Multimedia Motion:

motivating learners

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The Multimedia Motion CD-ROM is used as part of the teaching for the Supported Learning in Physics (SLIP) project, an Open University-led project to develop open and flexible learning materials in physics for use by post-16 students in schools and colleges. Multimedia Motion enables students to chart and analyse a range of movements: displacement, velocities, accelerations, etc. of a variety of people and vehicles. During the pilot phase of the project, we conducted an evaluation of the CD-ROM-based activities. The evaluation consisted of observations of teacher and student use of the material in two schools, augmented with data obtained from questionnaires administered in a further two schools. The resulting data raises a number of issues about how exploratory learning can best be supported by multimedia. We observed the expected benefits of increased motivation for learners because of access to more realistic applications of the laws of physics illustrated on the disc. However, several others factors appeared to be important to students when using it. In this paper, we explore how teachers' and students' perceptions of the task involved in learning post-16 physics must be addressed in designing suitable multimedia presentations and exercises.

Introduction

Multimedia Motion is a CD-ROM, designed by Gill Graham and David Glover, for teaching post-16 students about dynamics. It allows students to select data from moving bodies (such as space rockets and tennis players), and to explore how that data can be displayed graphically and what the relationships are between distance moved, velocity, acceleration, impulse, momentum, etc.

Use of parts of the disc is incorporated into the Supported Learning in Physics (SLIP) programme, and it is in this context that the evaluation of its use reported here was carried out.

The SLIP Project

The SLIP Project is a curriculum development programme, led by the Open University, to provide flexible, supported learning materials for students studying for A or AS level physics or GNVQ advanced science or engineering. The materials are currently at various stages of development, and should be ready for use by post–16 students in the autumn term of 1997 (a description of the SLIP project can be found in Whitelegg, 1996). The materials are all text-based, but some authors are incorporating multimedia into their study units, and it is in this context that Multimedia Motion is used. It is currently used for four 'explorations' in the unit Physics on the Move (which teaches dynamics and statics), and is also used in the unit Physics for Sport. The CD-ROM complements the laboratory-based practical work incorporated in the units, and reinforces a core educational strategy used in SLIP: that of teaching the physics content through real-life contexts.

Motivation

Teaching through real-life contexts has been shown to increase motivation for learning (Hennessy, 1993), and this strategy is employed throughout the SLIP materials. The contexts for the Physics on the Move unit is the safe transportation of people and goods, and for the Physics for Sport unit the contexts of rock climbing, springboard diving and scuba diving are all used to teach forces, vectors, oscillations and pressure. The Multimedia Motion disc asks students to examine videos of car and train crashes, people jogging, playing various sports, etc., and thus reinforces the real-life approach introduced in the text materials. Because of this approach, Multimedia Motion is more consistent with the philosophy of the project than certain computer simulations which could have been used instead. The disc also uses examples of laboratory-based experiments, such as the linear air track to teach momentum and kinetic energy. These can be compared with real experiments done by students in the school or college laboratory. In addition to increasing motivation for learning physics through the use of real-life contexts, it was felt that the inclusion of the CD-ROM would increase motivation in students who might perceive it as a new and exciting way to learn, particularly for those who already used CD-ROMs for entertainment.

The evaluation

The evaluation of the use of the disc was carried out in parallel with, but separately from, an evaluation of the text material (Abraham, 1996). Separate teams undertook the text and CD-ROM evaluations, although the same schools and colleges were used for both. The aim of the evaluation was to determine whether the incorporation and use of the disc in the project's materials was realistic or not, and whether it could provide an effective learning experience which might replace some conventional laboratory-based practical experiments. Yilditz and Atkins (1993) suggest a wide range of aspects of multimedia to be addressed in any evaluation. Our eclectic approach was that advocated by Jones *et al* (1996).

Evaluation method

Observations were carried out at two schools. One was involved in the evaluation of the SLIP project texts, and the other acted as a control school. These observations involved 12 students in around 60 hours of computer-based activity, and the resulting data is in the form of videotape records, observation schedules and student self-reports.

To confirm our findings from the observations, we devised two questionnaires about students' use of the disc, one for students themselves, the other for their teachers. The questionnaires asked them about their previous experience, and their perceptions of the advantages/disadvantages, of using computers in physics lessons, their use of CD-ROMs generally, and about the Multimedia Motion disc and the particular sequences on it which they used. Students were asked to compare the Multimedia Motion explorations to real practical work, to compare watching practical demonstrations in the laboratory with watching videos in computer simulations, and to report on how much teacher-support they needed in order to use the disc. These questionnaires were sent to the schools and colleges involved in the evaluation of the SLIP Project. Twenty-one questionnaires were returned.

Evaluation outcomes

Increased motivation for learners

We observed some of the expected benefits of increased motivation for learners because of access to more realistic applications of the laws of physics illustrated on the disc, as predicted by one of the authors of this paper, Hatzipanagos, at a presentation given in 1995 at CAL'95 in Cambridge. Some students wrote that Multimedia Motion made physics more fun, and provided a variation in the approach to the subject, though not all agreed ('The Multimedia Motion explorations offer more accurate results and an easier way of obtaining them, but are not as much fun as performing the real experiments').

Support for exploratory learning styles

Throughout the observations, most students did not use the disc to its full extent. The SLIP material which incorporates the use of the disc directs students to undertake particular activities and provides some questions to answer resulting from its use. However, students often ignored these instructions, and once they had got Multimedia Motion running, their use of it became rather unstructured. The disc provides data-files which students need for solving physics problems, and there was often a reluctance to embark on these problems, particularly if calculations were involved. Without teacher input, either in the form of teacher-directed problems to be solved through use of the disc, or monitoring and help provided by the teacher during its use, there was a tendency for less motivated, less able students to jump around the various contents without engaging with them very constructively. Also, as most students used the disc in pairs or groups of three, some just observed others using it, and did not interact with it themselves. This led to a passive experience, similar to watching a video.

Practical work and computer-based activities

In general, students felt that the computer-based activities on the disc had some advantages for learning dynamics over laboratory-based practical work. Typical comments were that the disc gave 'examples of real situations where realistic data can be manipulated and understanding made easier', and that the explorations 'can be used faster than doing all the experiments for yourself'. There were also positive student comments concerning the ease of printing out information, the reliability of results, and the usefulness of a frame-by-frame feature of the software. One teacher commented that students concentrated on data rather than on setting up and adjusting physical equipment. There were, however, some opposing views from students, such as that 'much of the learning stems from mistakes made in real practicals', and that Multimedia Motion 'lacks the hands-on feel of a practical lesson [and] some of the problem-solving elements of setting up a practical'. One student wrote: 'Seeing something for yourself in real life leads you to believe it more', while another wrote: 'More is learned by doing practical experiments than by *looking* at the computer screen' (our italics).

Difficulties with graphing

Many students had difficulty in interpreting the graphs that their data produced. This was sometimes due to the data points they selected, but they were also sometimes left confused and frustrated because they had not attained the outcome they expected. They complained that they could not ask the computer questions in the same way as they would normally ask their teacher.

School/college mode of use

In nearly every case, the use of the disc was limited by the number of computers with CD-ROM drives available in the school or college. In both the institutions where observations took place, only one computer was available for students to use the disc. The results of the postal questionnaires also indicated limited use because of lack of hardware.

Conclusions

There are certain learning styles which, it is claimed, multimedia can support, among them exploratory learning (see, for example, Laurillard, 1993). But for students of this age and relative inexperience, multimedia may not be effective on its own. The students in this study needed more teacher intervention and to be provided with problem-solving activities which required their interaction with the disc. This would also encourage the more passive students to interact with it, and the more dominant ones to share the use of the computer.

The lack of hardware was a problem in every institution which responded, and prevented the disc from being built into the core of the teaching programme. It tended to be used as an added extra outside the main curriculum, or for revision.

The creators of this disc have now produced a Teachers' Pack which may help to solve some of the problems. However, while Multimedia Motion provides an alternative to some laboratory-based practical work, without frequent teacher intervention, students will probably not make effective use of all that it offers. It can provide an effective learning experience, particularly for high-ability, motivated students, but for others it does so only with substantial teacher support and monitoring. Multimedia in this form is not stand-alone but is a useful and enjoyable way for students to increase their learning in a conceptually difficult area of physics, and to relate it to real-life situations in an interactive way. As one student put it: 'Lab-based and multimedia approaches should both be used to complement each other.'

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