics.

A bivariate correlation analysis was carried out to calculate the Pearson correlation coefficient between English language comprehension and engineering mathematics achievement. The results showed a significant positive correlation between the variables ($r = 0.416$, $p < 0.01$). A paired samples statistics also indicated a significant positive correlation between English language comprehension and engineering mathematics achievement ($t = –2.57$, $df = 286$, $p < 0.01$, $r = 0.416$). English language comprehension (mean = 51.68, SD = 14.93), engineering mathematics achievement (mean = 53.95, SD = 12.43).

ii. Difference in students' performances between engineering mathematics worded problems and non worded problems.

An independent sample t-test was carried out to find out if there was a significant difference in mathematics worded and non worded problems in engineering mathematics. The result revealed a statistically significant difference between the performances in engineering mathematics worded problems and non worded problems. ($t = -11.48$, $df = 572$, $p < 0.01$). Students performed significantly less in the worded problems (mean = 45.67, SD =18.19) than the non worded problems (mean = 62.22, SD = 16.31).

iii. Relationship between English language comprehension and students' performance in engineering mathematics non-worded problem.

The bivariate correlation test for the scores of students in non worded problems and English language comprehension test scores revealed a statistically non significant weak correlation. ($r = 0.049$, $p > 0.01$). English language comprehension (mean = 51.68, SD = 14.93), non worded problems (mean = 62.22, SD = 16.31).

iv. Relationship between English language comprehension and engineering mathematics worded problem.

Bivariate correlation analysis revealed a strong positive correlation between English language comprehension and achievement in engineering mathematics word problems ($r = 0.612$, $p < 0.01$). A paired sample t-test also showed a significant positive correlation ($t = 6.84$, $df = 286$, $p < 0.01$, $r = 0.612$). English language comprehension (mean = 51.68, SD = 14.93), engineering mathematics word problems (mean = 45.67, SD = 18.19).

Discussion

The present study was able to reveal the relationship between English language comprehension and achievement in engineering mathematics. The average English language comprehension score of the students was satisfactory. (mean = 51.68, SD = 14.93). Four research questions were discussed in the analysis of results. A significant and positive correlation exists between English language comprehension and achievement in engineering mathematics. This result supports the findings of Donlan et al (2007), Ramos et al (2015), Laurito et al (2016), Akbasli et al (2016), Gillam et al (2016), Stoffelsma and Spooren (2018). However, the results contradicts the findings of Imam (2013), Vince and Fatima (2016), Azur (2017) and Trakulphadetkrai et al (2018) that found no significant correlation between reading skills and mathematics performance.

The overall performance of students in engineering mathematics was averagely good (mean 53.95, SD = 12.43). However, there was a very wide gap in the average performance of students between worded and non worded problems with mean =45.67, SD = 18.19 for worded problems and mean = 62.22, SD = 16.31 for non worded problems. A significant difference was also observed between the two variables using independent samples t-test. ($t = -11.48$, $df = 572$, $p < 0.01$). In other words, lower performance was observed in engineering mathematics worded problems.

There was no significant relationship between English language comprehension and performance in non worded problems in engineering mathematics ($r = 0.049$, $p > 0.01$). This supports the earlier findings by Trakulphadetkrai et al (2018). A strong relationship was observed between English language comprehension and engineering mathematics word based problems ($r = 0.61$, $p < 0.01$, $t = 6.84$, $df = 286$). The performance of students in engineering mathematics word based problems is generally low. The finding confirms the research findings of Orosco (2014), Barbu and Beal (2010), Basol et al (2011) and Tuohimaa et al (2008).

Conclusion

The findings of this study confirm the existing literatures on the relationship between English language comprehension and achievement in Mathematics. We can also deduce from the findings that the medium of instruction influence the attainment of instructional objectives in mathematics. According to the finding in the present study, a significant difference exists between word-based problems and wordless problems in engineering mathematics. It was observed that the students performed better in non worded problems than the word problems in engineering mathematics. There was no significant relationship between English language comprehension and performance in non worded problems in engineering mathematics. In other words, English language comprehension has no effect in the mathematical ability or the manipulative skills in solving the numerical problems in engineering mathematics. However, the finding revealed a strong relationship existing between English language comprehension and word based problems in engineering mathematics. This implies, apart from mathematical ability of the students to solve numerical problems, they require a certain level of fluency and understanding of English medium in order to effectively handle word problems in engineering mathematics. It is therefore necessary for teachers of mathematics to be on the alert in selecting appropriate level of English language to help their students attain the set instructional objectives. The finding of the present study is also very important to the students themselves as it encourage them to improve their linguistic capability as to be able to learn and apply their mathematics skills in engineering problems.

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