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Mathematics Performance of Primary School Students in Assam (India): An Analysis Using Newman Procedure

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***Abstract*--- In spite of the SCERT and DCE work for basic learning needs for students of Assam, the problems of low performance in mathematics at primary school level exists mainly in the area of ability in mathematical problem solving. The paper attempts to disclose the fundamental reasons of students' poor achievement through analysis of the levels of their abilities using Newman Procedure. The abilities of students in rural and urban areas of Assam were compared. There are ten questions to interview one hundred Grade Four students of which fifty are from rural and another fifty from urban area divided into three different categories. The data recommended that most of students' errors occurred at comprehension as well as at the transformation level. Good achievers and fair achievers did not make mistake at reading level, but poor achievers errors is observed at reading level and mostly at comprehension level.**

***Key words*------ Reading errors, Transformations, Good, fair and poor achievers, Structured question, Rural and urban areas.**

I. INTRODUCTION

Mathematics plays a significant role in developing human thinking more creative and helps to analyze real life problems. In Assam mathematics education has been mostly emphasizing the textbooks and its memorization .The goal to achieve a good result in examination obstructs students to develop mathematical problem solving skills. Examination is based on memorization of knowledge which results in students' low potential in judgment of analyzing, innovating, and problem solving. Considering the above situation, the paper is aimed at enlightening the root causes of students' stumpy achievement in mathematics at primary schools in Assam.

For study both rural and urban areas are considered giving equal weightage and the paper tries to investigate

- Using Newman Procedure the levels of students' problem solving abilities from the view points of their linguistic fluency, theoretical understanding and capability of mathematical processing.
- Assessment was made among the group of good achievers, fair achievers and that of poor achievers and the causes of variation were examined by comparing the students' achievement in urban areas with that in rural areas.

The questions are based on

- The phase of problem solving where the students commit errors.
- Comparisons among the good achievers, fair achievers and poor achievers in terms of errors while solving problems.
- Difference between the students in urban areas with those in rural areas in terms of committing mathematical errors.

II. METHOD OF THE STUDY

The Newman Procedure: The Newman Procedure is a method that analyzes errors while solving sentence problems. According to Newman (1977) when a person attempts to answer a standard mathematics question then that person had to be able to pass over a number of consecutive hurdles. They are Reading, Comprehension, Transformation, Process Skills, and Encoding. During the process there is chances of making Careless errors. In Newman's process there are many factors that helps the students to turn up at a correct answer while solving mathematical problem. The method is based on the fact that in the process of problem solving there is two types of hurdles that hinder students from arriving at correct answers. They are:

- Troubles in reading language fluency and abstract understanding that helps reading and understanding meaning of problems.
- Troubles in processing mathematical problems that consists of transformation, process skills, and encoding answers.

It is important to investigate the reasons of students committing mistakes and often continue to repeat the mistake. Mistakes may become deep-rooted, so error analysis is an important step towards doing something significant that will remove the cause of the mistake. Five questions for framework of the study levels are –

- LI. Can the student read the question? (Reading level)

- LII. Can the student recognize the meaning of the question? (Comprehension level)
- LIII. Can the student opt for the suitable mathematical operations or procedures? (Transformation level)
- LIV. Can the student carry out the mathematical calculation perfectly? (Process skills level)
- LV. Can the student represent the answer correctly?(Encoding level)

The Newman Error Analysis Procedure (RCTPE) requests for following five communications with the students.

R: Read the question.
C: What the question asked you to do.
T:What method you are going to use to find the answer.
P: Go through the steps you did and tell about your thinking.
E: Lastly, say the answer to the question.

If student fails to get the correct answer in first attempt but succeeds in second attempt then the error would be classified as CARELESS (coded as x).

- READING ERRORS (R). If the student could not read a key word or symbol that prevented him/her from proceeding further is classified as reading errors.
- COMPREHENSION ERRORS (C). The student read all the words in the question correctly but had not understood the overall meaning and thus unable to proceed further.
- TRANSFORMATION ERRORS (T). The student unable to identify the operation, or series of operations.
- PROCESS SKILLS ERRORS (P). The student was able to identify the appropriate operation, or series of operations, but did not know the necessary measures to carry out these operations perfectly.
- ENCODING ERRORS (E). The student worked out the solution to a problem, but could not express the solution in an acceptable written form.

Professor Clements states (2003, pp. 5-6) careless errors(x) as follows.. " In Newman research a careless error has been defined as one which occurred even though the student knew (from a cognitive perspective) exactly how to gain a correct answer to the question at the time the incorrect answer was given and would be expected to give the correct answer when responding to the same question at some later time. Thus, if a student gave an incorrect response in the original whole-class test situation but then gave a correct answer immediately before the Newman interviews, then the interviewer would suspect that an X (Careless error) classification of the error might be appropriate. Data from the Newman interviews should then enable the interviewer to decide whether the X-classification is really appropriate. If, during the Newman interview for that question, it becomes clear that the student was not sure which of the two answers that he had given - the incorrect one, given when the test was administered to the whole class, or the correct one, given just before the Newman interview took place - was correct, then the original error should not be classified as X (Careless)".

"Newman also allowed for "careless errors" and errors due to a lack of motivation on the part of students (see Newman, 1977, 1983). Newman error analysis research by Marinas and Clements (1990), Singhatat (1991), and Clements and Ellerton (1992), in Southeast Asia reported that about 70% of errors made by students on standard word problems could be attributed to a lack of comprehension or to an inability to select an appropriate sequence of operations (that is, in Newman's terms, to carry out the required "Transformation"). The strength of such data suggests that one of the urgent agendas of mathematics education research is to establish a way of addressing this state of affairs. Above all else, Newman research points to the students' lack of a deep understanding of mathematical vocabulary, semantic structure, and the absence of links between the students' formal language and mathematical skills, and their personal worlds. In other words, the Newman research procedure provides a framework for investigating each of the major themes discussed above (Clements & Ellerton, 1996). Clements (1999) argued that mathematical modeling should be present whenever a learner attempts to solve a real-life problem or a mathematics word problem. In that sense, Newman's transformation often involves mathematical modeling. Often, this process of transformation or mathematical modeling is not evident in mathematics classroom discourses." (Clements, 2004, pp. 2-3).

III. THE STUDY AREAS AND THE RESEARCH INSTRUMENT

The study was conducted in two parts(one urban and other rural area)of Assam. Ten primary schools were considered for study of them five are from urban areas and the other five from rural area giving equal representation to both parts. In each school, ten Grade Four students were selected of them three were good achievers, three fair achievers and the other four were poor achievers. Altogether the data of one hundred students is considered for outcome of the study conducted.

The interview was conducted using ten questions (See Annexure).Care is taken so that to cover questions from major areas in Grade Four curriculum followed in the state of Assam. The data collected was considered for

examine the followings:

- General performance of the students in Assam
- Comparison of good achievers, fair achievers and poor achievers
- Comparison of students in rural and those in urban area in Assam.

Question 1. It is a multiple choice question to find the number of edges of a geometric figure. The Table1 shows that 53 % of the students could not understand the meaning of the question to solve the question. Only 31% of the students got the correct answer as most of the students have no concept about edges.

Question 2. It is also a multiple choice question similar to the last one. The result shows that 45% of the students made a mistake at the transformation level and only31% of students could get the correct answer. Most of the students did not have the idea of a geometrical figure inside a figure.

Question 3. It is also a multiple choice question that requires detail knowledge of counting numbers. Result shows that 47% of the students made mistakes at the transformation level and 41% of the students got the correct answer.

Question 4. It is a direct question but 41% of the students made mistakes at the transformation level as they undergo difficulty in relation between two different quantities.

Question 5. It is a simple question that asks to put appropriate number in the box provided. It is observed that 31% student have problem with use of specific operation.

Question 6. It is a question to find the length of a garden. The result shows that 41% of the students made a mistake at the transformation level and only 26% of students could get the correct answer. Most of the students did not know the Formula of the perimeter of a square. Some students could read and understand the meaning of the question that it required but not in a position to solve the problem as formula is not known to them.

Question 7.It is a structured question that asks to find the number of people in the train at station B. The result reveals that 59% of the students made errors at either the comprehension level or at transformation level

Question 8. It is a structured question that asks to find the total amount of fee received in a month. The result reveals that 36% of the students made errors at the transformation level. It is because they could not understand the proper operation required to get the result

Questions 9& 10 are structured question that requires knowledge of fractions.. The result reveals that around 25% of the students made errors at the comprehension level while around one third of the students could get the correct answer. In this question, the structure of the sentence was simple and the only calculation necessary was addition. Some students who gave wrong answers did not seem to understand addition of fractions.

Table 1 exhibits students errors occurred at different levels in each question. Symbols used: Number of students having (reading errors—NR, comprehension errors--- NC, transformation errors----NT, process skills errors--- NP, encoding errors---NE, correct answers---NC)

TABLE 1

Q. No.	R		C		T		P		E		C	
	NR	Percentage	NC	Percentage	NT	Percentage	NP	Percentage	NR	Percentage	NC	Percentage
1	6	6.00	10	10.00	53	53.00	0	0.00	0	0.00	31	31.00
2	4	4.00	17	17.00	45	45.00	3	3.00	0	0.00	31	31.00
3	6	6.00	6	6.00	47	47.00	0	0.00	0	0.00	41	41.00
4	7	7.00	10	10.00	41	41.00	0	0.00	0	0.00	42	42.00
5	9	9.00	7	7.00	31	31.00	10	10.00	2	2.00	41	41.00
6	4	4.00	23	23.00	41	41.00	6	6.00	0	0.00	26	26.00
7	6	6.00	33	33.00	26	26.00	5	5.00	1	1.00	29	29.00
8	5	5.00	29	29.00	36	36.00	6	6.00	1	1.00	23	23.00
9	5	5.00	23	23.00	26	26.00	6	6.00	2	2.00	38	38.00
10	5	5.00	29	29.00	25	25.00	7	7.00	3	3.00	31	31.00

IV. COMPARISON OF VARIOUS CATEGORIES OF ACHIEVERS

TABLE 2. LEVEL OF EERRORS IN PERCENTAGE. (GA--- GOOD ACHIEVER, FA---- FAIR ACHIEVER, PA---- POOR ACHIEVER)

Q. No.	R			C			T			P			E			C		
	GA	FA	PA	GA	FA	PA	GA	FA	PA	GA	FA	PA	GA	FA	PA	GA	FA	PA
1	0	0	6	0	0	10	15	18	20	0	0	0	0	0	0	15	12	4
2	0	0	4	2	3	12	14	15	16	0	1	2	0	0	0	14	11	6
3	0	0	6	0	0	6	13	16	18	0	0	0	0	0	0	17	14	10
4	0	0	7	0	2	8	9	15	17	0	0	0	0	0	0	21	13	8
5	0	0	9	0	0	7	8	12	11	2	3	5	0	0	2	20	15	6
6	0	0	4	7	6	10	10	13	18	1	2	3	0	0	0	12	9	5
7	0	0	6	5	8	20	9	10	7	0	2	3	0	0	1	16	10	3
8	0	0	5	6	8	15	10	10	16	1	3	2	0	1	0	13	8	2
9	0	0	5	3	5	15	9	8	9	0	3	3	0	0	2	18	14	6
10	0	0	5	6	7	16	5	9	11	1	2	4	0	1	2	18	11	2

TABLE 3. LEVEL OF ERRORS PER LOCATION (IN NUMBERS) RA---RULAR AREA UA--- URBAN AREA

Q. No	R		C		T		P		E		C	
	RA	UA	RA	UA	RA	UA	RA	UA	RA	UA	RA	UA
1	5	3	9	7	30	21	0	0	0	0	6	19
2	4	2	12	10	25	15	3	1	0	0	6	22
3	6	2	4	2	30	21	0	0	0	0	10	25
4	5	2	9	6	30	22	0	0	0	0	6	20
5	6	3	4	3	20	15	6	5	2	0	12	24
6	4	3	10	8	24	19	6	2	0	0	6	18
7	5	3	20	17	10	4	4	2	1	0	10	24
8	5	2	10	8	22	25	4	3	1	1	8	11
9	3	3	18	11	7	4	6	4	2	0	14	28
10	5	4	11	10	13	8	7	4	2	1	12	23

TABLE 4. PERCENTAGE LEVEL OF ERRORS PER LOCATION RA---RULAR AREA UA--- URBAN AREA

Q. No.	R		C		T		P		E		C	
	RA	UA	RA	UA	RA	UA	RA	UA	RA	UA	RA	UA
1	10	6	18	14	60	42	0	0	0	0	12	38
2	8	4	24	20	50	30	6	2	0	0	12	44
3	12	4	8	4	60	42	0	0	0	0	20	50
4	10	4	18	12	60	44	0	0	0	0	12	40
5	12	6	8	6	40	30	12	10	4	0	24	48
6	8	6	20	16	48	38	12	4	0	0	12	36
7	10	6	40	34	20	8	8	4	2	0	20	48
8	10	4	20	16	44	50	8	6	2	2	16	22
9	6	6	36	22	14	8	12	8	4	0	28	56
10	10	8	22	20	26	16	14	8	4	2	24	46

Table 2 shows that many errors occurred at the level of transformation by all categories of students in Newman Procedure. Majority of poor achievers failed to clear the comprehension level and the transformation level (CT). The result shows that at every level the student of urban area performed better than those in rural area. It is observed that in most of the questions RCT of urban area is less than RCT of rural area. The RCT factor made huge difference in getting correct answer in the two areas. In most of the structured questions the number of students giving correct answer in urban area is almost double of the number of students giving correct answer in rural area. Good achiever did equally better in both areas. The gap widens in case of poor achievers.

Thus it is observed that patterns of problem solving levels are almost similar in both areas in case of good achiever except the transformation level where differences are seen.

V. CONCLUSION

It is observed through the analysis of the mathematics achievers of grade four students in Assam that students need to go through different levels to obtain correct answers in the mathematical problems.

In multiple choice questions errors were mostly made at the transformation level but in structured questions mistakes were made at the stage of the comprehension level. So improvement in language is essential for mathematics learning. There was not much difference between good and fair achievers. But differences between good and poor achievers are distinct. Good achievers have stronger comprehension ability than poor achievers mainly because of better reading ability. The study establishes that there is remarkable difference between rural and urban areas. The difference in achievement level questioning structured question seemed to be due to better linguistic

ability of the urban students. The study showed poor achievers had linguistic and conceptual comprehension problem. This situation can be improved if language teachers and mathematics teacher's work together to improve language ability as well as mathematical concept to make certain that each student understands it.

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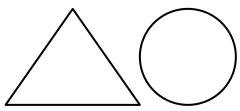
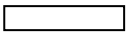
ANNEXURE

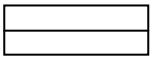
1. Look at the following pictures of a triangle and a circle. Triangle has three edges. How many edges are there in circle.



(a) 0 (b) 1 (c) Many

2. The shape of a rectangle is 

How many rectangles are there inside the following rectangle?



(a) 0 (b) 1 (c) 2

3. How many hundred makes ten thousand?
(a) 10 (b) 100 (c) 1000

4. Which is more,5 kilogram apple or 4000 gram apple.

5. Fill up appropriate number in the box.

35 +  = 80

6. The perimeter of a square garden is 160 meters. What is the length of the garden?

7. There were 1500 people in a train. 325 people got down at station A and 475 people got down at station B. How many people are left in the train?

8. There are 375 pupils in a pupils in a primary school. Each pupil pay Rs. 150 per month as fee. What is the total amount of fee received per month?

9. A school library has 120 books in English ,60 books in Mathematics and 180 books in Science. How many books are there in library. Is it true that number of books in Mathematics is 1/3 of the number of books in Science?

10. Raj bought a Mathematics book for Rs.25½ and a Science. Book for Rs.20¾. How much money did he spent?