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Keeping Control using Computer Aided Assessment

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Keeping Control using Computer Aided Assessment

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Abstract: The impact of introducing Computer Aided Assessment (CAA) into a standard mathematics and statistics course is discussed in this article. It is based on embedding the strategy in lectures and tutorials and how this can be managed so that control is maintained by the lecturer. CAA can be introduced as a relatively minor back up resource, as described below, or as the first step towards the introduction of a significant part of the substantive assessment as CAA. Such an approach can be used to monitor student performance.

1. Introduction

Many lecturers of Mathematics and Statistics courses in Higher Education have long cherished the principle that the courses they teach belong to them and that they have full control of delivery and assessment, subject to the formal syllabus requirements. On top of this, it is recognised that important courses at first-year level, which lay the foundation for mathematical and statistical skills, can be further improved and controlled by:

- monitoring the performance of students;
- supplying timely remedial work; and
- providing further exercises and assignments when needed.

This article discusses the impact of computer-based techniques on these different aspects of maintaining control of courses.

The advent of VLEs and developing techniques in CAA and CAL have created both opportunities and problems in the wake of the perceived increased teaching needs at the early stages of degree courses.

Amongst the opportunities, the modern environments give the chance to:

- organise the course using a VLE as a coordinating and resource forum;
- provide more scope for practice of basic mathematical and statistical skills through CAA; and
- employ CAA to provide a method of monitoring student performance.

This article discusses the problems of perceived and actual loss of control arising from these opportunities. It is worth noting that institutional VLEs were developed in the USA and Canada where there is less of an ownership culture, especially for lower level courses.

2. VLEs and Control

The availability of VLEs, their take-up and investment by HE institutions is forcing course leaders and designers to think of online delivery and to exploit, enhance or replace the inbuilt assessment methods. Students value VLEs as a source of dynamic information about their courses. This is not surprising since, without much effort, they can access missing course notes, find out about assignments, look at current solutions and, in general, use the VLE to take over much of their course organisation. It makes sense to build on this acceptance of VLEs in order to establish courses as interactive communities within VLEs, as long as meaningful interaction can be created and then managed and controlled. This interaction is vital for good quality feedback on practice and assessment, and to create a stimulating environment. For example, the use of the inbuilt communication tools allied with CAA tools capable of monitoring students. But there are major caveats: staff wanting to develop these courses within institutional VLEs do not, in general, have adequate control over the infrastructure and there is always a major effort involved in extending functionality such as linking in databases, using third party assessment tools, finding good whiteboard technology etc. This activity is very dependent upon the support supplied by the institution and can be very time-consuming. Open source VLEs are discussed briefly below. Such VLEs are locally managed and have interaction built into them.

2.1 Institutional VLEs

Do these types of system result in a loss of perceived and actual control? It would seem so, especially as many of the possible controlling techniques used in these systems are script-based and/or otherwise technical and are outside the competence of many lecturers. Giving over some control of the presentation of exercises and the organisation of courses may, at first sight, seem desirable and efficient. However, when network problems arise or the VLE has significant downtimes, then there can be critical impact on the course and its delivery. Institutional VLEs have to be managed centrally and there is a natural reluctance of administrators to give any control to course leaders, in various areas, as they tend to be academics, some of whom like to experiment with new tools and possibly create problems. At the same time, changes can be made at the administrative level that can cause frustration to course develop-

ers as administrators tend to assume that all applications are standard and their actions will cause little dislocation. If the administration was at a local level with the lecturer as part of the team, then such problems could be easily managed.

An example of the lack of control is provided by this present author deciding to run the CAA package i-assess (see http://www.i-assess.co.uk and Lawson [1]) from a course within the institutional Blackboard VLE. By delving into the deeper recesses of the Blackboard documentation, a smart way was discovered to send the user's name to the log-in of various types of i-assess examinations or practice questions using inbuilt Blackboard variables in HTTP code. At the same time the Blackboard method of logging in was being reviewed, and subsequently changed, by Computer Services at Newcastle. They had just taken over the support and so there was a 6 months delay before this novel method could be tested and used. In the meantime, the i-assess system was employed as a stand-alone assessment tool accessed via a different route.

2.2 Open source VLEs: Creating more control

Open source VLEs such as Moodle give localised control. For example, at York this VLE has been used and integrated with AIM, a very powerful intelligent assessment tool, under the complete control of the developers. More details are given in Delius [2] and the York Moodle site can be found at:

http://maths.york.ac.uk/moodle/yorkmoodle/

This site includes a review of the reasons why Moodle was chosen over a commercial VLE at University College Dublin and the implementation plans there, see:

http://maths.york.ac.uk/moodle/yorkmoodle/mod/resource/view.php?id=166

The following site has all the major open source tools

http://www.opensourcecms.com/

Newcastle University is setting up a Numeracy Support Centre website (under development at http://sandpit.ncl.ac.uk/maths-aid/index.php) using Mambo as the open source tool. There is a team of Postgraduate Tutors for the Support Centre who will be running and contributing to this Wiki-style site (see *What is Wiki?* at http://wiki.org/wiki.cgi?WhatIsWiki). The Wikipedia (http://en.wikipedia.org/wiki/Main_Page) is the most famous example of a Wiki site.

The development of this type of online database leads to questions about involving students' contributions and how to manage them effectively. The experiences at Dublin and York will be followed with great interest.

3. Controlling CAA

The impact of introducing CAA into a standard mathematics and statistics course is examined below. It is based on embedding the strategy in lectures and tutorials and how this can be managed so that control is maintained. CAA can be introduced as a relatively minor back up resource, as in the first section below, or as the first step towards realising a significant part of the substantive assessment as CAA. Perhaps, also, monitoring student performance by this method.

3.1 Introducing CAA into a course as a back-up resource

In this case, CAA is used as an extra resource that students can use if they wish to refresh their skills and practice. For example, the excellent and elegant package that is described in the August article in this series (pp. ??) or directly accessed via

http://www.tech.plym.ac.uk/maths/resources/PDFLaTeX/mathaid.html

This material can be referenced at suitable points by the lecturer and there is no more work than that: it is self explanatory, well presented and well designed CAA material. These attributes are essential for such back-up material, especially as the lecturer has no input or control other than advising which topics to study.

3.2 Introducing CAA into a course starting with online practice

The systematic use of CAA within a course that is currently delivered is now described. The assumption here is that the lecturer believes that CAA should be introduced as an integral part of the course but wishes to maintain as much control as possible. A rational plan is to start by introducing CAA as practice material that is directly linked to the delivered course.

The assumptions are that the CAA tool chosen:

- is affordable and supported by the supplier over a reasonable time period, and that there is finance to support the system over this time period;
- can be fully implemented on the network without complaint from the

relevant computer services, and that these services are fully aware of all aspects of the implementation and have cooperated;

- is reliable and is a stable version of the software with a clear history of development and testing;
- ideally has current users of the system who can be contacted and questioned together with any reviews;
- has the functionality it claims and this functionality is documented;
- can be accessed by all relevant students across a network either from a VLE or as stand alone system;
- keeps results data secure if it is to be stored; and
- has been tested to see if students can use the interface without complaint.

The following questions are concerned with how well the proposed CAA fits in with the course, how much more extra work is needed and how much control there is over the use and implementation of the CAA tool.

1. Are the CAA questions produced by the tool suitable for the course? In particular, and crucially, can questions be easily authored and published? It is important to play with the software and to attempt the emulation of typical questions in your course or close approximations to them.
2. Is the feedback and advice supplied by the tool adequate and/or within your control? Can you create your own feedback if you author questions?
3. If scripting is needed to write suitable questions how much work is needed and do you have to learn new scripting languages? Low level scripting usually means that the software is not yet in a finished form and that shells will be developed.
4. Is there adequate support for the tool both internally (university and departmental finance and computer infrastructure and support) and from the supplier? Being crucially dependent on other people can be a sobering experience especially for the typical one semester course that does not allow for many interruptions.
5. Should there be a back-up method of delivery of practice questions prepared in case the CAA tool is not used by the students or if the general infrastructure support it needs is found to be inadequate? After all if you feel that this extra-practice resource is important then it should be supplied.
6. Do you intend to review the efficacy of the CAA implementation? Obvious criteria are given by student results (if good quality comparison data is available), student feedback, the amount of resource used and the amount of work that is entailed in maintaining the system. Other criteria include the departmental, institutional and external views of these activities, e.g. increasing diversity of assessment is a “good thing” etc.
7. If the outcomes are assessed to be marginal or negative, how difficult is it to undo the work, both politically and practically?
8. If the use of CAA as practice is positively viewed after review is there a next stage planned? For example, replacing all exercises and some assignments by CAA.

Positive answers to these questions would indicate a proper degree of control over the implementation of CAA, in line with expected practice in UK HE institutions.

4. Monitoring Student Performance Using Skills Databases

Given that there is a successful and well-used CAA tool, together with a fully interactive VLE implementation under the full control of the lecturer/instructor, then, and only then, the present author believes, there is the opportunity to set up a computer based monitoring system that effectively controls the delivery of material to individual students. The assumption is that students will try the assessments, and a report on their attempts will then be automatically stored and subsequently accessed by the lecturer for review. The reductionist approach to realising this is to set up a skills database, assuming that the questions in the CAA tool can have attributes attached to them, including the skills from the database they are designed to test. The lack of success in some skills, as indicated by performance on the assessment, will trigger appropriate remedial action. For example, a successful application of a hierarchical skills network is John Appleby’s well known program Diagnosys (see http://www.staff.ncl.ac.uk/john.appleby/diagpage/diagindx.htm). This is a static implementation giving information on a student’s mathematical background on entry to the University and with pointers to remedial action. The present author does not know of any dynamic use of such a system over the lifetime of a course.

Another interesting application of a skills list is that of the Mathematical Learning Hierarchy (http://www.physsci.heacademy.ac.uk/resources/math_hierarchy/home.html) by Dr Paul Yates of Keele University. Here a mathematical problem in the Physical Sciences is presented and a list of skills needed for the problem is also displayed. On clicking one of these skills an exercise in that skill is presented so that the problem solver knows what he is expected to know!

There is no standard list of skills for mathematics written anywhere as far as this present author can judge. However, any lecturer giving a first-year course in

say Mathematics for Scientists or Engineers can happily write down a long list. For example, the Numeracy Support Centre at Newcastle is using many of the excellent mathcentre (http://www.mathcentre.ac.uk) leaflets and booklets from which the Postgraduate Tutors have built up an impressive list of 300 or so hierarchical mathematical key skills that will be used for cross referencing and searching via a database in the Numeracy Support Centre at Newcastle University. More information on the Numeracy Centre at Newcastle will be reported in future articles.

References

[1] Lawson, D. 2003. An Assessment of i-assess, *MSOR Connections,* **3**(3). LTSN Maths, Stats & OR Network, Birmingham.

[2] Delius, G. W. 2004. A Conservative Approach to Computerised Marking of Mathematical Assignments, *MSOR Connections,* **4**(3). LTSN Maths, Stats & OR Network, Birmingham.