The Future of Multiple Choice Questions in Learning: Formative Assessment, Interactive Teaching Modules and Student-created Questions within WebMCQ

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Introduction

Multiple choice questions (MCQs) have become increasingly prevalent in modern education. The potential for automatic processing of MCQs has encouraged their use in educational testing in a wide range of contexts, including secondary and tertiary level education aptitude testing, formal examinations, and also as part of surveys and attitudinal measures. The use of computers in this processing has been substantial, with optical character recognition (OCR) and direct computer based examinations being major contributors to the rise of this method in modern educational practice. The ability to test large numbers of students using computer based marking systems has helped ease the marking burden of teachers involved in large courses, a problem common to many early undergraduate science programs.

More recent developments in this field have seen the rise of web-based assessment systems, such as *WebMCQ*. These systems combine the advantages of traditional computer marking with the flexibility in time, place and pace of Internet delivered educational materials. Student evaluations of web-based materials, particularly where these are provided for practice prior to formal assessment (Dalziel and Gazzard, 1999), are extremely positive. Student feedback indicates that the ability to "get a feel for the test" (using practice questions), immediate feedback on incorrect answers, multiple layers of feedback, and the ability to use the system when and where they choose are among the reasons for these positive responses. Where formal exams use the same computer systems as those experienced earlier using practice questions, student familiarity with the interface should help to lessen exam tension and anxiety. Students using these systems for formal tests also appreciate the ability of these systems to provide final scores immediately upon completion of a test.

Web-based systems can offer new advantages to teachers as well, particularly where the entire process of creating, presenting and monitoring MCQ material is available over the web. By centralising all materials, and providing a system for editing questions and monitoring student usage, web-based administration tools can substantially reduce the burdens on teaching staff related to the implementation of computer based MCQs. As systems of this kind evolve in this area and elsewhere in educational courseware, easy to use web tools will help teachers to focus more on content and less on technical requirements (such as new programming languages, web site maintenance, knowledge of TCP/IP, etc.). This evolution in educational software systems should help teachers to spend more time on the task of teaching, and less time developing and testing software.

The use of MCQs in fostering student learning

WebMCQ is one system that has taken advantage of the major shifts in education and computing described above so as to aid teachers in the development of educational assessment material. For a description of the system and its development, see Dalziel and Gazzard (1998, 1999) or visit http://www.webmcq.com/. However, in the process of developing and implementing MCQ assessment material with a range of education and training partners, it has become clear to the authors

that MCQs have much wider potential application than just testing. While using MCQs in the **testing** of existing knowledge in some kind of assessment format is well established in education, we see new avenues for the use of MCQs in **learning** within education. This new branch of MCQ usage, where MCQs are used as a primary basis for encouraging student learning, rather than merely as a method for testing existing knowledge, is a new possibility encouraged by web-based implementation of MCQs. Three examples of the use of MCQs in learning are described below, although the first of these (formative assessment with multiple layers of feedback) is an existing method that can be classed in both testing and learning categories.

Formative assessment with multiple layers of feedback

The original success of *WebMCQ* was based on practice questions provided to First Year Psychology students prior to an end of semester test (Dalziel and Gazzard, 1998). These practice questions did not simply give correct or incorrect responses, but rather provided this and two levels of feedback about each question. The first layer of feedback indicated specific information about the question and why certain answers were correct or incorrect. The purpose of this layer of feedback was to provide information particular to the question to assist those students who may have given an incorrect answer, but who understood the question sufficiently to grasp the nature of the mistake they had made once feedback was provided. But in designing this feedback, it was clear that some students would not understand the initial reasons given for the correct/incorrect answers, and other students may not understand the topic at all due to lack of study. For this reason a second, more general level of feedback was provided to discuss the issue raised by the specific MCQs in a more general way. This feedback was designed to help students still struggling with basic concepts, and would sometimes include further references to handbook material or additional resources such as relevant textbook sections.

Student evaluations of this material indicated that both self-testing and self-teaching was occurring. Some students used the questions only after study of existing handbook notes and related material, whereas others started the process of study by using the questions and feedback provided as a basis for learning. Many students combined both of these methods, with the average number of sessions in which *WebMCQ* material was accessed (across all students) being more than two times (some used it more than ten times). Feedback indicated that students valued the multiple layers of feedback as a way of understanding both the specific issues of the question, and the more general issues raised by the relevant topic area. The following evaluations from a set of practice questions for a 1999 Social Psychology lecture series support these findings. In answer to the "best thing" about the material, students responded:

> "The feedback given once the question was answered would probably be the best part. Knowing where you went wrong and understanding the correct answer is quite helpful."

> "Explanations are thorough for both right and wrong answers . . . [the] notes relate to theories looked at in lectures."

> "[*WebMCQ*] provides answers concisely with additional information as well as the ability to print out the question, answers and feedback for revision."

Interactive question teaching modules

While formative assessment can combine both teaching and testing, it is possible to use the MCQ format as a primary instructional vehicle. While traditional methods of disseminating content rely on relatively passive methods (such as reading text or listening to lectures), a teaching module based on MCQs has the potential to be far more active in its engagement of student learning. If regular questions about current learning, new ideas and contentious issues are provided for students within an instructional module, together with subsequent feedback on the issues raised and provision of new instructional material, then MCQs can be a basis for entire interactive teaching modules. These MCQs need not have right or wrong answers in all cases, as questions which force students to choose

their own view of a contentious matter can then be used to help students reflect on the relative strengths and weaknesses of other views when given appropriate feedback. As *WebMCQ* and other similar systems can incorporate pictures, sound, movies, etc., it is possible for either questions or answers (or both) to incorporate the best aspects of multimedia training under the umbrella framework provided by the familiar MCQ structure.

By adopting this approach, whole teaching packages can be developed without the need to learn special programming languages or authoring systems, and given the multimedia options possible, these packages can be as rich as traditional computer assisted learning (CAL) systems, but without the difficulties in dissemination, creation and subsequent editing. An example of this approach to instruction is currently being developed by the authors for a guide to writing good MCQs, in which aspects of good question design, pitfalls to avoid and common misunderstandings about MCQs are all addressed within a teaching module that uses MCQs as a method for teaching about these issues. This guide should be available later in 1999 from the main *WebMCQ* web site.

Student-created MCQs

MCQs have long been derided as being incapable of testing higher levels of learning. While this may be true of many practical examples of MCQs in education, it is by no means a necessary phenomenon – well written MCQs can test some of the higher order types of learning such as application and analysis. However, it is difficult to see how traditional usage of MCQs can test the highest levels of learning such as broad-ranging synthesis and evaluation of knowledge, and especially, creativity.

However, a newly developed feature of the *WebMCQ* system may change the way this issue is considered in the future. This feature allows teachers to create student workgroups with limited access to the same web-based creation tools used by lecturers. Using this approach, teachers may allocate designated areas where students may create their own MCQs for other students to access for self-testing or later discussion. Students can provide feedback as well as designate correct and incorrect answers. This approach is expected to allow higher order learning (especially creativity) due to the fact that for students to create MCQs, they will need to synthesise their existing knowledge, form this into a testable question, and produce both a correct answer and plausibly incorrect answers (to this can be added feedback designed by the student if so desired). The process engaged in by the student would produce a qualitatively different learning experience to that produced by typical MCQ testing, and this process can be used in the classroom to allow students to view each others' questions and to consider any problems that arise with the student-created questions.

This is an innovative use of MCQs, and evaluation of this approach is currently underway, but initial student feedback is positive. There are a variety of ways in which student created MCQs can be applied in education, some of these include: individual versus group question creation, how students reacted to combined sets of teacher and student created questions, whether feedback on questions is required, whether question creation is optional or mandatory for all students, whether student-created questions may be subsequently used in formal testing, and so on. We expect the next few years will provide a rich source of options for the effective use of student-created MCQs in the learning process, and that this, together with the other uses outlined above, will vastly extend the range of educational uses of MCQs.

References

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