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Impact of Knowledge of Symbols on Mathematics Learning Among the Secondary School Students of Morigaon District (Assam, India)

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Abstract

Mathematics is a subject with signs and symbols. Different symbols are used to express different expressions in a short and easy form. So importance of symbols in learning of mathematics cannot be neglected. But due to difficulties in symbols recognition or lack of understanding of symbols affect mathematics learning. Through this paper it is tried to find out the fact how knowledge of symbols affects mathematics learning. For this purpose a study has been made on secondary level students in Morigaon district of Assam, India. In the study it has been observed that lack in knowledge of symbols affects the learning of the subject badly and proper care in symbol teaching can improve mathematics performance to some extent.

Keywords: mathematical symbols, mathematical language, mathematics learning

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Introduction

During the construction of a building, the foundation is the primary concern. If the foundation is not laid properly the building may collapse. Same is the case in education and life. Good habits inculcated at a young stage remain forever. This is also true for learning of mathematics. Since mathematics is a subject full of signs and symbols, so proper learning of mathematics needs appropriate knowledge of signs and symbols along with other basic concepts. So teaching–learning process of mathematics is not similar to other subjects. From the primary stage onwards children need to use the basic mathematical signs. Gradually, use of symbols increases in mathematics learning. If the students face difficulty in the use of appropriate mathematical symbols in appropriate places they cannot exhibit good performance in mathematics. Therefore special attention in the use of appropriate symbols is required for the learners. In this paper an attempt has been made to study how the students use mathematical symbols. For this purpose, the secondary level students are selected from Morigaon District of Assam, India.

Background of the Study Area

Morigaon is one of the backward districts of Assam. There are two small towns in the district –one is Morigaon and the other is Jagiroad. Morigaon Town (district headquarter) is situated at a distance of around 78 km from the state capital Dispur while Jagiroad is situated at a distance of around 53km from the state capital.

In rainy season large portions of the district submerge under flood. During floods, bullock carts are the only means of transportation to some remote areas. Most of the roads are damaged by water every year during rainy season. Means of communication to most of the interior places are small vehicles. In river islet the only means of communication is boat. Many students as well as teachers in these areas come to the school by boat every day. Sometimes accidents also occur on their way. Agricultural fields go down under the water. In some schools, 50% of total students come to school by boat throughout the year. Because other means of communication are not available in these areas. In some areas, school authority provides fare-free boat service for the students through negotiation with the local people. Electricity facility is not available in these areas. So in the schools of these areas, provision for electric fan, light are meaningless. In other words it can be said that the environment of each school situated in remote areas is not satisfactory. However in town areas the scenario is a better one.

Population of the District, their Economy, Education, Belief Etc

The district is considered as a tribal dominant district. However the river bank of mighty Brahmaputra (Lahorighat area- extreme north of the district) is a place for immigrant *Muslims* and *Hindu Bengalis* with little facility of education and healthcare. In greater Mayong area of Morigaon district, the population consists of Scheduled Tribe, Scheduled Caste and general castes. Population towards the extreme eastern part (Dolonghat block) consists of *Assamese Muslim* and *Tiwa* people (under Scheduled Tribe) and towards south-east (in Barapujia area of the district) population consists of *Ahom, Koch, Chutia, Tiwa, Karbi* and other general castes of. In Junbil area (south west part of the district), most of the people are also from *Tiwa* tribe. In the nearby areas of Jagiroad (extreme south west part; attached to Junbil area) a variety in population is observed. In these areas, *Bengali Hindu, Nepali, Tiwa* and *Karbi* along with other *Assamese* people are living cordially for many years. Most of the tribal people of the area have a mixed settlement along with the non-tribal indigenous groups. The scheduled caste people generally settle near the lakes and rivers where there are facilities for fishing.

The literacy rate of the district is 69.37%. The literacy rates for male and female are 73.66% and 64.99% respectively (according to census of India 2011).

Review of literature

Susanne Prediger studied about the meaning of equal sign for development of mathematics teaching and understanding. The author also studied about the difficulties of multiplication of fractions. The author emphasizes on proper teacher courses for mathematics teacher. According to the author teacher courses cannot be held by general educators alone as this need a mathematical focus. Mathematics teacher must understand the students' mind to teach mathematics for fruitful learning. The author advises the teachers to listen to the students.

J. Baroody and P. Ginsburg studied about the effects of instruction on children's understanding of equal sign. They observed that in initial stages children seem to view the equal sign as operator rather relational symbol. But after proper training they take relational view that both sides of the sign have same value.

L. Lisa Lamb and co authors studied about the minus sign. According to the authors minus sign is a multi-functional mathematical symbol. But most of the learners do not have clear conception, as result they cannot use the sign appropriately.

K. P. Falkner and co authors discussed about equal sign as foundation knowledge for algebra learning in their paper.

R. S. Moyer and T. K. Landauer studied about numerical inequality. They explained that between two numerals there exist one inequality sign with some sort of digital computation which a child cannot understand.

Objectives of the Study

Main objectives of this paper are ─
1) to investigate about the knowledge of symbols of the students,
2) to study about the impact of knowledge of symbols on their performance in the subject.

Hypothesis

The following hypothesis was used in the study -

There is a positive correlation between the knowledge of symbol and performance in the subject.

Methodology and Sampling

For the study, a mathematical test is taken among the students. Both government and private schools are selected from different locations. All the students present in a class (10th standard) of the selected schools are taken for the study and for the study, a question paper is prepared with some symbols and simple mathematical problems related to symbols.

For the collection of data, 300 students (10th standard) of 14 schools situated in different locations (both urban and rural) of the district are selected.

For analyzing data statistical method is applied.

Analysis of the Topic

On analyzing the data it was found that students lack in basic knowledge of symbols or signs. In the question paper there were fifteen mathematical symbols and five geometrical shapes. These symbols and shapes were considered due to the difficulties arising in problem solving by the students; which were found by discussing with some of the teachers working in the schools and the discussion was done prior to taking the test. Students are provided five basic level geometrical shapes to match with their names. Most of the students could recognize the shapes of triangle and circle. Out of the total students only three could not recognize the shape of the triangle and only one could not recognize the circle.

In the case of symbols, one most basic level sign was included and that was the equal sign ' = ' (equal sign). Students were asked to explain the meaning of the signs by giving examples. Approximately seventy five percent (75.7 %) of total students could explain the meaning of the equal sign with an example; which was the correct answer most students could give. Another important point was observed that most of the students who were capable of answering the questions relating to the signs involved ' < ' and ' > ' in the

problems, were unable to distinguish the 'less than sign' and 'greater than sign'. So when they are asked to write '5 is greater than 3', around fifty-five percent (55%) of them wrote 5 > 3 and the rest wrote 3 < 5. When the reason was asked they answered that the larger number will stand on the open side of the sign. Most of the students do not have the basic idea of symbols of set. They do not know subset superset, union, intersection of sets. Only a few students could answer about the use of the symbols of set theory correctly. Some simple problems were provided to solve (using the concepts of different symbols such as <, >, ⊂ etc.). But due to lack of knowledge of these symbols most of them failed to solve. When the students were asked whether their teacher taught about the use of different symbols, the answer was negative. After discussion of some mathematical problems it was observed that students require special attention and care in the subject as most of them were not taught properly due to many factors. In this case one point that is to be kept in mind is, not only the lack in symbol knowledge but lack in basic mathematical knowledge is responsible for incorrect answers.
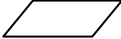
The teachers were also asked whether they taught their students, about the use of different symbols (including symbols used in lower classes) in their classroom practice. All of them admitted that they did not clarify the symbol knowledge but in the process of teaching they taught about the symbols related to the topic of discussion. After this discussion with the teachers most of them felt the importance of teaching the 'use of different symbols'.

In **Table-1,** students' responses were shown according to symbol notations and in **Table-2**, some simple problems of mathematics are presented which were offered to the students, at the time of test.

Table 1.

Sl. Nos.	Symbols	Total students	No. of students with correct answer	No. of students with wrong answer /no response	% of students with correct answer
1.	=	300	227	73	75.7
2.	<=>	300	52	248	17.3
3.	<	300	131	169	43.7
4.	>	300	98	202	32.7
5.	≤	300	33	267	11.0
6.	≥	300	27	273	9.0
7.	≠	300	108	192	36.0
8.	⊂	300	22	278	7.3
9.	⊆	300	11	289	3.7
10.	⊃	300	7	293	2.3
11.	⊇	300	4	296	1.3
12.	⊥	300	93	207	31.0
13.	~	300	19	281	6.3
14.	≅	300	24	276	8.0
15.	%	300	204	96	68

Table 2.

Sl. no.	Problem type	Total marks = 22
1.	If X>Y and Z is a real number. If XZ >YZ , then find whether Z will be a positive number or a negative number.	2
2.	If A={a, b, c, d, e, f}; B={a, c, e, f}; C={b, d, e, g} then (i) which one is true (a) B$\subset$A; (b) B$\subseteq$A (ii) whether it is true or not C $\subset$A (iii)find A∩B, (iv) AUC	1+1+2+1=5
3.	5 % of 50 = ?	1
4.	Write true or false and give reason on your answer $.2 = 20$ %	1
5.	Write true or false $\phi = \{ \phi \}$, where ϕ denotes the Null set, and give reason on your answer.	2
6.	Match the followings a)Triangle a) b)Square b) c)Parallelogram c) d)Rhombus d) e)circle e)	5
7.	If $x \neq y$ then express the relations between x and y.	1+1
8.	In a triangle ABC, if AB=BC and AB $\perp$ BC, then $\angle$ABC=? $\angle$BAC=? $\angle$ACB=?	4

For calculating coefficient of correlation, the following data are taken (these calculations are done with the help of statistical software and coefficient of correlation is found with formula given below)

Here, N = 300 (sample size)

$\sum$ X= 2846 (sum of the total marks in symbol recognition)

$\sum$ Y= 1971 (sum of the total marks in symbol related problems

$\sum X^2 = 30702.00$ (sum of the squares of the marks in symbol recognition)

$\sum Y^2 = 18539.00$ (sum of the squares of the total marks in symbol related problems)

$\sum$ XY =22102.00 (sum of the products of marks in symbol recognition and that in symbol related problems)

$$\overline{X} = \frac{\sum X}{N} = 9.49 \qquad \overline{Y} = \frac{\sum Y}{N} = 6.57$$

Sample size N	$\sum X$	$\sum Y$	$\sum X^2$	$\sum Y^2$	$\sum XY$	$[(\sum X)/N]$	$[(\sum Y)/N]^2$
300	2846	1971	30702	18539	22102	9.49	6.57

The Correlation coefficient r is calculated by the following formula

$$r = \frac{\frac{1}{N}(\sum XY) - \overline{X}\,\overline{Y}}{\sqrt{(\frac{1}{N}\sum X^2 - \overline{X}^2)(\frac{1}{N}\sum Y^2 - \overline{Y}^2)}}$$

$$= \frac{\frac{1}{300}(22102) - (9.49 \times 6.57)}{\sqrt{\{\frac{30702.00}{300} - (9.49)^2\}\{\frac{18593.00}{300} - (6.57)^2\}}}$$

=0.743

Calculated value of Correlation coefficient is 0.743 which is near to 1. So it is found that there is a positive correlation between the marks in symbol recognition and that in symbol related problems. Thus it may be concluded that lack in symbol recognition affects the performance in the subject.

From the **Table-1** it is observed that only few students know the inequality symbols specially 'less than or equal' and 'greater than or equal'. Similarly only few of them know the symbols of similarity or congruence or proper and improper subset or proper and improper superset.

Symbols namely $=, <, >, \neq, \perp, \pi$ are known to many students. Rests of the symbols are unknown to the students.

In the following table, problems are presented which were supplied to the students at the test.

Thus it can be concluded that majority of the students do not have basic knowledge in use of symbols. So they can not apply these symbols in proper places and also they are unable to understand the concept behind the topic. This makes a great disadvantage to the students in learning the subject and to the teachers to teach the same.

Another important point is that the teachers are not aware of the importance of symbol knowledge in mathematics learning. In some cases it was also observed that the teacher has not much knowledge about different symbols nor they are interested to learn about symbols.

Suggestions

1)From the very beginning teacher should be very careful in teaching the mathematical symbols and their use as the subject is full of symbols and signs.

2)Examples should be provided to teach the use of mathematical symbols.

3)Stress should be given in proper use of mathematical symbols, otherwise this will create problem not only in future scientific study but in other subjects.

4)In this paper, discussion is made on only a few mathematical symbols but at present day context different types of symbols are used in various field. So necessary care should be taken in teaching different symbols.
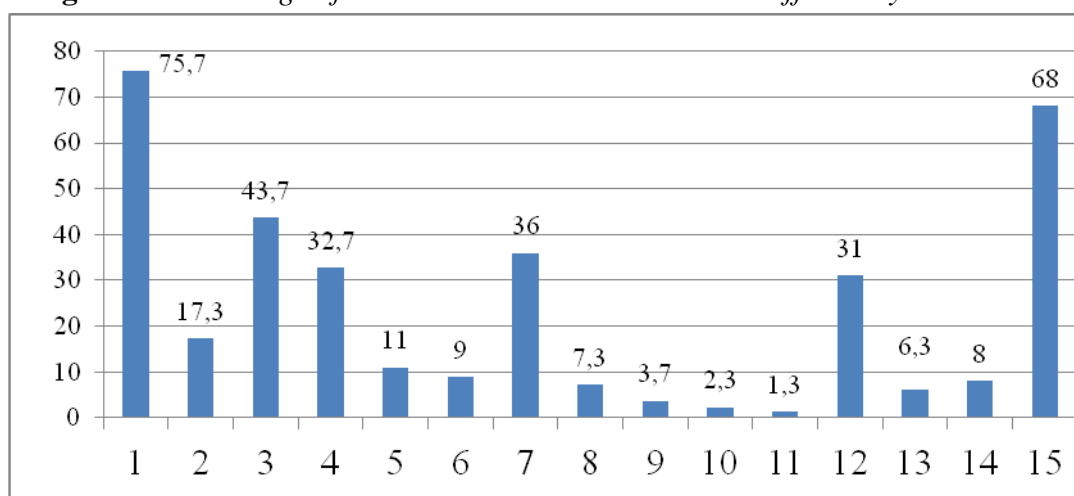
5)Mathematics should not be treated as other science subjects such as physics, chemistry or subjects like economics, as it gives the language to the subjects to express the facts and figures with the help of its symbols and signs.

6)In every training programme for mathematics teachers, some discussion must be made on mathematical symbol and its use.

7)Meaning and use of symbols must be properly explained in the respective books.

8)In teaching mathematics audio visual tools must be used. Computer technology may be use to teach mathematics specially in symbols representation.

Figure 1. *Percentage of students with correct answer in different symbols*

Conclusion

In the conclusion it can be said that for proper mathematics learning, proper learning of the meaning and use of symbol is very much important. Otherwise students will be at disadvantage in the process of classroom learning.

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