Lower achieving primary students’ opinions on virtual reality

James Cook University

A frequently reported characteristic of students who are not successful at school is that they are inactive learners (Cole and Chan, 1990). Inactive learners are students who usually do not engage in activities with enthusiasm or curiosity, taking a passive role in the classroom and displaying a lack of motivation. According to Cole and Chan, inactive learners do not take control of their learning, and tend not to make decisions about their interaction with materials which could improve their performance.

There is growing interest in the use of virtual reality (VR) to support learning in schools generally (for example: Ferrington & Loge, 1992; Helsel, 1992; Auld & Pantelidis, 1994; Lewis, 1994; Kelly, 1996), and Pantelidis (1993) argues that it has potential benefit specifically for inactive learners. From this perspective, one of the main characteristics of virtual worlds is that they do not perform for an inactive viewer, in the way that film or television does. A virtual world remains static until the viewer decides to use an input device and explore it. Virtual worlds are three-dimensional, and users may move through them at will, for example going from one room to another in a virtual building. As well as moving through the world the user may also be able to change it, such as by moving objects with a virtual hand. A student who decides to engage with a virtual world has no choice but to make one decision after another about how to explore it.

It is entirely up to the individual to decide how to explore and what to change. Unlike most presentations of information, where the observer has little or no influence over what is shown, VR is highly interactive. The options for exploring even a simple scene are numerous. It is possible to move quickly or slowly in any direction, to stay on the virtual ground or to fly, to take a straight or meandering route, to stop frequently and examine detail or take a superficial tour, to explore objects from the inside as well as the outside, and to pick up and rearrange them. The probability of two students exploring a world in an identical manner is very low, and thus interaction with VR is highly individual. Ferrington and Loge (1992) suggest that when students actively pursue their individual strategies for exploring educational virtual environments, they will learn more effectively than when playing an inactive role in a traditional classroom. This suggestion is supported by Ainge’s (1996) finding that VR had a significant, positive impact on primary students’ learning about three-dimensional shapes.

Expectations about the usefulness of VR in challenging inactive learners rest, of course, on the assumption (Lewis, 1994; Orwig, Barbato, Kincaid, and Mosshel, 1993; Pantelidis, 1993) that virtual worlds will appeal sufficiently to students that they will take up the challenge. The use of VR in classrooms is a new field, and only a small number of investigations have been undertaken. There is some evidence that students tend to find VR sufficiently attractive to make the choice to engage with it (Bricken and Byrne, 1993; Osberg, 1995). Information is needed, however, on the maintenance of engagement by lower-achieving students over an extended period, in order to differentiate between the impact of novelty, and VR’s capacity for sustaining interest when it is a regular feature of school work.

This study investigated the attitudes of a group of primary students to working with VR over a six week period. The study was conducted with a grade 6/7 composite class in the state of Queensland, Australia. This class, which was the first in the state to use a VR program, started working with the Vream Virtual Reality Development System. The students used the Vream editor to create solids such as cubes, cylinders, spheres and pyramids as part of their mathematics curriculum. They found that it was easy to make the shapes, and they explored them by zooming in or out, viewing them from any side, and going inside the shapes to experience a very unusual viewpoint. Their ability to recognise these shapes in the environment, such as buildings and common objects, was tested before and after the work with VR, and they improved significantly. They were also compared with a control group who built the same shapes from card, and the VR students learned much more (Ainge, 1996).
The class consisted of twenty students (6 girls and 14 boys). The mean age of the students was 12 years 1 month, and the ages ranged from 11 years 3 months to 13 years 2 months. The school is officially recognised as a socio-economically disadvantaged school. Before commencing the study the researcher observed the class over a period of several weeks. Although some students showed enthusiasm on a regular basis, the majority took little active interest in class activities. They did the minimum, were frequently off-task, and were sometimes disruptive.

The students had not done any work on 3D shapes in the current year, and not all students had heard of VR. Some of the students had limited experience of VR arcade games which had recently arrived in the town. The students were accustomed to working with computers in the classroom on a daily basis, and therefore the results found were due to the work with VR, not the novelty of using a computer.

All of the work with VR was supervised by the researcher, working with students in pairs in the computer area at the back of the classroom, while the class teacher continued with unrelated work. All students in the class became involved in the VR work.

The VR program was the Vream Virtual Reality Development System running on a Pentium 90MHz computer with 8Mb RAM. Before the work on shapes began, the students were introduced to one of several demonstration virtual worlds supplied with the Vream program (Figure 1). They were then taught how to run these worlds, observing the display on the monitor (desktop VR), and how to navigate through them using keystrokes initially, then a joystick. They were then shown how to pick up objects with a virtual hand controlled by a two-button mouse. The students had the option of exploring these worlds further in class time and during breaks, and they did so at every available opportunity. The program on shapes did not commence until all students were able to explore the worlds with ease.

The shapes studied were the cube, rectangular prism, triangular prism, square-based pyramid, triangular-based pyramid, cone, cylinder, and sphere. They were chosen because these shapes are easily created with the Vream editor. In the editor a shape is drawn with a two-button mouse, by selecting the editor button which displays the desired shape, pointing to a starting position, then dragging and clicking the width, depth and height as desired (Figure 2).

The students were first taught how to create shapes in editor mode, and alter their dimensions. They were then shown how to save their shapes to a file, and explore them in the Runtime mode. Exploration could involve viewing shapes from any angle by flying around them, zooming in and out, and going through the shape walls to examine them from inside. There was also the option of picking up and moving the shapes with a virtual hand. After this initial training each pair of students created a world which had to contain all the specified shapes, but they made their own decisions about dimensions and layout (Figure 3).

They then had regular opportunities for interacting with their worlds by exploring and moving shapes. They were supervised, but not told how to interact with the shapes. A problem that sometimes occurred was that students made movements which resulted in their shapes disappearing from view, and they had difficulty in finding them again. When this happened they were assisted. No systematic instruction about shapes was given, but students frequently initiated discussion. The purpose of the hands-off approach was to focus on the impact of VR, and allow students to display lack of interest, or show that they had exhausted options for meaningful interaction with their shape worlds.

In addition to sessions in class time, there was frequent, voluntary interaction with the demonstration and shape worlds during breaks. Six weeks after the introduction of VR, the students were asked, individually, eight open-ended questions, and their replies were tape-recorded.

Two of the twenty students could not be asked because of prolonged absence. The questions were chosen to explore the students’ views about the impact of VR on their learning, possible improvements, and their enjoyment of it.

1. Did using virtual reality help you learn?
   All eighteen students replied that it did.

2. How did it help you learn?
   Seven students replied that VR helped their understanding of shapes, but were not able to be very specific about how it had helped them ("It’s definitely helped me look at all my shapes to remember them’; “Recognising shapes’; “It helps you a lot with them ’cause it’s easier to see on the virtual reality’). Four said that they had been helped by seeing the shapes from...
Lower achieving primary students’ opinions on virtual reality

The purpose of the hands-off approach was to focus on the impact of VR, and allow students to display lack of interest, or show that they had exhausted options for meaningful interaction with their shape worlds.

3. Could it have been better?
Eight said that it could not (“I think it’s excellent now”). Three were uncertain, and seven felt that it could be improved.

4. How could it have been better?
Four wanted it to be more realistic (referring to the demonstration worlds: “A little bit more fun, like, stuff like getting to go underground where everything is brown, lava, something like that”; “You can like open the doors and all that”). One of these students, referring to his shapes world, would have preferred a background so that movement of the shapes would have been more realistic. One student would have preferred the shapes to be labelled. Two wanted more games.

5. What was the one thing you liked best about it?
Nine students most enjoyed being able to move around in the virtual worlds (“Being able to go inside things and spin round”; “The joystick, being able to slide”). Four liked being able to pick up objects with the virtual hand. Two referred to being able to make their own worlds. One student said “It looks like it’s real, sort of”. One student was uncertain, and another said “I think I liked everything about it”.

6. What was the one thing you liked least about it?
Twelve students replied that there was nothing that they did not like. Two did not like having to type in commands in order to run Vream. One did not like the disembodied virtual hand, saying “I prefer like you see like a bit of the body and the hands and the arms”. One did not like using the keys to navigate, preferring the joystick. One student complained of dizziness. One said that the VR program was too popular and it was hard to get a turn.

7. Do you find it as enjoyable now as when you first started, or are you getting tired of it?
Eleven said that it was as enjoyable. Three replied that it was more enjoyable now than at the beginning indicated a unanimous feeling that VR had helped them learn, a high level of enjoyment of VR, and strong maintenance of interest over the six-week period. First, the students unanimously stated that VR helped them learn (question 1). Second, eleven students were able to say specifically how VR had helped them. The comments that they made, such as seeing shapes from various viewpoints, the 3D character of their virtual worlds, the benefit of seeing the shapes from the inside, appear to pinpoint characteristics of VR which are highly relevant to learning about three-dimensional shapes. One student’s wish to have the shapes labelled (question 4) seemed similarly relevant. Third, fifteen students found after six weeks that VR was at least as enjoyable as when they first began (the complaint about not getting a turn is taken, of course, as a favourable response). Fourth, the responses to question 8 clearly demonstrated the preference expressed by seventeen of the eighteen students for learning with VR rather than other activities.
Only a minority of students made specific criticisms of the VR experience. Several of the criticisms called for more realism, which is both understandable and encouraging. It is a reasonable criticism to make of virtual worlds created by novices, with one of the less expensive programs, running on an inexpensive computer, with low-immersion display. It is encouraging that a very modest VR experience was received so favourably. None of the criticisms suggested insurmountable problems for VR in classrooms. It is also encouraging that only one student complained of dizziness, which is a potential problem. Future research will need to investigate this matter carefully, and particularly investigate health issues associated with immersive devices such as head-mounted displays.

The responses strongly support the notion that interaction with VR is highly individual. The students had different views on how VR had helped them learn, ways it could be improved, and their likes and dislikes. The range of views strongly supports Kelly's (1996) position that VR as an educational tool has very little in common with the teach-test-correct programs of traditional computer-aided instruction. By contrast, it provides opportunities for students to construct their individual learning.

Observations.

From the outset, the class was very enthusiastic about using VR. Students voluntarily explored the demonstration worlds whenever possible, including during breaks, and some students complained that the computer was never free. Throughout the initial training, construction of final shapes, and exploration, not one student required any encouragement to remain on task, and many were reluctant to stop when their session came to an end. The teacher had to regulate usage in order to give all students time on it.

The teacher was impressed by the high level of student engagement and enthusiasm when working on VR, and the maintenance of interest over the six week period, which contrasted sharply with the response to other classroom activities.

Conclusion.

Although this was a small-scale study, the high level of student approval and interest, and the persistence of interest, strongly support Pantelidis' (1993) suggestion that VR has potential for inactive learners. The individuality of student responses, coupled with the superior learning of these children compared with a control group (Ainge, 1996) support Ferrington and Loge's (1992) claim for the benefit of active, individual learning. The success of VR in this study extended beyond short-term novelty appeal and suggested that it has a unique contribution to make as a regular tool in the classroom. There is a need now for other studies which investigate VR's appeal to, for example, different age groups, students who are not usually difficult to motivate, and students working on other aspects of mathematics or in other areas of the curriculum.

REFERENCES


