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Solving word problems performance of students in L1 (Mother Tongue) and L2 (English language)

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Abstract

Language plays an important role in understanding word problems in mathematics. Familiarity or lack of it may determine the success or failure in understanding and working out word problems. This study was conducted to know the difference in the performance of Grade IV pupils when word problems in mathematics are expressed in English language and Mother Tongue-Based language (Hiligaynon). Descriptive-comparative statistics was used in the study. Qualitative design was also used. The participants were divided into two groups; one group took the test expressed in English language and the other group took the test expressed in Mother Tongue-Based language. Result showed that there is no significant difference ($t = -1.745$, $p = 0.09$) when word problems are expressed in English language and Mother Tongue-Based language. However, the registered mean for the two groups were below proficiency level which may imply that both groups had experienced difficulty in solving word problems regardless whether the items are expressed in English language or in Mother Tongue-Based language. Findings further showed that students from the two groups were able to answer easier items and both groups found difficulty in similar items. Thus, it could be concluded that language may have helped the students in understanding the word problems. However, students lack the necessary skills in solving word problems.

Keywords: Language; Mother Tongue-Based Mathematics; English, Philippines; Problem Solving Performance

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1. Introduction

Mathematics is an essential subject in every curriculum. It teaches the learner perform simple arithmetic and eventually lead him to a more complex nature of numbers. It places itself an important role in the development of future engineers, inventors, scientists and the likes. Thus, it becomes one of the important subjects taught to learners starting from preschoolers. However, though much attention was given to the teaching of mathematics, national and international evaluations show that, on completion of basic education, many pupils' mathematics knowledge and competencies fall short of the expected level (UNESCO, 2012). Moreover, different mathematics assessments showed that Philippines does not perform well in mathematics. As evidenced by the result of the Trends in International Mathematics and Science Study (TIMSS) administered in 2003 results where, the selected Grade 4 and Grade 8 pupils from sample schools earned low achievement scores in Science and Mathematics. Mullis, Martin, Gonzalez, and Chrostowski (as cited in Feliciano et al., 2013) found out that Philippines placed 23rd among 25 countries for both Science and Mathematics for Grade 4. These data were quite alarming and calls for innovation in the way mathematics and sciences are taught.

In response, the Department of Education introduced the K to 12 Reform Curriculum in 2012. The said curriculum is expected to bring remarkable innovations in the system of Philippine education and to bring forth excellence in the delivery of quality education. One of the salient features of the said curriculum is the use of mother tongue in teaching major and minor subjects including mathematics (DepEd Order, 2012). This innovative change in the way mathematics is taught in school was assumed to break down the gap between the language of the community where the learner belongs and the language of learning in school. Enclosure No. 1 to DepEd Order No. 74 (2009) requires the use of the learner's first language as the primary medium of instruction from preschool until, at least grade three. During such period, the first language of the learner shall be the main vehicle to teach understanding and mastery of all subject areas like Math, Science, Makabayan and language subjects like Filipino and English. After three years of teaching mathematics in mother tongue, when the learners reached Grade 4, mathematics will be taught in English. The aim for teaching it in mother tongue in the first three grade levels is for the learners to better understand mathematical concepts in their early years. This is supported with a study conducted by Gutierrez (2002) which proves that allowing learners to work in their primary language are among the successful strategies in the teaching and learning process. Further, the use of mother tongue encouraged high level of participation among students (Quijano, 2012). Likewise, UNESCO (2012) considered the problem in poor mathematics performance of learners in the basic education is the term which demands mathematics to be taught in a language that is not the pupils' mother tongue. A problem that is common to a number of developing countries such as the Philippines in which the language of instruction is influenced by the language of its colonizers and at the same time local languages exist.

Among the different areas of mathematics, the researcher believed that problem solving is one area in the study of mathematics where language plays an imperative role in achieving some degree of understanding. In fact, Carteciano (2005) had proven that most pupils remain unsuccessful in solving word problems. There may be a number of reasons why the learners often found difficulty in solving word problems. One of these

might be because word problems found in the Philippines references and sources usually involve words and texts aside from numbers which are mostly expressed in English which is not the first language of every Filipino learner. While language problems often arise as a cause for poor performance in mathematics, based on the findings of the Philippine Executive Report on the TIMSS as cited by Carteciano (2005), what is not clear is whether the lack of English language proficiency is the main reason for Filipino children's poor problem-solving performance (Verzosa, 2011) or it is just more than the understanding of language itself. It is for these reasons that the researcher deemed the importance of conducting this research.

1.1. Statement of the problem

This study aimed to determine the performance of Grade 4 pupils who were exposed to solving mathematics word problems using mother tongue during the last 3 years. Specifically, the study sought to determine the performance of the Grade 4 pupils in solving real world problems in mathematics when the problems are written in Mother Tongue and in English and discover the prevailing issues the pupils experience in solving real world problems in mathematics when written in Mother Tongue and in English language.

1.2. Conceptual framework

According to Jean Piaget and Lev Vygotsky (as cited by Ozer, 2004) constructivist theories, learning is a social advancement that involves language, real world situations, and interaction and collaboration among learners. Vygotsky, known for his theory of social constructivism, believes that learning and development is a collaborative activity and that children are cognitively developed in the context of socialization and education. Children learning development are shaped by vital cognitive tools provided which includes language (Ozer, 2004).

In the Philippines, learning and speaking in English gained popularity. In fact, a Speak English policy was passed and implemented some years ago in all levels to allow pupils and students to practice their English proficiency. This language is the most acceptable language in the global market. Good communication skill in English or English proficiency is a common attribute of college students which is being practice as early as elementary level. However, mathematics is considered to be a language itself complete with its own notations and symbols and "grammar" rules, with which concepts and ideas are effectively expressed (Kto12 Curriculum Guide, 2013). Thus, teaching mathematics in English language seems like teaching two foreign languages simultaneously. This is obviously difficult and becomes a common source of mathematics anxiety.

On the contrary, the use of local language may help pupils develop comprehension and understanding. To respond to this awareness, one of the features of the K-12 Reform Curriculum is the use of Mother Tongue-Based Multi-Lingual Education (MTB-MLE) instruction in the first three levels in the primary education. The rationale behind is the belief that the use of mother tongue as a medium of instruction makes possible for numeric achievement and development, hence, pupils would learn faster and better if something is taught in a language they understood (Mufanechiya and Mufanechiya, 2011). DepEd Order No. 74 (2009) cited some reasons on the implementation of MTB-MLE in the teaching of the different subject areas including

mathematics which is based on the findings of projects like the Lingua Franca Project and Lubuagan First Language Component which proposed that learners taught in the first language acquire competencies in different academic areas more quickly.

But since mathematics is a language in itself (Esty, 2014), it is important to consider how learners learn math. Specifically, it is imperative to note how they respond to a given word problem which involve the language and mathematics concept. Sometimes, though students understand each word in a problem, certain skills are absent which make it difficult for them. Thus, pupils should be allowed to think logically any possible solution through any possible representation and medium when they encounter word problems. This approach gives the teacher the opportunity to process the learning deeply. To sum up the concept presented, Figure 1 shows a schematic diagram.

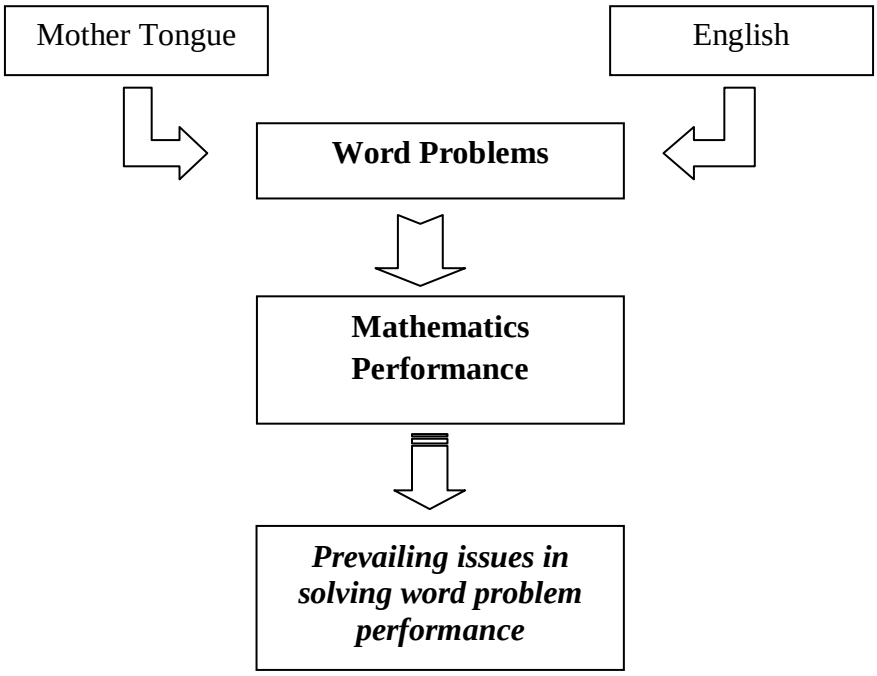


Figure 1. A Schematic Diagram showing the Conceptual Framework of the Study

1.3. Scope and Limitation

The respondents of the study were the Grade 4 pupils of the pilot class that uses mother tongue in the delivery of mathematics lesson, who were officially enrolled during the academic year 2014-2015. The learners were taught in mother tongue during their Grades 1 to 3 and were introduced to the second language (English) in the delivery of mathematics lesson when they reached Grade 4. The pilot class is

composed of only one section one which is classified to be of almost the same intellectual capability based on their academic grades.

The data analyzed in this study was based primarily on the responses of the respondents to the various items of the data-collection instrument which covers the four basic operations and word problems which includes one step and two steps operations.

The findings of this study were viewed from the standpoint of the formulated conceptual framework, data-collection instrument, procedure in data collection and statistical tools employed in the analysis of the data.

2. Methods

2.1. Research design

To meet the objective of the study, a descriptive-comparative research method using a mixed quantitative-qualitative research design was considered the most appropriate. Descriptive in the sense, that the level of performance of the pupils in the two tests was described and discussed. The result was then the basis for identifying differences between the performances, thus comparative.

2.2. Participants of the study

The participants of the study were the Grade 4 pupils in the pilot class who were officially enrolled during the academic year 2014-2015. Since, the number of respondents was manageable, total enumeration was employed. The class was composed of 35 pupils 17 of which were boys and 18 were girls. The participants had been taught Mathematics in mother tongue in their primary years as recipient of the K-12 program implemented in school year 2012-2013. Randomly chosen, 17 pupils took the test in English language and 18 pupils took the test in mother tongue.

2.3. Research instrument

A researcher-made test specifically designed for the study was used. The tests were divided into two sets. Set A questionnaires consisted of word problems expressed in English and Set B questionnaires consisted of word problems expressed in Mother Tongue (Hiligaynon).

The five (5) items in Set A and five (5) items in Set B were parallel but not congruent. No choices were provided for each question instead, pupils were allowed to use any possible strategy to answer the problems. The real world problems dealt with fundamental operations which were not evidently defined to further gauge the critical thinking skills of the pupils. Each item is scored from 1 (lowest) to 4 (highest) points for a maximum score of 20 points. Rubrics were used in giving points for the solution of each item. To determine the performance of the grade 4 pupils and its corresponding proficiency level based on DepEd standard, the following scale was used.

Mean Score	Proficiency Level
17.6 – 20.0	Advance
14.6 – 17.5	Proficient
11.6 – 14.5	Approaching Proficiency
8.6 – 11.5	Developing
5.0 – 8.5	Beginning

2.4. Validity

Since the instrument was researcher-made, it passed through necessary procedures to establish its validity. The research instrument was presented to three competent evaluators who are considered experts in the field of education. The researcher employed Good and Scates checklist for validating the instrument. The yielded mean of the instrument was 4.33 which is interpreted as excellent. Moreover, recommendations and suggestions by the evaluators for the improvement of the instrument were taken into consideration by the researcher.

2.5. Reliability

To establish the reliability of the instrument, inter-rater reliability test was conducted to make the scoring of the researcher reliable. Inter-rater reliability confirms that the produced results meet the accepted criteria defining reliability, by qualitatively defining the degree of agreement between two or more observers (Shuttleworth, 2015). Cohen kappa was used to interpret the data of the inter-rater reliability test. This was done by judging the answers of one respondent in each item. There were two raters; the researcher and the other expert. Rubrics were followed in rating the answers. Using Cohen kappa in computing the inter-rater reliability of the instrument, the result showed that the instrument was reliable with k=1.0 which is greater than 0.70 which makes the instrument reliable.

2.6. Data collection procedure

In the conduct of the study, permission from the principal of the school was sought for the administration of the research instrument. When the permission was granted, the researcher reproduced sufficient number of the research instrument and administered the same to the respondents. There were 2 sets of instrument; the first set is expressed in Mother Tongue, while the second set is expressed in English. To avoid bias in the distribution of the instrument, the researcher randomly distributed the instrument to a group composed of 35 participants. There were 18 participants who were able to answer mathematics problem expressed in English, while 17 participants were able to answer the test expressed in Mother Tongue. The test was untimed for purpose of making the child think different ways of solving the problem. Phillips (2013) stated that one of the reasons for the anxiety of students in mathematics is timed tests among others. The researcher collected the test afterwards. The researcher then checked the pupils' test papers and performed the necessary statistical treatment for the data. To further validate the results, the researcher identified the 2 highest scorers and 2 lowest scorers from each group. The chosen participants were interviewed using a

simple interview guide. A voice recorder was used during the interview and was transcribed and analyzed by the researcher. Qualitative data from the interview was synthesized and was consolidated.

2.7. Statistical treatment of data

In the analysis of the data obtained through the questionnaires, the researcher utilized the following descriptive and inferential statistics:

- To answer problems 1 and 2 which determine the performance in the Mother Tongue and English-based Mathematics tests of pupils, mean was used. Mean is used when data are interval in nature.
- To answer problem 3 which determines the difference in the performance in Mother Tongue and English-Based Mathematics test of the pupils, t-test for independent samples was used.
- To answer problem 4, the researcher analyzed the answers of the respondents to identify their existing skills in problem solving and supported by the respondent's responses in the interview.

3. Results and Discussion

This chapter deals with the presentation, analysis, and interpretation of data.

3.1. Performance of the Grade 4 pupils in solving real world problems in mathematics written in Mother Tongue

Table 1 shows the performance of the pupils when the test uses the mother tongue language. Results show that pupils fall on the developing level of proficiency (M =9.9, S.D.= 2.9343) .

Table 1. Performance of the Grade 4 pupils in solving word problems written in Mother Tongue

Variable	Mean	S.D.	Interpretation
Word Problem Performance of Grade 4 pupils	9.9	2.9343	Developing

This shows that the pupils did not perform well in the test expressed in Mother Tongue. Though mother tongue was used in expressing the word problems, the respondents fail to address the problem correctly which may lead to the statement that mother tongue does not necessarily guarantee success in word problem solving performance of the pupils. They may be able to read the problem and understand the problem but fail to find the correct way of solving it. The pupils may have the concept and understanding of the problem however, they fell short in working out the right solution which requires their critical thinking. The findings revealed a contradictory result from the researchers conducted Noren (2008) which state that pupils perform better when Mathematics instruction is done in mother tongue. This is also in opposition to the findings of Mufanechiya and Mufanechiya (2011) which showed that the use of mother tongue as a

medium of instruction makes it possible for numeric achievement and development, hence, pupils would learn faster and better if something is in a language they understood. The contradiction in the findings may be caused by the some factors present in the study of other researcher which was not measured by the existing research.

3.2. Performance of the Grade 4 pupils in solving word problems in mathematics written in English

Table 2 shows the performance of the Grade 4 pupils when word problems are expressed in English. As shown in the table, the pupils fell at the Approaching Proficiency Level (M=11.9, S.D.= 3.9478).

Table 2. Performance of the Grade 4 pupils when word problems expressed in English language

Variable	Mean	S.D.	Interpretation
Word Problem Performance of Grade 4 pupils	11.9	3.9478	Approaching Proficiency

Results show that pupils who took the word problems expressed in English language had shown some proficiency in solving each problem. The language used might have effectively helped them in working out each problem. Though expressed in English, most of the respondents had able to work it out. The use of the English language in the test while may not be conclusive since what interplays in the problem solving is the skills of the students more than just merely understanding the problem, may show that expressing word problems in English is a helping factor for the learner to better understand the problem. The study of Nillas (2002) supports the findings as shown by the results that students who took English version of mathematics test performed significantly better than those who took Filipino version of mathematics test. Though the English-based test is slightly higher than Mother Tongue-based tests, it can be noted that they were not able to achieve the proficient or even the advanced level. Kgomotso (cited by Adidja, 2014) asserts that proficiency in the English language does not guarantee success in Mathematics. The findings can be attributed to the pupils' lack of comprehension and necessary strategies in solving the problem.

3.3. Significant difference in the performance of the Grade 4 pupils in solving word problems in mathematics written in Mother Tongue and in English

Table 3 shows the significant difference on the performance of the Grade 4 pupils when real world word problems are expressed in Mother Tongue Based and English language.

As shown in the table, there was no significant difference in the performance of Grade 4 pupils who took the word problem expressed in Mother Tongue and English language ($t = -1.745$, $p = 0.09$).

Table 3. Significant Difference in the Performance of the Grade 4 pupils in solving word problems written in Mother Tongue Based and English language

Variable	Mean	df	t-value	p-value	Interpretation
Mother Tongue Based Language	9.88	33	-1.745	0.09	Not Significant at 0.05 α level
English Language	11.94				

p>.05 not significant at .05 alpha

Result shows that language does not necessarily create significant difference in the word problem solving performance of the Grade 4 pupils may it be English or Mother Tongue. Finding shows that though language is necessary in expressing the word problems, what still matters is the proper equipment of necessary skills to students in solving word problems. Findings further revealed that pupils had somehow the same skill level in performing word problems as they tend to come up with the same results. Bernardo (2002) whose study sought to answer how language affect the bilingual students' ability to model the structure of word problems in arithmetic found out that that students were equally successful in modeling the structure of problems in Filipino and in English whether their first language was Filipino or English. They were just likely to succeed with the easy problems in both languages and equally likely to have more trouble with the difficult problems in both languages.

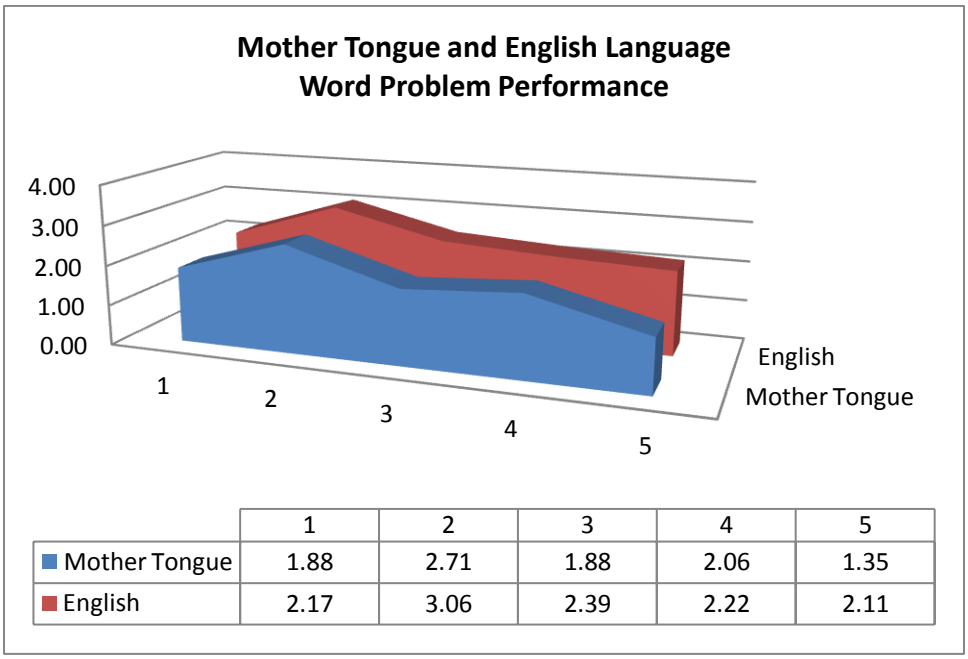
3.4. On the prevailing issues the pupils experience in solving word problems in mathematics when written in Mother Tongue and in English language

Figure 2 shows the mean scores of the respondents for every item in solving word problems written in Mother Tongue and English Language.

The figure shows how well the pupils perform in solving word problems. As shown in the figure, the pupils' performance for each items are almost similar regardless of the language being used. They tend to answer similar items correctly and find difficulty with the same items as well. The figure might only shows that language might had took part in the word problem solving performance of the pupils but what is imperative to note, is the fact that the results shows that pupils in both groups lack the necessary skills in critical thinking and problem solving.

Items in the test involve a gradual increase in the level of difficulty from one-operation problem to multi-step word problems. When the respondents were interviewed, about the item in the test that they found easier to answer, surprisingly, 3 out of 4 respondents from the group who took the test in mother tongue chose item number 1 which can be best worked out through diagram. Their reason was simple, because they only have to draw to get to the solution. Ironically, they all got wrong in the said item. From their responses, it can be inferred that pupils show interest in solving word problems using drawing, diagram or illustrations where they can actually picture out what the problem is asking. This goes to show that teachers should

integrate block model among others in solving word problems whenever this strategy is applicable because pupils might get to learn easier using such strategy. The remaining respondent chose item number 2 as easiest which is a multi-step word problem using subtraction and/or addition.



	1	2	3	4	5
Mother Tongue	1.88	2.71	1.88	2.06	1.35
English	2.17	3.06	2.39	2.22	2.11

Figure 2. A figure showing the performance of the pupils in solving word problems in English and Mother Tongue

On the other hand, 3 out of 4 respondents from the group who took the test expressed in English language found item number 2 as easiest. This particular item is a multi-step word problem which involves subtraction and/or addition somehow similar to the item number 2 of the mother tongue test. It is noticed that the group who took the test expressed in English language are more aware of what item made their test easier. This may show that they understand the items more than their counterparts.

On the question of which item did they find most difficult to answer, 2 out of 4 respondents who took the test expressed in Mother Tongue pointed item number 5. Item number 5 is a problem that requires critical understanding of the problem before going into the solution. In the same manner, 2 out of 4 pupils who took the test in the English language pointed out the same item to be the most difficult to answer. Their reasons were; they cannot understand the problem, they do not know how to work it out and they are confused with the problem. Bernardo (2002) shared the same findings and further concluded that the students were just likely to succeed with the easy problems in both languages and equally likely to have more trouble with the difficult problems in both languages.

One of the respondents who took the test in Mother Tongue chose item number 1 to be difficult because he could not understand the problem. The other one chose number 4, and the reason was unexpected

because when the respondent was asked about it, the reply was because of the school. On a personal note, this may be because of the stereotyping of the delivery of quality education in the public schools.

When the respondents were asked for a reason of getting wrong answers on some items they did not pointed out as difficult, the following reasons came out: they did not understand the problem, they cannot find the correct way of solving the problem, or their solutions were wrong.

As to the approach in solving real world problems in mathematics, analysis of their works showed that pupils used drawing in analyzing the problems regardless whether the problems were written in mother tongue or in English language.

4. Conclusion

After all the data were subjected to statistical treatment, the following are the salient findings of the study. Findings revealed that local language does not warrant success in solving word problems in mathematics. In as much as English language do not guarantee same success. Pupils succeed in working out problems that involves simple calculations and fell short on problems that requires a deeper understanding. Thus, it can be concluded that language of mathematics goes far beyond the text that the pupils read. It does not limit itself neither to the reading of the words that composes it nor to the extraction of salient facts from the problem. It does not stop from how one understands the problem but how critical is the understanding of the problem the pupil performs. Language is just one of the complex factors that play together for a pupil to learn solving the problem. Mathematics had proven itself to be a unique language that is aided by the functional language in the community which includes not only their local language but the English language as well. English language had been observed to play part in the mother tongue of the child being exposed to English shows and movies in the television and from their parents as well. Pupils who took the word problem expressed in the mother tongue had reached below standard level and pupils who took the mathematical word problem expressed in English did not perform so well. One of the observations in their responses pointed out that they were able to extract necessary data but failed to solve it with correct operations that are important to solve the problem. Failure to understand the whole thought of the problem and lack of strategies in solving mathematical word problem might be some of the reasons why the pupils got the low performances. The performance of both groups showed that language should not only be the focus in understanding the problem, but it can be of help for a student to work out the problem he is encountering. The low means suggest that there was a certain difficulty in their manner of dealing with word problem. The twin goals of mathematics education which are critical thinking and problems solving was not yet evident when the results are considered.

5. Recommendations

Based on the findings and the given conclusions, the following may be recommended:

1- English language should still be used in teaching mathematics as we are aware that mathematics in the global arena are expressed in the international language while Mother Tongue Based language shall be used as an aid in the understanding of mathematics especially in problem solving.
2- Teachers should teach problem solving carefully not disregarding minor details that would make each word problem simpler and understandable. Contextualizing and localizing each problem if necessary.
3- Teachers should include problems which require the higher order thinking skills of the pupils even in the primary level of learners to condition their minds to the twin goals of mathematics education.
4- Teachers should employ other applicable and effective strategies in dealing with real world word problems.
5- At some point, being a pupil in the public school had somehow created a low self-esteem among them as demonstrated by the response of one interviewer. As teachers, it is imperative to inculcate to the learners that education, regardless if it is in a public school or private school, is similar and comparable in terms of instructions and the quality education the school offers.
6- Since this study covered only a small population, it is recommended that the same study shall be conducted to a larger population. Moreover, this study is only limited to operations in whole numbers, thus it is recommended that similar study shall be conducted covering a larger scope of the real numbers.

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