EFFECT OF INSTRUCTION ON ACHIEVEMENT IN MATHEMATICS USING LEXICALLY AMBIGUOUS ENGLISH WORDS AMONG JUNIOR SECONDARY SCHOOLS IN MICHIKA/MADAGALI LOCAL GOVERNMENT AREAS, ADAMAWA STATE

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Abstract

This paper examined the effect of instruction on Achievement in Mathematics Using Lexically Ambiguous English Words among Junior Secondary Schools in Michika/Madagali Local Government Areas, Adamawa State. A sample of 271 junior secondary III students was sampled for the study from four schools. The study adopted the pre-test post-test Quasi - experimental research design, in which a fully randomized control group as well as an intervention group was selected. Two research instruments, Translation of Mathematical words to English (TMWE) and Translation of English words to Mathematics (TEWM) were concurrently used. Both the instruments TMWE and TEWM consists of 15 multiple choice questions (MCQs) of ambiguous words each constructed by the researcher. The instruments were validated by experts. The reliability of the instruments was determined using Cronbach-Alpha. Reliability coefficient of .71 and .73 were obtained for TMWE and TMWE respectively. Mean and standard deviation was used to answer the research questions, while analysis of variance (ANOVA) and multivariate Analysis of Variance (MANOVA) were used to test the hypotheses stated at 0.05 level of significant. The Test of Translating Mathematical Words to English treatment (TMWE) generally improved student's performance in mathematics than Test of Translating English Words to Mathematics (TEWM). Results of overall mean scores of Inter-Gender performances revealed that, there was no statistically significant difference in their performance. In line with the findings, it was recommended that there is need to translate Technical words expressed in English Language in the students' own mother-tongue.

Key Words: *Effect; lexical Ambiguity; English words; Instruction; Achievement*

Introduction

Language is a major means of communication of ideas. It helps students build understanding and process ideas in mathematics and provides a method through which student learning is assessed. Therefore, Language of teaching and learning is an integral part of "language of instruction" or "medium of instruction".

Language proficiency is therefore related to learning ability and general academic achievement in mathematics Kaplan, Fisher and Rogness (2010). As a result of this phenomenon of language and mathematics, many students are now learning mathematics in their second or third language and this is making English Language to become the language of instruction and lingua franca at this era of globalization. While, mathematics meaning is achieved

through language, however, language is one of the stumbling blocks for mathematics understanding, especially in Nigeria where students learn mathematics in their second or third language, particularly vocabulary, syntax and discourse can cause problems for students learning it in their second language at all levels of education. (Okoronka and Agah 2016) also pointed out that by importing theories from linguistics, there is a danger of misreading and simplifying, and she states that there is a difficulty in agreeing what is meant by 'language'.

Lexical ambiguity is another aspect of problem for some students in understanding mathematics. Durkin and Shire (1991) in Agah, (2015) mentioned different types of lexical ambiguities including homonymous words, words having the same form/spelling but distinct meanings such as leaves; polysemous words, words having the same form/spellings but somewhat related and different meanings such as product; homophonous words, words having different spelling./meanings but similar pronunciations such as two/too/to, four/for, sum/some, pi/pie etc. For some students such words cause problems to understand the contextual meanings when they are not proficient in mathematical and general language. Likewise some students may copy or hear the different terms such as "to" instead of "too" or "two" and so on when their teacher or classmates pronounce them.

Furthermore, Durkin and Shire (1991) in Agah, (2015) listed numerous ambiguous words that are used at different levels of curricula. From their own and others, they said that, there existed evidence that children experienced difficulties with this aspect of mathematics vocabulary when reading, and in direct exchange or in following instructions. They noted the various types of ambiguity as they relate to language in mathematics education.

Lexical ambiguity therefore, refers to when a word can have various meanings depending on its context. That is to say some words share the same form but distinct meaning. A standard example is bank, meaning financial institution, and bank meaning an area of land beside a river. An example relevant to mathematics is leaves, which in everyday use can refer to the outgrowths of a tree but which has quite a different meaning when it refers to the process subtraction (e.g. "3 from 7 leaves 4"). Here is an exchange between a teacher and a student which further reflects this confusion of words in relation to their meaning – in response to a question, "How many four in 24? A ten year old pupil answered "one" (The word "in" was apparently interpreted as meaning "making up" (as with the number of letters in a word) rather than "Going into" (as expression used to indicate division). The various dimensions of lexical ambiguity encountered in mathematics word problems are further explored under polysemy and homophony.

Polysemy

This refers to a situation where a word can have two or more different but related meanings. Manyara (2012) distinguished between mathematical English and ordinary English. He states that, "mathematical English and ordinary English are sufficiently dissimilar and require different skills and knowledge on the part of readers to achieve appropriate levels of readings comprehension" (Kieffer and Lesaux (2010). Moreover, Orton (1993) reports the difficulties of a child when asked: "What is the difference between 24 and 9"? In response to the question, a nine-year old replied, "One is even and the other is odd", whereas another said, "one has two numbers and the other has one". The word "difference" commonly refers to qualities which distinguish one thing from the other in the everyday English, but in the specified mathematical English; it is an accurate measure of how much one quantity exceeds another.

Homophony

This refers to the phenomenon where different words sound the same. There are some interesting sets of homophony within mathematics, these include: (two, to, too), (sum, some), (four, for), (pi, pie). Thus in most occasions' students particularly the bilinguals have problem of comprehending which words teachers are saying in the course of their teaching, because of their poor background in English.

Some lexical ambiguities are compounded by the fact that they relate to mathematical symbols which themselves are described by different words in different contexts. For example, "=" can mean equals, makes, leaves, the same as, gives, results in, any of which is itself multi-meaning. There may well be other conceptual factors involved, but this linguistic diversity seems likely to be implicated in the findings that children experience difficulties in interpreting the equals sign well into their school years (Jorgensen and Dole, 2011; Kamau, 2010).

There are anecdotal reports in the mathematics education literature of pupils misinterpreting mathematics expressions, instructions, or questions in ways which show clearly that they are attempting to decode an ambiguous word in its everyday sense. Hart (1981) reported the following exchange between a secondary school pupil and an interviewer who was probing on mathematics concepts.

Interviewer: Do you know what volume means?
Child: Yes.
Interviewer: Could you explain to me what it means?
Child: Yes, it's what is on the knob on the television set.

Furthermore, a charming example is provided by Hobart (1980) of a child finding difficulties with questions that began "What is common to ...? This suggests that difficulties with lexical ambiguity are expected widely, and indeed it is conceivable that not all come to the attention of teachers.

Nicholson (1977) reported that only about 20% of a sample of secondary pupils taking the British Certificate of Secondary Education (CSE) understood the word product as used in mathematics. Teachers may use multi-meaning terms in ways which their pupils misunderstand, and pupils working independently may impose incorrect interpretations on mathematics vocabulary. One context in which this may occur where teacher feedback cannot be immediately available is in textbook and work card activities. If children have set exercises based on written materials, their understanding of the instructions/tasks is crucial, and ambiguous words could lead to confusions.

Kaplan,Rogness and Fisher (2012), in their study requested children to read sentences which contained ambiguous words such as make, table, times, big, above etc. Each word appeared in two sentences. One of the sentences used the word in its everyday sense, e.g. "Ali and Halima make cakes". The other sentence used the word in a mathematical sense, e.g. "Two and Three make five". The child's task was to identify, from a set of options presented in the sentences, what the target word meant (the word in this case make, was underlined).

Beal, Adams and Cohen (2010) had found that children were prone to an error pattern in which they would identify the dominant sense of an ambiguous word even when the sentence context was biased toward the subordinate sense. They found very similar results with other sentences. When children misidentified the meaning of an ambiguous word in a mathematics sentence, the sense they chose was often the everyday sense. This happened significantly more often than the reverse type of error (i.e. interpreting an everyday use of ambiguous word as though it conveyed its mathematical sense).

Nevertheless, the fact that systematic error biases are detectable toward the everyday meanings of the words suggests the possibility that at least some students sometimes make such misinterpretation in the course of their use of written materials in mathematics and that errors were still occurring even among the older children. Lexical ambiguity among words that adults take for granted may cause serious misunderstanding for pupils. Therefore, this study intends to employ the effect of lexical ambiguity encountered in mathematics and students Achievement.

Statement of the Problem

Linguistic and psychological factors have been attributed to the cause of students' low achievement in mathematics. The problems due to second language may be just as high in mathematics as in other subjects. It was against the implications for countries which teach their students through the standard of a second language rather than in native language that investigations and adoption of a bilingual education on academic subjects was made. Perhaps, it is against these backdrops that in Nigeria, the revised National Policy on Education (NPE, 2014) introduced the teaching and use of the language of the environment which is to be taught as L1 in JSS where it has orthography and literature, where it does not have, it shall be taught with emphasis on oracy. However, since the implementation of the policy and concerned with lack of adequate research based information, particularly in students learning mathematics, which usually records the highest failures in Nigerian schools (Onwuachu, Agu and Olibie, 2010) this study becomes imperative. Therefore, this study is designed to investigate the influence of Instruction on Achievement in mathematics using lexically ambiguous English words

Purpose of the study

Examine the influence of students' Achievement in mathematics using lexically ambiguous English words.

Research Questions

1. To what extent does a lexically ambiguous English word influence students' Achievement in mathematics?

2. Does inter-gender influence students' Achievement in mathematics when exposed to lexically ambiguous English words?

Research Hypotheses

H_{o1}: There is no significant variation in mathematics Achievement using lexically ambiguous English words.

H_{o2}: There is no significant difference in mathematics Achievement between boys and girls using lexically ambiguous English words.

Significance of the Study

The findings and recommendations made in this study will be useful for identifying those English language lexical ambiguities hindering achievement in mathematics among JSS students. It is hoped that this work will also help teachers of mathematics to anticipate and understand the difficulties of their students and the basis for particular misconceptions by students of ambiguous lexical items used in mathematical contexts.

Scope and Limitation of the Study

The study is limited to JSS students in public junior secondary schools in Michika/Madagali Local Government Areas, Adamawa State. It is also limited to the use of English as a medium of instruction and students' Achievement in mathematics content at JSS level.

Research Methodology

The study adopted the pre-test and post-test Quasi - experimental research design. The population for the study consists of all JSS III students in Michika/Madagali Local Government Areas of Adamawa States. The sample comprised all public Junior Secondary School students extracted from the population. Using the simple random sampling technique, subjects were pooled from four out of 47 junior secondary schools in the study area. Intact class streams were used for instruction and assessment.

Schools in the study were selected in such a way that subjects in the group could not easily get in touch in order to reduce contamination.
Group A: the method of instruction was based on Translation of Mathematical words to English (TMWE), while Group B: was based on Translation of English words to Mathematics (TEWM)

Research Instruments

The following two instruments were used for the purpose of collecting data in this study:

1. Translation of English Word to Mathematics (TEWM) and
2. Translation of Mathematics Words to English (TMWE)

In each TEWM and TMWE consists of 15 Multiple Choice Questions (MCQs) ambiguous words constructed by the researcher in sentences biased towards either their primary or secondary sense. The test lasted for 45 minutes. In each question, the target word was underlined while five possible options were listed. The essence of the test is to measure students' comprehension of ambiguous words in mathematical context and contexts that support their every day meaning in English Language.

V**alidity and Reliability of the instruments**

In order to ascertain the validity and reliability of these instruments, a pilot test was conducted in two schools namely: Federal Polytechnic Staff School, Mubi and GSS Mubi which are different from the sample schools used for the main study. The content and face validities were determined by two English lecturers in the General Studies Department of Adamawa State University, Mubi and a Mathematics lecturer, from the department of mathematics Adamawa State University, Mubi. The observations and comments by these experts were summed up and the items pruned to 15 from 18. The instrument was then administered to some 80 junior secondary school students in the said schools above. The reliability coefficient was calculated using Cronbach-Alpha statistic. The result gave stability coefficient of 0.71 and 0.73 which was considered high reliability coefficient adequate for the main study.

Method of Data Collection

The data for this study was collected using the TMWE and TEWM instruments. The instruments were administered to students in the sampling schools after seeking proper permission from school principals. Mathematics and English teachers were served as research assistants. Figure 1 buttress the schedule of treatment and data collection.

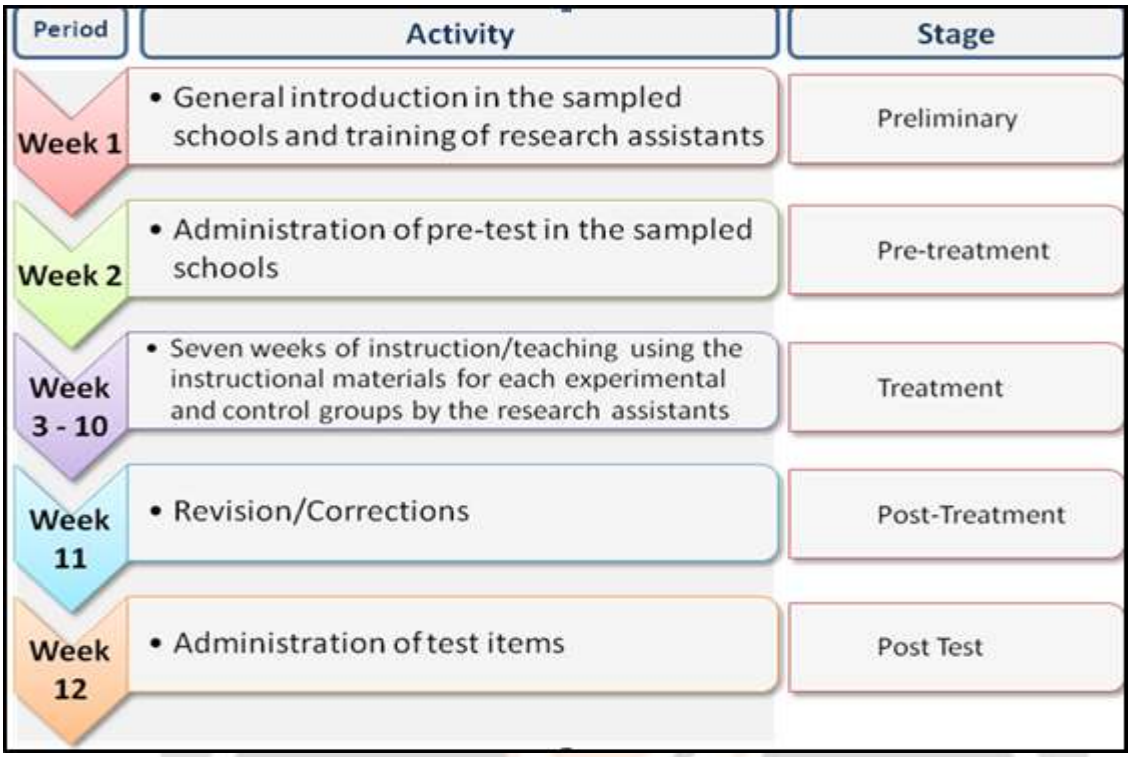

Fig. 1 Fig. 1. Schedule and Stages of Treatment Procedure.

Method of data analysis

The data collected in the study were analysed using descriptive statistics to answer research questions and inferential statistics to test the hypotheses. The research questions were answered using mean , standard deviation and mean difference, while the hypotheses were tested using Analysis of Variance (ANOVA) and Multivariate Analysis of Variance (MANOVA) at 0.05 level of significance run at SPSS (Statistical Package for Social Science) version 20.

RESULTS

Research Question 1: To what extent does a lexically ambiguous English word influence students' Achievement in mathematics?

Table 1: Descriptive results of students' scores in test to TMWE and TEWM by treatment group

TEST	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
TEWM	38.462	1.498	35.512	41.411
TMWE	47.374	1.516	34.389	40.359

The result on Table 1 has shown that in both test, the Test of Translating Mathematical Words to English treatment (TMWE) generally improved student's performance in mathematics than Test of Translating English Words to Mathematics (TEWM).

Therefore, it can be observed from Table 1 that student's performances in mathematics were improved when exposed to, the Test of Translating Mathematical Words to English treatment (TMWE).

Research Question 2: Does inter-gender influence students' Achievement in mathematics when exposed to lexically ambiguous English words?

Table: 2 Summary of Descriptive Analysis of Inter-Gender Post-Test Performance of Subjects in the Two Instruction Groups

Group	Gender	N	Mean Score	Mean Difference	SD	95% CI Min	Max
TMWE	Male	175	57.1		12.25	11	75
	Female	96	55.9	1.2	11.33	13	55
TEWM	Male	175	50.5		10.17	09	76
	Female	96	48.5	2.0	12.36	10	66

Table 2 present the descriptive statistical analysis showing mean difference of inter-gender performance and standard deviations of the post test mean scores of subjects in the groups after treatment. The Table revealed that there was uniform performance among boys and girls when exposed to lexically ambiguous English words

H_{01} There is no significant variation in mathematics Achievement using lexically ambiguous English words.

Table 3: Results of multivariate test of students in TMWE and TEWM by treatment group and language proficiency.

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	TEWM	10322.667	5	2064.533	11.178	.000*
	TMWE	9061.559	5	1812.312	9.582	.000*
Intercept	TEWM	368666.912	1	368666.912	1.996	.000*
	TMWE	346239.471	1	346239.471	1.831	.000*
Group	TEWM	5447.257	1	5447.257	29.492	.000*
	TMWE	4918.408	1	4918.408	26.005	.000*
Lang. Prof	TEWM	587.876	2	293.938	1.591	.206
	TMWE	641.404	2	320.702	1.696	.185
Group * Lang.Prof	TEWM	103.419	2	51.709	.280	.756
	TMWE	547.727	2	273.863	1.448	.237
Total	TEWM	570982.000	271			
	TMWE	547443.000	271			
Corrected Total	TEWM	59269.173	270			
	TMWE	59180.974	270			

*Significant at $p < .05$ level.

The results from Table 3 indicated that there were statistically significant difference in the mean TEWM score (F=29.492, df (2, 270); $p < .05$), and TMWE scores (F=26.005, df(1, 270); $p<.05$) was statistically significant. However, there is no significant effect of treatment on language proficiency (F = 1.591, df (2, 270); $p > .05$) and not significant on the interaction of the groups and language proficiency (F = .280 df (2, 270); $p > .05$). Therefore, considering the significant difference in the mean scores for the treatment groups obtained in Table 2, it can be said that the study hypothesis which states that, there is no significant variation in mathematics Achievement using lexically ambiguous English words, is hereby rejected.

H_{o2}: There is no significant difference in mathematics Achievement between boys and girls using lexically ambiguous English words.

Table: 4 Summary of one-way Analysis of Variance (ANOVA) of boys and girls in their test **using lexically ambiguous English words**

Source of Variation	Sum of Squares	Df	Mean Square	F statistic	Sig. 2-Tailed
Instrument Type	663.6	4	165.9	2.06	0.0844
Residual	108945	1350	80.7		
Total	109608.6	1354			

Not significant, $p > .05$.

The ANOVA results of students' test in mathematics performance show that there was no statistically significant difference in students performances in mathematics (F = 2.06; df = 4, 1350); $p > .05$). This suggested that boys and girls had equivalent ability when espoused to lexically ambiguous English words

Discussion

The analysis of the study was based on the Lexical ambiguity as affecting the students' performance in the learning of mathematics. It was revealed that Language Proficiency is very important factor in determining students' performance in mathematics, suggesting that lexical influence in mathematics is a principal factor of the barrier posed by English language. The findings of this study agree with other studies Licuanan (2010), Orton, (1993) in

which lexicon in mathematics Achievement was implicated. This increase in Achievement was ameliorated by the use of native language in addition to the conventional English language. According to (Durkin and Shire, 1991) in Agah 2015, lexically ambiguous words in foreign language which are capable of weakening Achievement in mathematics can be reduced or eliminated by the use of native language.

The statistically significant difference between dominant meaning and secondary context can be interpreted to mean that students cannot distinguish the meaning of English words as their test indicated that they seem prone to access the dominant sense of the common terms used here even when they are used in sentences biased towards a mathematics meaning. It is notable that the present finding in the specific area of mathematics are consistent Beal, Adams and & Cohen, (2010) result using a wide selection of ambiguous words. Their studies found that the dominant meaning was selected in secondary context more often than the reverse. This poses questions for future research concerning what happens in the classroom when children work independently on mathematics texts which may contain ambiguous vocabulary and concerning the prospects for intervention to ameliorate the difficulties that the study suggest may be wide spread in our schools.

Referring to the problem of language in study of mathematics by Nigerian students, Agah, (2015) wrote that language difficulty (both technical and non-technical) and the confusion between language used at home and language of instruction and learning are major factors in students' under- Achievement in mathematics. These are the mother tongue, language of the medium of instruction (English language), language of science and language of mathematics. It is the belief of Licuanan (2010) that the language and terminologies of science, technology and mathematics contribute to student learning difficulties thereby leading to poor acquisition of practical skills. This finding of Nyamongo, Sang, Nyaoga and Matoke, (2014) also corroborates with the finding of this study.

Appraising the poor Achievement of many students in science, technology and mathematics, Agah (2015) suggested that the subject were not successfully being transmitted. He observed that the problem could be with the transmission system itself, the methods used and the facilities available with the learners and the nature of the message itself. The truth is that many students claim that science is difficult to learn. This might not be unconnected with the abstract nature of some of the concepts that made up the subject. Concepts like numbers, measurement and volume are taken as they are named without having access to their origin or history. Their comprehension is therefore based on what is written about them.

Therefore, the finding of this study indicated that junior secondary school students with different level of achievement in lexically ambiguous words significantly differed in their mathematics Achievement. Their study found that lexical ambiguity is ubiquitous in the language of mathematics education and is widely recognized as a persistent hindrance to children's progress.

Recommendation

Based on the findings, the following recommendations were made:

1. There is need to translate technical words expressed in English Language in the students' mother-tongue. This can be achieved through workshops for the teachers designed on the students' mother-tongue.

2. Teachers should provide opportunities for students to practice in both the mathematical meaning of words and their symbolic notations with emphasis on the use of the Margi language in the region.

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