
Educational software design:

applying models of learning

Stephen Richards

University of Teesside

Numerous psychological models exist which aim to explain how people learn, but the knowledge from educational theory is often missing from the design of computer-based learning applications. This may stem from the abstract and complex nature of many learning models. In order to address this problem, there is a need for simplified models of learning which include guidelines indicating how such models can be implemented in courseware design. This paper identifies such a model, and presents a series of guidelines intended to enable courseware designers to apply educational theory to the practical design of quality computer-based learning materials.

The 'spreading ripples' model of learning

The model of learning adopted within this paper is the 'spreading ripples' (SR) model proposed by Race (1994). This model was chosen for two important reasons. First, it makes use of accessible ideas and language, and is therefore simple. Second, Race suggests that the model can be used in the design of educational and training programmes (and can thereby be applied to the design of computer-based learning materials).

There are four key terms central to the SR model: Wanting, Doing, Feedback and Digesting.

Wanting. Race uses the term *wanting* in place of the term *motivation* which is more often used by psychologists. He argues that *wanting* implies much more than *motivation* since it lies at the centre of 'human urges'. When individuals attempt to learn, and are also highly motivated, excellent results are often possible. However, when wanting is lacking it is unlikely that efficient learning will take place.

Doing. When individuals are asked how they learn, very few refer to being taught or trained. Most refer instead to the process of 'doing' in some form or other. Race sums up these responses into four statements of active learning: *practice, doing, trial and error* and *learning from mistakes*. Here the emphasis is firmly on the activity of the learner.

Feedback. An important issue in all human behaviour, including learning, relates to

feelings (Mueller, 1975). When individuals have positive feelings, they are likely to be capable of more effective learning – an issue often overlooked by learning theorists (Race, 1994). It is therefore important to understand how people most frequently obtain positive feelings about their behaviour so that attempts can be made to produce the same positive feelings when they are involved in learning behaviours. When individuals are asked about where they obtain positive feelings from, a typical pattern of responses emerges. Few claim that the feelings come from within; most obtain their positive feelings from the comments made about their behaviour by others. In other words, people need feedback about their behaviour in order to feel good about it. Feedback is therefore an important mechanism by which positive feelings towards learning processes can be engendered.

Digesting. When discussing the processes that learners undergo in order to make sense of new information, educational psychologists often use terms such as *reflection* and *reflective observation* (Kolb, 1984). The term *digesting* is used by Race as an everyday alternative to these terms. For effective learning to take place, the learner must not only take in new information, but must also sort out what the important points were and extract or formulate any underlying principles that may exist. It is only by actively processing information in the context of previous knowledge that the new information can be effectively assimilated.

Guidelines for designers

From all this, eight guidelines can be produced, two for each of the learning processes identified by the model.

Wanting guidelines

1. Wanting must be consciously programmed into courseware.

An assumption often made in higher education is that students already possess the wanting, and that this is evident simply by virtue of the fact that they are undertaking advanced education as a matter of choice. In reality, wanting is often lacking for some students. If motivational issues are not addressed directly, some will fail to make adequate use of the learning materials provided.

2. Two basic ways exist for embedding wanting: increased value and increased enjoyment.

Within all areas of learning, there are aspects of the subject matter that students will find uninteresting, and others that they will find enthralling. Unfortunately, although trends can be identified, the areas in which students are intrinsically motivated vary from one student to another. For this reason, it is important to provide embedded motivation. Increased value can provide that motivation by showing students the purpose of studying each aspect of a course, and also a schema of how the various aspects of the course link together. In this way, topics are no longer seen as isolated items, and the value placed on each topic by students can be increased. Motivation can also be increased by trying to present the learning in a more enjoyable format. This can be achieved in a number of ways, including the use of multimedia and the use of game-playing strategies. Extreme care must be taken, however, not unnecessarily to embed expensive multimedia resources or to trivialize the learning experience by an inappropriate use of the game approach.

Doing guidelines

1. Avoid passive interaction.

A problem found in many computer-based learning applications is a reliance on the relatively passive interaction involved in page turning. Here the user is not interacting with the information in any meaningful sense. Instead, the user's primary task becomes the monotonous and repeated selection of a 'next-page' icon. Interestingly, it seems to be a particular problem in those applications which use digital video as an information-presentation medium. It seems that the inclusion of high-cost video resources, which improve the aesthetic appearance of learning products, has led to a de-emphasis of the learning design. A return to more meaningful interactions that stimulate active thinking processes is required (for example, investigating interrelationships between concepts, and controlling simulations).

2. Support practice and/or trial-and-error learning.

When people are asked how they learned to do something which they are good at, their most common responses centre on the terms *practice* and *trial and error*. People seem to learn most effectively by doing something over and over again. Each time they make a mistake, the error is recorded and attempts are made to avoid making the same error again. In order to produce effective computer-based learning products, this capacity to provide students with the opportunities to practice new skills or knowledge, to make mistakes and correct their errors, is crucial.

Feedback guidelines

1. Provide students with a sense of progression.

In order for students to improve their skills or knowledge, they must have some sense of their progression. They must be able to see the improvements that are being achieved and compare those achievements with their own progression up a particular learning step. In terms of computer-based education, this means that the scope of the learning target should always be readily available. A problem encountered in many hypermedia learning products is that the scope of the learning is never clearly available to students. This means that they are often unable to see how they are progressing with regard to the learning goals, and may rapidly lose interest because there is no way of assessing their direction or achievement. This can be remedied by providing students with a clear idea of the scope of the learning objectives. Students should also be provided with the means to assess their own progress through appropriate feedback.

2. Encourage use within a social context.

The impact of both teacher and peer feedback is often much more powerful than that automatically generated by the computer. As a result, it is important that learning software is designed so that advantage can be taken of use within a social context (for example, with friends, in a classroom, or even in a remote or virtual class). In such social contexts, students are able to obtain personal feedback with respect to their progress. Such feedback also has the advantage that it can be targeted specifically at individuals, taking into consideration individual personalities, abilities and expectations.

Digesting guidelines

1. Embed computer-based student evaluation.

In order to assimilate new information, students must undergo a process of making sense of new material in relation to their existing knowledge. This is a process that can be encouraged by providing an environment in which students are required to think about the materials they are learning. Perhaps the simplest way of achieving this in computer-based learning applications is through the embedding of appropriate evaluation techniques. Such evaluations must be designed to cause students to analyse the concepts or information delivered, and then link the material together in new ways. This process causes the student actively to digest what has been learned, rather than simply trying to reproduce the delivered information without considering meaning.

2. Encourage reflection away from the computer environment.

As already mentioned, learning tends to take place most effectively within a social (rather than a purely computer-based) environment. Just as feedback can be obtained through mechanisms outside the computer environment, so too can digesting take place away from the machine. There are several ways in which this can be achieved. The most obvious way is to encourage students to undertake tasks away from the computer which involve them in trying to apply the concepts or information they have been exposed to in the computer-based environment. Such tasks can also encourage the use of team work or discussion groups which provide the social context in which digesting can take place most effectively.

Conclusion

The guidelines outlined in this paper are intended to be used by designers in the practical development of courseware. Such work has already been undertaken in one project which is targeted at teaching undergraduate psychology (Richards, 1996). Preliminary findings have shown that the guidelines are useful (from the developer's perspective), and that they lead to the production of effective learning materials (from the student's perspective). The wider practical application of Race's model should lead courseware engineers to reconsider the importance of educational theory in the design of effective computer-based learning packages.

References

- Kolb, D. A. (1984), *Experiential Learning: Experience as the Source of Learning and Development*, New Jersey: Prentice-Hall.
- Mueller, R. J. (1975), *Principles of Classroom Learning and Perception*, London: Unwin Education Books.
- Race, P. (1994), 'How real people learn – not what educational psychologists think!', in Hoey, R. (ed.), *Designing for Learning: Effectiveness and Efficiency*, London: Kogan Page.
- Richards, S. M. (1996), 'Designing educational software: a case study', *Proceedings of 13th International Conference on Technology and Education, New Orleans*, pp. 40–2.