

GENUINE THINKING OR RANDOM BUTTON PRESSING? SELF-ASSESSMENT DESIGN IN COMPUTER-BASED LEARNING MATERIALS

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Abstract

This paper asks how computer-based learning materials can be designed to maximise cognitive engagement on the part of the learner. Computer-based materials are often based around self-assessment questions. How can we ensure that these will stimulate thinking rather than random button pressing? The paper argues that a key issue is that of how feedback is presented, and uses the experience of developing and evaluating a computer-based tutorial based around drag-and-drop style matching questions to discuss four specific questions: At what point do you present feedback? How much information should the feedback contain? How many times do you allow the learner to attempt the question? At what point do you allow users to move to the next question? The paper tentatively concludes that a solution may be to design questions so that it takes more effort for learners to randomly guess the answer than to work out the answer themselves. It is recognised however, that such an approach will depend on the ready availability of the information needed to answer the question, and on the complexity of the subject matter.

Keywords

Design, self-assessment, computer-based learning, motivation, feedback

Introduction

Computer-assisted-learning materials are often designed to emulate face-to-face teaching, using the “conversational” model of teacher-student interaction: teacher poses question; student attempts answer; teacher gives feedback on answer; student reformulates answer (Laurillard 1994). This approach is considered preferable to materials that simply present large amounts of materials without actively involving the learner. A common method of realising this model in computer-based learning is by designing materials around self-assessment exercises. This paper discusses some alternative ways of designing self-assessment exercises in computer based learning, and considers how best to motivate learners to reflect and think about the materials, rather than just get to the end of the tutorial.

Sources and methods

This paper focuses primarily on the experience of developing a tutorial and self-assessment on recognising dog breeds for the Veterinary Nursing and Practice Administration (VNPA) course at the University of Bristol. The tutorial was aimed at replacing face-to-face teaching. Additionally, a revision tutorial on the Renal System developed for the Department of Physiology has been used for comparison. Both tutorials were evaluated by observing students using the tutorial in pairs, and by discussion with students after they had used it.

Promote thinking, discourage random guessing

Although we may not expect computers to replicate the flexibility of small group face-to-face teaching, the intention of computer based materials designers should still be to promote active involvement, thinking and reflection on the part of the learner. However Zipf's (1949) principle of least effort would predict that by contrast, the intention of the learner might be to find the quickest way of getting the computer to tell them the right answer, which may simply be to guess randomly. But this will be influenced by the design of the materials, particularly by how and when feedback is provided. As Schimmel (1998) says, feedback can serve to support learning processes, but by providing too much feedback too soon it can also short-circuit them.

Teaching or Testing?

Self-assessment questions in computer-based learning can have a variety of functions, some of which aim principally to test, and others mainly to teach. Designing self-assessment that promotes thinking is clearly more important where the aim is to teach. However in the author's experience, these aims can often become confused, and need to be articulated at the beginning of the design process.

Description of the tutorial

The self-assessment questions in the Dog Breeds tutorial principally aimed to teach rather than to test. It was intended that at the end of the tutorial students would be able to recognise and name 112 major dog breeds and allocate them to their correct breed group. The tutorial was supported by the Kennel Club web site. This contains, in readily accessible form, all the information needed to answer the questions in the tutorial. Most of the tutorial was based on drag-and-drop matching questions (see Figure 1) each containing between 4 and 8 dogs from the same breed group.



Figure 1

Design Questions

The following paragraphs discuss some of the questions that faced the designers of the Dog Breeds tutorial when considering how to provide feedback for these exercises.

Do you give feedback a) after dragging each item or b) when the learner has answered the whole question?

It was thought that approach a) might encourage the learner to solve the question using strategies such as trial and error, and elimination, rather than by thinking about the question itself. The Physiology Renal tutorial contains a drag-and-drop question that takes this approach (see bottom of Figure 3), and students who used it said that they did indeed tend to apply this kind of strategy. Approach b) was duly chosen for the Dog Breeds tutorial. This, in conjunction with the many possible combinations of dog name/picture would make it very time consuming to arrive at the correct answer by trial and error.

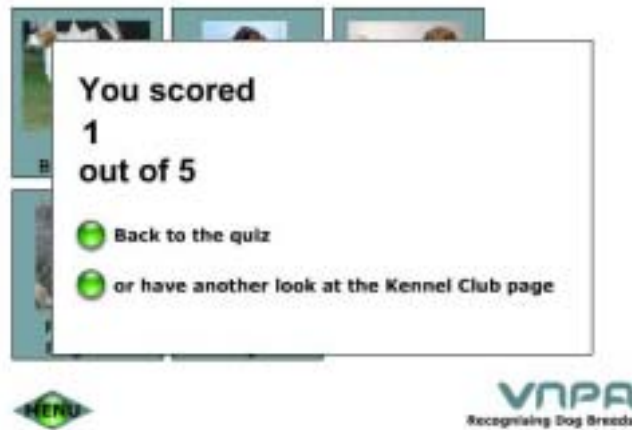


Figure 2

Do you tell the learner the correct answer if they get the question wrong?

The topic covered by the Dog Breeds tutorial was relatively simple, and the necessary information was readily available. It was therefore thought that learners could work the answers out for themselves, and this would be the best of way of maximising their internal processing. As a result, until they have got the whole question correct they do not receive confirmation of the answer, but are told only how many items they have correct (see Figure 2). The VNPA students expressed frustration at not knowing which ones were correct, which was perhaps an understandable reaction to having to think harder but also a potential motivation problem.

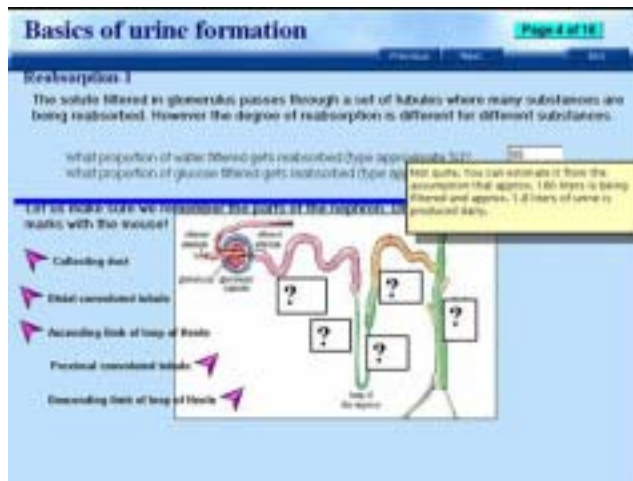


Figure 3

The approach taken depends on learners making effective use of the Kennel Club site. The VNPA students seemed to prefer to solve questions through discussion with their peers and in one case by reference to a Dog Breeds book. However, they said if they'd been working alone they would have made more use of the Kennel Club site. The Renal tutorial also contains some questions that don't tell the learner the right answer until they've correctly calculated the answer themselves, but what the feedback does offer is a hint to help students to do this (see top part of Figure 3).

How many times do you allow the learner to attempt the question?

It could be argued that by only allowing the learner one attempt at a question, it raises the stakes and encourages them to think first, click later. However if feedback is still provided whether the learner gets the question right or wrong, then they might just as well click on any old button and see what it says. The Renal tutorial gave learners a total score for the tutorial, which seemed a sufficient incentive for some students to try and get the questions right. In the case of the Dog Breeds tutorial, since the learner can

neither receive confirmation about the correct answer nor move on to the next question until they have answered correctly (see below), it was thought there would be no advantage in either limiting the number of attempts or providing a score.

Do you allow users to move to the next question before they've got the question correct?

The concern here was that if you allow learners to move through the tutorial whether or not they've completed the questions, they might just skip over any that seem difficult. The Dog Breeds tutorial (see Figure 2) therefore allows learners to move to the next page only when they have correctly answered the whole question (although they can use a Menu button to jump to another section or to Exit the tutorial). By contrast, the Renal tutorial allows the learner to move from page to page without answering the questions, and students said that if they found a question too hard they did tend to do this. Although this may simply be the principle of least effort at work, it may also constitute an effective self-diagnostic learning strategy.

Conclusions

This paper set out to raise some questions about the design of computer based learning materials and aims not to produce any firm conclusions, but to act as a stimulus for further discussion, research and evaluation. However some tentative ideas have emerged from the process of writing.

If we apply the principle of least effort, computer-based self-assessment may maximise learning if answering questions by trial and error takes more effort than working out the answer, depending on:

- How much effort is involved in answering the question; drag and drop with multiple combinations might be better than single-click MCQs for this purpose.
- How much is invested before getting feedback; a whole drag and drop question is more effort than clicking on a single button
- What feedback is provided; it may be better not to simply give the answer after the learner has made one attempt at the question, but to guide the learner to finding the answer themselves. However it is clearly necessary to provide enough (just enough?) information to make this possible.

The design decisions described in this paper clearly arise in combinations rather than individually. For example, if you prevent learners moving on until they've got the right answer, it makes no sense to give the right answer in the feedback, although you might decide to tell them how much they'd got right so far.

Finally, effective design choices will depend ultimately on the subject matter, particularly on its complexity, and on the aims of the tutorial. A self-assessment that aims to help the learner understand a complex concept, for example, will require more explanatory feedback than the Dog Breeds tutorial, which essentially provides a more interesting way of supporting rote-learning and pattern recognition.

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