Cognitive Approaches to Understanding the Challenge of Computer-Based Learning

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INTRODUCTION

Increased motivation amongst pupils has been readily observed in schools when they are allowed to use computers and other forms of information and communications technology (ICT) (Cox, 1997; Denning, 1997; Wishart & Blease, 1999). In fact, Denning reports almost universal enthusiasm amongst students for the use of ICT to support their work in schools. Many psychologists (Light, 1997; Loftus & Loftus, 1983) have used behaviourist theories originating from the work of Thorndike (1898) to describe positive extrinsic reinforcements generated by or associated with the computer software. For instance, children find the use of a computer rewarding; they get nearly immediate feedback from the programs on their efforts, which often include entertaining sound effects, graphics, and animations. Therefore, they are more likely to take up opportunities to use ICT in and outside of lessons. What is more, as described by Loftus and Loftus, these rewards arrive in the variable-ratio schedule of reinforcement, which Skinner (1938) believes is the most compelling.

However, other more recent motivational theories focus on cognition rather than behaviour, and include controlling the software, intrinsic rewards (challenge, visual complexity), and graphical and epistemological curiosity.

BACKGROUND

The importance of a perception of control and/or autonomy to pupil learning has been justified theoretically by psychologists studying the links between motivation and learning. Byrnes (1996) notes the way in which students can become intrinsically motivated when they have control over their environment, set challenges for themselves, and satisfy their curiosities. He cites research by Stipek where researchers found that future competence will follow successes particularly if students believe they controlled the success.

Byrnes also discusses the role of self-efficacy, linking the agency beliefs (beliefs that enable individuals to personally control successes) proposed by Skinner, Chapman, and Baltes (1988) to the idea of intrinsic motivation. Control or choice within the learning environment will motivate pupils and so engender success; this in itself will therefore lead to further motivation.

Early work by Papert (1980) advocated the idea of the user controlling the computer versus the computer controlling the user when he proposed the use of LOGO, a programming language designed for education, in preference to the drill and practice software typically used. Underwood and Underwood (1990) reinforce this view in their study of the role of computers in the learning process. They emphasise the idea that if the learner is in control or in charge of his or her learning, he or she will respond to and appreciate the independence and so will learn. In a later review of the use of databases in classroom practice, Underwood (1994) returns to the idea of learner control, this time linking valued learning experiences with ICT to the ways in which students take responsibility for the learning outcome, and how new technologies could support a move to more independent approaches to learning.

In fact, using software to provide an open learning environment encouraging student autonomy and choice has been seen as good practice in ICT teaching in the United Kingdom for a number of years now (NCET/NAACE, 1994). The idea of empowerment and its relationship to the learning process is further discussed by Davis, Desforges, Jessel, Somekh, Taylor, and Vaughan (1997), who argued that the degree of autonomy that secondary school pupils had over the pace and content of their

learning with ICT was directly related to an increase in the quality of learning itself.

It appears that another key motivator of ICT is its ability to provide different levels of challenge for pupils of all abilities, inviting them to take control of the software and respond. For example, ICT can be used both to provide differentiation by task with pupils running the same educational program but at different levels, and by outcome with pupils using an applications package to produce a more or a less complex piece of work. Suitably chosen or content-free software provides appropriate challenges for different levels of ability, enabling most students to master the task and achieve their goals.

The importance of other cognitive, intrinsic rewards within software, such as challenge and complexity, was first described by Malone (1981a, 1981b) in his analysis of what makes video games so involving for the player. He considers that complexity created by the use of graphics and sound motivates the computer user through evoking curiosity to explore the software. Pupils using a multimedia CD-ROM can be seen to be satisfying this visual or graphical curiosity to see what images and sounds there are, as well as following up their epistemological curiosity to know more about a topic.

INVESTIGATION

This was tested empirically by Wishart (1990) who investigated the effects of the three cognitive factors—user control, challenge and visual complexity—on motivation to use and learn from an educational computer game. The game itself was intended for use by young children, written for the BBC micro, and it illustrated how to get out of a house fire safely. Three hundred primary school students played different versions of the game, which had been constructed to provide user control of movement through the house, challenge through scoring points, and visual complexity through use of graphic effects in different combinations. Control through user choice was found to be the most significant factor in creating involvement with and learning from the software.

These ideas were further investigated in a classroom project carried out by Fisher (as cited in Wishart, 2003), a grade-9 teacher in the humanities department of an English school. She allowed her pupils (two classes making 61 students in all) free choice in the use of ICT in terms of accessing, handling, and communicating information. The main difference from their previous work would be the use of ICT to extend the range of sources available and as a tool for both accessing information and presenting work.

The setting chosen for the task was the main computer room together with an adjoining work area, allowing a choice of software, printing facilities, desks, and printed resources to be simultaneously accessible. The teacher was helped in the planning and organisation of the project in that it did not coincide with any significant ICT tasks in other curriculum areas that would have limited access to the computer facilities.

After the pupils had completed this work, it was assessed by their teacher for level of attainment using the standards given in the UK national curriculum for history (DfEE, 1995), and it was compared with the level obtained for the pupils' last piece of assessed work.

Overwhelmingly, 89% of the pupils reported that they felt that using the computers had helped them do better in their work, and indeed 67% achieved a national curriculum level better than their previous assessment. Whether this would have been achieved in a normal assessment situation is difficult to say, but all pupils showed a good historical knowledge of the period studied, and they used in general a wider range of historical evidence gathered from a greater number of sources than in previous tasks. Their use of ICT included a range of presentation and information packages that was far wider than used in previous assessment tasks for history that had made use of ICT. Also, without exception, the groups had concentrated to a greater degree throughout and had been better motivated than in previous assessments.

It is clear that for these pupils, the element of choice in the use of ICT had a positive effect on the pupils' approaches to their work, with 77% reporting that they preferred it. What they enjoyed most was being able to use the software they chose when they wanted to (22% of answers), not being told what to do, and being able to choose not to use the computer (both, 18% of answers). When given this choice, they made full use of it, choosing a range of options, some familiar and some new to them. The pupils