Graphical Representations and their Relation to Instruction

Eileen Scanlon
Open University
Institute of Educational Technology
Milton Keynes
Bucks, UK., MK7 6AA
e.scanlon@open.ac.uk

Introduction

Representations of abstract ideas in physics are hard to understand and manipulate. In recent years it has been assumed that the some of the tedium of graph drawing and problems of interpretation can be ameliorated with the aid of the computer. The interpretation of graphical representation has particular relevance for physics learners, as many of the tasks involved in developing physics understanding involve the facility to move easily between algebraic and graphical representations. A research project which explored the difficulties that students of physics have with such representations and provides a framework with which to review two recent attempts to use information technology to help students with these difficulties. The research project was an exploration of physics students' behaviour on a number of written physics problem solving tasks including two graphing tasks (Scanlon, 1993) which involved subjects in graph drawing and graph interpretation.

The two instructional case studies deal with students' experiences with dynamically produced graphs. The first case study involves observations of twelve high school students working together in pairs on *Multimedia Motion* a CD-ROM designed to teach them about dynamics (Scanlon et al, 1997b). The CD-ROM allows students to select data from moving bodies (such as space rockets, tennis players etc.) and explore how that data can be displayed graphically and what the relationships are between distance moved, velocity, acceleration, impulse, momentum etc. The second case study uses data from a project where 30 adult distance learners were studied using a simulation of chaotic motion. The purpose of the simulation was to allow them both to observe some of the generic features of chaotic motion, and to explore ways in which these could be represented graphically (Scanlon at al., 1997 a).

Problem solving with graphs

Representations have been shown to influence how well students learn. For example the use of graphical representation can impact learning and problem solving (Larkin and Simon, 1987). Properties such as specificity can be studied to investigate and suggest improved forms of representation (Stenning & Oberlander, 1996). Mathematics education provides us with a body of research on students' understanding and skill in graphing. For example, Leinhart et al. (1990) review work which presents a complex picture of students' understanding of graphing. Distance educators have particular problems in supporting students in their use of representations. The research highlights a number of issues including:

- the role of contextual features in graphical understanding,
- the interaction between data, and algebraic and graphical accounts of phenomena and
- how collaborative working on these problems can influence subjects' learning outcomes.

References

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