

A STUDY ON STUDENTS' ERRORS ON WORD PROBLEM

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INTRODUCTION

Word problem is defined as 'A Mathematical problem that is stated in words rather than in symbols or as an equation' (Mathematics Thesaurus). Sri Lankan Primary Mathematics syllabi consist of six main topics – Numbers, Mathematical Operations, Measurement, Money, Space and Shapes, and Data Handling. All the above topics contain word problems. These word problems are introduced to the students from the primary level. Most of the students find word problems challenging. There are several points at which students fail to solve the problem correctly.

Newman (1977) analysed the errors made by the students when solving word problems. She developed a model to classify errors. She identified a sequence of steps in the error analysis model. This model is called as 'Newman's Error Analysis Model' (NEA model). The sequence of steps the model postulate is;

Reading → Comprehension → Transformation → Process → Encoding

The steps are elaborated as:

- (i) **Reading abilities;** can the student actually decode the question? Does the child recognize the words or symbols within the question?
- (ii) **Comprehension:** once the student has decoded the words or symbols, can he or she understand the question
 - (a) In terms of general understanding related to mathematical topic and
 - (b) In terms of specific mathematical expressions and symbols?
- (iii) **Transformation:** Can the student choose an appropriate process or algorithm to solve the problem?

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- (iv) **Process Skills:** Can the student accurately do the operation(s) he or she has selected at the transformation stage?
- (v) **Encoding:** Can the student relate his or her answer back to original question to record the answer in appropriate form?

(Adapted from Dickson, Brown and Gibson, 1984)

Clements (1980) conducted a research using the Newman's Error Analysis Model (NEA) to analysis the data. He found that 66.67% of the errors made when solving the word problems occur at the Reading, Comprehension and Transformation stages (first three stages). That means before students perform any calculations. Nanayakkara (1993) conducted a study in Sri Lanka with Sinhala medium Grade 3 and 5 students. He also used NEA model to analyse the data and noted that 60.4% of the errors made when solving the problems are also related to the first three stages of NEA model. The results of these two studies indicated that more than 60% of the students made errors in performing any calculations.

Many researchers have studied the different levels of difficulty presented by the word problem (Carpenter and Moser 1982). Anghileri (2001) conducted a study in Holland and suggested that students should be introduced to real life problems.

There were many studies conducted related to primary grade students' errors on word problems worldwide. Nanayakkara's (1994) study is the only study conducted in Sri Lanka related to children. But that study considered only the Sinhala medium students in Sri Lanka. There are no studies in this field related to Tamil medium primary students. Therefore an urgent need exists for research on Students' errors on word problem in Primary school students who are in the Tamil medium schools.

Research Problem

There are many studies highlighted that students are weak in solving the word problems compare to other topics in Primary mathematics.

National Institute of Education (NIE) carried a study in 394 schools in eight districts thought the country to examine the performance of Grade 5 students in Literacy and Numeracy- after five years of implementing educational reforms in 1998. This finding of this study indicated that, ' the most important sub skill Problem Solving in numeracy have not shown the expected

improvement (Suranimala, Fernando 2004). The Sri Lankan context word Problems called as problem solving.

Although National Education Research and Evaluation Center (NEREC) of the Faculty of Education, University of Colombo carried out a study throughout the Island and noted that, students are very weak in solving Word problems.

Basic Education Sector Unit of the Provincial Education Departments of the Northern and Eastern Provinces carried out a study to identify the errors made by the Primary school children in all the districts in Northern and Eastern Provinces in Sri Lanka. The findings of this study noted that, students performance in mathematical Word Problem is very poor (Sibli, 2009)

In this back ground, this study attempts to find the reasons for this problem.

Objectives

The objectives of this study are

- (i) to identifies the reasons for students' weakness in Word Problems
- (ii) to find the types of errors made when solving Word Problems by boys and girls
- (iii) to find the types of errors made when solving Word Problems by students of different grade levels

Research Design

This is a descriptive study. Data collection in this study was mainly based on several students in two grade levels and at least a single measurement of performance for each individual within each grade level. Therefore this is a cross-sectional study design.

Sample

Sample of this study is Grades 4 and 5 students (All students in these two classes) from a 1AB type Tamil medium school in Colombo Education Zone. The sample is given in Table 1

Table 1: The Sample

Grades Gender	Grade 4	Grade 5	Total
	Boys	16	06
Girls	08	07	15
Total	24	13	37

Research Instruments

A question paper containing 5 word problems covering all four mathematical operations was used for collection of data. This question paper was designed by the researcher.

Data collection

After marking the answer scripts, the students who have made errors were interviewed to identify the reasons for making such errors. The data collected from the interview were further analysed to categorise the errors.

Finding and Discussions

Table 1

Questions Error Type	Q.1		Q.2		Q.3		Q.4		Q.5	
	n	%	n	%	n	%	n	%	n	%
Reading	10	50	6	23.1	9	29.1	10	33.3	9	40.9
Comprehension	6	30	14	53.8	15	48.4	13	43.3	7	31.8
Transformation	0	0	2	7.7	0	0	4	13.3	3	13.6
Process	4	20	4	15.4	7	22.6	3	10	2	9.1
Encoding	0	0	0	0	0	0	0	0	1	4.5
Total	20	100	26	100	31	100	30	100	22	100

The English translation of the first Question is: 48 boys and 62 girls went to the playground to watch a sports meet. Find the total number of children who went to the playground.

The Tamil medium Question one contained two sentences. There were eight words in the first sentence and six words in the second sentence. The relevant mathematical operation was addition ($62+48=$). That is adding two 2-digit numbers with carrying over. The table shows that 50% of

the students surveyed could not read the question and 30% of the students did not comprehend the question. The long sentences may be the reason for these results. But Primary level mathematics text books contain similar word problems.

The English translation of the second question is: A bag contains 60 marbles of black and white colours. 37 marbles are black. Find the number of white marbles in that bag?

Question 2 also contained two sentences. There were 6 words in the first sentence and 9 words in the second sentence. Mathematical operation was subtraction ($60 - 37 =$). Table above indicates that 53.8% of the students surveyed did not comprehend and 23.1% of the students could not read the question. This indicates that, students' language skills are very poor and it affects their mathematics learning.

The English translation of the third question is: Price of a coconut is Rs. 45.00 and a papaya is Rs. 35.00. If I gave Rs. 100.00 to the shop keeper find the balance?

Question 3 contains only one sentence with 16 words. But this question related to day to day life situation. There were two mathematical operations involved in this question. First operation was adding two 2-digits numbers ($45.00 + 35.00 =$) and the second operation is subtracting the answer of the first operation from 100.00. The table indicated that 29.1%, 48.4% and 22.6% of the students surveyed achieved the Reading, Comprehension and Process levels respectively. It was noted that the error in processing level of the third question was higher than the other four question. This may be due to the multiple operations.

The English translation of the fourth question is: There were 4 students seated on a bench. How many children can sit on 8 similar benches?

Question 4 contained two sentences. There were four words in the first sentence and five words in the second sentence. The mathematical operation involved was multiplication ($4 \times 8 =$). More than three quarter of the students surveyed faced problems in Reading and Comprehension. A significant number of students selected the mathematical operation addition instead of multiplication ($4 + 8 = 12$). The students could not understand the question and just added the numbers.

The English translation of the fifth question is : 27 colour pencils were equally shared among 3 siblings. How many pencil did one sibling get?

Question 5 contained two sentences. First sentence contained 6 words and second sentence contained 5 words. The mathematical operation involved in the question was division ($27/3 = 9$). The table indicated that more than 80% of the students faced difficulties in the first three stages.

To identify the reasons for students’ weakness in Word Problems

All type of errors identified during the interview were recorded. Total number of errors diagnosed during the interview was 129. Details by grade and gender are shown in

Table 2.

Table2: Error diagnosed

Grade Gender	Grade 4	Grade 5	Total
Boys	57	18	75
Girls	35	19	54
Total	92	37	129

Errors were classified according to error types postulated in Newman’s Error Analysis model

Table 3: Categorising of Errors according to NEA Model

No of Students Error Type	No.	%
Reading	35	27.13
Comprehension	55	42.64
Transformation	10	7.75
Process	18	13.95
Encoding	01	0.78
Total	129	100

The table above indicates that, a high percentage of the students in Grades 4 and 5 were unable to comprehend the question. A considerable number of students made errors on reading. 77.52% of the students made errors in the first three stages. It means that more than three quarter of the students made errors before performing any calculations. This finding indicates that, students’ lack of skills in their first language (Tamil Language) affected their mathematics learning.

The sentences in the primary level Tamil language book contain no more than six words. But mathematics word problems contain more than 14 words sentences. Therefore, the primary level curriculum developers have to take this matter into consideration. At the primary level the same teacher teaches Tamil language and Mathematics. Therefore primary teacher need to prepare the students to read and understand word problem in mathematics through the language subject.

To find the types of errors made when solving Word Problems by boys and girls

Gender wise number	Boys		Girls	
	No	%	No	%
Error Type				
Reading	23	30.67	22	40.74
Comprehension	35	46.67	20	37.04
Transformation	05	6.67	05	9.26
Process	12	16.00	06	11.11
Encoding	0	0	01	1.85
Total	75	100	54	100

Statistical tests have revealed that there is no significant error type between the boys and girls.

To find the types of errors made when solving Word Problems by students of different grade levels

Grade	Grade 4		Grade 5	
	No	%	No	%
Error Type				
Reading	27	29.35	18	48.65
Comprehension	41	44.57	14	37.84
Transformation	09	9.78	01	2.70
Process	14	15.22	04	10.81
Encoding	01	1.09	00	0
Total	92	100	37	100

Statistical tests have revealed that there is no significant of the error type between the boys and girls.

Conclusion and recommendations

Mathematics and First language are the compulsory subjects in GCE (OL) in Sri Lanka. Most of the sums in GCE (OL) paper are in the word problem format. Therefore students have to get good competencies to solve the word problems. The primary mathematics is the foundation for the secondary level mathematics. But the studies highlighted that, students performance in Word problems are very weak.

This study identified the reasons for students' weakness in Word problems. Most of the students made errors on the Stages of Reading, Comprehension, and transformation. Reading and Comprehensions are related to language. Same teacher is teaching the Language and Mathematics at the Primary Schools. Therefore the teacher has to prepare the students to learn mathematics through during the language lessons.

A significant number of students made mistake in process stage also. These are related to the mathematical operations. Many studies identified the error patterns on mathematical operations. These errors on operations were classified as Systematic errors, Random errors, Careless errors (Nanayakkara, 1994). Therefore teachers have to identify these error patterns and take remedial measures.

As noted earlier, the sentences in the primary level Tamil language textbook contain no more than six words. But mathematics word problems contain more than 14 words sentences. Therefore, the primary level curriculum developers have to take this matter into consideration.

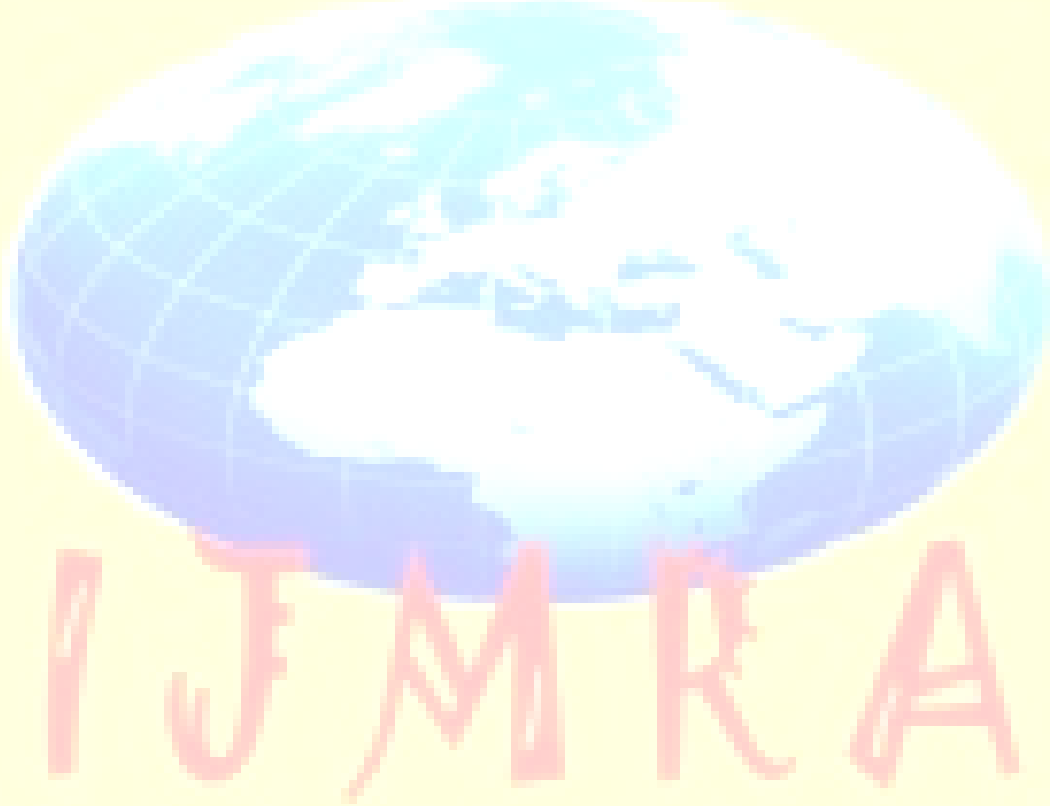
Key Words: Word Problem, Newman Error analysis, Error

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Annex

Error Type	Grade 4				Grade 5				Total	
	Boys		Girls		Boys		Girls		No	%
	No	%	No	%	No	%	No	%		
Reading	15	26.32	12	34.29	08	44.44	10	52.63	35	27.13
Comprehension	26	45.61	15	42.86	09	50.00	05	26.32	55	42.64
Transformation	05	8.77	04	11.43	00	0	01	5.26	10	7.75
Process	11	19.30	03	8.57	01	5.56	03	15.79	18	13.95
Encoding	0	0	01	2.86	00	0	00	0	01	0.78
Total	57	100	35	100	18	100	19	100	129	100



But with a word problem, significant effort goes into understanding the scenario even before one gets to the “real math”™ in the problem. We are studying student responses to questions from the American Mathematics Competition (AMC) on the Edmodo platform. Once the specific error is correctly identified, it is not difficult to address it with either a simpler question testing the same concept or even re-teaching, if the misconception is widespread. Analysis of student performance is dependent on student focus and engagement. Student engagement is best when the questions are answered by students in a medium-stakes environment.

But the studies highlighted that, students performance in Word. problems are very weak. This study identified the reasons for studentsâ€™ weakness in Word problems. Most of the students. made errors on the Stages of Reading, Comprehension, and transformation. Reading and. Comprehensions are related to language.Â Many studies identified the error patterns on mathematical operations. These errors on operations were classified as Systematic errors, Random errors, Careless errors. (Nanayakkara, 1994). Therefore teachers have to identify these error patterns and take remedial.