Pupil collaboration and teacher intervention in the Logo environment

Abstract
The Logo Maths Project was a longitudinal study of the use of Logo within the mathematics curriculum which took place from 1983-1986. Systematic data was collected for four pairs of case study pupils (aged 11-14 years) throughout the three years of the Project. This paper points to some of the cognitive effects of peer collaboration in this computer environment. It also presents a categorisation of teacher interventions in the learning process and discusses the research findings concerning the effects of intervention. Conclusions are drawn which point to the importance of developing computer based environments structured to optimise mathematical learning whilst maintaining a spirit of exploration and experimentation.

Background and Aims of the Research

There is no doubt that computers will be part of the mathematics classrooms of the future. Why and how they should be used are questions addressed by the Logo Maths Project. The main aim of the research project was to investigate the ways Logo could be used as an aid to pupils' thinking and learning in mathematics at the secondary age level. A subsidiary aim was to analyse the relationship between the role of the computer, the role of pupil collaboration and the role of the teacher in a computer based environment. These last two aspects, the role of pupil collaboration and the role of the teacher in the learning process are the focus of this paper. The theoretical rationale for our work is that children learn mathematics through active construction of their own knowledge and that this can be facilitated in a computer environment through the process of inductive generalisation derived from conjecture and feedback. Logo was chosen as the programming language for the Project because the turtle graphics microworld provided in our view the best available introduction to computer programming for mixed ability classes. It is accessible and highly motivating as well as challenging in both a mathematical and programming sense. The

1 For a full description of the Project and its implications for teaching and research see Hoyles, C. and Sutherland, R. 'Logo Mathematics in the Classroom', Routledge, 1989.
procedural nature of Logo we hoped would encourage the breaking down of problems into parts and the use of the part solutions as building blocks of alternative structures—all important mathematical activities. Additionally the extensible nature of Logo would allow the possibility of teachers and pupils building new tools for themselves.

At the beginning of the Logo Maths Project the effects of the computer in the classroom were little understood and limited research had been undertaken particularly at secondary level. In circumstances where technology, pedagogy and representation of mathematical content are new it is foolhardy to set up tight hypotheses which predict the outcomes of research. Our methodology was therefore ethnographic and illuminative. Two computers were placed in the mathematics classroom of a London comprehensive school and pairs of pupils took turns to work with Logo during their 'normal' mathematics lessons. We case studied four pairs of pupils, initially two single sex and two mixed sex. The pairs were chosen to take into account spread of mathematical attainment and the teacher's opinions as to constructive working partnerships. The research data included recordings of the pupils' Logo work, all the spoken language of the pupils whilst working with Logo (a video recorder was connected between the computer and the monitor), the researcher's interventions and a record of all the mathematical work undertaken by the pupils. The video recordings were transcribed and these together with researcher observations and teacher and pupil interviews provided the basis of the research data.

The Role of Collaboration

Some Positive Effects

Pupils, by the time they have reached secondary school, tend to have developed a dependence on the teacher as the provider of their mathematical knowledge. Our research certainly indicated

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2 Two partnerships were changed in the third year.