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An Analytical Assessment of Mathematical Learning of Students of North-East Delhi

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***ABSTRACT**--Students, bypassing over different grades, show a fall in the mathematical achievement level. In the following paper, we tried to analyse the learning level of the students of the North-East district of Delhi. NCERT developed Learning Outcomes for each grade from I to VIII classes regarding these learning outcomes. We found that the learning of mathematics is not at all satisfactory in the schools. Students show the inferior quality of mathematical understanding; we tried to find out the poorly developed concepts and the reasons behind this. We also tried to find out the highest developed concept of mathematics in students and the ideas for it. Lack of pedagogical understanding in teachers, no use of concrete material, non-revisiting of the previous concepts are some of the reasons behind low performance of the students, on the other hand, visual ideas of mathematics, and thoughts that develop automatically with no or little help of school developed better in the minds of kids. We find that a majority of teachers say that they have full understating of curricular expectations and know the entire pedagogy, but the result which was obtained about students' learning level speaks different picture. The majority of kids say that it is challenging for them to understand teachers' talk in the classroom, but almost all the students like to come to school whatsoever is the reason.*

***Keywords**--Mathematical understanding, NAS, Achievement level, Pedagogy.*

I. INTRODUCTION

Mathematics is directly linked to human thoughts and logic, and integral to all the attempts to understand the world and ourselves. Mathematics is responsible for encouraging logical reasoning, mental rigour and most above all; it provides a valid path of building mental discipline. Mathematical understanding also contributes to the development of concepts of various subjects such as Science, EVS, Arts and Music.

Elementary mathematics curriculum in India has the main aim of developing several mathematical skills and various mathematical processes. The Curriculum is constructed in such a way that it ensures that kids build a strong foundation in mathematics, and this should be through connecting and applying concepts in different situations.

1.2 Vision for School Mathematics

- Students should love mathematics; enjoy it rather than hate it.
- Students should learn essential mathematics; not just formulas and complex procedures.
- Students should see Math as a point of discussion; work on it collectively rather than fear it for its mechanical processes.
- Children should create significant problems and try to solve it.

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• Students should use algebra and perceive different relationships in various daily life context; they should use abstract thinking to look for patterns/structures; pose questions based on reasoning; argue for truth based on evidence; check the validity of something logically.

• Arithmetic, Algebra, Geometry and Trigonometry, these are the four basic block of math, our students should understand it. These offer a lot for generalisation and algebraization.

*1.3 What is the Learning Outcome***?**

The learning outcome was first mentioned in the Right to Education Act 2009. Although these were defined poorly or the definition of learning outcomes was inadequate, so to make it clear, NCERT developed a document called Learning Outcomes. In this document, the input is taken from multiple sources/stakeholders at different levels. This document was designed to fulfill the promise of quality education, which was made in the Right of Children to Free and Compulsory Education Act 2009.

Learning Outcomes document is highly helpful for teachers. In addition to teachers educationists, educators, parents; independent data collecting organisations can take benefit from this document. This document was made for improving the quality of teaching and also for enhancing the quality of learning. It can be done by empowering educators/teachers in deciding the learning skills and learning tasks. LOs also help teachers in taking remedial actions in case of misunderstanding of the subject matter by the students. LOs can also help teachers to improve learning for all kids, including children with special needs.

"NCERT has developed expected learning outcomes class-wise (from classes I to VIII) for main subjects. These are EVS, Science, Mathematics, Social Sciences, Hindi, English and Urdu. These are to help different stakeholders viz. teachers, parents, other persons interested in knowing about learning and learning level of kids. This document helps them to improve the quality of teaching and also for improving the quality of education. It can help the school organisation, district-level organisations, state-level organisations, national and even international agencies to conduct different surveys and also to assess the condition of the system to improve the future course of action. Learning outcomes can be contextualised as per the local conditions and requirements.

-- Learning outcomes document, NCERT

1.4 Expected Learning Outcomes at Primary Level;

Learning mathematics in the early years include knowing about the number and appropriately using it, learning and understanding the value of numbers in different situations, using symbols and comparing and making arrangement of objects. These things lay a strong base for the development of mathematical concepts which students will use in senior grades of schooling and also in life.

In a document of learning outcomes, we have a list of expected LOs for each class; these are as follow;

- Students should be able to develop a link between real-life context and mathematics.
- Students should recognise and understand different shapes. Students should distinguish among shapes based on visual properties by taking similarities and differences into consideration.
- Students should develop and use their methods to solve problems in daily life, relating to addition, subtraction, multiplication and division.

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- Students should develop mathematical vocabulary; mathematical symbols; mathematical algorithms for doing operations on the number.
- Students should be able to estimate the outcome of operations and use them in daily life activities.
- Students should be able to represent the part of the whole, i.e. fraction.
- Students should be able to collect data, analyse it, and finally make interpretations from this (taking context in consideration) in daily life.
- Students should observe patterns in numbers and shapes, understand it and extend it.

II. PERFORMANCE OF CHILDREN- GAPS IN LEARNING AND POSSIBLE REASONS BEHIND IT

NCERT conducts NAS, i.e. National Achievement Survey on different occasions. A version of this achievement survey for classes III, V and VIII was held on November 13, 2017. This survey was conducted in various government and government-aided schools. In this survey, different booklets were used to collect data. In the booklet for call III and V, there were 45 questions, and for class VIII, there were 60 questions. Questions were asked from different disciplines such as Language, Mathematics, Science, and Social Science. In the booklet, all items were competency-based, and each item reflected a competency, as per the LOs document. In addition to this, questions were also asked from students, teachers, schools through separate questionnaire for each. In this nationwide survey, the students of the North-East district of Delhi were also included, and we are specifically focusing upon them.

On average, the correct responses in mathematics in the North East district of Delhi are shown in the following table.

Table 1: On average, the correct responses

Class	**Average correct response**
III	51.52%
V	46.14%
VIII	27.08%

From the above table, we can say that the learning of mathematics is not satisfactory at all, the figures are not only lower than from national average, but they are also lower from an average of whole Delhi.
"We are witnessing a fall in the achievement level of the students."

Table 2: Range of Performance of Students who Answered Correctly

Range	**III**	**V**	**VIII**
Below 30%	22.02	24.44	60.73
30-50%	28.81	34.61	33.64
50-75%	29	31.11	5.36
Above 75%	20.17	9.84	0.27

Total	**100.00**	**100.00**	**100.00**

*Figures are in percentage.

Clearly, in class III we have 22.02% students in below 30% category, 28.81% students in 30-50% category, 29% students in 50-75% category and 20.17% students in above 75% category, this implies that the distribution is almost equal, we have the same number of children in different ranges.

Now we proceed to class V we have 24.44% of students in the first category, 34.61% of students in the second category, 31.11% students in the third category, and 9.84% in the last group. In second and third category we have seen an equal number of students, but in the above 75% category, we have witnessed a sharp fall from 20.17% in class III to 9.84% in class V.

In class VIII, the majority of the students,60.73%, lies in below 30% category, indicating an alarm for all, the majority of our kids have now been shifted from average to below average, and only 0.27% of our kids in this class belong to above 75% category.

We are losing our cream as students pass over different grades. It can be explained as "students, bypassing over different grades shows fall in the mathematical achievement level."

The following example can help understand the possible reason for this. A child belonging to the 50-75% range, knows only 62% of his grade level. Hence, there is a deficit of 38% knowledge, when he will pass this grade and continue to learn mathematics in the next class, he will learn things with this knowledge deficit, making the future learning more complicated, and this results in a loss in the full understanding of the next grade level content, this will lower his achievement level, and this cycle will continue. Finally, the majority of the students will be seen in the lower 30% category.

III. WHAT CAN BE DONE?

The cycle must be broken, the teachers must work on the ideology of "No child left behind", every child should be exposed to the full content, and this exposure should be as per his individual needs, the teachers at later grade must ensure that the basic concepts have developed before developing difficult concept over them, no concept is un-important.

In the following discussion (next two points), each learning outcome starts with a unique number, in this number the M stands for mathematics, the following numbers describe the learning outcome for each class, as defined by National Council of Educational Research and Training, Delhi in its District Report Cards issued based on NAS 2017 achievement. The number in brackets, after each learning outcome, shows the average performance of students.

3.1 Discussion on highest-performing areas:

1. **M317: Reads the time correctly to the hour using a clock/watch (70).**

Students have performed well in the reading of time, perhaps it is because of its necessity in daily life, and students learn reading the time at home. Another thing is that all the teachers in the locality know the reading of time and clock, and this has been transferred from them to their students.

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2. M309: Identifies and makes 2D-shapes by paper folding, paper cutting on the dot grid, using straight lines etc. (69).

Students performed well in the area of paper folding and cutting; it is because children do not consider it a part of mathematics and hence all their fear goes away, they learn it quickly and without any pressure of learning mathematics. Moreover, students learn art and craft with enthusiasm, and that is the reason behind the highest scores in this area.

3. M319: Records **data using tally marks, represents pictorially and concludes (66).**

Data recording is considered as one of the basic concepts that students learn automatically. A little effort of school is required to learn these basic concepts, and that is why children have shown a high level of performance in this area.

On the whole, we can conclude, from the above data, that areas where visual concepts are involved, students have performed well. The concepts that are linked with the daily life of the students are learned automatically by the students, and last but not least, is that the concepts which have been developed conceptually and pedagogically in the minds of teachers, students show a high level of performance in that. Thus, teachers' efficiency is positively correlated with the performance level of the students.

3.2 Discussion on the lowest-performing areas;

1. M514: Applies **the four fundamental arithmetic operations in solving problems involving money, length, mass, capacity and time intervals.**

The lower understanding of the basic operation and lower understating of the number sense by the students, in lower grades, will hinder the development of these concepts, and hence those students who have shown weaker understanding or students who were from "below 50% achievement range" performed severely inadequate in these questions.

2. M401: Applies **operations of numbers in daily life situations.**

This learning outcome is for class 4, but in the survey, it was found that Class 5 students find it challenging to apply basic mathematics operation with everyday life; this indicates the lack of understanding of the concept even of previous grades. The reasons behind it can be a poor quality of teaching and exposure of the content to the students.

3. M311: Fills a given region leaving no gaps using a tile of a given shape.

Tessellation is one of the difficult concepts in class 3, as it requires a considerable amount of working memory. This concept requires much practice with concrete objects, and a shortage of it causes difficulty not only in the understanding of this concept but also a misunderstanding of concepts related to areas and perimeter.

4. M706: Uses an exponential form of numbers to simplify problems involving multiplication and division of **large numbers (19).**

Some students of Class 8 students were not able to solve the problem relating to class 7 learning outcome; this shows an alert for all of us. In class 8, the exponential way is one of the most challenging concepts. It is abstract and requires the right amount of knowledge and concept clarity of various mathematical concepts. Low understating of any pre-required concept will lead to misunderstanding of the concept, in class 8 we have a bulk of students with half or even lesser understanding of fraction, squares, cubes, operation on fraction, and hence

students have shown lower performance in this area. Teachers made no or little efforts for the teaching of these basic concepts to children before teaching them exponential form.

5. M710: Solves problems related to the conversion of the percentage to fraction and decimal and vice versa (21**).**

Low understating of fraction and operation on fraction has resulted in this lower performance.

6. M818: Finds **surface area and volume of cubical and cylindrical object & M513 Estimates the volume of a solid body in known units.**

This concept requires more concrete material, at least in the initial phase, and lack of these materials along with the stern lectures of mathematics teachers made it impossible for kids to learn this.

On the whole, we think that the learning of difficult concept at later grade is impossible for the students who learnt up to 50% of the previous class, and none revisiting of the last concept before introducing new one is the reason of this failure. The most important thing to note here is that our kids show a lower level of performance in the lower grade level outcomes.

IV. CHILDREN'S VOICES-WE DO NOT UNDERSTAND TEACHERS' TALKS

"77% of children in Class 3, 81% in Class 5 and 78% of children in Class 8 could understand what the teachers say in the classroom." A significant share of the students reported that they do not understand teachers' talk in the classroom while transacting the Curriculum. This figure is not negligible at all; our kids do not understand the teacher; this indicates a mass failure of the entire system. The teachers must be made sympathetic and empathetic toward the different needs of our kids. Teachers need to make deliberate efforts to tackle this situation.

"94% of children in Class 3 and 95% children in Class 5 and Class 8 like to come to school". Even though they do not understand teachers' talk, they like to come to school. The reasons behind it seem to be Mid-Day-Meal distribution and the other benefits provided to them.

"22% of students in Class 3, 20% in Class 5 and 24% in Class 8 find it difficult to travel to school." We have achieved the target of reaching the child at 1km from habitant, but students still find travelling to school difficult. The lack of proper planning and strict observation has to lead us to this situation.

"For 79% of students in Class 3 and Class 5 and 70% of students in Class 8, the language used at home and by the teachers is the same." Majority of the teachers serving in Delhi are from Delhi, and these teachers use the same language as these children use, the teachers that have been selected from outside of Delhi (being a Union Territory, recruitment in Delhi is open to all Indians), use slightly different language and hence the expression becomes the distance between children and teachers.

V. TEACHER'S RESPONSE

"65% of teachers in Class 3, 67% in Class 5 and 82% in Class 8 are teaching the same subjects they have pursued during their higher studies.", "53% of teachers in the state fully understand the curricular goals." & "93% Teachers in the state have adequate instructional material and supplies."

These figures are contradicting to the achievement level of students on the one hand majority of children show a lack in the achievement of grade-appropriate learning levels, on the other hand, teachers say they fully understand the curricular goals.

VI. CONCLUSION

In this research paper, we talked about learning outcomes developed by NCERT and analysed the NAS 2017 data with particular reference to the North-East district of Delhi. It was found that the learning level is shallow, and it is showing a falling trend as students pass over different grades. The highest performing areas were also found out, and reasons behind these were analysed; similarly, lowest-performing areas and the possible reasons behind this lower performance were also discussed.

Students and teachers' voices were recorded to analyse the situation critically, it was found that all students love to come to school for many different reasons, children do not understand teachers' talk in the classroom, and teachers speak a slightly different language from children.

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