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1984-03
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http://hdl.handle.net/10539/17929
Glencross, M.J. (1984, March). Language aspects of mathematics. Lengwitch: [The Journal for Language Across the Curriculum], pp. 1-6.

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LANGUAGE ASPECTS OF MATHEMATICS

Most mathematics teachers are aware that many people, adults and children alike, have developed negative or even hostile feelings towards mathematics. The recently published Cockcroft Report (HMSO, 1982) revealed that a lot of people are afraid of mathematics or ashamed of their inadequacies. In fact, half those invited to take part in interviews refused to have anything to do with the questions they were asked, while apparently simple and straightforward pieces of mathematics induced feelings of anxiety, helplessness, fear and even guilt. What is there about mathematics that causes people to regard it with distaste and even fear? No doubt there are several possible answers to this question, but I should like to suggest that the root cause is one of understanding, or rather the lack of it and that a major factor related to the understanding of mathematics is the language of mathematics.

Some of the problems associated with the acquisition of mathematical language are similar to those of learning a second (natural) language; in particular, a vocabulary is needed before a person can understand. Another difficulty is that the language of mathematics contains

words which often have a meaning in everyday English as well as a more precise and, in some cases, a different meaning in mathematics (eg 'set', 'field'). It has also been suggested that difficulties arise because, although people learn their own language in a natural way from native speakers of the language, '...they are taught mathematics by people who were taught by people...who were taught by mathematicians' (Griffiths and Howson, 1974, p 21).

It is important to distinguish between, on the one hand, mathematics as a language and, on the other, mathematics and language. When mathematicians discuss mathematics with one another, it is likely to be through the medium of such natural languages as English, French, German or Russian. Furthermore, when we turn our attention to the process of communicating mathematical ideas to children, we soon realise that it is not possible to provide the 'official' mathematical descriptions used by adult mathematicians because of the lack of appropriate language and of necessity we must explain in the language of the child. For this reason it has been suggested (Griffiths and Howson, 1974) that there are three distinct levels of language employed : That which is used between mathematician and mathematician, that between mathematician and teacher, and that between teacher and child. Thus, the translation of a piece of mathematics from one person's

conceptual framework to that of another may be fraught with language difficulties, especially when the conceptual framework of one person is less complex and less mathematically sophisticated than that of the other.

Mathematics, just like any other subject, uses many specialised or technical terms to refer to important abstract ideas. Such abstract ideas, or concepts, are mental objects which require the use of either spoken words or written symbols to facilitate communication between individuals. Words like 'parallel', 'factor', or 'square root' are used as linguistic labels for mathematical concepts, while a collection of such specialised terms may be described as a mathematical vocabulary. Research related to the effects of language factors involved in the learning of mathematics suggests that linguistic abilities have a direct influence on performance in mathematics and that knowledge of mathematical vocabulary is important in solving mathematical problems (Aiken,1972).

A simple but effective way of diagnosing linguistic difficulties due to problems arising from weak mathematical vocabulary is to construct a test in which each test item consists of a simple question or problem involving a mathematical word or term, pupils being required to respond with a written answer. Since a child may understand a particular word but be unable to explain its meaning, the

intention of such questions is to test whether or not the child understands the mathematical word involved, rather than to test the child's mathematical ability. For example such questions as:

> What is the remainder when 17 is divided by 5?
>
> Give one example of a factor of 21

can be used to give the mathematical word in a specific context. Calculating the percentage of correct responses to each question provides the teacher with a clear indication of how well each word is understood and reveals instances where serious difficulty is experienced with particular words.

Research carried out in England (Otterburn and Nicholson, 1976) showed, for example, that the words 'product' and 'multiple' produced confused reponses in 75 per cent and 85,6 per cent of cases respectively, while in Zimbabwe (Glencross, 1979) there was great confusion about the words 'multiple', 'integer', and 'rhombus'.

As teachers we should remember that while the 'specialist' language of mathematics may itself be a barrier to children's understanding and concept development, this barrier becomes even greater when the specialist language is used in complicated sentence structures (such as occurs

in many mathematics text-books), or in language patterns with which many pupils may be unfamiliar. Thus, if learners are confused by the use of mathematical words that are not immediately meaningful to them, their confusion may be aggravated when complex sentence structures and unfamiliar language patterns are also used and, in this way, the development of children's mathematical concepts is likely to be inhibited rather than aided by mathematical language.

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EXAMPLES OF MISUNDERSTANDINGS AND MISINTERPRETATIONS THAT HAVE OCCURRED IN THE CLASSROOM

1) Teacher: What are you left with when you keep taking away 7 from 86?
Most children: 2
One child: I keep getting 79.

2) (From a Std 6 test)
Question: Write down the following product without brackets: $\frac{1}{2}p(4p - 8q + 2)$.
Answer: $\frac{1}{2}p \times 4p - 8q + 2$

3) $3x + 2 = 5$ "You cannot, because 30 something plus 2 will not give you 5."

4) $7 - x = 9$ " It is stupid. How can you take something from 7 and get an answer bigger than what you started with?"

5) $y = x$ Teacher: What can you tell me about that?
(Expecting something about a straight line)
Pupil: It is silly. They are different letters, not the same, so how can they be equal? You would not be pleased if I spelt 'yacht' as 'xacht'.

6) $n + 2 = p$ "...because it is two more letters along."

7) "If is a right angle, is a left angle?"

COLLECTED BY M J GLENCROSS