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Mathematical Language: Its Issues in Learning Process

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Abstract:

It is well known to all that in sharing information and thoughts, language is a key component. Every subject has simple language. In these subject, language of mathematics is unique from other languages that can be understood by any one even high skilled person in mathematics field also faces difficulties to talk in mathematical language. The learning of mathematics in schools is very important for high skill and teaching and learning the language of mathematics is vital for the development of mathematical proficiency. The problems also come in the teaching and learning of mathematics. There are many factors that affects the learning of mathematics such as vocabulary and use of prepositions. In mathematical language, the prepositions play a vital role for explaining the problems of mathematics. This article represents the relation between mathematics and language and the problems in learning the language of mathematics which have different categories. It also explain the role of culture in the understanding the concepts, terms and ideas of mathematics.

Keywords: *Prepositions, Culture, Vocabulary*

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Introduction

Like other subjects, for teaching and learning of mathematics there is a need of effective communication between teacher and learner. The mathematical language defined in the term of how to create and share meaning of mathematics by the help of language. The concept of mathematics is quite simple until the teacher and learner use a common language. Difficulty is generated where two different languages are used. For understanding the objectives of mathematics instruction, it is necessary to use the language by the author in their book and also by teachers whose structure, meaning, technical vocabulary and symbolism can be understood by learners of a particular class level. As many individual and sociological factors have impact on the mathematical learning. In the same way, linguistic (language) also has an impact on the mathematical learning. For understanding the number and arithmetic competence, the language plays a role for accounting the children form different culture. If language is used for the representation of calculations of large quantities and algorithms, it is essential to use the distinct linguistic characteristics that could lead for differential computational efficiency and arithmetic understanding **(Mulwa, 2014)**.

Role of Language in Mathematics Instruction

For sharing the mathematical knowledge, the primary role is played by the language between teacher and learners. There is a need of language used by the teacher which is appropriate for the cognitive development of learners. In the formation of concepts, acquisition of particular perspective abilities and transfer or communication of these concepts, language is a powerful instrument. Three important functions are served by language as follows:

1. People are allowed to communicate with each other by the help of language.
2. It enables the thinking process.
3. By the use of language, people can recall information beyond the limits of memory.

This last point shows that language is not only for communication but also used for facilitates thinking. Language that is used in thinking generally first language. Therefore, mathematical concept is communicated in one language. There might be chances to convert it into another language that allows thinking and then converted back in order to converse with the teacher. Misunderstanding and error can be generate at any step of this two- way inner translation process.

Language Categories

Roughly, language is divided into two categories: oral and literacy forms. In which oral language skill contains phonological, grammatical and vocabulary abilities that are the prerequisite of attaining the literacy that have reading and writing skill. The performance of mathematics are affected by the linguistic abilities. In spite of it, the mathematics is a special and unique language in itself. So, the leaners should construct the semiotic representation for the mathematical concepts, symbols, and notions by which it would be possible to generate a connection between new knowledge and previous mental representation. However, from our everyday language, mathematical language is very different and with the grade levels, the difficulty and complexity of mathematical language are also increased. In the understanding of problems and strategies are affected by the complexity of the verbal languages and semantic structure of word problems in the case of beginners of mathematics.

The strong relation is seen between phonological processing and mathematical development. Three components are consisted by the phonological processing. These are as follows: phonological memory, phonological retrieval, and phonological awareness. For the development skill in mathematics, each of them has been evidenced.

In these, phonological memory contain encoding and temporary storage of speech. The arithmetic problems are converted into verbal representations by encoding. While temporary maintenance works for preventing the verbal information from decaying for further processing. Another is phonological processing which is called as phonological awareness. It is defined as the ability of manipulating the sound structure of languages. The phonological awareness is a significant correlate of individual differences in mathematical abilities. There are two possible reasons that associate between phonological awareness and mathematical abilities.

1. By the number word learning, the phonological awareness can be linked with mathematical skills.
2. Substantial support of central executive control and phonological memory are required by both phonological awareness and mathematical problem solving.

Mathematics Categories

As language is divided into two categories. In the same way, mathematical skills can be divided into two main components: Informal math and Formal math.

Informal Math: it is defined as the sense and basic concepts of number that are attained by students before the learning of writing skill about the mathematics in school. It is the process of developing the understanding into children about the magnitudes of sets of objects or of symbols, comparison and estimation of magnitudes of small sets, associate the numerical value with the quantity of the set, etc. According to Purpura and Ganley, the informal math development can has the three phases.

- In first phase, comparison of magnitudes of two sets or objects and counting sequentially are learned by children.
- In second phase, they are familiar with the link phenomenon, how to link numbers with their corresponding quantities and number words.
- In third phase, simple operations of number words are learned by children like sum and which number is large/greater or which number is smaller?

Formal Math: It is refers to as the skills and concepts taught in school. It includes basic arithmetic like addition and subtraction and more complicated calculations.

Informal math works as a basis for the formal math because the learning mathematics is an accumulative process. And as we know, the prior knowledge is a keystones of new knowledge **(Zhang et al., 2017).**

According to Donaldson (1978) the interpretation of child is influenced by three things; his language knowledge, his valuation according to our intention which can be showed by non-linguistic behavior and the way in which he present the physical situation to himself. Some symbols and words that are used to communicate the mathematical ideas may be the reason of misinterpretation which is done by learners during the imitation of their teachers. The report was given 1992 by Pimm that with the determination of pattern of communication in the classroom, role model of native speaker of mathematics should be played by the teachers. Regarding the mathematical language, another report was given by Orton in 1987 as an instance learning tendency can change the meaning of mathematical words into their own thinking as the thought that teacher intended to say that. With the end, in 1998, a technical co-operation project known as SMASSE in Kenya was developed by the the Government through the Ministry of Education Science and Technology (MoEST) and the government of Japan. The main purpose of it was for the realization that the quality of classroom activities is serious for the effective teaching and learning of mathematics.

Many studies has been carried out with the learner for whom has English as a native language and the result show that the learners face difficulties in the use of mathematical terms. According to Pimm (1992) observed that:*It is common place to hear a teacher ... asking pupils if they have understood the meaning of a certain word, and possibly trying to test their understanding of it by requesting either a formal definition or a paraphrase of its meaning!*

Mulwa (2014) analyzed the role of language of mathematics in students in the term of understanding the concept of number and stated that difficulties in the learning and use of mathematical terminology are faced by the learner because some terms in the mathematics cannot be expressed in ordinary language. However, the student's great difficulties relate with the development of technical term which is seems as these are avoided at the time of mathematical instructions and they do not link these terms with the ordinary English language. They also explained the concept of 'factor' term used in mathematics. The concept of factor in the term of divisor is used in the text book as the factor and divisor have the same meaning. For example

20 can be divided by 5; hence it is proved that 5 is a factor of 20

5 is a factor of 40 when we divide 40 by 5 we get 8 as an answer.

The term factor can be used in the term of multiplication as for example:

5 can be 'multiplied exactly' to give 15; hence we say 5 is a factor of 15.

5 is a 'factor' of 15; when we 'multiply' 5 by 3, we get 15

The concept of factor is generally used to perform the divisibility tests that leads to the concept of prime number. Prime number a term, is defined as a number which is not divided except itself and '1'.

Implication for Learning Mathematics

Preposition

In the mathematics, preposition play an important role. It is used to study the space strand as relation of one object with respect to others. The reader requires to pay attention on the term 'preposition' that makes the

meaning. The lexical density of mathematics is defined as every word is used for a purpose. So, instance reading of the sentence can create difficulties. Prepositions are the small words that are generally ignored by readers or learner. A range of preposition is used within the school mathematics. Some preposition have higher value in mathematics classes compare to others. Without the use of preposition, it is difficult to think of teaching.

Table: Some Prepositions used in the Mathematical Classroom

Across	After	Against	Around	Among	Along
beneath	between	before	by	beside	below
during	down	on	into	like	near
from	for	through	off	over	of
past	toward	through	under	up	with
underneath	without	Within			

These are the preposition which are commonly used in mathematics classroom **(Robyn, 2011).**

Mathematical Vocabulary

In the learning of mathematical language, there are many challenges for students. The communication in the mathematical language is very complex task even for the most mathematically advanced student. There is a need of mathematical understanding for effective communication in the language of mathematics. There are some essential components which are required: a robust vocabulary knowledge base, flexibility, fluency and proficiency with numbers, symbols, words, and diagrams and comprehension skills.

Many students face problems in the concepts of mathematics especially those students who have learning disabilities. In the mathematical classrooms, text-centered instructional setting is encountered by students by which unintentional barrier is created in the learning process. By Rubenstein and Thompson in 2002, eleven categories were given that shows the difficulties in learning the language and mathematical vocabulary. These categories are as follows:

1. Meanings are context dependent (e.g., foot as in 12 inches vs. the foot of the bed).
2. Mathematical meanings are more precise (e.g., product as the solution to a multiplication problem vs. the product of a company).
3. Terms are specific to mathematical contexts (e.g., polygon, parallelogram, imaginary number).
4. Multiple meanings (e.g., side of a triangle vs. side of a cube).
5. Discipline-specific technical meanings (e.g., cone as in the shape vs. cone as in what one eats).
6. Homonyms with everyday words (e.g., pi vs. pie).
7. Related but different words (e.g., circumference vs. perimeter).
8. Specific challenges with translated words (e.g., mesa vs. table).
9. Irregularities in spelling (e.g., obelus vs. obeli).
10. Concepts may be verbalized in more than one way (e.g., 15 minutes past vs. quarter after).
11. Students and teachers adopt informal terms instead of mathematical terms (e.g., diamond vs. rhombus, orin the house vs. in the division bracket) **(Riccomini *et al.*, 2015).**

In 2015, Yushau and Omar studied about the performance in mathematics and its relation with English language. They investigate the effects of student proficiency levels of bilingual Arab students in English on their performance in mathematics. They noticed that the lack of proficiency in English have the effects in the understanding and performance in mathematics. Because the mathematic performance is related to the English Proficiency level of students. From their study, they reported as the top performance is seen in mathematics for those students who have high proficiency in English compare to others. The student are not aware from the disadvantages due to the lack of proficiency that give an effect on mathematical performance.

The role of language in the mathematical skill development was examined by Landerl Bevan and Butterworth (2004). They compared the children that have deficiency in the reading and arithmetic or dual deficit group. The performance on the basic number processing tasks was indicated that pattern of broad-ranging and substantial impairment was similar in both arithmetic only and dual deficit groups, not only in reading group. In mathematical development, conceptual understanding is a central issue. The language, core medium of teaching should affect the

concepts of mathematics. Specific Language Impairments (SLI) can play an important role on the language in mathematics developments. The development of calculation skills, and number sequences are inhibited in the children by the use of specific language impairments (SLI). The development of conventional calculation skills and understanding of number notation is affected by the linguistic constraints which regulate children's developing ability to produce the spoken number sequence. Knowledge of arithmetic principle may be developed by the support of separable system.

Regional Language and Mathematics

The mathematical language is considered a particular social language that is categorized as white, middle class. Let's take an example, the comparison by the use of binary opposites 'less and more'. Walkerdine and Lucey (1989) mention in their report that both words 'more and less' are used by the middle-class mothers with their children during interaction while working-class mother use only the term 'more'. The mathematics is accessed greatly or less by some students that depends on their home language. The region language become a tool for the communication and concepts to the students. Those students who have classroom language they have better access to the mathematical ideas and knowledge and vise-versa. For teaching the mathematics, the language is adopted. Now it becomes important for recognizing the specific language of mathematics. Mathematics has its unique features like any other language. At the time of standard Australian English (SAE) language, this is noticed that home language and school language have a great difference in which difficulty come in the learning of school mathematics. Across the social background and non-English speakers, this phenomenon has been well documented. Indigenous speakers have the same issue with the language.

The culture and social background are also very important factors in the learning process of mathematical language. Benson and Effiong (2005) reported that when home language is used for teaching the students, they are more understood with the concept. Matang (2003) also highlighted the importance of home language as for gaining the interest in mathematics and make meaning out of what children are learning. There is a need of culture for the learning of mathematics. They suggested that the material from their culture background should use in the teaching for making the concepts and ideas of mathematics easy. Same thing was said by Israel and Thomas in 2014 that by the use of mother tounge, the mathematics can be understood in better way. The leaning through the mother tongue, the mathematical vocabularies can be developed which could be easily understandable and remember. Before Israel, in 2009, Niesche has discussed about the use of mother tongue and children's culture in the teaching of mathematics.

By incorporating the knowledge of cultural background, the concepts and ideas of mathematics are easily grasped by students, evident in the form of scores and activities. When the children is taught without using their local language and culture, they lost their interest in learning because of the difficult vocabulary of mathematics. Due to this reason, they give poor performance in mathematics **(Hafiz and Farik, 2016).**

Conclusion

This article discussed about the language of mathematic this is unique in itself. It can be defined as the using of words and terms for defining the mathematics. According to many researchers, the students and teachers have difficulty in learning and teaching the mathematics respectively. Many factors affect the language of mathematics. Preposition and Vocabulary are the factors which are discussed in this article. From the reviews and studies of other researchers, this article concludes that the cultural and local language are very helpful for learning the mathematical language. The use of children culture and their local language, students are able to learn the concept of mathematics. And they can remember the concepts of mathematics for long times.

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