INSUFFICIENT KNOWLEDGE OF MATHEMATICAL SYMBOLS AMONGST TRAINEE TEACHERS: STRATEGIES FOR CORRECTING THEM

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Abstract

Mathematical learning requires learners to interpret the mathematical text, convert the text to an appropriate symbolic representation and then perform mathematical operations with these symbols. This can only be achieved when trainee teachers have acquired sufficient, appropriate and effective communication skills and numbers. A symbol is a mark or character used as a conventional representation of an object, function or process. It is a thing that represents or stands for something else, especially a material object representing something abstract. Symbols in mathematics enhance understanding of mathematics concepts and give a universally acceptable way to represent mathematical ideas or illustrate mathematical concepts. This paper discusses the concept of symbols, usefulness of symbols in mathematics, difficulties encountered by trainee teachers relative to mathematical symbols and strategies for correcting them.

Keywords: Mathematics, Symbols, Trainee Teachers.

Introduction

Mathematics is a complex and compact symbol system and unless meanings are attached to those symbols, mathematics becomes literally meaningless to children (National Council of Teachers of Mathematics (NCTM) 2002). In the process of teaching and learning, effective communication is fundamental for achievement of set goals. Effective communication cannot be possible without good understanding and appropriate use of relevant language. According to Halliday (1975), mathematics language is a distinct register within a natural language (for example English language) which is described as “a set of meanings” that is appropriate to a particular function of language, together with the words and structures which express these meanings. He further noted that once the register is mastered, learners will have the ability to listen, question and discuss together with the ability to read and record. The language of mathematics comprises of terminology and symbols with unique features. Symbols are the components of the mathematics language that make it possible for a person to communicate and reflect upon abstract mathematical concepts (Rubenstein and Thompson, 2001). Using symbols fluently and correctly is a necessary condition for an overall mathematics achievement. To fluently and correctly use symbols, one must be able to know the name of the symbol and its meanings. Earle in Oguguo, (2020b) argued that the problem of students difficulty to grasp (understand) mathematical symbols lies on how symbols are used and perceived by the students. Many difficulties in mathematics can be attributed to students’ problem with manipulating and understanding algebraic symbols (Briscoll, 1999; Gray and Tall, 1994). The goal of teaching cannot be achieved without sufficient, appropriate and effective communication skills (Oguguo, 2020a). Effective communication requires language sufficiency and appropriateness. This paper discusses the concept of symbols, usefulness of symbols in mathematics, difficulties encountered by trainee teachers relative to mathematical symbols and the strategies for correcting them.

Concept of Symbols

A symbol is a mark or character used as a conventional representation of an object, function or process. It is a thing that represents or stands for something else, especially a material object representing something abstract. Wikipedia 2020 defined a symbol as a mark, sign or word that indicates, signifies or is understood as representing an idea, object or relationship. A symbol is an ordinary object, event, person, animal or color to which we have attached a special meaning and significance (Alam, 2020). Symbols are images of real object or imagination that evokes feelings or is aroused by feelings (Masbid in Nurlita, 2017). According to Skemp in Nurlita (2017), symbol is a sound or something to be seen, which is mentally related to an idea. This idea is what the symbol means, without the idea the symbol has no meaning. Symbols take the form of words, sounds, gestures, ideas or visual images. There are different categories of symbols namely socio-cultural symbols, Religious symbols, Economic symbols, Scientific symbols, etc. Scientific symbols are standardized signs that have been adopted by convention to simplify the writing of numbers, formulas and equations used in Science and Technology. Scientific symbols embody mathematical symbols. The meaning of a symbol depends on the context and content used.

Usefulness of Symbols in Mathematics

Symbols are one of the most distinctive features of mathematics (Maria, 1997). Symbols are the components of the mathematics language that makes it possible for a person to communicate and reflect upon abstract mathematics concepts (Rubenstein et al., 2001). They

further noted that using symbols fluently and correctly is a necessary condition for an overall mathematics achievement and that symbols in mathematics are used to describe mathematical structures, make routine manipulation, deal with problems quickly and automatically without losing meaning, enabling reflective activities in mathematics, awareness of the schema and concepts it possess, understanding relationships and structure, accommodating neatness and ease.

Symbols in mathematics enhance understanding of mathematics concepts and give a universally acceptable way to represent mathematical ideas or illustrate mathematical concepts. Some ideas (for example ideas and concept in geometry) in mathematics can only be clearly illustrated by the use of relevant symbols. Use of symbols in mathematics reduces confusion and errors. Symbols in mathematics takes the form of pictures (as used in set theory, statistics), Signs (as used in arithmetic, calculus, algebra etc), Letters (as used in algebra), functions (as used in calculus, geometry, etc.), Numbers (as used in arithmetic) etc.

Mathematical Symbol Difficulties encountered by Trainee Teachers.

The problem of student difficulty to grasp (understand) mathematical symbols lie on how symbols are used and perceived by the students. If a student cannot recognize and pronounce a symbol correctly then he/her will have difficulty in using it (Earle in Oguguo, 2020b). He gave example with $\sqrt{4}$ that “if a reader is unable to pronounce $\sqrt{4}$ as the square root of 4” it stands to reason that he/she will have an inordinate amount of difficulty in mastering more sophisticated tasks involving those symbols.

Recently, Oguguo (2020b) carried out a study on Pre-Service teachers’ level of mathematical symbols mastery. The mathematical symbols studied were categorized into General mathematical symbols, Algebraic symbols, Statistical symbols and Set theory symbols. The results of the finding showed a high level of insufficient knowledge of symbols amongst Pre-Service teachers. The findings showed that most Pre-Service teachers had difficulty in correctly naming the symbols $\cong$, $\equiv$, $\prod$, $\sqrt[n]{a}$, (a,b) , $[a,b]$, $Var(X)$, σ^2 , $Cov(X,Y)$, $Corr(X,Y)$, σ_x , x , $\{ \}$, $A \subset B$, $A \supset B$, 2^A , A' , $A \Delta B$, $A \times B$ giving correct meaning of the symbols $>$, $<$, $\leq$, $\geq$, $\div$, $\pm$, $\cong$, $\equiv$, x , $\sum$, a^b , $\sqrt{a}$, $\sqrt[n]{a}$, $Var(X)$, σ^2 , $Cov(X,Y)$, $Corr(X,Y)$, σ_x , x , m_0 , Q_1 , p_2 , $\bar{x}$, $\{ \}$, $A \supset B$, 2^A , A' , $\in$, $A \Delta B$, $A \times B$ none gave correct meaning of the symbols $\prod$, (a,b) , $[a,b]$, $A \Delta B$ as shown in the table below:

Table 1: Percentage of respondents on the name and meaning of some mathematical symbols.

S/N	Symbol	Name		Meaning	
		CR (%)	WR(%)	CR (%)	WR(%)
1	=	100	-	57	43
2	$\neq$	84	16	47	53
3	>	100	-	41	59
4	<	100	-	37	63
5	$\leq$	65	35	22	78
6	$\geq$	61	39	22	78

7	$\div$	100	-	43	57
8	$\times$	100	-	39	61
9	$-$	100	-	65	35
10	$\pm$	73	27	20	80
11	$\cong$	35	65	20	80
12	$\equiv$	45	55	16	84
13	x	55	45	39	61
14	$\sum$	80	20	45	55
15	$\prod$	39	61	-	100
16	a^b	53	47	16	84
17	$\sqrt{a}$	67	33	12	88
18	$\sqrt[n]{a}$	43	57	6	94
19	(a,b)	37	63	-	100
20	$[a,b]$	27	73	-	100
21	$Var(X)$	35	65	10	90
22	σ^2	24	76	14	86
23	$Cov(X,Y)$	14	86	6	94
24	$Corr(X,Y)$	20	80	14	86
25	σ_x	24	76	8	92
26	x	31	69	18	82
27	m_0	53	47	37	63
28	Q_1	65	35	24	76
29	p_2	61	39	20	80
30	$\bar{x}$	88	12	43	57
31	$\{ \}$	33	67	27	73
32	$A \subset B$	45	55	61	39
33	$A \supset B$	22	78	10	90
34	2^A	20	80	8	92
35	A'	43	57	24	76
36	$\in$	80	20	45	55
37	$A \cap B$	100	-	55	45
38	$A \cup B$	100	-	55	45
39	$A \Delta B$	-	100	-	100
40	$A \times B$	18	82	10	90

Extract from Oguguo, 2020b.

Gurefe (2018) reported that prospective mathematics teachers were not able to use the mathematical language adequately and usually not able to explain the concepts using symbols. The study also showed some mistakes on the verbal level that the prospective teachers used to explain the concepts in the research.

These difficulties experienced by trainee mathematics teachers if not corrected will transcend to their students which will result in continuous poor performance in mathematics and low participation in Science, Technology, Engineering and Mathematics (STEM) related courses which are the driving force of any country's development.

Strategies for Correcting them

Difficulty of trainee teachers in mathematical symbols fluency is of great concern since according to Rubenstein et al. (2001), using symbols fluently and correctly is a necessary condition for overall mathematics achievement. To correct these abnormalities, teachers at all higher educational level should emphasize the importance of symbols in mathematics achievement.

The trainee teachers particularly and all learners should be reminded of the central role symbols play in the successful teaching and learning of mathematics. Teachers should recommend textbooks that give background information of the symbols used, since most mathematics textbooks change symbols too often without giving information on the symbols. Mathematics teachers should give names and meaning of symbols in the content before teaching the content and ensure that the students are familiar with the names and meaning of those symbols.

Teachers should not limit their method of teaching to lecture method in order to develop students' mathematical language and related mathematical progression. Students should be encouraged to solve mathematical problems frequently and discuss mathematical problems and concepts among themselves and teachers.

Conclusion

In communicating mathematics, one must be able to formulate his/her thoughts into sentences by using words or symbols. Symbols in mathematics provide precise and concise information about the object. Symbols hold a key position in mathematics therefore to achieve in mathematics the good knowledge of symbols. Problems in mathematics are translated to mathematical expressions and equations through the use of appropriate symbols. When the trainee teachers start having challenges with understanding mathematical symbols, this is passed on to their classroom. By extension this will lead to increased failure rate in internal and external mathematics examinations and dwindling mathematical knowledge and skills among students.

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