SEACHANGE: DESIGN OF ONLINE QUIZ QUESTIONS TO FOSTER DEEP LEARNING

Catherine McLoughlin
Australian Catholic University, AUSTRALIA
c.mcloughlin@signadou.acu.edu.au

Nick Reid
University of New England, AUSTRALIA
nreid@metz.une.edu.au

Abstract

The design of different types of quiz question will influence the extent to which formative and summative feedback is presented to students. Typically, quiz questions are considered limited in their capacity to assess higher order cognitive skills. This paper extends the notion of online quiz design by presenting examples in a WebCT learning environment in order to demonstrate a formative approach to assessment, closely integrated with learning processes. A matrix of questions is presented using Bloom's taxonomy showing the type of question, pedagogical underpinnings and cognitive skills required. The implications of this type of question design is that automated quiz type questions do not necessarily imply a narrow focus on recall, but may assess a range of learning processes.

Keywords

online learning, Web-based quiz, assessment, question design

Limits of traditional assessment

Educators can be in no doubt of the demands of society for lifelong capable learners who are able to perform cognitive, metacognitive and metacognitive tasks and demonstrate competencies such as problem solving, critical thinking, questioning, searching for information, making judgments and evaluating information (Reeves, 2000). Assessment processes are now in the limelight, with increasing emphasis placed not on testing discrete skills or on measuring what people know, but on fostering learning and transfer of knowledge. The traditional approach to assessment is largely a form of objective testing which tends to value students' capacity to memorize facts and then recall them during a test situation. Magone et al (1994) calls this the *one right answer mentality.* A second form of assessment is the measurement of competencies, or what we call 'sequestered problem solving' (Schwartz et al, 2000). In these contexts students are asked to solve problems in isolation and without the resources that are typically available in the real world such as texts, Web-resources and peers. Often these tests of aptitude are single shot, and summative rather than formative. In contrast, assessment that supports learning and knowledge transfer provides the basis for future learning, and continuing motivation to learn. This approach is sometimes called the alternative assessment movement, as it is concerned with assessing performance (Cumming & Maxwell, 1999).

Both testing and measuring competence as forms of assessment have been critiqued as being controlling, limiting and contrary to student-centered teaching and learning. Other indicators of the need to rethink online and off-line assessment have come from Bull & McKenna (2000) who argue that "the development and integration of computer-aided assessment has been done in an ad hoc manner". In a similar vein, Angelo (1999) maintains that we need a more compelling vision of assessment, research-based guidelines for learner-

centered assessment, and a new mental model of assessment. In online learning, there is evidence that increasingly, assessment procedures may be radically modified to inform and support change in teaching and learning, as the following example illustrates.

Context of the study

The context of the study was a 2nd/3rd year level university course of study in Linguistics delivered online. In this unit students are required to develop and apply skills in analysing the grammar of a language which they have not encountered before. Intended learning outcomes are analytical skills, the capacity to synthesise conceptual knowledge and transfer concepts to complete a new task.

It was decided to use the quiz feature of WebCT to create a database-driven item bank of questions to assess student learning and provide feedback. The learning objective was for students to develop skills in linguistic analysis and synthesis. Students are given a database of 84 sentences in *language X*, beginning with simple sentences (like 'The woman is going home'), and increasing in complexity until they involve quite complex sentences involving constructions like relatives and passives (as in 'The woman who cooked the meat is sitting down.') Students are supplied with English translations for each sentence, but they do not receive any indication of which words mean what, and which of the meaningful subparts of words (morphemes) are represented. Using prior knowledge of linguistics, students have to make inferences about words parts and combine these in order to interpret the language. Students are required to satisfy assessment requirements by completing two separate activities; the construction of a dictionary of the language and the completion of a grammatical description of the same language. This requires higher order thinking skills and the capacity to analyze and synthesize language elements. Higher order thinking skills are defined as "thinking which is complex, multifaceted and self-directed and in which the learner plays an active role (McLoughlin & Oliver, 1998). Bloom's taxonomy (1956) was used to categorise questions according to cognitive skills required. See Table 1 for the matrix summarizing question types.

Question type	**Link with learning outcome**	***Level in Bloom's taxonomy***
Multiple choice	Learn about and understand how to use the lexicon	Knowledge, Analysis
Matching items	Apply new knowledge	Comprehension, Analysis
Short answer	Synthesise new knowledge in order to create new sentences	Application, Synthesis

Table 1: Matrix showing question type and cognitive skill required

Design of the quiz questions

The quiz items were constructed using three different question styles, designed to assess a range of learning outcomes, including higher order thinking. **Multiple Choice Questions** were used to test skills in the cognitive domain, focusing on comprehension and analysis of the grammatical patterns evident in the data. For example in the sample question below, students are asked to select variables true of a word class type.

Question 5 (3 points)
Which of the following characteristics are true of the class of nouns in this language? [You need to select all the characteristics which are true to score full marks, and there may be more than a single correct answer]
Nouns can occur;
1. as a bare stem (unaffixed root)
2. with the prefix 'ma?-'
3. with the possessive suffixes
4. with the definite suffix '-e'
5. with the suffix -ka?

Multiple choice items were extended in several ways to increase the cognitive demand on students:

- multiple variables could be true
- all true variables had to be selected for full marks
- all untrue variables were negatively weighted, so that selection of all variables gave 0%.

Matching Questions were also used to test the skills, focusing on comprehension and analysis of the grammatical patterns evident in the data. For example in the sample question below, students are required to demonstrate their understanding of word class characteristics by matching each word class type with a sample sentence which only that wordclass could fill. Note that the sample sentences are not necessarily in the database, and are untranslated. In WebCT Quiz mode, students see all four matching variables randomly listed for each subpart of the question.

Question 2
Match each word class category listed on the left below with the Lg X structural frame that could only be filled by a word of that class.
noun: u-ita-i ____-e
verb : ____-i tau-e
adjective: tau _____-e pole-i
preposition: lao-ka? ___ marege

Short Answer Questions were used to test students' ability to synthesise and apply concepts. Application and synthesis, as cognitive objectives, were demonstrated by students' ability to apply general grammatical rules they have learned to the creation of new sentences. In other words, students were required to go beyond the database given to them, and make up new sentences in *Language X* which were fully grammatical in terms of the grammatical rules they had already worked out.
The Short Answer style of question allowed students to translate a language item and to enter a response, as in this sample question.

Question 36
How would you say the following sentence in Language X?
[Use lower case only, use no punctuation, leave only a single space between words, leave no spaces between morphemes within a word].
The woman who cooked the meat is hit by her father.
Answer:

The marking of questions of this type is also automatic using the *Regular Expression* syntax feature built, into WebCT's Short Answer shell. This compares students' responses against a specified string, but unlike the *Equals* and *Contains* functions, *Regular Expression* allows predictable variables (*Is the first letter capitalized or not? Have the students put a double space between two word?*) to be catered for.

Task 1: Building the dictionary

Firstly students had to work out the meanings of each of the words and word parts in the data provided to them on *language X*. This was achieved as a collaborative task whereby students contributed their analyses of word meanings to an online dictionary available on the unit homepage. This dictionary begins as an empty shell with 4 fields of information for each entry. Students are free to add any text to the 'headword' and 'meaning' fields. The 'word class' field offers a fixed menu of choices. The 'name of contributor' field is generated automatically. The dictionary required the development of a specialized tool which does not come as a standard feature of WebCT. This tool enables an online class of students to contribute entries to a database, and those entries are viewed on screen as though they were a single document.

The unit co-ordinator has the capacity to edit and delete any entry, while each student has the capacity to edit and delete only the entries that they themselves have contributed. The class as a whole is responsible for the accuracy of all entries, so students must negotiate changes to other students' contributions through discussion on the Bulletin Board. This form of collaborative negotiated learning is highly conducive to co-construction of meaning and self-directed learning (Coomey & Stephenson, 2001). Each student was asked to contribute to the construction of the dictionary, with a maximum of 5 entries per student specified to encourage

involvement. Participants were highly motivated to assemble the dictionary as soon as they could, in order to facilitate their capacity to tackle the higher-level grammatical analysis. All words were entered within the first 3 weeks of the semester, with subsequent tinkering, as negotiated on the Bulletin Board, over several more weeks. The lexicon was essentially completed by week 6 of the semester.

Task 2: Completing the grammar

After analyzing the grammatical structure of this language, students were required to demonstrate their understanding of it by completing an online Quiz consisting of 39 questions. Students had the option of submitting their Quiz responses twice. On the first submission, they received back only a grade, but no indication of which answers were right or wrong. This mechanism had several advantages. It was reassuring to those students who were apprehensive about the technology, and who felt uncomfortable with opening a new tool and submitting a response in a single attempt. These students took comfort from a practice run and gave some means to check that they were on the right track, but without explicitly highlighting their weak spots. Most students reported that they found this spurred them on to do better.

Results and conclusions

Analysis showed that the short answer items were the most demanding as it was these questions that required students to transfer their knowledge of the lexicon into more abstract forms of understanding. The items also required students to synthesise and apply knowledge to create new lexical items, and there was a greater range of responses and grades than for the other items. Without a doubt, students who successfully completed task 2, (creating the dictionary) demonstrated the desired learning outcomes of analysis and synthesis. In all three types of questions, the automated quiz tool and feedback mechanisms provided learning support.

Computer-based assessment may suffer an 'image problem' as some assume that it is capable only of summative testing using multiple choice tests derived from item-banks. Increasingly, computer-based assessment is enabling innovative approaches to formative assessment that closes the gap between actual and desired levels of performance. In this paper, the online quiz questions provided scope for individual and group feedback, self-checking of responses, and comparison their scores with peers. In addition, it fostered self-regulated learning as learners could access the tests at a time and place convenient to them. Both pedagogy and design features are readily applicable to other disciplinary areas.

References

Angelo, T. (1999). Doing assessment as if learning matters most. *AAHE Bulletin, May 1999* (http://www.aahe.org/Bulletin/angelomay99.htm)..

Bloom, B. S. (1956). *Taxonomy of educational objectives: Handbook 1. The cognitive domain*. New York: David McKay.

Bull, J., & McKenna, C. (2000). Computer assisted assessment centre update. *Proceedings of the 4th International Conference on Computer Assisted Assessment, http://www.lboro.ac.uk/service/ltd/flicaa/conf2000/pdfs/jbull.pdf*.

Coomey, M., & Stephenson, J. (2001). Online learning: it's all about dialogue, involvement, support and control- according to the research, *Teaching and Learning online* (pp. 37-52). London: Kogan Page.

Cumming, J. J., & Maxwell, G. S. (1999). Contextualising authentic assessment. *Assessment in Education: Principles, Policy and Practice, 6*(177-194).

Magone, M. E., Cai, J., Silver, E. A., & Wang, N. (1994). Validating the cognitive complexity and content quality of a mathematics performance assessment. *International Journal of Educational Research, 21*(317-340).

McLoughlin, C., Oliver, R. Planning a telearning environment to foster higher order thinking. Distance Education, 19(2), (242-264).

Schwartz, D. L., Biswas, G., Bransford, J. D., Bhuva, B., Balac, T., & Brophy, S. (2000). Computer tools that link assessment and instruction: Investigating what makes electricity hard to learn. In S. P. Lajoie (Ed.), *Computers as cognitive tools: no more walls* (pp. 273-307). 2000: Lawrence Erlbaum.

Reeves, T. C. (2000). Alternative assessment approaches for online learning environments in higher education. *Journal of Educational Computing Research, 23*(1), 101-111.