

University of Groningen

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SUMMARY.

This study is a report of experiences of teachers and student-teachers as explainers of mathematics. 'Explaining mathematics' is considered as a special kind of speech-act in the classroom-situation. In other words: explaining mathematics is a kind of rule-governed conduct of language-handling through which the teacher aims to bring about a kind of understanding by the pupils. This point of view forms the basis for observations and analyses of class-room discourse and it can provide a framework for studying the complexity and interconnectedness of the various educational components as a whole.

The aim of this study is to obtain a deeper understanding of the human processes through which the explaining of mathematics takes place.

Chapter 1 concerns the terminology of explaining as a speech-act. This results in an operational definition of 'explaining' and 'understanding'. Furthermore a distinction is made between different kinds of and different strategies for explaining. Difficulty, clarity and the structure of an explanation are identified as fundamental elements of the phenomenon.

The design of the research is set forth in chapter 2. Because the domain of study was so extensive a choice had to be made between the objects and questions of this research project. In this way this chapter functions as a preview to the succeeding chapters.

At the Department of Mathematics of the University of Groningen students participate in the course "Presenting a mathematical topic" during which they explain mathematics to fellow-students. The situation is a real one, that is to say: it is not an imitation of a classroom-situation in a secondary school. However the situation is much simpler than a classroom one, in that more is known about their mathematical background. It is this aspect which makes it an eminently suitable research topic. In chapter 3 a description is given of the methodology and of the results of this part of the research. In particular attention is given to the possibilities and the effects of interaction and to the relationship between the difficulty of a subject and the clarity of the explanation. It turns out that there is a preference in the students' opinion for the assertion: "if the subject is not difficult, then the explanation is clear". Four parts of their presentations are analysed in order to give an explanation of this finding.

Explanations can be based on real contexts. Some of them are suitable but others are not. In chapter 4 two of these contexts are analysed with respect to their expected effects. They both concern the introduction of negative numbers and they both have the same structural characteristics, but only one of them has the desired explaining force. A difference between the rules of translation from the two contexts to the mathematical contents is identified which may explain the observed differences.

In chapter 5 a heterogeneous classroom-situation is compared with two homogeneous

situations. The three classrooms are of grade 7 (age 13-14) but the first one comprises pupils from three school types, whereas the other two only have pupils from one school type. In all the classes the mathematical topic is the introduction of symbols and formulas. There are significant differences between the strategies behind the explanations, between the prior knowledge of the pupils and between the effects of the explanations.

Linear equations can be introduced by means of a (verbal) model of balancing of objects. Explanation takes place in a real context. It is interesting to investigate whether there are differences between two groups of pupils of grade 8 (age 14-15) but from different school types with the same teacher and the same mathematical topic from the same textbook. In chapter 6 relevant differences are found with respect to the mathematical abilities of the pupils.

The concept of 'angle' is fundamentally rooted in physical reality. Pupils already know the word 'angle' before they are confronted with the mathematical concept. Moreover the word 'angle' refers to several different meanings which are strongly interrelated at an intuitive level. Chapter 7 concerns the introduction of this complex many-sided concept in a classroom situation. Through the complexity of the subject, this lesson has the character of a scientific discourse wherein teacher and pupils create the meaning of the new mathematical concepts in an interactive manner.

Finally, in chapter 8, conclusions are made about explaining mathematics as a professional qualification for teachers of mathematics. The consequences of this opinion are considered with respect to the chosen fundamentals of explaining mathematics, such as: interaction, structure, meaning, difficulty and clarity. In particular an answer is given to the question: Which aspects of explaining mathematics can be learned by student-teachers in the course 'Presenting a mathematical subject'?

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