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Newman Method Used to Analyze the Math Performance of Somali Sixth-Grade Students

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Abstract

Somalia faces the problems of low performance in mathematics at primary school level, especially in the area of ability in mathematical problem solving. The purpose of this study was to understand the cause of students' low achievement through analysis of the levels of their abilities, which are classified into the five stages, i.e. reading, comprehension, transformation, process skills, and encoding. And relationship between those levels and mathematical abilities to determine the contribution of these levels to math performance. In this study, 40 students were selected from among 6th graders of elementary school; there are five questions to interview forty Grade six students. The data suggested that most of students' errors occurred at comprehension level for structured questions while the errors for multiple choice questions occurred at the transformation level. Good performers' errors did not occur at reading level, but poor performers' errors occurred mostly at comprehension level.

Keywords: problem solving; transformation; encoding; math performance.

1. Introduction

Mathematics is a branch of human knowledge which has received a lot of attention in recent years. Power has been currently gained on the basis of technology, which heavily rests on mathematics. Problems in learning mathematics appear at a very early stage in children, but mostly in elementary school, and then continue up to high school [6]. low performance in mathematics at primary school level has been addressed by many researchers from various aspects. Many have attributed math disability to information processing inefficiency, yet others have attempted to draw a dividing line between such educational progress problems and cognition [5].

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Mathematics is the science of reasoning and computations. It is the science or study of numbers, quantities or shapes [7], According to [8], mathematical demands on students increases as they progress through school; take up their adult lives at home and in the workplace. In order to function in a mathematically literate way in the future, students must have a strong foundation in mathematics. A strong foundation involves much more than the rote application of procedural knowledge. [11]shows that, all students should be able to understand, make sense of, and apply mathematics; make connections between concepts and see patterns throughout in mathematics. World Conference on Education for All in 1990 is one of the monumental landmarks in the educational development as it has led the world to work together towards realization of the ideal of universal primary education by appealing the importance of meeting basic learning needs in order for people to survive, to develop their full capacities to live and work in dignity, to participate fully in development, to improve the quality of their lives, to make informed decision, and to continue learning[12]. In the same conference, it was further declared that the basic learning needs comprise of both essential learning tools such as literacy, oral expression, numeracy, and problem solving and the basic learning contents such as knowledge, skills, values, and attitudes that are required by human beings. Considering the above in the context of mathematics education, nurturing ability of mathematics problem solving is an important task.

1.1 Problem Statement

When it comes to Somalia, studying mathematics plays a critical role in developing human thinking that is more creative, reasonable, and capable of analyzing problems and forecasting the future. On the other hand, Somali education has placed a premium on textbooks. It focuses on memorization rather than developing critical thinking skills. This trend is supposed to impede kids' ability to develop mathematical problem-solving skills. In Somalia, school education has focused on memorizing textbooks rather than fostering problem-solving skills and self-learning talents. Examinations concentrate heavily on the memory of knowledge, which has the disadvantage of limiting pupils' abilities to think, analyze, synthesize, innovate, and solve problems.

1.2 Research Objectives

The purpose of this article is to discover the fundamental cause of the children's low math performance in Somali primary schools. In order to accomplish this, the paper first used the Newman Procedure to determine students' problem-solving abilities in terms of language fluency, conceptual understanding, and mathematical processing capacity. Second, a comparison was made between the groups of good and poor performance. Finally, the causes of district disparity were investigated by comparing student success in a high-performing district to that in a low-performing district, as represented by the Hodan and Wadajir districts, respectively.

1.3 Research Questions

(1) At which level of problem solving do the students commit error/s in mathematics?
(2) Is there any difference between the good performers and poor performers in terms of error/s in problem solving?
(3) Is there any difference between the students in good performing district and those in poor performing

district in terms of committing error/s in mathematics?

2. Methodology

2.1 The Newman Procedure

Since 1977, when the Australian educator M. Anne Newman published data based on a system she had developed for analysing errors made on written tasks see [9, 10], a steady stream of research papers has been published in many countries in which data from many countries have been reported and analysed along lines suggested by Newman (see, for example, [1, 2, 3, 4]. The Newman Procedure is a method that analyzes errors in sentence problems. In the process of problem solving, there are many factors that support the students to arrive at a correct answer. This method supposes that in the process of problem solving there are two kinds of obstacles that hinder students from arriving at correct answers:

(1) Problems in linguistic fluency and conceptual understanding that correspond with level of simple reading and understanding meaning of problems, and

(2) Problems in mathematical processing that consists of transformation, process skills, and encoding answers.

This classification implies that the students have to interpret the meaning of the question in mathematical context before they proceed to mathematical processing to obtain appropriate answer. In summary, Newman Procedure can be described as follows (See Figure 1):

Newman	**Procedure**
I. Reading (if students can read the question)	
II. Comprehension (if students can explain what the question was?	
III. Transformation (if students can select appropriate mathematical operations and procedures)	→
IV. Process skills (if students can perform correctly mathematical processing)	
V. Encoding (if students can represent answer appropriately)	

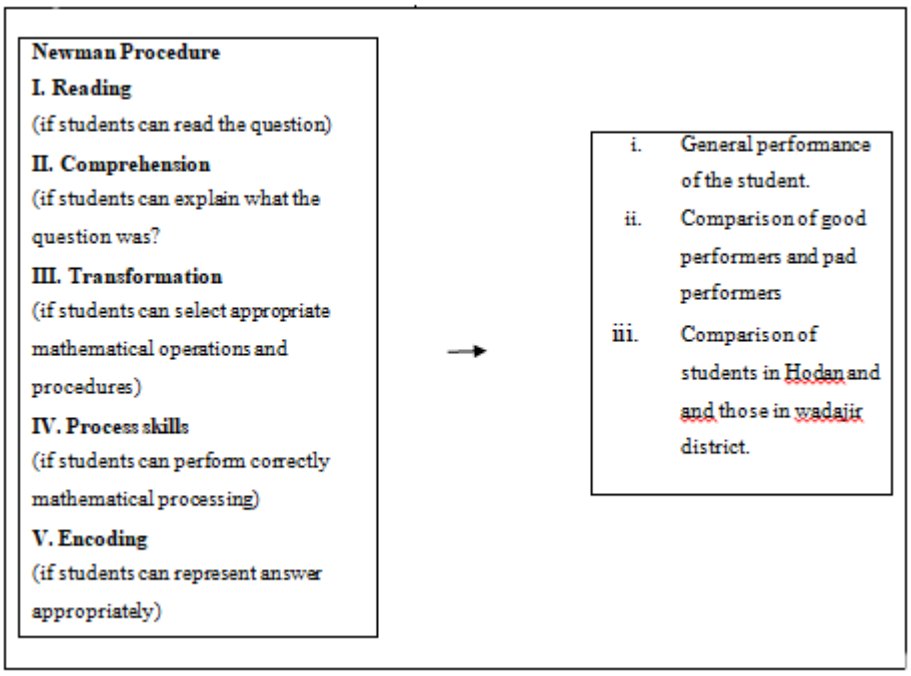

Figure 1: Conceptual Framework of the Study.

Table 4

Indicators of ProblemSolving Capability using Newman's Theory	
Stages of Newman	Indicator
Reading	If students can't read keyword or symbol that prevent it continued, could classify it as a read error.
Comprehension	The student read all the words in the question but had not understood the overall meaning and thus unable to proceed further.
Transformation	The student unable to identify the operation, or series of operations.
Process Skill	The student could identify the operation or series of operations but did not know the measures to carry out these operations.
Encoding	The student worked out the solution to a problem but could not express the solution in an acceptable written form.

I . Reading level: Can the student read the question?

(Simple recognition of words and symbols)

II. Comprehension level:

Can the student understand the meaning of the question?

(Linguistic understanding of problems)

III. Transformation level:

Can the student select the appropriate mathematical operations or procedures?

(Transformation from linguistic understanding to mathematical interpretation)

IV. Process skills level:

Can the student perform the mathematical calculation or the procedure accurately?

(Execution of mathematical processing)

V. Encoding level:

Can the student represent the answer appropriately?

(Representation of results from mathematical processing)

This procedure can be conducted by a kind of interview. It can identify at which level students' errors occur in problem solving. For example, the following conversation describes this method (See Figure 3). In the transcript below, "I" stands for interviewer and " S" stands for student.

(Problem)
20 eggs, costs four hundred thirty nine shillings. How much will one egg cost?
(Process of Interview)
I:"Can you read the question?" (Reading level)
S: (Student reads the whole question.)
I: "What does the question ask you to do?" (Comprehension level)
S: "It's asking me to find one egg, and how much?"
I: "Then, what operation do you work out to find the answer?"
(Transformation level)
S: "Using subtraction." ← (Error occurred at this level.)
I: "Can you show me your calculation or write it on this paper?" (Process skills)
S: "There are 20 eggs, so one egg is 439-20–12 = 408."

Figure 2: An Example of Problem and Process of Interview in Newman Procedure.

The interview continues like this. In this example, the error occurred at the transformation level because the student comprehended what the question is after, but was not able to succeed in developing an appropriate operation. And in this way, the interviewer identifies student's difficulties by Newman Procedure.

2.2 The study areas

The research was conducted in two districts that were Hodan and Wadajir district. Four public primary schools were chosen from each of the two districts, to equally represent both districts. They sum up to the total of four

schools as a sample. In Somalia not only the Ministry of Education Culture and Higher Education but some other organizations establish primary schools. So besides the location of a school, we consider the similarity of category of schools as per establishment.

In each school, the interview was carried out to five Grade Six students. Two of them were good performers and the other three were poor performers. In total, forty students were interviewed in this research.

2.3 Research instrument

The interview was conducted using five questions (See Annex) that were divided into two parts; Question one and two were multiple choice questions, and the rest of the questions were structured questions. The questions attempted to cover major areas in Grade Five curriculum.

3. Results and Discussion

3.1 Presentation and Analysis of Data

The information collected by the interview was examined in terms of the following:

(1) general performance of the students,

(2) comparison of good performers and poor performers, and

(3) comparison of students in Hodan and those in Wadajir district.

3.2 General performance of students

Table 1 shows the levels at which the students' errors occurred in each question.

Table 1: The Students' Level of Errors in Questions 1-5.

Question Number	I.		I.		I.		V.		V.		I.		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	3	7.5	5	12.5	30	75	0	0	0	0	2	5	40	100
2	5	12.5	10	25	17	42.5	0	0	0	0	8	20	40	100
3	4	10	13	32.5	0	0	2	5	0	0	21	52.5	40	100
4	3	7.5	22	55	4	10	3	7.5	0	0	8	20	40	100
5	4	10	10	25	2	5	4	10	1	2.5	19	47.5	40	100

Note: I=Reading, II=Comprehension, III=Transformation, IV=Process skills, V=Encoding, VI=Correct Answer, n=Frequency of students.

Question number 1, is a multiple-choice question concerning how many faces there are on a cube. According to Table1, 75% of the students polled were unable to comprehend the question's content in order to select an appropriate mathematical operation to answer the problem. As a result, just 5% of the students got the correct

response during the interview. It's because most students were only able to view the visible elements of the shape and were unable to identify the invisible parts of the cube, which has three more faces at the back. Only two students properly answered this question.

Question number 2 is a multiple-choice question about determining the length of a playground. According to the results, 42.5% of the students made a mistake at the transformation level, and just 20% of the students got the correct answer. The majority of students did not comprehend the formula for calculating the area of a rectangular shape, nor did they understand the relationship between the length, breadth, and area in the calculation. They simply attempted calculation, such as addition or subtraction, to get a result that corresponded to one of the given options. Some students were able to read and comprehend the question on determining the length of an area.

They, on the other hand, had no idea what length and width were. Students who got the correct answer, on the other hand, were able to retain the calculation and apply it correctly to get 600 m2 (20m 30m) of area.

Question number 3 is a planned question in which you must determine the number of fruits. The results suggest that 32.5% of the students committed comprehension errors, while 52.5% of the students received the correct answer. Students made a mistake since they didn't comprehend the phrase "half of sixteen" and were unable to solve the problem. And pupils who encountered difficulties at the process skills level made mistakes owing to carelessness during their summing.

Question number 4 is a structured question that asks for the overall number of pupils in a class as well as the proportion of female students in the class. The results show that 55% of the pupils committed comprehension faults. It's because they didn't understand the question's content and couldn't tell if it was an affirmative phrase or a question. Furthermore, many were unsure on how to articulate their answer in proportion and fraction. The majority of them guessed their responses and illustrated the process with graphics. However, in the majority of situations, the explanations were determined to be useless. They also didn't seem to understand what 1/2 meant.

Question number 5 is a structured question in which you must estimate the quantity of cartons of milk in the graph provided. The results show that 25% of the students committed comprehension errors, whereas more than half of the students got the correct answer. The language structure in this question was straightforward, and the only computation required was addition. As a result, the majority of children had no problems. Some students who submitted incorrect answers did not appear to understand the term "a week."

Comparison of the good performers and poor performers In this section, the number of students who performed well was compared to the number of students who fared poorly. Table 2 summarizes the findings.

Table 2 shows that several errors occurred at the transformation stage in the Newman Procedure. In multiple choice questions, good and poor performers made nearly identical mistakes; however, in structured questions, there was some difference in performance.

The majority of low performers failed at the level of verbal and conceptual comprehension and did not progress

to the stage of mathematical processing. In some circumstances, they simply calculated all of the numbers to arrive at an answer. Good performers, On the other hand, good performers could perform relatively well with any problems. They could fluently read, understand whether it was an affirmative sentence or a question, calculate fast, and accurately.

Comparison of the students in HODAN and those in Wadajir District In this section, comparison was made between the students in HODAN and those in Wadajir district. The results are presented in **Table 3**.

Table 2: Level of Errors per Students' Performance (%).

Question Number	I.		I.		I.		V.		V.		I.	
	GP	PP	GP	PP	GP	PP	GP	PP	GP	PP	GP	PP
1	0	8.3	0	16.7	87.5	75	0	0	0	0	12.5	0
2	0	16.7	6.3	33.3	50	41.7	0	0	0	0	43.8	8.3
3	0	12.5	6.3	50	0	0	0	8.3	0	0	93.8	29.2
4	0	12.5	37.5	70.8	6.3	8.3	6.3	4.2	0	0	50	4.2
5	0	12.5	0	37.5	0	8.3	6.3	12.5	6.3	0	87.5	29.2

Note: I=Reading, II=Comprehension, III=Transformation, IV=Process skills, V=Encoding, VI=Correct Answer, GP=Good performance, PP=Bad Performance.

Table 3: Level of Errors per Location (%).

Question Number	I.		I.		I.		V.		V.		I.	
	HDN	WDJ	HDN	WDJ	HDN	WDJ	HDN	WDJ	HDN	WDJ	HDN	WDJ
1	10	0	10	15	65	80	0	0	0	0	15	5
2	10	10	20	25	45	40	0	0	0	0	25	25
3	10	5	45	25	5	0	0	15	0	0	40	55
4	10	10	45	60	10	5	0	10	0	0	35	15
5	10	10	25	20	5	5	20	0	0	5	40	55

Note: I=Reading, II=Comprehension, III=Transformation, IV=Process skills,V=Encoding,VI=Correct Answer,HDN=Hodan,WDJ=Wadajir.

In question one the result showed that the students in both districts presented similar trends in their errors as the meaning of the question was simple. In question two, there was not much difference observed between the two districts and the students in both districts seemed to have problems at the transformation level.

However, causes of their mistakes vary widely from student to student. For example, a student in Wadajir district could read, understand what the question asks, and even know the appropriate formula, but input numbers in wrong places as 600× 20= 12000.In case of a student in HODAN, he could read and understand the question but did not know the formula to calculate. So he selected addition to calculate as 600 + 20= 620. More distinctive differences occurred between the two districts when it came to the structured questions. In question three, more students got the correct answer in Wadajir district than in HODAN district. Students in HODAN made more mistakes than those in Wadajir district at the comprehension level. Further analysis revealed that more students in HODAN district could not understand the phrase 'half of sixteen' nor know how

to find it. Some students thought it is equal to 15 or 13, and then did addition to get the answer of 24 (10-6= 4, 8-5= 3, 18-1= 17, ∴ 4+3+17 = 24) or 20 (10-6= 4, 8-5= 3, 18-3= 15, ∴ 4+3+15 = 22). In question four the trend is similar to that in question three, but it is in an opposite manner this time. In this question, most of the students in Wadajir district could answer only the first part that required simple addition, but they could not understand meaning of 1/2 in the latter part. Thus, their explanation was not consistent to the question or meaningless in some cases.

In question five the trend was a little bit different from the other two structured questions. In this question the difference was caused by errors at the process skills level only with the students in HODAN.

Otherwise, most of them could get the correct answer because it was an estimation and simple calculation. Summarizing the above, patterns of problem solving levels are often similar in both districts despite the claim that Wadajir district is poorer than HODAN in terms of mathematics performance. In the structured questions, the linguistic fluency and conceptual understanding cause differences to some extent. In some questions, students in HODAN performed better and in other questions, the opposite is true.

This may imply that achievement is determined not only by levels of linguistic ability but also by familiarity to the context of the students in each area.

4. Findings

(1) Students' errors in multiple choice questions were mostly made at the stage of mathematical processing that comprises of transformation, process skills and encoding level, while those in structured questions were made at the stage of the comprehension level. They call for more attention to the importance of language factors in mathematics learning.

(2) There were notable differences between good and poor performers. Good performers tended to have stronger comprehension ability than poor performers. However, if we consider the mathematical processing stage, similar patterns were found regardless of different performance.

(3) Concerning difference in locality, the study found that there is no notable difference between both districts. On the other hand, the difference in achievement level questioning structured question seemed to be caused not only by students' linguistic ability but also by familiarity to the context.

5. Conclusion

In this research, the researcher has analyzed the mathematics performance of Grade Six students in Somalia by using Newman Procedure.

And he has revealed that there are many stages that students need to go through in order to arrive at correct answers in the mathematical problems.

6. Recommendations

1. Somali language teachers and mathematics teachers should collaborate in considering their appropriate teaching methods. As stated above, this paper results clearly showed poor performers had linguistic and conceptual comprehension problem.

2. In case of mathematics, the teachers should give clear explanation about mathematical concept to ensure that each student understands it.

3. Students have different comprehension levels, and therefore, some activities may be employed to support poor performers' understanding through working with good performers. And they learn how to interpret the mathematical problems from their peers.

4. Finally, this paper also found the usefulness of Newman Procedure to examine the students' level of problem solving skills. Our future issues are related to application of this method. They are to diagnose students' level of errors, and to improve daily practice through these, which will result in improvement of students' performance in the long run.

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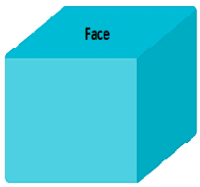
Annex

1. This picture shows a cube with one face marked. How many faces does the cube have altogether?



a. 8

b. 9

c. 12

2. The area of a basket ball play ground is 600m^2, and the width is 20m. What is the length of the classroom?

a. 30 m

b. 150 m

c. 955 m

3. Mom bought 10bananas and gave 6bananas to a neighbor; Dad also bought 8bananas and gave 5 apples bananas to the neighbor; their son ‘Ali’ bought 18oranges and gave half of them to his friends.

How many fruit do they have now? Answer: _____

Use words or pictures to explain why.

4. There are 10 girls and 20 boys in Hawa's class. Hawa said that there is one girl for every two boys. Her friend Maria said that l/2of all the students in the class are girls.

How many students are there in Hawa's class? Answer:_____

Is Hawaright? Answer: _____

Use words or pictures to explain why.

Is Maria right? Answer:_____

Use words or pictures to explain why.

5. The graph shows the number of cartons of milk sold each day of a week at a school.

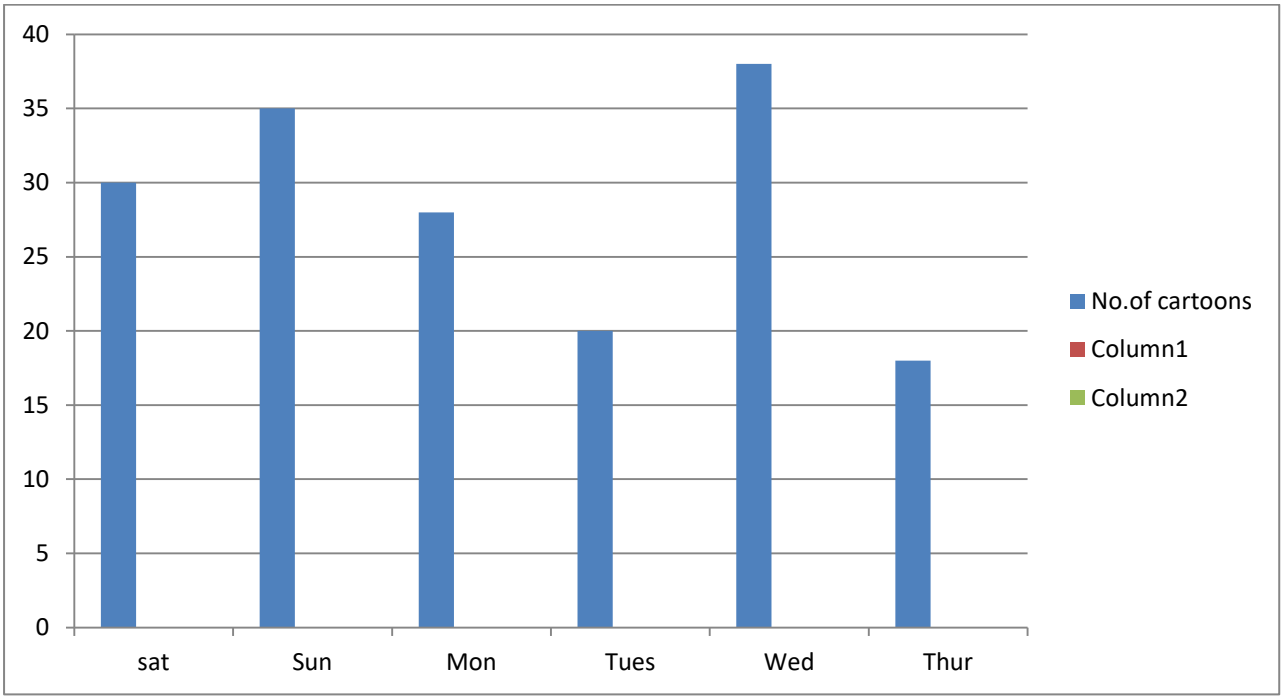


Figure 3

How many cartons of milk did the school sell on Monday?

Answer: _____

How many cartons of milk did the school sell that week? Show your work.