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BRIEFING PAPER

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Computer Aided eAssess-ments

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Introduction

Successful construction relies on good architecture. Detailed designs, capable foundations, the appropriate use of materials, and the successful management of construction processes, are all guided by architectural blueprints. In turn, the architecture itself is guided by the proposed use and users of the building.

This analogy applies well to building effective programmes of learning, whether for delivery face to face in a classroom, at a distance, or blended.

The challenge facing today's "learning architects" is to develop the framework and the blueprints – the "learning architecture" – that will guide the design and construction of effective programmes able to satisfy the ever widening spectrum of learners, and their individual needs.

Within that overall architecture, well designed assessment can greatly enhance the learning process by providing immediate and personal feedback to students. This helps to promote better overall understanding and a capability for self-reflection. Assessment is therefore a critical catalyst for student learning, and should be an integral component of any learning architecture.

Computer aided assessment falls into two broad categories: assessments that can be computer marked, and assessments that still require a human valuator somewhere in the loop. While the former is reasonably well catered for (though most people still use it in a content and an educational objective light manner) computer aided tutoring has traditionally be difficult to implement. However recent advances in technology has seen this grow in importance, as it both speeds the processing of results, and can give more detailed feedback to students, tutors and examiners for less effort.

In this briefing paper we will examine the current state of computer aided assessment, and explore where it might fit into your learning architecture. A future briefing paper will cover designs for content rich, computer-marked assessments.

Computer aided tutoring

The growth in the use of on-line learning environments has meant that for many institutions, electronic submission and assessment of their student's work is now possible. The Open University uses its own bespoke Tutor Marked Assignment (TMA) system and is experimenting with intelligent essay assessment, applying known statistical analysis techniques such as regression analysis to develop scoring models that compare well to human markers, and latent semantic analysis to estimate how similar one body of content is to another at a meaningful level.

The OU built and tested an open source prototype tutor mentoring tool called "OpenMentor", which used 178 known rules derived from the analyse of thousands of TMA responses, to give individual tutors feedback on their marking of assignments. Using Bales (1950) analysis, tutor responses are analysed and categorised into 4 socio-emotive categories:

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1. Positive reactions – agreeing and boosting the other person;
2. Negative reactions – disagreement;
3. Directing or teaching;
4. Questioning – requesting information or further clarification.

OpenMentor was used extensively on the OU's MA in Open and Distance Learning course as part of the overall mentoring process, but used as a training tool it is particularly useful for new tutors joining the university. A second prototype was developed to monitor and graph how tutors analyse students free text responses.

While both of these computer aided tutoring applications are not yet developed to a standard where they might be as capable as human markers, they are able to provide weak but statistically significant models that correlate well with human graders.

Computer aided assessment

Computer aided assessment (CAA) has had a long and eventful childhood. Recent surveys on the uptake of CAA confirm that the widely felt concerns that tutors and administrators have had that CAA tools are difficult to use, and that computer aided assessments are mostly 'dumbed-down assessments'.

However, most of the early threats to the credibility of CAA have been addressed. Concerns about students 'guessing' answers, have been largely addressed by new question authoring strategies including removing clues, increasing the number of distractors, and by careful use of negative marking schemes.

Concerns that computer assessments are unable to assess Bloom's (1956) higher learning outcomes (evaluation, synthesis and analysis) have also largely been addressed in research. Boyle et.al concluded in 2002 that computer aided assessment is appropriate for use in examining Bloom's higher level outcomes in undergraduates, so long as sufficient care is taken in the construction of the assessments. Mostert et al (2011) in a study done in the Faculty of Health Sciences at the University of Pretoria, concluded that it is a suitable assessment method to test on a variety of cognitive levels.

There has been a gradual realisation that computer based convergent assessment (leading to the selection of a single answer) is a valid tool to use in assessment, as is as tutor-marked divergent assessment (multiple answer options often provided by students in the form of free-text prose). Both are distinct, and have a role to play in any blended assessment strategy.

There are still many issues being addressed by the CAA community, but mastering the art of assessment authoring is a critical one. There is also still a steep learning curve for assessment designers, and it is important that they are given the time to work to reduce the scope of guessing, test learning outcomes at Bloom's higher level of abstraction, and explore how to vary the difficulty of questions.

At an organisational level, making CAA a fully integrated part of your existing assessment procedures increases its perceived value, easing uptake and in turn helping to secure the considerable benefits CAA can bring when used appropriately. Establishing shared, subject-specific question banks help to drive the large scale adoption and use of CAA. Comprehensive training in assessment construction and analysis will help to underpin the academic value, and underpin the rigorous quality of the necessary assurance procedures.

An important aspect of computer aided assessment design at all levels of adoption is consistency. Once authors, tutors and students are conditioned to expect and understand computer aided assessment features, they will more quickly move beyond the 'context' and into the 'content', and have improved assessment facilitated, learning experiences.

Conclusion

The adoption of computer aided assessment technologies is still very much positioned in the "*Early Adopters*" stage of Roger's (2003) technology uptake curve.

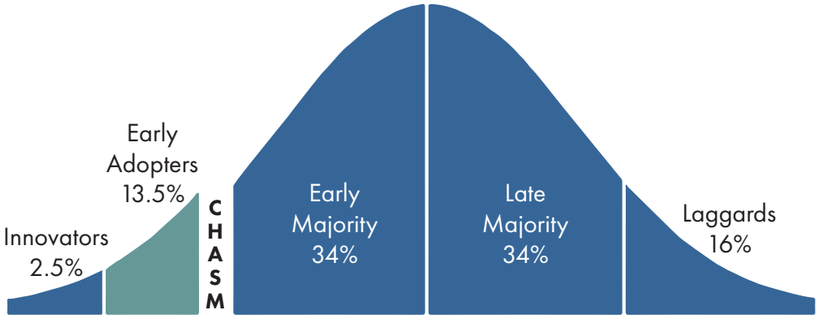

Figure 1: Technology uptake curve (Rogers 2003)

Moving from there into the *Early Majority* stage of uptake will require more effective training in best practice, improved tools, adoption of wider interoperability standards, and the realisation by institutions that a strategy, architecture, and IT infrastructure for CAA is needed. Leaving it for early innovating academics and departments to continue on an ad-hoc basis is a risky approach, and unlikely to secure the considerable gains and benefits CAA has to bring to the institution and customers.

However, it is also a mistake to consider computer aided assessment in isolation. It exists within the wider overall learning architecture that encapsulates all your learning materials and processes. Managing assessment materials effectively means they should be managed in conjunction with the other sets of learning outcomes and materials assets you have, and which you have probably also spent considerable time and effort creating.

What can be usefully explored is the use of classifications, or taxonomies – such as Bloom – to ensure that assessment questions are rich and varied, and cover all aspects of the educational objectives being tested. Other design benefits can also be explored, such as ensuring that courses and course materials are designed around a well-defined set of learning objectives, that assessment answers link to a specific context in the core learning materials, and that there is a coherent and consistent context provided by the learning materials. In a properly designed course feedback can be enhanced – through the computer – to offer personalised progress reports based on the defined key learning objectives, thereby allowing for richer dynamic feedback to both students and tutors.

These capabilities become particularly relevant when you set out to create more effective on-line learning environments, with well designed self-assessment capabilities for flexible and distance learners. Assessments integrated into knowledge domains also make it easier for authors to construct the higher order assessment questions that challenge students to analyse, synthesise and evaluate across the whole body of knowledge.

Computer aided tutoring and assessment will eventually fit into these overall delivery environments. It is good sense to be preparing for this next stage of development in on-line and blended assessment strategies, and for the integrated learning architectures of the future.

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