



Journal of Hospitality, Leisure,
Sport & Tourism Education

Vol. 7, No. 1.

ISSN: 1473-8376

www.heacademy.ac.uk/johlste

PRACTICE PAPER

Evaluating the Use of Computer-Aided Assessment in Higher Education

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DOI:10.3794/johlste.71.181

©Journal of Hospitality, Leisure, Sport and Tourism Education

Abstract

The use of computer-aided assessment (CAA) can provide lecturing staff with easy cost-effective solutions to heavy marking workloads. This case study explores the implementation of CAA into a limited number ($n=2$) of level 1 modules. The aim was to explore students' responses and lecturers' perceptions of CAA. Students who had experienced the new assessment regime completed an evaluation questionnaire ($n=68$), and semi-structured interviews were conducted with the teaching staff ($n=4$) of the modules. Results indicate that students did not perceive CAA negatively within the assessment regime and staff clearly identified that this form of assessment had certain time saving benefits.

Keywords: Computer-aided assessment; Sports students; Feedback; Attitudes

Introduction

Higher education has traditionally utilised face-to-face delivery and paper-based distance learning (Dale and Lane, 2004). However, recent developments in computer technology have enabled a move towards online provisions (Haven and Botterill, 2003). As such, there is an increasing use of virtual learning environments (VLEs) in UK higher education (Dale, 2003; Haven and Botterill, 2003). These VLEs are commonly designed to enhance student learning by encouraging discussion, feedback and establishing online tasks (Batey, 2002; Dale, 2003). Given students increasing familiarity with VLEs, the possibility of utilising computers as a method of formative assessment becomes feasible (Lepper, 1988; Sewell, 1990). With increasing class sizes at many higher education institutions (HEIs), such an approach offers a number of potential benefits for students and lecturers.

Research suggests that university lecturers within the UK are commonly exposed to high levels of work-related stress (Court, 1996; Kinman, 1996). The antecedents of stress among

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academics include: work overload; time constraints; inadequate recognition; inadequate salary; changing job role; inadequate management and/or participation in management; inadequate resources and funding; and student interaction (Boyd and Wylie, 1994; Daniels and Guppy, 1994; Harrison, 1997; Seldin, 1987). Work overload is commonly attributed to increasing student numbers and decreasing resources (Devonport *et al.*, 2008; Niven and Cutler, 1995; Thorsen, 1996). Fisher (1994:61) suggests that within UK universities, "the demands on academics have risen rapidly over the last ten years and all the signs are that this will continue". Given these findings, the use of computer-aided assessment (CAA) as an automated method of marking work from large student numbers becomes appealing. However, when changing assessment, it is necessary to monitor levels of student satisfaction (Aldridge and Rowley, 1998; King *et al.*, 1999; Wiklund and Wiklund, 1999).

Aims

Student evaluation commonly occurs at module rather than programme level, which makes monitoring across modules difficult because data are not compared. In addition, assessment changes are often implemented without a systematic review of the impact of the change. The aims of the present study are twofold:

1. To critically evaluate level 1 students' experiences, with a focus on assessment in general
2. To explore lecturers' perceptions of the impact of CAA in level 1 modules in detail.

Method

Ethical approval was gained from the relevant university committee to conduct the research. Two different stages were used to address the two aims. Quantitative data were collected from module evaluation forms for the first aim and qualitative data were collected from lecturer interviews for the second aim.

Quantitative data collection method

Participants

CAA was implemented in two level 1 core modules ('Physical challenge' and 'Scientific principles') during the academic year 2003-2004 in a large British university. During welcome week in semester 1, 2004-2005, level 2 students (n=68) completed a module evaluation for each module studied in level 1. Students were informed that there were no right or wrong answers and were encouraged to complete the questionnaire honestly. All data were anonymised.

Measure

The standard university module evaluation questionnaire was modified and used to assess perceptions of the student experience. For each module in level 1, students rated their agreement on a six-point Likert scale anchored by 0 (totally disagree) to 5 (totally agree). Students were asked to rate 13 aspects for each module, focussing on: learning outcomes; workload; grading; use of VLE; tutor support; student attendance; and resources.

Procedure

In contrast to module evaluations, students were asked to rate all modules at the same time and did not rate each module at the end of the delivery stage. In some cases, modules had been completed four months previously and in some cases eight months previously. There are seven level 1 modules serving five undergraduate sport degrees. CAA was piloted in two modules: one that was core to all degrees and one that was core to two degrees. The common core module, 'Physical Challenge', aimed to equip students with a practical learning environment within which to explore the theories of skill acquisition and the impact of anxiety on performance in the context of teaching and coaching. This module had both theory and

practical elements to each contact class. The second module, 'Scientific Principles', aimed to provide students with detailed knowledge of key underlying principles of biomechanics, physiology and psychology, as they relate to sport and exercise. This was taught in three blocks of each of these discrete disciplines.

Table 1 outlines the assessment patterns of the modules in level 1, highlighting the two modules with CAA.

Module	Assessment 1	Assessment 2
Study of Sport	Essay	Presentation
Introduction to Investigative Techniques	Descriptive Stats	Univariate Stats
Introduction to Coaching and Teaching	Essay	Poster presentation
Physical Challenge	Reflective Essay	Multiple choice exam (CAA piloted)
Sport in a Social Historical Context	Essay	Essay
Personal Professional Development (PPD)	CV & Action Plan	Reflective Essay
Scientific Principles	Essay	Multiple choice exam (CAA piloted)

Table 1: Assessment patterns in level 1 modules

Qualitative data collection method

Semi-structured interviews were completed with the teaching teams for 'Scientific Principles' (n=2) and 'Physical Challenge' (n=2), including module leaders who were responsible for the development of CAA within the modules. The schedule examined the previous experiences' of teaching staff (in terms of assessment) and their perceptions concerning the impact of CAA. Table 2 details the participants; pseudonyms are used to protect identities.

Scientific Principles	
Jon	Module leader
Sam	Tutor
Physical Challenge	
Chris	Module leader
Peter	Tutor

Table 2: Details of the interview participants

Quantitative results

Multivariate analysis of variance (MANOVA) was used to explore differences in students' perceptions of assessment methods. MANOVA revealed a significant main effect (Wilks' lambda (6,297) = 0.69, $p < 0.001$), thereby indicating that there were significant differences in the 13 aspects between modules (see Table 3). Follow-up univariate analyses indicated that the module, 'The Study of Sport', scored significantly lower on the following seven aspects: Modules and learning objectives clearly explained $F(13, 292) = 7.17$ $p < .001$; Learning materials clearly presented $F(13, 292) = 6.61$ $p < .001$; Work load correct $F(13, 292) = 2.63$, $p < .001$; Overall level of assignments right $F(13, 292) = 4.47$ $p < .001$; Assignment 1 $F(13, 292) = 4.02$ $p < .001$; Assignment 2 $F(13, 292) = 5.05$ $p < .001$; and Tutors response $F(13, 292) = 10.51$ $p < .001$.

	Factor	
	1	2
The learning materials were clearly presented	.84	
The learning objectives were explained clearly	.83	
The overall level of assignment work was about right	.78	
Assessment 2	.77	
The workload was about right	.76	
Assessment 1	.74	
Tutor(s) responded to my enquiries within an acceptable time frame	.67	
The WOLF interface was easy to use		.81
WOLF enhanced my learning experience		.79
Off-campus use of WOLF was satisfactory		.76
University resources, e.g. the library, worked well	.38	.63
My attendance at lectures was good		.62
Attending lectures enhanced my learning experience	.40	.56
Eigenvalue	6.11	1.74
Percentage variance explained	35.23	13.36

Table 3: Factor analysis of aspects of each module

Figure 1 indicates that there is considerable variation in students' perception of assessment, even between the two modules that contained CAA. It should be emphasised that the CAA in the two modules was essentially the same, and it is therefore speculated that perceptions of assessment are influenced by students' perceptions of other factors within the module. To elucidate relationships between students' perceptions of factors within modules, a factor analysis was conducted.

Factor analysis with varimax rotation indicated two emergent factors. Factor 1 contains aspects that relate to elements under the control of the lecturer, such as how well learning objectives were explained, whether the overall level of assignment work was about right, the overall workload, and how the lecturer responded to enquiries within an acceptable time-frame. Factor 2 contains aspects that relate to other factors, such as learning and teaching resources and student motivation. Examples include the use of the online learning support framework (WOLF), the effectiveness of university learning resources such as the library, and student attendance.

Qualitative results and discussion

Interviews were conducted with the teaching teams of 'Scientific Principles' and 'Physical Challenge' to examine their experiences of the impact of CAA. In the module 'Scientific Principles' there are three academic strands: physiology, psychology and biomechanics, all applied to a sport and exercise setting. CAA was used as part of the multiple choice questions in an examination setting (MCQ), which quizzed students on all three academic strands. CAA was only used in the physiology section; the other sections were completed in a traditional paper format. It was deemed appropriate for all sections, but was used only for physiology for pragmatic reasons. This was explained by Sam:

We [the other module tutor and I] had tests in a different format ... I didn't do mine that way because it could be that mine was before Christmas ... I don't think there was ever the intention to have it in the whole module.

In 'Physical Challenge' the students experienced a combination of practical sessions with the theory of motor learning and basic psychology. The aim is for the students to put theoretical concepts into practice so 'they know how they apply it in the real world setting' (Chris). In this module, CAA constituted the second form of assessment and covered all aspects of the module. Analysis of the interviews identified three clear themes: time, front loading and testing knowledge.

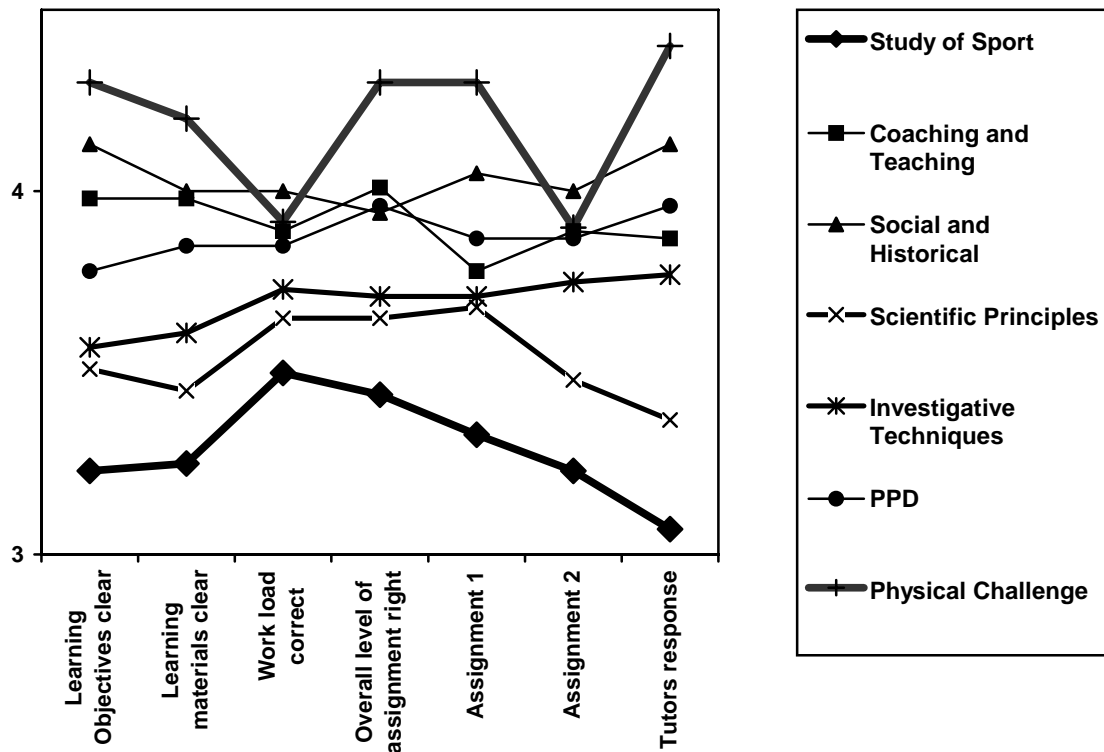


Figure 1: Ratings for students' perceptions of aspects for each module

Time

The tutors and module leaders acknowledged that the main benefit gained from the implementation of CAA was a saving of marking time. The technology assesses each answer in turn and provides every student with a score at the end of the test. In traditional methods, the mechanistic form of marking consumes time. Academic staff were extremely enthusiastic about the time saved by the technological process:

- It saves the academic a massive amount of time. (Sam)
- ... the computer is marking it for you so you can use that time in better ways. (Sam)
- Because of the time it would take to mark hundreds of scripts. (Sam)
- It cut down on our marking time ... it is a wonderful tool. (Jon)
- The thing it helps which is a massive thing is the whole marking time issue. (Chris)
- The assessment comes at a time when we are all snowed under as well ... (Chris)
- Efficient time saving method of assessing the students. (Peter)
- Saves time from assessment full stop. (Peter)

Staff acknowledged that one of the additional benefits of time efficiency was a reduction in stressful workloads. Stressful workload patterns are previously acknowledged (van der Klink *et al.*, 2001; Niven and Cutler, 1995; Thorsen, 1996) and CAA could assist academic staff at times of marking hot spots. Marking time saved through this process could then be used for other purposes.

Front loading

The module leaders acknowledged that the use of CAA was an up-front investment of time at the start of the module, leading to a long-term saving. This early investment of time needed to write the bank of questions was then utilised at a later stage as the marking process was not so time-demanding. They referred to this process as 'front loading'. As Chris explained:

There is no getting away from the fact that CAA is front loaded so we worked really hard on getting the MCQs in place ... because there was no resource, there was nothing in existence, we didn't have that option. It was a lot of work to develop the questions and make sure they were sound ... but once that's done you are saving a lot of time, then.

Testing knowledge

Module leaders reported another advantage of the use of CAA – the ability to use the assessment method to test knowledge:

It tests knowledge ... basic level of understanding is quite good ... they pick bits out that they are happy with ... with CAA they are forced to confront things they are not comfortable with and I think that's a good thing (Chris).

Staff were clear about the application of CAA for this purpose and that, in the two example modules, the assessment element was designed for this purpose: 'But I suppose for us in 'Scientific Principles' it was quite nice because we were testing knowledge' (Jon). Chris reported an advantage of CAA: "[It] allowed us to assess all of the concepts within the module"; but it was also possible that this was an advantage of a MCQ assessment rather than specific to CAA.

Tutors also discussed the limitation of CAA to simply testing knowledge and questioned whether it was suitable for a deeper form of assessment:

It is an interesting discussion as to whether we can use it for more than knowledge, and I am not sure... (Jon).

Advantages and disadvantages

A direct comparison between CAA and other forms of assessment was made and a number of advantages and disadvantages were commented upon. In addition to time saving, a clear advantage, both module leaders commented on the benefits of CAA for reflective practice. The technology allows for an analysis of student progression and achievement in relation to each individual question set. Chris commented that the statistics provided from the results allowed for an immediate reflection so that the module leader could 'evaluate individual questions'. Jon was also appreciative of the options created for reflection: 'The analysis sheet allowed me to analyse the questions. The output was really good.'

One of the major disadvantages noted by staff was the issue of students' levels of IT competence on which the two module leaders had differing perspectives. Chris believed that this issue was a negative aspect of the project owing to the number of students who were described as 'computerphobic' (Chris). In contrast, Jon believed that the technology was well suited to assessment for contemporary students because they are very 'computer literate' (Jon). Chris considered some of the finer details associated with the technology. For example, she commented on setting up and applying the assessment as a 'scary trust process'. She also considered that the use of technology might be more problematic for students with special educational needs, with particular reference to dyslexic students. As previously highlighted, the final disadvantage discussed by both module leaders was the notion that CAA was limited in its application for testing knowledge rather than for deeper forms of learning.

Summary

Module reviews reflecting on course content, delivery and assessment undertaken in this way allow staff to be more critical about the changes made to the module content. It is important to avoid hasty judgments and prevent the risk of change initiated by dissatisfaction in the early stages. Both formal and informal reflection on modular progression used in this project was useful in the development of these modules and the holistic level 1 curriculum. CAA benefits staff through a more manageable workload, thereby enabling the subject team to be proactive in student support systems, which can identify potential problems before they develop into a crisis.

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