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# Computer-Based Assessment: Its Use and Effects on Student Learning

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Computer-based assessment (CBA) has practical and economical benefits in that it allows testing of a large student cohort with the facility of automated marking of responses. In 2001, we incorporated CBA as a means of promoting and measuring student understanding of course content. While anecdotal information suggested that student learning was enhanced and results showed that learning had occurred, the learning processes promoted by this technology needed explanation. We have tried to do this. In 2002, over 300 students in their second year of teacher education participated in formative and summative CBA while undertaking an English course. Data were collected to track learning pathways and effects on learning outcomes. Surveys, monitoring of student use of technology, and interviews provided data sources. Of particular interest were the ways in which students used on-line discussion group to engage in learning.

## Introduction

The use of computer-based assessment (CBA) as a summative tool has both practical and economical benefits in that it allows testing of a large student cohort with the facility of automated marking of responses (Charman 1999; Zakrzewski & Bull 1998). In addition, pedagogical advantages have been suggested. These include: immediacy of feedback to students and staff; repeatability of tests consisting of randomly-generated test items; reliability and equity of computer-marked assessment; flexibility in terms of time and place of assessment; and, responsibility for own learning and test taking (Charman 1999).

Student response to CBA, as a summative tool, has been mixed and clearly associates with individual differences associated with computer experience, computer anxiety and computer attitudes (McDonald 2002). Many students have described CBA as less threatening than conventional examinations (Bocij & Greasley 1999); others have reported enhanced levels of motivation and confidence (Thelwall 1999). However, this same level of enthusiasm for CBA has not been shown by students who are computer-anxious or less experienced with technology (Brosnan 1999).

The benefits of formative assessment have been well documented (Yorke 2001). In addition to these benefits, formative CBA provides flexible and self-paced learning with immediate feedback. Much of the research has looked primarily at student attitudes to

formative CBA, with its effects on student-learning remaining comparatively under-researched and under-theorised (Bocij & Greasley 1999; Charman & Elmes 1998). It is important to identify the learning that is promoted by this technology and to explain the learning processes involved. Of particular interest is the role of asynchronous on-line collaboration involving text-based discussion as a feature of the learning process.

On-line discussion promotes thinking and facilitates socially negotiated meaning. Its effectiveness has been contributed to the nature of on-line written discourse as compared to oral discourse and formal written discourse (Lapadat 2000). Unlike oral discourse, on-line written discourse has permanency that allows continued reflection on the comments of others. Unlike formal written discourse, the student is not required to use precise terminology and phrasing when using the forum. Ideas can be edited before being submitted. In addition, asynchrony allows students to contribute ideas without constraints of time.

While the potential of on-line discussion is apparent, the medium is not without its problems. Comments can be trivial and, therefore, time wasting for students who read them (Klemm 2000). Messages are public and permanent. According to Hammond (2000), this causes reluctance on the part of some students who are unwilling to expose their ideas to public scrutiny and are uncomfortable at not being able to retract what they have written. Learners who focus on these constraints are unlikely to participate in on-line discussion.

## **Background**

In 2001, we introduced formative CBA as a means of promoting and measuring student understanding of English grammar. For a period of four weeks, students were able to access an electronic quiz consisting of 40 randomly-generated assessment items drawn from a bank of 65 items. Students attempted the quiz as often as necessary. On each attempt a result was provided. Questions that were answered incorrectly were identified and relevant sections of text, associated with errors, were nominated for review. Student achievement of a threshold mark of 85% was a pre-requisite for passing the course.

In 2002, we re-introduced formative CBA, again in relation to students' learning of English Grammar. This time, the item bank was increased to 200 items and students' summative performance on the quiz was assigned a weighting of 20% of marks for the course. As students participated in formative CBA, data were collected in the form of surveys, interviews, forum discussion and CBA statistical information.

## **Method**

### **Data collection**

During the first week of the course, all students completed a survey which provided a profile of their beliefs about learning and themselves as learners. On completion of the tenth week, students completed a similar survey which contained additional questions relating to use of formative CBA. In both surveys, students responded to a series of statements that required responses with a response range that varied from 'strongly agree' to 'strongly disagree'. Results of both surveys were compared.

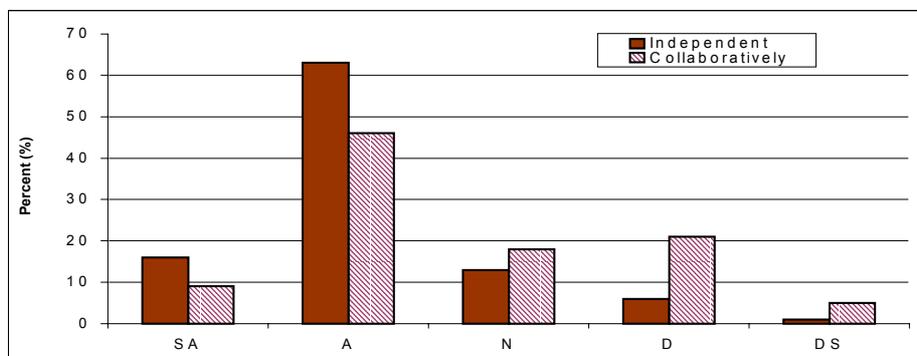
During Week 12, results of the Week 10 survey were shared with students. Students were invited to comment on trends that had been observed using a discussion forum on the course website. There were 107 contributions posted. Of these, 28 were posted anonymously. These data were analysed for common and repeated themes. About the same time, twelve students were interviewed by an independent researcher about their experience with formative CBA. Participation at all phases was voluntary and students' identities remained anonymous. Data were used to explain trends observed in the survey data.

**Participants**

The 340 students in this study were completing a second year course of a Bachelor of Education (Primary) program across two campuses of a large university. Female students comprised about 82 percent of the group with almost half of the group aged below 20 years. Twenty students participated in the on-line discussion forum. The number of students posting anonymous messages is unknown. Twelve students were interviewed. They were selected randomly from the course database, their participation was voluntary and their identities remained anonymous. Interviewees from both campuses were representative of the wider population of students in the course.

**Results**

**Learning pathways: Independent or collaborative?**



**Figure 1**  
Comparison of students' selection of learning pathways

Most students were confident working independently and in small groups, with levels of confidence relatively stable between Week 1 and Week 10. A preference for working independently is evident in Figure 1. This trend was supported in forum discussion

where there was a pattern of resistance to group work. A typical comment was:

I prefer to work independently simply because I can guide my own learning, study the way I want to and I don't have commitments of meeting people at certain times. I also find that studying in groups can often be a time waster as people start to talk and lose focus on the topic of study! (I found this from personal experience!)

In fact, the practice of working collaboratively on the summative quiz became a contentious issue on the forum:

*Date:* Thu May 9 2002 11:09 am *Author:* Anonymous *Subject:* Re: Fair learning!

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I hate to sound slack but as we were able to take the quiz at home people are able to have books and friends there to help, while some people did the test unaided. I consider this unfair.

*Date:* Fri May 10 2002 8:50 am *Author:* Anonymous *Subject:* Re: Fair learning!

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Everyone has a choice how they take the test you know. With a friend, by yourself, with textbooks or without that choice was yours to make so there is little point in complaining about the fairness of it now. You made a choice based on weeks of practice. Get over it.

*Date:* Sat May 11 2002 2:25 pm *Author:* Anonymous *Subject:* Re: Fair learning!

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Yes i also agree, there was no rules saying that u couldn't use textbooks, friends or other means to answer the questions correctly! If u wanted to do the questions alone and by yourself, that was a choice u made. In fact working with friends to answer the questions was actually a way of re-learning the grammar terms, through student to student language.

Approximately 80% of students acknowledged that the flexible learning approach associated with the quiz suited their situation and almost 74% agreed or strongly agreed that they mainly accessed the formative quiz independently at home. As indicated in the following forum contribution, this decision associated with ease of access:

*Date:* Mon May 6 2002 4:13 pm *Subject:* Re: Using the quiz at home

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I did it at home for 3 reasons, none of them to do with 'learning partnerships'

1- I could access the quiz quicker, it loaded heaps faster than at uni

2 - I was guaranteed the use of a computer

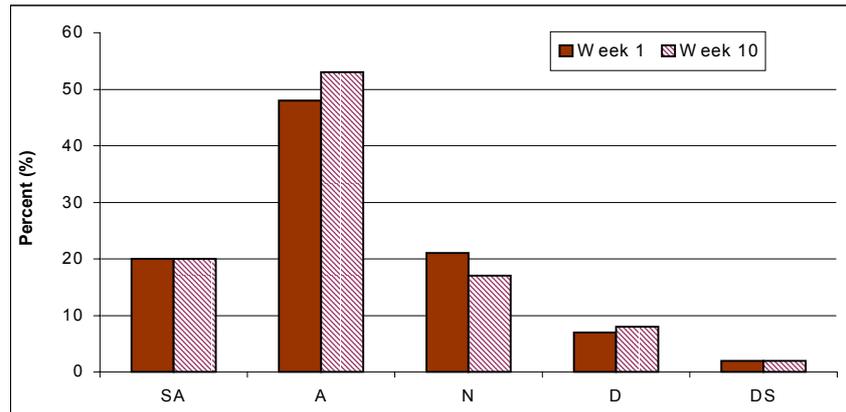
3 - I could do the quiz at midnight if I wanted to

A typical process followed by students is described by one of the interviewees:

I practised it more than 20 times but less than 30 times. Each time I practised it I printed it out and I looked up my answers and the stuff that I wasn't sure about I'd take notes on that topic (I:4)

**Learning pathways: Face-to-face or on-line?**

As shown in Figure 2, students' confidence using technology increased slightly.



**Figure 2**

Student response to the statement, "I am confident using technology", at Week 1 and Week 10

In line with current research (McDonald 2002), high levels of anxiety were seen as problematic for students when they worked with CBA. Some students internalised the source of anxiety, acknowledging a lack of competence:

*Date:* Mon May 6 2002 8:16 pm *Subject:* Re: Using technology

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... not being a wiz at the computer I also have to agree that when a problem arose I did not have the skills that a more competent computer user would have to troubleshoot the dilemma. That caused no end of stress.

Others externalised the source of anxiety:

*Date:* Mon May 6 2002 4:06 pm *Subject:* Re: Using technology

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I don't think it is the lack of computer literacy that may disadvantage some people, rather the actual computer itself having a problem when the pressure is on. Whether it be time-outs, disconnecting, overall quiz glitches or whatever... that's what stressed me out the most - not ME doing the quiz, but can my computer do it? We have confidence USING technology, but not always confidence IN it.

**Table 1**

Levels of agreement/disagreement with statements about using the electronic forum

	Strongly agree/ Agree (%)	Neither agree nor disagree (%)	Neither agree nor disagree (%)
I used the electronic forum as an <b>observer</b> to understand about English grammar	47	25	28
I used the electronic forum as a <b>participant</b> to understand about English grammar	29	31	39

Findings indicated (see Table 1) that 29% of students contributed to website forums while almost half participated as 'lurkers', that is, they participated through observation. Seven of the twelve students interviewed participated in either role for various purposes:

"Generally I used it when I couldn't understand something. I'd just put a question on the web, 'Please, I don't understand. Can you tell me...and someone would come along and comment.... I find them more useful when the lecturers or tutors are making comments because a lot of people will go there just to see what they say.'" (I:2)

"I used it to see what people were and weren't understanding." (I:10)

Both contributors and lurkers, however, seemed most interested in contributions from lecturers and tutors:

"When you see the lecturer's name you automatically look at that first." (I:7)

"It's good when you see the lecturer make comments....you find out how to go about something properly rather than getting four or five different opinions that might be wrong." (I:10)

#### **Learning outcomes – surface or deep?**

Biggs (1993) made the distinction between surface learning and deep learning. With surface learning, information is memorised while meaning is ignored. It is illustrated in the following statement:

I ended up doing it 42 times but that defeated the purpose really because most of the answers I ended up getting because I memorised them (I:6)

With deep learning, meaning is cumulative as the learner organises and structures content into a more coherent whole. This type of learning was described also:

*Date:* Mon May 6 2002 11:01 am *Subject* Re: Flexible learning

I felt that the quiz actually made me think. Because I was drawing on my knowledge every time I took the test I had to revisit what I had learnt. I found myself thinking, WOW i know this when in a non-flexible exam i feel always unsure. I think this is due to being able to practise and practise using the information and not just using it once and forgetting it.

## Conclusion

CBA offers students new opportunities to further their learning. Yet, educators need to proceed with caution especially when formative and summative CBA rely on randomly-generated items from a shared source. We have two concerns. First, our research suggests that surface learning is encouraged. Second, we do not know whose work has achieved the summative result? Reversion to a summative assessment involving paper-and-pencil would provide a solution to both concerns.

On-line discussion appears to provide a worthwhile learning experience for many students. However, there are questions to be answered, especially in relation to the role of educators. What do we do to help lurkers contribute to discussion? How do we facilitate student-centred learning when students value a teacher-directed discussion? Clearly, there is further need to explore the learning pathways associated with CBA in order to optimise learning outcomes for both students and educators.

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