ENCOURAGING THE TRANSFER OF 'SCHOOL' MATHEMATICS TO THE 'REAL WORLD' THROUGH THE INTEGRATION OF PROCESS AND CONTENT, CONTEXT AND CULTURE

ABSTRACT. This paper reports upon a research project which considered the transfer of students' mathematical understanding across different task contexts. The research involved two groups of students from contrasting learning environments. The first environment was characterised by the complete integration of mathematical process and content using open ended activities. The second environment represented a 'typical' English classroom with a content based scheme being predominantly used. The research demonstrated that the procedure and performance of students in response to addition and fraction tasks varied considerably when the context of the tasks changed. This variation suggested that students' perceptions of the contexts were individually constructed and contexts did not have a uniform effect upon the difficulty of tasks. The research also suggested that students who had learned in an environment characterised by the integration of process and content were more able to transfer their learning across contexts. Students who had learned mathematical process independently of content were more likely to vary their procedure and performance in response to the contexts of the tasks. This was considered in relation to the problems of 'school' – 'real world' transfer and the effectiveness of different learning environments.

1. INTRODUCTION

Mathematical reasoning appears to develop differently in different situations. This, in itself, is unremarkable but the degree of discontinuity of performance in a subject which many regard as immutable and objective is interesting and still, to a large extent, unexplained. A number of research projects are now challenging the perception that mathematics can be learned in school, embedded within any particular learning structure and then lifted out of school to be applied to any situation in the 'real world'. Observations that mathematical performance is markedly inconsistent particularly across what may be termed as 'school' and 'everyday' situations have suggested that it is the environment in which mathematics takes place, not the problem to which it is applied, which determines the selection of mathematical procedure. If this assertion is true then the implications for teaching, learning and assessment are great.

The processes which determine the degree of mathematical specificity which can be maintained across contexts probably also determine whether students are able to transfer their school learned mathematics to 'real world' situations. A detailed consideration of the way that students interact with the contexts of tasks becomes particularly interesting in furthering this debate. For if students can learn mathematics in such a way that enables them to see the underlying similarities...
between questions set in different contexts they will probably also develop enhanced capability in transferring their school learned mathematics to 'real world' situations.

This paper will report upon a research study which contrasted an unusual mathematical learning environment characterised by the complete integration of process and content with an environment more typical in nature which concentrated mainly upon content with some separate attention to process. The research took as its starting point the assumption that the nature of a student's mathematical environment determines whether or not students are able to develop a mathematical understanding which they can transfer to the 'real world'. For the purposes of the research it was also assumed that if students could transfer their mathematical understanding to tasks set in different contexts they would be more likely to transfer their understanding to problems set in the 'real world'. The research contrasted the effectiveness of the two learning environments by presenting students with questions set in different contexts and observing whether their capability in transferring their mathematics was related to the way they had learned mathematics. This allowed a general consideration of the influence of context upon students' choice of procedure as well as a comparison of the relative effectiveness of the two environments with relation to a student's capability in situations requiring transfer to the 'real world'.

2. THEORETICAL FRAMEWORK

2.1. Contexts in Learning and Assessment

In the late 1970's increasing awareness of employer dissatisfaction with school leavers as well as general reports of adults' inability to transfer mathematics learned in school prompted a shift toward the 'everyday' use of mathematics. Advocates of everyday mathematics generally believe that this focus not only prepares students for the specific content studied but that questions which refer to the 'real world' provide learners with a bridge between the abstract role of mathematics and their role as members of society (Broomes, 1989). Twenty years of research findings are still suggesting that students perform differently when faced with 'abstract' and 'in context' calculations aimed to offer the same mathematical demand. Taylor (1989), for example, compared students' responses to two questions on fractions; one asking the fraction of a cake that each child would get if it is shared equally between six and one asking the fraction of a loaf to be shared between five. One of the four students in Taylor's case study varied their methods in response to the simple variation of the word 'cake' and 'loaf'. The cake was regarded by the student as a single entity to be divided up into sixths, the loaf of bread was regarded as something that had to be divided into a large number of slices - the student therefore had to think of the bread as cut into a minimum of ten slices with each person getting two tenths of the loaf. In two questions which required students to perform percentage calculations both in and out of context the APU (Foxman et al., 1991) found that 54% of students gave the