

Sustaining learning through assessment: an evaluation of the value of a weekly class quiz

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Commencing each class session with a class quiz, which emphasizes the previous week's work and is supported by immediate feedback, encourages students to revise their notes ahead of the session, undertake more reading and keep pace with course progression. It reduces the necessity for any spoken review of the previous week's work, provides guidance on the status of current student learning, and creates a knowledge platform upon which deeper learning may be constructed. When pitched at an accessible level, regular class quizzes are popular with students because they reinforce student engagement with the course and provide immediate positive feedback and reward. In this case study, quiz results correlate significantly with many other forms of assessment, especially those that require immediate individual knowledge such as examinations, learning journals and spoken presentations. They do not correlate so strongly with assessments based on teamwork or deductive exploration such as problem-based laboratory study or self-directed field trails. Class quizzes and formal examinations, alone of the assessment strategies compared in this study, are associated with significantly higher marks from female students. It is recommended that the technique is used as part of a diversified assessment strategy.

Introduction

Would it not be wonderful, if ahead of each class, students revised their notes and arrived in class, with the knowledge they need to progress? If when they missed a session, they returned to class having already undertaken remedial action? This paper examines the benefits of weekly class quizzes.

Currently, class quizzes are linked to the ancient assessment tradition that ranks students by how much they remember of what their teacher said (Gibbs, 1995 p. 1; Gibbs, 1999, p. 52). They are associated with surface learning, memorization, and the unthinking reproduction of learnt information (Entwistle, 1981). However, class quizzes are educational tools and, like any tools, their effect depends greatly on the

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way they are used. Here, the technique is used to try to foster student learning, increase student engagement and help remove dysfunctional study patterns. The argument is that class quizzes can provide formative feedback to students and instructors on the progress of learning (Hewson & Hughes, 2002; Dochy *et al.*, 2002, p. 279). They also may reduce the need for any substantive review of the previous session, so proving an efficient use of class contact time, and they can add extra variety to classroom proceedings.

This study examines the role of class quizzes in promoting better student learning. It provides an analysis of the impacts of introducing a weekly class quiz into advanced level undergraduate courses at Oxford Brookes University in England. These impacts are analysed qualitatively, in terms of the reactions of students, specifically whether or not they found these class quizzes helped their learning, and quantitatively, in terms of the relationships between quiz marks and other forms of assessment. The gender equity of the method is also analysed. This seven-year study employs information from students reported in 372 anonymous, end-of-course consultation questionnaires collected and it employs assessment records, which are used to compare the marks obtained from quizzes with those gained by the same students in other varieties of assessment. These include formal essay examinations, spoken presentations, term papers, field study trails, learning journals, problem-solving laboratory project work and computer assisted learning (Table 1).

Background

From a student’s point of view, the assessment is the curriculum (Ramsden, 1982, p. 187). Since success is measured by the marks they receive, students strive to be efficient and effective mark winners. Marks are the measure of any particular learning task, so tasks given the highest marks are also those that receive the greatest effort.

Table 1. Assessment components

Assessment	Strategic purpose	Character of exercise
Class quizzes	Quizzes are delivered in an attempt to encourage students to review the previous week’s work ahead of each class and to provide rapid feedback on their understanding of key ideas and basic concepts. The emphasis on basic concepts ensures that students who keep abreast of the course receive good marks and encouragement through this process.	A series 4–6 of brief 15-minute quizzes, each worth between 2% and 4%, each consisting of 2–5 questions, requiring single concept sentence answers or single-word lists in response (cf. Figure 1). After each quiz, a model answer sheet is displayed, so that each student can evaluate their performance.

Table 1. (Continued)

Assessment	Strategic purpose	Character of exercise
Examination	The examination provides a summative assessment for the course. However, ahead of this, prepublication of the source question bank aims to help students to focus on key issues raised in the course by focusing their attention on key issues.	A 1.5 or 2-hour essay examination, worth 30–40%, of the total marks requires students to answer two essay questions from four on a paper drawn from a question bank of six included in the course guide. It is intended that candidate examination questions should guide student independent reading through the term.
Laboratory project (Haigh and Kilmartin, 1987)	This exercise encourages students to construct their own understanding by self-defining, self-designing, executing and reporting the results from a laboratory, field based or in the Gaia module, computer simulation based project. The exercise requires students to justify and conduct their experiment and later explain their findings to their peers in the class room. A reflective self-assessment of this teamwork project is a key part of the final report.	Students, organized in teams of 3–5 design, develop, execute and report the results of an experiment. The work usually involves dynamic modeling, either conducted on especially constructed laboratory equipment or through computer simulation. Student teams make two classroom reports. In the first, they propose their project and justify their experimental plan. In the second, they report their results as a spoken presentation and formally constructed scientific paper. This optional exercise is worth 30–40%.
Classroom presentation	This exercise aims to build skills in spoken communication and some self-awareness of the techniques of communicating scientific understanding. The challenge is for students to convey, effectively, the message contained in some key technical literature in terms their peers can comprehend and appreciate. The talk strives to summarize the key points in the target papers and encourage students to read the work for themselves.	Students review either a self-selected topic of relevance to the course or some pre-selected readings or a computer routine and summarize their findings as a classroom presentation, which is supported by a short written report. These optional exercises are worth 20%.

Table 1. (*Continued*)

Assessment	Strategic purpose	Character of exercise
Learning journal ('Gaia' course only) (cf. Haigh 2001)	The aim of this exercise in reflective learning is for students to try and 'think like a planet' and in the process gain insights into their own ways of knowing and learning.	Students keep a record of their learning experiences, ideas and questions through the course. The exercise culminates in a classroom written assignment during which the student compare the human and Gaia perspective on one from a range of issues listed in the course guide.
Field trail ('Soil conservation') course only	It is one thing to write an essay based on textbook understanding and quite another to construct a personal interpretation in the field. This exercise attempts to develop a student's ability to read field evidence – in this case of land degradation (cf Stocking & Murnaghan, 2001). It consists of two elements. In the first, student pairs follow a guided trail and answer questions on the problems faced at clearly identified problem areas. In the second, the students are set free to prepare their own assessment.	Students walk a self-directed field-trail in pairs and answer questions in the trail workbook. The questions challenge their ability to interpret the severity and character of erosion processes in the field and the effectiveness of different erosion control strategies. This optional exercise is worth 20%.
Virtual field trail ('Soil conservation' course only)	This VFT follows the same route as the live Field Trail described above. The advantage of a VFT is that it is not limited to conditions at the time of access. It can include historical data, indeed, it quickly becomes a historical document. It can also allow the immediate interactive review of questions.	This VFT is used for a reflective review of the field trail experience and to bring the experience to those unable to attend the live trail. It was examined by means of a compulsory class quiz worth 5%, which replaced the last of the normal class quizzes.

Traditionally, most assessment is awarded through summative end-of-course tests. Class sessions carry few marks. So, some students come to imagine that class attendance matters only to the degree that it facilitates a good examination outcome. Student learning activities become tightly focused on the questions they hope to answer (cf. Gibbs & Simpson, 2002; Gibbs, 2002).

Analysis of student learning diaries has suggested that student activities during a course may resolve into three phases (Haigh, 2001). First, there is a process of exploration, during which the student works hard to find out what the course is about, what are its values, goals and standards (cf. Snyder, 1971). Second is a monitoring phase, during which the student keeps an eye on the development of the course in order to discover those areas that are most relevant to the examination (cf. Miller & Parlett, 1974). Third is a cramming phase, the intense preparation of self-selected subjects for the final test of the examination, when other matters are neglected. This pattern is often reflected in the classroom. Class is packed and attentive for the first sessions. Engagement wanes to a low after mid-term. Towards the end of the course, involvement recovers as students start to search for hints on the final examination or whatever may be the culminating assessment.

Of course, if part of the assessment were meted out throughout the term, such as through as short quizzes on the previous weeks' work, this pattern might change (cf. Ehrlich, 1995). Now, there is an incentive for each student to engage with the class and to review their notes from the previous session in order to win the quiz marks. Equally, they might receive immediate feedback to remind them how much they know—or don't know, which might encourage extra study. If a course were progressive, each session building upon foundations laid in its predecessor, then after reading and review towards a quiz, a student might enter the classroom with greater knowledge, hopefully greater understanding, and be able to move ahead more confidently. Additionally, the risks of any student becoming lost and leaving themselves too much to adsorb in an end-of-class 'cram' could be reduced or, at least, recognized in time for the problem to be remedied.

Today, British Higher Education is buzzing with Biggs (1999; Rust, 2002). Biggs 'principle of constructive alignment' states that a good teaching system will align its teaching methods and assessment to the learning outcomes desired and assure that the system supports appropriate student learning (Biggs, 1996). 'Assessment is the most powerful lever that teachers have to influence the way students respond to courses and behave as learners' writes Gibbs (1999, p. 41) but, traditionally, it is used unimaginatively (Gibbs, 2003). Most is used only as a measure of student failure to achieve 100% perfection. Typically, it is received after the end of a course and so fails to provide the feedback that might help a student improve their learning during the course. Much better is formative assessment that runs through a course, so keeping students aware of their progress.

Where courses build progressively, standard guides of good practice commend that each new session should begin with a brief review of previous material (Ramsden, 1992). However, this review may not be enough to help students who carry insufficient knowledge from the previous session and may also tempt students, who miss a session, not to make any serious effort to catch up. As Dochy *et al.* (2002, p. 266) remark: 'It would be difficult to find an educational study conducted in the past two decades that did not implicitly or explicitly acknowledge the powerful impact of one's existing knowledge base on subsequent learning and development'. Content knowledge, which includes explicit memorized facts and concepts, is a fundamental part of

all prior knowledge, alongside the deeper understandings implied by implicit content knowledge and ‘metacognitive understanding’ (Dochy *et al.*, 2002, p. 270). Class quizzes, which encourage students to review previous work ahead of class, may be a reliable method of ensuring that students arrive in class with the knowledge they need to progress fresh in their minds.

Context

This study reviews the effects of introducing regular class quizzes into two advanced level courses at Oxford Brookes University. It also maps the class quizzes among several alternative modes of assessment (Table 1).

‘Soil conservation’ is an advanced level module, which is accepted as an option by several fields of study including geography, physical geography, environmental sciences, and water resources. ‘Gaia: the Earth as a living system’ is a similar module, but one accepted by a wider array of courses that extends to fine art and planning.

Class quizzes were introduced in 1997, the strategy borrowed from a colleague—Peter Keene. Each course enrolls 15–45 students annually, mainly Year 2–Year 3 undergraduates, the majority reading combinations of physical geography, geography and environmental sciences. ‘Soil conservation’ includes 32 hours of classroom activity in eight four-hour sessions and a day of fieldwork supported by a virtual field trail and optional assessed laboratory, computer, spoken and field project sessions (cf. Haigh & Kilmartin, 1987; Birnie & O’Connor, 1998). ‘Gaia: the Earth as a living system’ has a similar workload and structure. However, there is no laboratory option, the field session is two hours of tree planting for carbon sequestration and reflection, while a large part of the assessment is taken up by a learning journal (Haigh, 2001, 2004; cf. Burrows *et al.*, 2001). Both courses include summative assessment elements. In ‘Soil conservation’, there is a formal two-hour seen examination. In ‘Gaia’, there is a 1.5-hour timed essay test held near the close of the course.

Character of the quizzes

Class quizzes are introduced as ‘Echoes’ from previous sessions. Each ‘Echo’ consists of two to five questions, each requiring a sentence or so in answer (Figure 1). Each question strives to elicit a response that requires understanding of a broad concept rather than simple memorization. Four to six ‘Echoes’ are administered. Each is scored as 2–5%. In sum, they contribute 20% of the assessment for the entire module.

Students are advised that quizzes will be administered ‘at the whim of the instructor’ but normally at the start of each session or at the official end of a coffee break. Each quiz takes 20 minutes to administer and, for 40 students, about 1.5 hours to assess and record results.

Answers are given back to the class as a ‘model’ answer sheet, which is displayed and discussed after the quiz answer sheets are collected. This process provides immediate feedback and instruction to those students who cannot answer parts of the quiz,

1. In the video case study, why was the school in the Yemeni mountain village 'Iriyani' said to be a factor in the collapse of its terraced agriculture system?

The school took children away from their work in the fields and its education encouraged them to leave farming and the village to seek 'better' jobs working in the cities and for the Government. As a result, there was insufficient labour to keep the terraced agricultural system running effectively.

2. Name TWO advantages and ONE disadvantage to using conventional hard engineering structures in soil and water conservation engineering.

A1. Tried and tested procedures—reliable.

A2. Tolerances & capacities are well known and understood—easy to design.

D1. Require repair and maintenance—often involving skilled inputs.

Figure 1. Sample class quiz questions for 'Soil conservation' course

it offers reinforcement for those who were unsure that their responses were correct, and it completes the review function of the quiz.

Methods

The impact and effectiveness of the quiz programme was evaluated in three ways.

- First, it was evaluated by an analysis of student course consultation returns for the module as a whole.
- Second, it was evaluated by some specific inquiry into student views on the value of the quiz programme.
- Finally, the results from the quizzes were correlated with those from other aspects of the module's assessment to determine the degree to which the quiz results echoed other measures of student attainment.

Open course evaluation

The general course evaluation questionnaire was administered to all students at the close of each run of the module. Previously, the author was heavily involved in a search for the most effective type of course questionnaire (Haigh & Gibbs, 1984). At Oxford Brookes University, attempts were made to develop a system that encouraged a constructive dialogue between teachers and learners and that would result in improvements in the processes of communication and course delivery. Eventually, the author concluded that outside the context of pedagogic research, formal questionnaires, with response scales that strait-jacket student responses and obscured student feelings, were poor practice, especially for courses with small numbers (<50) of students. So for this and other general purposes, a formative open format was

adopted. This consists of a single request: 'Please describe, as completely as you can, your experience of this module'. This request was administered as a single A4 sheet report form in the final week of the module. Results are scored according to the issues addressed, whether addressed in the context of a positive or negative comment, and how many student respondents volunteered similar comments. This is a standard form of analysis (cf. Soifer, 1991).

Targeted course evaluation

In 2001–2003, a question specific to the quizzes was added to the normal open questionnaire. This was placed on the reverse of the evaluation form. Students were asked not to turn the page until they had completed their response to the general evaluation question and many complied although most were aware that the question existed. The specific question ran as follows: 'the class quizzes are intended to encourage you to review your notes ahead of each session and to replace the need for any spoken review of the previous week's work. To what extent do they achieve these objectives?' Administered at the close of the final session, 139 responses were retrieved from a total of 163 students.

Analysis of mark sheets

Mark sheets were collected and collated from the 11 classes included in this study. The final matrix of all results obtained from the whole population of students taking these modules in the years 1997–2003, included a total of 373 students. Year-to-year variations in the proportions of marks given to individual coursework components were adjusted and nil returns from students, who signed up to either the whole or part of the class but did not submit work for assessment, were removed from the record. This data base was then subjected to statistical analysis.

The first test conducted examined the null hypothesis that the class quizzes resulted in different mark distributions in the two modules under examination. Independent sample *t*-testing proved that there was no significant difference between the quiz scores awarded in the two modules, which means that the quiz scores from the two modules may be treated as a single population.

Next, a one-sample Kolmogorov–Smirnov test was used to determine whether any of the data sets were significantly different from normal. Apart from the quiz result and term paper data, this proved to be the case for all variables. So, Spearman's rank correlation, which produces a result that is similar to that of the parametric Pearson's product moment correlation procedure, was adopted for the construction of a correlation matrix.

Results

Class quizzes in students' overall responses to the course

Formative course evaluation is an iterative procedure. At the end of each cycle, student views are used to frame adjustments to the course and the emphasis given to

different components. The objective is to build up the attributes of the course that contribute to student learning and enhance positive feelings and to redesign and eliminate those attributes that inhibit learning and make students unhappy. Initially, changes made can be quite substantial. Later, response patterns stabilize and adjustments become fine-tuning. Quizzes were introduced to these modules in 1997. By 1999, they were established as a regular of the programme with assessment set at 20% of the marks.

In the 'Soil conservation' course (1999–2003), over a fifth (31/142) of the students' open-response course consultation returns included comments on the class quizzes. Most comments were positive. 'Echoes' class quizzes ranked fifth, sixth, fifth, ninth and ninth respectively among the positive course features mentioned in the sum of the lists produced by the students in the five years from 1990–2003. When this list is adjusted to exclude those student generated comments that address more general attributes of the course—such as timetabling, enjoyability, information content, curricular structures, modes of presentation etc, class quizzes rank second to the video case studies (that are shown and analysed in class) amongst the course components that remain. Table 2 rates class quizzes against other course components and shows that the quizzes are the most highly valued element of the assessed course work.

The pattern of response is very similar in the Gaia course (Haigh, 2001). Quizzes featured in the returns of about a sixth (23/153) of respondents and, in the four years from 2000 to 2003, they were ranked eighth, fourth, twelfth and thirteenth amongst positive comments most frequently mentioned by the student group. The principal reason was 'that they encouraged revision'. Class quizzes were also the highest ranked course component ahead of lectures, videos, learning journals, student presentations etc (cf. Haigh, 2002). It may be significant that, in both modules, quizzes dropped down the ranking after they became the subject of a special question on the consultation form.

Table 2. Class quizzes in relation to students' comments on all course components

Course component (Respondents 1999–2002: <i>N</i> = 142)	Assessment	Positive comments	Negative comments
Echoes class quizzes	20%	31	3
Fieldwork exercise	20%	20	3
Spoken presentation	20%	21	1
Examination	40%	6	4
Laboratory project	40%	5	2
Virtual field trail	5%	0	2
Video case studies	0%	38	2
Lectures	0%	16	3
Course handouts	0%	18	4
Textbook	0%	3	3

Table 3. Do class quizzes encourage the review of course notes and replace the need for a spoken review of the previous week's work? Extracts from student commentaries ($N = 139$)

Analysis of student comments (with number of respondents addressing topic)	
<i>Positive comments:</i>	
Encouraged me to read course notes before session each week	49
Effective replacement for start of class review	14
Discouraged me from leaving work until end of term	13
Encouraged me to do extra reading	10
Test answers are useful review/reinforcement	7
Encouraged me to keep up with the course	6
<i>Negative comments:</i>	
Did not encourage revision	8
Questions too specific	4
Too much work	4
Too few marks for each quiz	2
<i>Did the class quizzes help you learn? If so or if no, how do you know?</i>	
Reinforced understanding from previous session	16
Encouraged me to do extra reading	11
Improved my marks	9
Encouraged thorough revision	8
Corrected misunderstandings in notes	8
<i>Did the class quizzes help you learn? Specific illustrative comments:</i>	
'The quizzes reaffirmed information given in previous classes'	
'Helped me identify gaps in my knowledge, where extra study was needed'	
'It became essential to review notes ... this is one of only a few modules where I feel last minute cramming for the examination will not be necessary'	
'Kept you on top of the work'	
'Helped focus attention on key topics'	
'Tests work very well, if people didn't listen the first time, they won't listen to a spoken review!'	
'The tests don't encourage revision—but people check to see if they had the right answer afterwards'	
'It did encourage me to read my notes each week, which I didn't in other modules where I did not have a quiz'	

Students' responses to specific questions on the value of class quizzes

The results in Table 3 reinforce the notion that the class quiz serves a valuable function through encouraging most students to review their previous work. Students who did not argued that each test carried too small a score to be worth the effort of revision.

Class quizzes among other modes of assessment

Intuition suggests that the class quiz system is an efficient mode of assessment. It seems to favour those students who engage most actively and effectively with the module and

Table 4. Correlation between quiz scores and other types of assessment

Assessed activity	Sample size ($N_{\max}=372$)	Spearman's ρ	Significance $p =$
Examination	301	0.287	<0.0005
Fieldwork	99	0.197	0.025
Learning journal	129	0.309	<0.0005
Laboratory project	160	0.021	
Term paper	12	0.223	
Virtual field trail	67	0.373	<0.0005
Class presentation	168	0.354	<0.0005

disfavour those students whose involvement and achievement is least. However, the survival of dis-aggregated mark sheets, allows a formal comparison of the quiz scores with results from other forms of assessment used in these two modules (Table 4).

Statistical comparisons of the mark distribution from the quizzes with those from other types of assessment show strong positive, highly significant correlations linking high quiz scores with high scores in the examination, learning journal, virtual field trail exercise, and class presentations. The correlation between the class quiz scores and fieldwork exercise was weak but significant, whilst that between the term papers and quizzes was weak and not significant, largely by reason of the small sample size. There was no significant correlation between the quiz scores and laboratory team project scores.

Table 5 shows the full suite of significant correlations in the data set. Intuitively, this suggests that there are at least two themes in the data set. The first involves immediate factual knowledge, for example in the spoken class presentation, field trail, quiz, examination and possibly learning journal. The second involves a kind of analytical insight, which can be reinforced subsequently by knowledge, witness the links between the laboratory project, examination and beyond to the field project, learning journal, etc. It should be noted that, although they cover exactly the same questions and issues, there is no correlation between the results of the field trial and its virtual field trail counterpart, although both involve quiz style answers and both correlate with class quiz scores (cf. Jain & Getis, 2003).

Table 5. Significant correlations between the results of different modes of assessment

	Examination	Class presentation	Learning journal	Laboratory project	Virtual field trail	Field trail	Term paper
Cases	301	168	129	160	67	99	12
Quiz	0.250	0.354	0.309		0.373		
Examination		0.290	0.317	0.375			
Class presentation						0.611	

Gender

Although the average score for female students was slightly higher than for male students in this study, there were no significant differences in the performance segregated by gender for any of the assessment strategies apart from two: quizzes and examinations. It has been suggested that the competitive element in this system of class quizzes with immediate feedback could favour male students. By contrast, recent research by Smith (2004) has highlighted a tendency for female geographers to out-perform males in academic assessments, which conforms to a larger pattern of relative underachievement by males in British education. In this case, the average quiz score by female students was 7.5% higher than that for male students taking the same tests and, in a two-tailed t-test, the difference was significant ($p = 0.04$). Student examination scores show a similar pattern, with females outscoring males, slightly more strongly, by 9% on average ($p = 0.02$).

Discussion

The educational theory that underpins this use of class quizzes to promote learning has some respectably ancient antecedents. The Lotus Sutras of Mahayana Buddhism contain the parable of the burning house. Once, there was an old and infirm householder, who owned a mansion of many rooms in which lived his large family. The building, one day, was engulfed by fire. Inside, he sees children engrossed in playing with toys. He calls to them to come out quickly, but they have never seen a house on fire and see no need to respond. Finally, he alights on a stratagem, he promises that will give them new and better toys, if they come quickly. The children run outside and are saved. Once outside, the householder gives them not toys but 'real things of value' (Berry, 1992). Could it be that, during the last two millennia, the reason for awarding marks in environmental education has not been stated more succinctly? Of course, the main issue is whether 'the toys', in this case—the marks given for memorized concepts and ideas, do turn out to lead to learning of real value in the end.

Class quizzes correlate strongly with elements of assessment that are individual and have a strong reproducing orientation, such as the examination, spoken presentation and VFT (virtual field trail) (Ramsden, 1992). By contrast, quiz scores do not correlate so strongly with exercises, like the laboratory project or field trail exercises, which involve independent exploration and team work. The main difference between the field trail and the VFT, which derives from it, is that the VFT provides answers to questions and simultaneously corrects errors in interpretation. So, it is possible for a student to complete the trail, and learn the 'correct' answers for any future test, without gaining the intellectual depth required to answer the same questions, first time, in a field situation. This may explain why there is no significant correlation between VFT and real field trail scores, despite their using the same sites and an identical list of questions (cf. Hewson & Hughes, 2002; Jain & Getis, 2003).

High marks derived from learning journals, examinations and the ability to make a spoken presentation without reading from notes, are often accepted as measures of

deep learning. However, the significant correlations between the quiz scores and those for the learning journal, spoken class presentations and the examination may have another explanation (cf. Burrows *et al.*, 2001). These exercises all require immediate understanding. Those that do not correlate tend to include exercises where understanding can be accessed after the event through reading or discussion.

The mark-sheet data clearly contains at least one other component that is not contained by the quizzes. This links the laboratory project, examination, field trail, learning journals and spoken presentations and it may relate to sustained conceptualization—the kind of broad understanding that quizzes are ill-adapted to address. Clearly, different modes of assessment test different aspects of learning—as well as different student aptitudes. The relatively low correlations between the scores of the different components of assessment in these courses confirm that they are testing different things, which is why it is good practice to use a range of assessment methods within each course.

Reviewers of this paper have wondered whether or not class quizzes might be useful in more ideas-based, theoretical/cultural and problem-solving courses such as those found in human geography and cultural studies. The answer may be that quizzes, which generate text, as distinct from multiple-choice tests—where student assign answers, remain best at assessing introductory understanding. The student has to signal that they know the correct terminology and solve the small problem that the quiz question poses. It is a matter for the skill of the question-setter to ensure that the quiz question requires more than simple factual knowledge—for example to ensure that the answer requires understanding of a theory (cf. Figure 1). However, the method is not especially apt to test problem-solving or deep reasoning.

An abiding concern is the question of whether or not a new style of assessment favours any particular part of the student population. Does the technique favour either male or female, through differences in their ‘ways of knowing’ or construction of gender perception in this particular cultural context? In this case, the data shows no significant differences between male and female performance across the main range of exercises (Table 1). However, there are two exceptions—quizzes and formal essay examination scores, which favour female performance, but quizzes less so than examinations. Overall, this pattern conforms to results from elsewhere in the UK, which finds female students outscoring male students by about 5%, often on the basis of measures based on these kinds of tests (cf. Smith, 2004). Once again, using a variety of assessment techniques is a recommended route to achieving gender equity (NECUSE, 1996). Koelsch *et al.* (1995) argue that instructors should never rely on a single assessment or assessment method, when making an important decision.

Although the author has no quantitative data, anecdotally, this class quiz style of testing may not much affect the performance of other subpopulations in the class (cf. Hall *et al.*, 2004). Dyslexic students, a substantial constituency, report that they found the class quizzes easier to cope with than formal examinations or term papers. On the basis of a very small sample, international students with weak language skills may underperform in this mode of assessment in comparison with

their performance in more extended individual, especially spoken, presentations. However, most difficulties may be resolved by the application of the guidelines proposed by Koelsch *et al.* (1995).¹

Researchers have frequently shown that assessment style drive students' learning (Hargreaves, 1996; McDougall & Granby, 1997). Ramsden (1992, p. 211) advises that objective tests should be used with caution because they may encourage surface learning more than a deep approach; class tests are frequently numbered in such lists (Kember *et al.*, 1995). Inevitably, the class quiz system emphasizes reproducing learnt information. However, students rank it among the most popular elements of course-work precisely because, by encouraging students to review their notes from previous sessions, it also helps them gain more from the current session.

Instructors often worry that quizzes are unpopular with students and, hence, have a negative impact on student engagement (cf. Nuzum, 1999). However, this may be a misjudgement. 'Quiz night' is a popular event in many student taverns of the UK. Quizzes are also the staple fodder of popular television programming around the world. So, obviously, there is widespread enthusiasm for the concept of a quiz. Certainly, students regard surprise quizzes as an unfair imposition. Zeidner (1994) reports that students considered surprise quizzes to be 'vindictive' and cause unnecessary stress. However, routinely administered quizzes are not, of themselves, inherently unpopular (McDougall & Granby, 1997). Indeed, some students may enjoy the challenge of a quiz, especially if this is reinforced by the positive feedback of good marks (cf. Ochs, 1998).

Rewards are the key. Undoubtedly, one of the components of the successful use of quiz techniques is positive reinforcement. The quiz questions have to be pitched at an accessible level. Ehrlich (1995, p. 379) describes how, in early experiments, he set questions that were too challenging, which only served to remind students of their own inability to master the material. As a consequence, students were unhappy and dreaded the quizzes. By contrast, when Ehrlich set quizzes that were more easily answered, the positive results improved student morale, self-belief, and determination to work hard to maintain good scores.

Zeidner (1994) found that students, who valued tests, did so for reasons similar to those discovered in this study. The quizzes provided a guide to progress (52%), motivation for the revision and review of course material (37%) and boosted grades (4%). Equally, most of Zeidner's sample of instructors (70%) welcomed quizzes because they kept students motivated (64%), provided prompt feedback on learning (25%) and provided a realistic appraisal of student knowledge (9%). Those instructors who opposed quizzes thought they were stressful to students (52%), reduced student grades (33%) and reflected only short term learning (7%). Zeidner's respondents also worried that their quizzes tested relatively unimportant information.

In response to these last points, quizzes that reduce student grades are pitched at a level that is too hard to be useful. A successful quiz strategy, that encourages student learning, should foster positive participation, reward and reinforce those who are striving to keep ahead of the work. The technique works best using 'carrots rather than sticks', to use a vernacular expression.

While it is undoubtedly the case that quizzes test surface learning, it is very useful to have a reservoir of memorized learning in place at the start of a class session (Dochy *et al.*, 2002). This gives the instructor something to build on during the session and hopefully, something to convert into deeper, longer-term, understanding (Sterling, 2001). Of course, this is also why it is important to ensure that the quizzes foster the development of the learning that is critical to course development; key concepts not marginal or trivial facts.

The necessity for class attendance makes the quiz technique unpopular with students that do not like to attend class regularly and, hence, are penalized by missing quiz scores. Elsewhere, high levels of attendance in class and longer, more diligent, studying have also been associated with students adopting inefficient surface learning strategies (Kember *et al.*, 1995). Such patterns may emerge from student insecurities that encourage them to focus on the word of the instructor or course textbook rather than its meaning. However, in a course that builds progressively away from the textbook, that requires discussion in order to promote reflection, class attendance is beneficial. In the cases at hand, soil conservation is in the throes of tumultuous and revolutionary change, which is being driven by field practitioners rather than academics and by workers whose works and arguments are hard to access through library publications. Equally, Gaia theory exists as a challenge to conventional scientific thinking and develops by seeing existing 'facts' in new ways (Haigh, 2001). In both cases, the easiest route to deep understanding is through the critical evaluation of 'grey' literature and video case studies, reinforced by classroom discussion between students.

Finally, quizzes have the advantage that they remove some debate over marks (cf. Zeidner, 1994, p. 47). Zeidner (1990) suggests that students view essay-type exams as more fair than objective tests but this does not seem to be supported in this case. Here, the quizzes were welcomed because they contributed to the variety of activities undertaken in class and because they provided opportunities for discussion with colleagues. The students also found these kinds of objective tests less stressful than essay tests (cf. Zeidner 1990, p. 158).

Conclusion

Class quizzes are about the reproduction of learnt material and the danger is that they promote shallow, superficial, learning rather than deep understanding. A deep approach to learning is characterized by: focusing on arguments and concepts, relating previous knowledge to new knowledge, relating knowledge across a range of subjects, relating theory to experience, and building holistic understanding (cf. Marton & Saljö, 1984; Biggs, 1990; Ramsden, 1992; Laurillard, 1993). Class quizzes may not be the best tool for the last three of these activities, perhaps one reason why, in this study, quiz scores do not correlate with results from the interpretive field trail or problem solving laboratory project exercises (Tables 1 and 5). However, quizzes can tackle the first three of these criteria, a fact supported by the strong correlation between quiz and traditional examination scores.

Gibbs argues that a deep approach is fostered by encouraging active engagement with content, interaction with other learners, access to a well-structured knowledge base, clear motivation by and interaction with the teacher, and opportunities for individual reflection on these experiences (Gibbs & Simpson, 2002). The class quiz process succeeds precisely because it builds student engagement with content, provides motivation in the form of marks, and fosters discussion between both learners and teacher on the quiz answers. Further, by fostering student revision, it also grants students better access to the course knowledge base in the form of those superficially memorized facts and concepts. Class quizzes, therefore, provide a valuable platform for deep learning, precisely because they also encourage initial memorization.

Class quizzes with immediate feedback, the system explored in this paper, may favour female students ahead of male students. The technique was the only one in this study, apart from formal examinations, that discriminated significantly between male and female students. However, using a range of assessment techniques may help eliminate such issues (NECUSE, 1996). Ideally, class quizzes should be used as part of a larger assessment strategy (Koelsch *et al.*, 1995).

Student evaluations rank class quizzes high among rival course components in both lists of positive and negative comments. Students report that quizzes encourage them to review their notes ahead of each session and increase their engagement in the course. Class quizzes foster positive participation and reinforce those striving to keep ahead of the work. However, class quizzes are about the reproduction of learnt material and correlate significantly with forms of assessment that require immediate individual knowledge such as examinations, learning journals and spoken presentations but not with assessments based on teamwork or deductive exploration.

In sum, the use of regular class quizzes can enhance and sustain student engagement, attendance and learning in courses that build progressively. They emphasize immediate knowledge, which provides a useful foundation upon which to construct deeper learning. However, they may not be the best means of testing deep learning itself (cf. Burrows *et al.*, 2001). Weekly class quizzes are valuable type of formative assessment and a useful component within any broad-based assessment strategy.

Note

1. Koelsch *et al.* (1995, p. 70) propose the following guidance to help those seeking to achieve equitable assessment: (1) link the assessment content to student experiences; (2) construct assessment tasks to suit students' known ways of thinking and understanding; (3) review the language demands of each assessments in the light of the students' capacity to respond and use opportunities to build necessary language proficiency; (4) ensure that students are familiar with the standards expected in each mode of assessment; (5) allow students the time they need for their work; (6) allow choice wherever possible; (7) always use more than one measure to evaluate student learning and never rely on a single assessment to make a major decision; (8) document contexts of assessment (time required, particular problems/solutions); (9) take outside advice—moderate/share assessments with others wherever possible.

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