Group work with multimedia

Brian Hudson

This article outlines the way in which the National Curriculum Council sponsored multimedia package, *World of Number* (Shell Centre et al, 1993), was used as the focus for group activity with a Year 9 (age 14/15 years) mathematics class. The initial version of *World of Number* was produced on video disc for the PC with a subsequent version following on CD ROM. There is a review of the package as a whole in *Micromath* by Cutler (1993). The classroom research was carried out in a South Yorkshire comprehensive school during the Spring Term of 1994. The classwork involved graphs of relationships, and close attention was paid to relationships between distance, speed and time in a variety of contexts.

The curriculum development was designed to fit in with the planned scheme of work: a two week unit on graphical interpretation of graphs of motion. This was loosely based upon the first chapter from SMP Yellow Book 1. A dice game was used as an initial whole group activity, in which children plot a path from start to finish on a graph. This activity was based upon an idea from my colleague Jim Smith, which is now published in Smith (1996). The numbers 1, 2 and 3 have the effect of taking the player forward by the corresponding number of steps, whilst a 4 has no effect and 5 and 6 move the player back by 1 and 2 steps respectively. Progress was recorded on the grid shown in Figure 1 before being transferred to a graph. This activity was used to set the scene, promote discussion and generally stimulate interest and involvement. The main mathematical aim of this activity was to begin to develop an understanding of distance-time graphs and for the students to be able to interpret the meaning of steeply and less steeply sloping lines, and flat sections, in terms of the movement.

Move number	Dice score	Distance from start
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

Figure 1

The second lesson built on the first, with an initial review and whole class discussion at the start. The next stage of the lesson was a whole class introduction to the specific chosen multimedia context, the module on World of Number entitled Running, Jumping and Flying. The aim was to set the scene further and give students a sense of what to expect in the future group activities on the system.

The unit is made up of video clips of various examples of motion, several of which are sporting events from the Seoul Olympics as detailed in Figure 2.

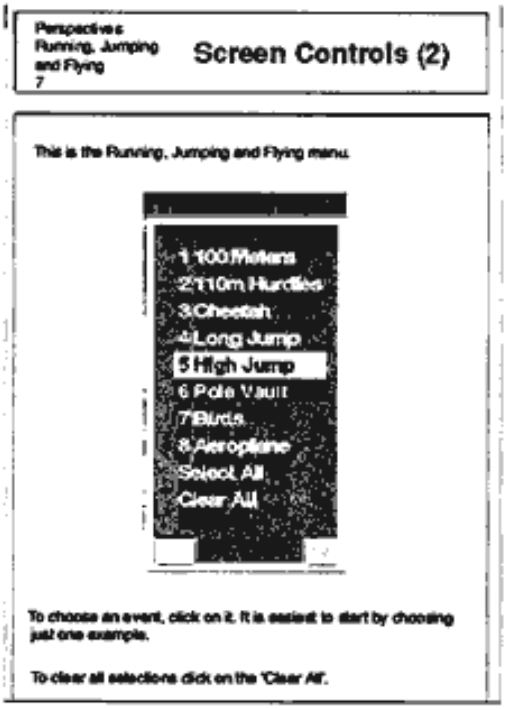

Figure 2

Each sequence has two or three graph options associated with it. For example, in the sequence shown in Figure 3, involving the women's 100 metres final, the chosen axes in the bottom left hand window are height and time. Other choices might be distance against time and speed against time, which in this case gives three graphs to choose from in the bottom right hand window. Having chosen both the axes and the graph to fit, the combined choice is illustrated in the top right hand window.

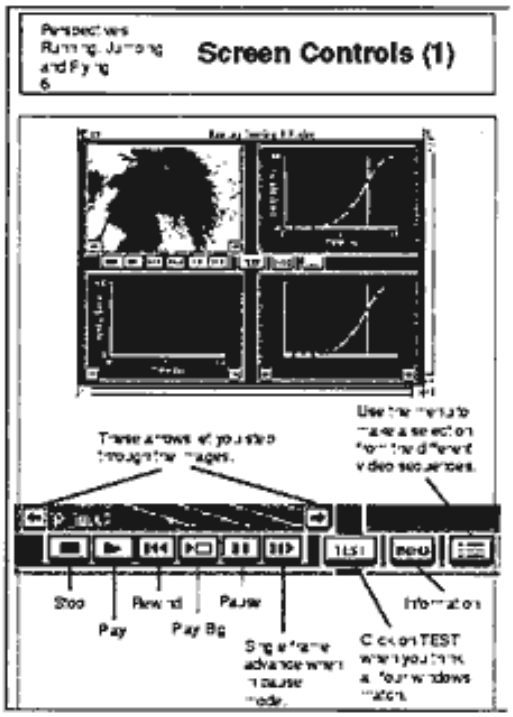

Figure 3

The women's 100m final, as illustrated above, was chosen for the initial whole class introduction. The sequence was played in full screen mode and then discussion took place about what the graph of distance against time might look like. Following this discussion, the facility for testing the choice was used to illustrate how the graph could be overlaid onto the motion, once the correct choice had been made. Using some of the other features of the software, particular aspects of the motion were highlighted, such as the time taken to get underway – the reaction time at the start. Other aspects that were the focus of class discussion included speed against time and acceleration against time.

Following this introduction some groups began working on the activities at the system. Pupils were organised in groups of three, with the aim of creating the optimum conditions for effective interaction. This resulted in ten groups

altogether. Each group was allocated an initial period of thirty minutes for intensive work at the system. The practical limitations were eased considerably by the use of two systems. In addition to the original laser disc package the school also had access to the CD ROM version. This provision enabled four groups to carry out the multimedia based activities in a one hour lesson, and each group to have a turn over the period of a single week. The class was timetabled for two lessons of one hour and one of half an hour per week.

The main aims of the multimedia-based activity were to promote discussion and provide time for reflection, whilst engaged in the process of graphical interpretation. The activity was structured in such a way as to encourage the following process:

- select and view a video sequence
- think about the distance-time graph
- sketch the graph, compare graphs
- choose a graph which fits your ideas
- explain to each other why a particular graph does or does not fit
- test out choice on the system
- repeat the process with a different choice of axes.

This can be summarised as a cycle of observation, reflection, recording, discussion and feedback (test) as outlined in Figure 4.

Figure 4

Data was collected by video recording the work of groups working on the multimedia-based activities. An example of some of the classroom interaction follows in Figure 5.

This episode is one example of the rich interaction that resulted during the classroom trials. The work of this group provides several examples of the use of language combined with gesture in response to what was being observed on the computer screen. This supports previous research, which has highlighted the role of the computer in supporting collaborative learning (Teasley and Roschelle, 1993). The computer stimulus provides a context for action and gesture to support the development of shared understanding. In addition, the activity was structured to encourage the pupils to sketch their ideas, in order to promote time spent on reflection. The pupils' sketches supported students describing their own visualisations, and provided a basis for arguments put forward in the discussion to further the development of shared understanding.

The key to what seemed to be the most effective group interaction was the engagement by all the group members in the cycle of observation, reflection, recording, discussion and feedback. Where this was not the case, there was no evidence of individual sketching of graphs or of any prior reflection, and the discussion centred on simply deciding which graph fitted, by a mixture of luck and guesswork. This reflected the dangers predicted by Hughes (1994) of a concern with the solution rather than the problem. This finding also supports the observations made by Atkins and Blissett (1989) in their study of the role of student discussion, which they note varied from a trivial and superficial conversation about the problem to real engagement with its constraints and possibilities. Further, it highlights the importance of the role of the teacher monitoring the quality of the group learning process. A fuller picture of the contrasting patterns of group interaction is available in Hudson (1996a).

A lasting impression from the classroom trials is of the quite exceptional power of the medium to support and sustain collaborative learning. The fact that groups of 14-year-olds consistently interacted with each other and the system for thirty minutes at a time to sketch, reflect on and discuss graphs of motion, in relatively unsupervised conditions, almost became taken for grant-

ed during the classroom trials. Teasley and Roschelle also refer to this phenomenon when they observe that "in ordinary circumstances, one cannot imagine two 15-year-olds sitting down for 45 minutes to construct a rich shared understanding of velocity and acceleration"

The multimedia environment, which was the focus of this study, has a number of particularly distinctive features. Firstly there is the utilisation of examples of motion from the real world which are of equivalent quality to that of TV and video. Secondly there is an element of choice over which episode to concentrate on; this offers the potential for a greater sense of ownership of the problem on the part of the user. Thirdly there is a flexible mode of viewing the options without any pressure to make a premature choice, and finally there is the element of non-judgmental feedback from the computer. In addition, the multimedia-based activity was structured to encourage group activity and collaboration.

With specific reference to the mathematics of the situation, the classroom activities emphasised the processes of graphical interpretation. They did this most effectively by combining the power of moving video involving motion with ability to represent the situation graphically derived from the power of the computer. There is a parallel here with the facility to draw graphs with a computer when using a graphing package, a spreadsheet or a data base.

The particularly unique feature of the multimedia software in *Running, Jumping and Flying* was the use of video of motion from the real world as a focus for joint problem solving activity. Another important element was the provision of feedback, both in confirming choices or otherwise, and in bringing episodes to a successful completion. A fuller evaluation of the package as a whole is included in Hudson (1996b).

One difficulty associated with the use of *World of Number* in the trial school arose from initial uncertainty about the role of the teacher in relation to the use of the technology. Reflections on the role of the teacher during the period of this curriculum development resonate with the notion of the *orchestrating* teacher offered by Shavelson et al (1984). This role involved integrating the content of multimedia-based work with the ongoing curriculum, co-ordinating multimedia-based activities with other activities, monitoring the ongoing group activity and

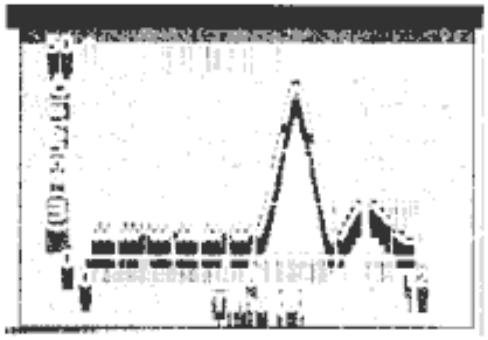

Figure 5a

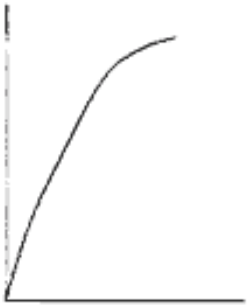

Figure 5b – Claires's Sketch

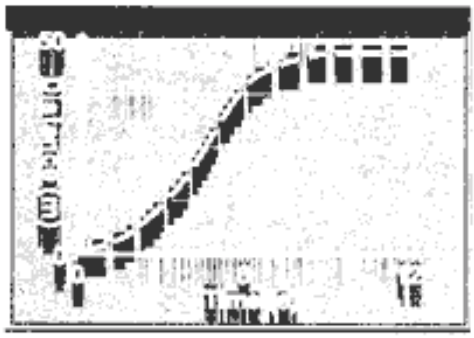

Figure 5c

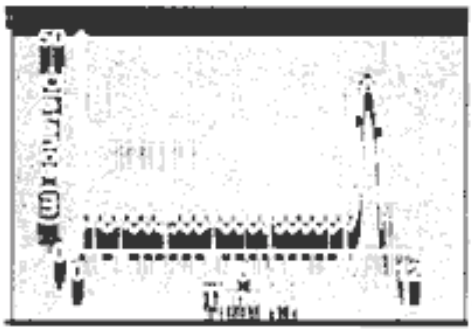

Figure 5d

Classroom interaction between Laura, Chantel and Claire discussing the Pole Vault.

Ch:	He's travelling – up, isn't he?	*Graph 5a on screen.*
Ch:	And he gets faster. So it's not that.	*Pointing at graph 5a.*
Cl:	So it …mm… it would go up, wouldn't it and it would drop down like that? Should we try it?	*Showing her sketch to Chantel, 5b. Referring to graph 5a. Replaying the motion.*
Ch:	No wait till we've drawn the graph first.	
Ch:	It would go up and just across …a bit *slanted a bit.*	*Showing her sketch to the others.*
L:	No! No! but no! but because it's … look it's distance against time right? He's running first isn't he?	*Referring to her sketch 5b.*
Cl:	Yes, and he's still travelling when he pole vaults.	*Holding up her sketch for the others to see.*
L:	Yeh but he's going, he's going…	
Cl:	Slower.	
Ch:	He's not going a right long distance, is he?	
L:	No.	
Cl:	So yeh it'll go like that.	*Sketching her graph again in response to Chantel.*
L:	No, go through the graphs.	*Pointing to the right-hand dialogue box (as opposed to the one for the choice of axes).*
Cl:	Yeh that.	*Referring to graph 5c.*
L:	Wait, try anther one. No not that one.	*Referring to graph 5a.*
L:	Oh it could be that yeh.	
L:	No not that one.	*Pointing to graph 5d.*
Cl:	How do you…?	
L:	Because he's going across there, isn't he?	*Now pointing to graph 5c.*
Ch:	That! That one I think.	*Referring to graph 5c.*
L:	Yeh. Test that one!	*Positive feedback from the system.*
L:	Yes!	

bringing the whole class together to discuss the results of the small group activity. These issues are discussed further in Hudson (1997).

It seems clear to me that existing resources offer significant potential for enhancing activity in the mathematics classroom, and also offer the opportunity to learn lessons for future development. However from recent discussions with some members of the development team, it seems that the package is not being used on as wide a basis as was initially hoped. Pricing policy seems to be a part of the problem, which raises questions for me about the policies and procedures of the former *National Curriculum Council*. Given that the initial investment in the development ran into hundreds of thousands of pounds of tax payers' money, it seems to have been a staggering lack of foresight that so little attention was given to dissemination or to the associated and very necessary in-service training for teachers. Who evaluates their (the NCC) effectiveness, efficiency and value for money, I wonder?

Brian Hudson works in the Mathematics Education Centre, Sheffield Hallam University

Acknowledgements
I would particularly like to thank Stuart Taylor and his colleagues for their help and support with this curriculum development.

References

Atkins, M. and Blissett, G.:1989, Learning activities and interactive video: an exploratory study, *British Journal of Educational Technology* 20, 1, 47-56
Cutler, B.: 1993, Review: The World of Number, *Micromath*, 9.2
Hudson, B.:1996a, Group work with multimedia in mathematics: contrasting patterns of interaction, *British Journal of Educational Technology*, 27, 3, 171-190
Hudson B.: 1996b, World of Number – a critique, an example of classroom use and some suggestions for future development, *IMA Journal of Teaching Mathematics and its Applications*, 15, 2, 56-66
Hudson, B.: 1997, Group work with multimedia in mathematics: the role of the technology and of the teacher, *British Journal of Educational Technology*, (In press)
Hughes, L.:1994, Tailors seek sharper needles, *TES Update*, 25 March
Shavelson, R., Winkler, J., Stasz, C., Feibel, W., Robyn, A. and Shaha, S., (1984), *"Successful" teachers' patterns of micro-computer-based mathematics and science instruction*, Report to the National Institute of Education, Rand Corporation
Shell Centre for Mathematical Education, New Media Productions and the National Curriculum Council.:1993, *The World of Number – Key Stages 3 and 4*, New Media Press
Smith, D. N.: 1996, *Getting Started*, The Mathematical Association
Teasley, S. D. and Roschelle, J.:1993, Constructing a Joint Problem Space: The computer as a tool for sharing knowledge in Lajoie, S. P. and Derry, S. J. (eds) *Computers as Cognitive Tools*, Lawrence Erlbaum

World of Number

Stuart Taylor

Having made a successful bid to the LEA to be involved in trialling the use of a multimedia computer system in mathematics, we were very keen to make as wide a use of the PC based system as possible.

With three laser discs of resource material available, the initial problem was finding time to view what seemed like a vast array of material on three laser discs, and to work out how best to use it. No external Inservice Training or funding was available, and trying to arrange for all our interested mathematics teachers to meet together for any length of time proved problematical. However, we were determined to get to grips with this exciting new resource and we quickly became enthusiastic about the potential of the system, which we thought could provide an excellent vehicle for 'Using and Applying Mathematics', as well as helping to promote groupwork and oracy, both targets in our school development plan.

The mathematical adventure game 'Who Stole the Decimal Point' soon established itself as a firm favourite with both staff and pupils of all abilities, and led to some good investigational work in class. Also, the 'Running, Jumping and Flying' module was used with more able groups to support work on graphical interpretation.

The work that went into the research, production and preparation of this document has to be supported somehow.

ATM receives its financing from only two principle sources: membership subscriptions and sales of books, software and other resources.

Membership of the ATM will help you through

Now, this bit is important - you must read this

- Six issues per year of a professional journal, which focus on the learning and teaching of maths. Ideas for the classroom, personal experiences and shared thoughts about developing learners' understanding.
- Professional development courses tailored to your needs. Agree the content with us and we do the rest.
- Easter conference, which brings together teachers interested in learning and teaching mathematics, with excellent speakers and workshops and seminars led by experienced facilitators.
- Regular e-newsletters keeping you up to date with developments in the learning and teaching of mathematics.
- Generous discounts on a wide range of publications and software.
- A network of mathematics educators around the United Kingdom to share good practice or ask advice.
- Active campaigning. The ATM campaigns at all levels towards: encouraging increased understanding and enjoyment of mathematics; encouraging increased understanding of how people learn mathematics; encouraging the sharing and evaluation of teaching and learning strategies and practices; promoting the exploration of new ideas and possibilities and initiating and contributing to discussion of and developments in mathematics education at all levels.
- Representation on national bodies helping to formulate policy in mathematics education.
- Software demonstrations by arrangement.

Personal members get the following additional benefits:

- Access to a members only part of the popular ATM website giving you access to sample materials and up to date information.
- Advice on resources, curriculum development and current research relating to mathematics education.
- Optional membership of a working group being inspired by working with other colleagues on a specific project.
- Special rates at the annual conference
- Information about current legislation relating to your job.
- Tax deductible personal subscription, making it even better value

Additional benefits

The ATM is constantly looking to improve the benefits for members. Please visit www.atm.org.uk regularly for new details.

LINK: www.atm.org.uk/join/index.html