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Mathematics and Language

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This study explores the relations between mathematics and the natural human language. At the very outset, a general definition of language was, given while it was attempted to make some comparisons between the words of natural language and mathematical symbols at that. Besides, the occupation of natural language functions within mathematics was handled. Consequently, it was tried to manifest that the language of mathematics enjoys the features of natural language as well. Mathematics makes use of many functional and structural features. The fact that fundamental ingredient of mathematics is symbols does not change this reality.

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INTRODUCTION

It is possible to view the relations between mathematics and natural language from different aspects. This relation between mathematics and language is not based on just one aspect. Language is towards determining and perceiving the phenomenal relationships, yet mathematics attempts to display abstract relations.

Now that mathematics deals with abstract concepts, it has formed a world unique to itself and a language consisting of symbols and belonging to this world. It is no use to

say that this expression is independent and different from natural language since natural language and mathematics are closely akin to one another. It cannot be considered as separate items. We use natural language in every phase of mathematics to express mathematical symbols. Namely, mathematics and language make us understand the universe through interaction.

According to Galileo, Science is written on the very splendid book, which is in front of us, named universe. But we cannot read this book without learning its language and alphabet. This alphabet is mathematics, and without this language, it is impossible to understand even just one word of this book (Aslan 2000, pp. 391–392).

Thus, mathematics is an effective way of expressing that makes us understand the universe. At this point, the relation between mathematics and natural language may be stated as follows; in essence mathematics, and natural language are not different from one another, namely, mathematics is the symbolic form, which develops in a multi-dimensional way, of natural language.

THE RELATION BETWEEN MATHEMATICS AND NATURAL LANGUAGE

Human, who was created being based on mental and physiological foundations, differentiates from other creatures since he has sophisticated mental activities, and can express these activities, emotions, ideas, love, etc. through language. But this does not come to mean that other creatures except human does not have any languages. The fundamental point which separates human language from languages of other creatures is human language occurs as a result of thought, and they can be stated through words.

Language is so multidimensional that we cannot think of it in an instance, and from diverse aspects it has some other qualifications, and it is a mysterious conception that we have not still figured out many mysteries of it. It is a system which has strongly to do with human, society, and all domains such as science, art, and technology, which cannot be perceived far from human and society, and at the same time it is a system that forms all of these ingredients (Aksan 1990).

Therefore, the question: “Is human granted intelligent since he speaks, or can he speak since he is intelligent,” has still unanswered. But it is self evident that all kinds of communication with ourselves and other individuals realize by means of this mysterious conception. In case even we do not speak to another, we continue to speak to ourselves since we think through words. That is why, there is not even just one instance that human does not use language.

As for mathematics, it seems to be a scientific branch, which is far from daily life, and includes entirely abstract conceptions and an activity unique to a restricted domain. Why

and what kind of relation does such an activity and such a scientific branch have with language? Because the concept mathematics is finally one of man's mental activities it should be expressed in a verbal or written way like other types of statements. This is the natural corollary of language. Namely, human, via lingual activities, must express each phenomenon and action that he produces.

For example, the sentences "Ilhan is going to University" and "three plus two equals five" are the same in terms of statement and communication since they both have a feature of proposal submitting information. The restatement of the second sentence using symbols "3+2=5" does not change the situation. However we must change these symbols into voice, and express them. Any symbol used in mathematics must have a voice equivalent in language. And since voice is the fundamental feature of language, mathematics and language are undivided.

Mathematics forming in the world of images has become a peculiar and harmonic language, which has established its own literature and melody. Establishing some sorts of communication between mathematics and language as a complicated phenomenon, and without deviating from basic principles, it is a must that mathematics be always got pleasured and believed that it is necessary. Mathematics is not a natural language like French, English and Turkish. There is not such a society of which mother tongue is mathematics, besides it is not a dialect of any language like English or etc.

Yet mathematics is the common language of science that whole world can understand each other. It is one of the fundamental self-evident points of contemporary linguistics that language is a system of signs. Sign is a whole phenomenon occurring in mind consisting of signifier and signified. For instance, when we say "tree", with the projection of these four sound units in our mind, a plant that has a root, branches, and leaves develops. Such an association makes up the conception, the "meaning". Likewise, any image in mathematics can produce an association in our mind and get a common meaning both in language of mathematics and human memory. For example, when we say "triangle" a meaning based on association occurs like the former example above. Namely, through this five-sound signifier, a three sided and three-angled shape is perceived. This may be seen in the Figure1 below:

Here the reason why "triangle" is called "signified" is that it has a function of carrier to the concept of "triangle". Therefore, it is possible to see mathematics as a composition of signs and, as a result, a language.

It does not change the situation that the basic ingredient of natural language is words and of mathematics is symbols and figures. For both, the relation between the auditory image and conceptions occurs through the same mechanism, and changes into utterance.

There is a mutual and inevitable relationship between mathematics and language. Mathematics is in a mutual and indispensable effort to express itself in a best way in

language whilst language tries to improve and renew itself so as to explain mathematical conceptions, and acquire them new dimensions. In this sense, mathematics and language are absolutely mingled to each other. Thus, language sometimes becomes mathematics and mathematics becomes language in due course.

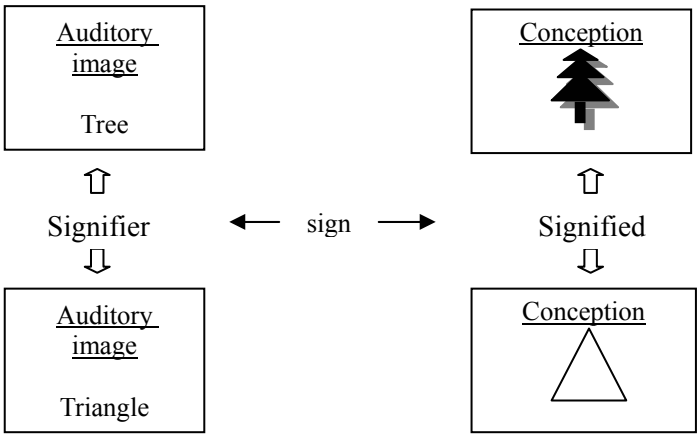

Figure 1. Conception and its auditory image

Richness in expression within natural languages is rather provided by diverse sense attributed to words. That is, the fundamental element in richness of statements is metaphors. In order to lead mathematics to its deserving harmony it should be benefited from the advantage of language. That is why people who learn and teach mathematics should firstly know the language very well. In that,

2+2=4, this symbolic statement can be manifested in different ways.

- Two plus two is four.
- Two plus two makes four.
- If we add two to two we have four, etc.

But they must use the most appropriate linguistic expressions, like the examples above, in order to use both natural language and mathematical one. Namely, the effort concerned is necessary and mutual.

During right time, an individual who uses natural language should use certain mathematical symbols accurately. For example, many numbers in mathematics can be used in function of adjectives describing words:

“ Two pencils, or the sixth chapter, etc”.

Needless to say that in mathematics teaching, both teachers and students have many difficulties in terms of language. In other words, mathematics challenges teachers and

students from several aspects. Why does this challenge focus on language? A mathematician studies in a field of which clarity and formal function are open to criticism, and in a field that is abstract, and highly symbolic. Stating his ideas as to substantial operation and numbers, does mathematician want to reach ahead of current utterance and frequent mistakes? (*cf*. Durkin & Shire 1991, pp. 3–4, pp. 15–17).

As David Pim stated, such an approach seems to ignore human and his communication, which are the two fundamental elements of mathematics.

Such a point of view also neglects the ideas of many instructors who are experienced in education of mathematics (*cf*. De Saussure 1985).

This approach attempts to minimize the difficulties and ambiguities during understanding mathematics. Education of mathematics begins in the frame of language and develops in this frame. Mathematics and language are in a development in unison. In that, the reality language renews itself day by day, and obtains new meanings and concepts provide mathematics with self-expression in an easier manner. In spite of this, the opinions about language and mathematics are in general quite complicated and contradictory. Though the methods used to support such assertions are so different from one another, they enjoy a common point. Naturally, in case the issue is about mathematics and language, new approaches and horizons should be applied to mathematics and everyone concerned is to painstakingly deal with it (Yıldırım 2001, p. 134).

Without this paradigm of language that bilaterally completes one another verbally and literally, it is scarcely possible to express mathematics straightforwardly.

The difference between the language of mathematics and natural language mostly occurs within written language rather than in spoken language. While the writing form is alphabetical, the form of expression of mathematics is carried out through symbols.

On one hand, the alphabetical system displays itself within each phase of natural language. On the other hand, symbols, in mathematics, can change according to the subject. Namely, mathematics, virtually for every subject, forms a new alphabet in this sense. A symbol previously learned can be used in a different field by means of "information transfer" that is placed in educational science. Thanks to this feature, it is easily possible to reach a similarity between symbols written ingredients of the language of mathematics and words.

Daily language, in spite of its richness of words and nuances, is not sufficient for a distinct and clear expression, which is all-important criterion within science. But, since mathematics we perceived as a language uses symbols of which senses and way of use are certain and limited, it provides a comprehensible expression and an ease of communication. The difference between the language of mathematics and natural language can be easily understood through the statements as follows: "The third law of Kepler pertaining to planets"; this law, which is displayed in an simple equation within

mathematical language, that is $T^2 = kR^3$, is stated as follows: The square of time elapsed by a planet in order to complete its orbit is proportioned to the cube of the distance to the sun.

As it is seen, this expression both long and difficult to understand is open to diverse comments. Yet, in mathematical language there is not such a difficulty. But, the probability of meaning transfer mentioned above within natural language is in a higher position. These differences seen in written language are minimized in verbal language. Because, when symbols change into an expression, they become a part of verbal natural language. In natural language, some of the characteristics existing in terms of meaning within a word are met in mathematical symbols. For instance, the opposite form of the sense "big" in terms of opposite meaning, in natural language, is "small" and it functions according to the same alphabetical rule. A similar opposite meaning exists in mathematical symbols as well.

Tabel 1. Opposite meaning

Big	Opposite meaning	*Small*	(Opposite meaning in verbal natural language)
>	Opposite meaning	<	(Opposite meaning in mathematical language)

The members of the community who speaks that language regard the sense attributed to words as a part of the culture.

The meaning attributed to the symbols, along the educational process, keeps its existence alive for instruction. Accordingly, symbolic meaning is not restricted with the members of a society. Namely, the language of mathematics enjoys a more common and universal characteristics than natural language.

CONCLUSION

Basically, the language of mathematics is not different from natural language. The chief goal of language is to be able to express the ideational and sentimental concepts. Concepts, in natural language, are expressed via words, and in mathematics symbols are used.

It would be a significant mistake to consider mathematics is not a language regarding that the language of mathematics is entirely based on symbols, because symbols require an issue pertains to itself, and a peculiarity or a generalization including these symbols.

Such a generalization or noticing such a relation is matter of language towards expounding mathematical conceptions and symbols. Like in natural language, within

mathematical language, to be able to explain the conceptions is dependent upon some individual abilities and experiences such as perceptual capability, intelligence, intuition, and interest.

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