Computer-assisted Assessment: Suggested Guidelines
for an Institutional Strategy

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Summary

Institutions are increasingly turning to technology to solve their teaching, learning and assessment problems. The use of computers in student assessment, when compared to their use for teaching is a relatively new development. The experiences gained from the development of computer-aided learning can inform and progress the use of computer-assisted assessment (CAA). This paper considers the development of CAA in higher education and proposes that a strategic approach is advantageous to institutions wishing to develop and implement CAA systems. A brief review of the lessons learnt from computer-aided learning and CAA is provided and the experiences of two institutions are described. Based on this, recommendations are made as to how effective CAA systems can be implemented on an institutional basis.

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Strategic Approaches to Institutional Support
of Computer-assisted Assessment

Introduction

The authors propose that a strategic approach to developing a centralised model of institutional support would be beneficial to universities considering Computer-Assisted Assessment (CAA). Computers in higher education have had a variety of impacts on students, academic and administrative staff. The pursuit of objectives such as the 1:10 ratio of computers to students has led to the increasing use of computers to deliver learning materials. The advent of a PC on most staff desks has aided the computerised collection and databasing of marks and the computation of degree results. Less well developed is the use of computers use in the area between those two activities, that is, the use of computers to measure student learning and contribute formative and summative marks.

Changes in higher education have meant that academic staff are under increasing pressure to become both active researchers in order to secure funding and effective teachers (Smith and Brown, 1995). Rising student numbers has increased the volume of assessment for staff. The impact of modularisation may well have led to the over-assessment of students (Leask, 1994).

Thus the changing nature of higher education has forced individuals and departments to re-examine the way in which they carry out teaching and assessment procedures, especially where large student groups are concerned (CSUP, 1992). The expansion and integration of campus networks offer opportunities for changes in the way in which the curriculum is delivered and assessed. However, an overall institutional information strategy is required to underpin the application of technology to the curriculum in an economical and effective way which achieves volume results (Campbell, et al, 1996). Specifically regarding CAA, Barnett et al (1996) proclaim the value of ë a comprehensive computerised system for assessment purposesí , but provide no practical and realistic suggestions as to how this may be achieved.

Computer-Assisted Assessment

CAA is the use of computers in student assessment. This may encompass a range of activities including the use of computers to:

- deliver, mark and analyse assignments or examinations;
- record, analyse and report on achievement;
- collate and analyse data gathered from optical mark readers (OMR);
- collate, analyse and transfer assessment information through networks.

In comparison to the use of computers to aid student learning, CAA is a relatively new development and has often been pioneered by enthusiastic individual academics. Examples include the use of Question Mark software at the universities of Luton (Bull and Zakrzewski, in press), and Plymouth (McCabe and Troise, 1996), the development of in-house CAA software at the University of Wolverhampton (Thewall, 1996) and a system built using Authorware at the University of Derby (Brown, Bull and Pendlebury, 1997).

The use of the World Wide Web (WWW) to deliver assessment has seen the work of projects such as Medweb, a WWW-based system designed to integrate teaching, research and administration, gain momentum but not necessarily full institutional acceptance (Richards, 1997). Often developments have to be curtailed, restricted or abandoned due to time and funding restrictions, or the movement of the individual(s) concerned. Therefore opportunities are missed, in part, because of the lack of strategic planning.

Formative and Summative CAA

Whilst some institutions may decide to concentrate their strategy on formative assessment and self-assessment banks, others have chosen to embark on the delivery of summative assessment using CAA (Prichett and Zakrzewski, 1996; Bocij, 1995; Brown, Bull and Pendlebury, 1997)

Formative assessment can be experimental, student-centred and student-led and concentrate on providing fast, consistent and effective feedback to large numbers of students in a way in which most tutors can not. Formative CAA can allow students to be automatically directed, through feedback, to follow-up references and resources. Summative systems need to be more rigorous, formal, structured and invigilated, and therefore require effective planning, management and co-ordination between academic departments and central services. Generally they do not provide feedback and suggestions.

It is essential to have the support of all staff involved in designing, implementing and maintaining the system. This may include academic, technical and support staff. Suspicion surrounding new initiatives, innovations and technology makes it crucial that every effort is made to ensure the smooth running and effective operation of such systems. This can only be achieved through a strategic mandate with general institutional approval. It must be acknowledged that no system, technology-based or not is foolproof (Neill, 1996). There are advantages and disadvantages to technology-based and paper-based systems (Sandalls, 1992). Institutional strategies should seek to establish procedures which encompass paper-based and computer-based assessments, and wherever possible standardise the two.

Student Experiences of CAA

Students have been found to be more motivated within a computer-assisted environment. When examinations take the form of CAA students react positively and feel more relaxed in the familiarity of a computer environment similar to the one in which they have been taught (Neill, 1996). Even in situations where students are not regularly taught using computers reactions to CAA have been positive (Ryan *et al*, 1996; Pritchett and Zakrzewski, 1996). Such positive reactions to assessment methods may be an important contributor to a studentís success (Kniveton, 1996).

The Need for Strategic Support for CAA

Often the impetus for the development of CAA comes from individual academic staff, and rarely from within computing services or management. This can be advantageous as pedagogic issues should remain key when innovation concerns teaching and learning.

However, it raises the issue of whether academic staff are embarking on CAA driven by assessment overload and hoping to save marking time. The time saving aspect of CAA can be illusive where development takes place on an ad hoc basis and is unstructured and unplanned at an institutional level (Stephens, 1994) Time savings may be dependent on effective central support (King, 1996). Further, academic staff favour being provided with support when implementing computer-based education (McDonough et al, 1994).

However, problems can be created when the responsibilities and services that need to be provided do not sit comfortably within an established remit. Frustrated academics may resort to progressing under their own steam, each individual spending time battling with the software, the intricacies of question design and the logistics of mounting tests on the network. The use of computer networks raises a number of issues regarding the security of data and confidentiality of personal results (McCabe, 1993; Neill, 1996).   It is therefore, imperative that procedures are established through strategic policy initiatives.

Provision of Strategic CAA Support

Figure 1 depicts two examples of strategic institutional support for CAA. At the University of Luton support is provided in a top-down approach with the inclusion of CAA within the university's strategic plan. In comparison, Loughborough University provided a CAA Support Unit within its Flexible Learning Initiative (FLI) to help individual staff and some departments as they investigated the potential of CAA. In both institutions a central unit was seen as a way of distributing good practice and shortening the learning curve for all concerned by shared access to central help.

The University of Luton has a central support unit which manages the institutional CAA system and supports and develops staff in the use of CAA. An initial pilot project provided the impetus for the university-wide system, based on Question Mark Designer for Windows (Pritchett and Zakrzewski, 1996). The backing of senior management helped to ensure the co-operation of computing and support staff. The primary focus of the system was on the use of CAA for summative end-of-module examinations, however increasingly formative and self-assessment question banks are being incorporated into a number of modules. Typically, three thousand students undertake end-of-module examinations each semester, in a range of modules from ten different departments. (See Bull and Zakrzewski, in press, for more details). The initial impetus for the use of CAA was through a top-down approach, however the system quickly gained momentum and expanded, driven by academics requirements.

In comparison, the FLI at Loughborough University is the universityís focus for innovations in the delivery of materials and a centre for teaching and learning support. The FLI has a campus-wide role in the strategic development of teaching, learning and assessment and offers a comprehensive support service to staff. The work of individual academic staff involved in CAA was identified using a campus-wide survey and provided the basis for the services offered. It identified formative assessment using CAA as being of primary importance. The aim of the CAA Support unit is to advise, encourage and enable individual members of staff to implement methods of CAA if these are appropriate. Consequently, the delivery of CAA materials is supported across a diversity of technologies including OMR, PC-based Question Mark and WWW-based software. As materials become refined following formative use they are often then incorporated into summative

assessments. Consequently it could be argued that the Loughborough model was a bottom-up approach to CAA using a variety of appropriate technologies.

From both examples common lessons have been learned.

1   Emphasis needs to be firmly placed on pedagogy.

Technology is a tool that needs to be harnessed efficiently. Removing the need to master the technology from academic staff, allows them to concentrate on considering the assessment, learning outcomes, feedback and effect on student learning.   The technology should not drive the learning.

2   A central focal point is critical.

Central support can provide staff with expert advice about the use of CAA, increase the rigour of assessment and provide students with benefits. It will also provide a focal point for the exchange of information, ideas, networking and products within and between institutions.

3   Issues of concern are best dealt with centrally with the co-operation of academic and support staff.

Many of the barriers to progression concerning the development of CAA arise from those areas which are outside the immediate control of the academic, such as network security. Other issues raised by academics include: obsolescence of materials; time savings and positive effect on student learning. Academics may also feel they are losing control of one of their major teaching activities by no longer grading their studentsí papers.

4   The development of institution-wide strategies can save time and effort.

Institutional strategies can be used to develop policies which deal with whether question papers are released to students post-examination; staff development to capitalise on time saving and evaluation strategies which monitor effects on student learning. Strategies may be developed to acknowledge academics reservations, drawing their attention to the potential the benefits, as well as the limitations of CAA.

Callear and King (1997) suggest a checklist of issues and tasks for an individual CAA Officer. The following lists extends these issues and considerations to offer suggested actions necessary for a strategic approach to providing CAA within an institution. Finally the difficulties inherent in institutional strategies to develop CAA are compared to the development of CAL within higher education.

Recommendations

1   Establish a CAA unit

> A central CAA unit for the institution or distributed CAA units within faculties/schools can provide a focal point and centre of expertise. This can assist with: internal development and external contacts; and the co-ordination,

development, implementation and evaluation of CAA within specific disciplines or subject areas

The location, in terms of organisational structure can not be underestimated. A single faculty-based unit may alienate members of other faculties, location in computing services may create the image that the initiative is a technology-led rather than an educational innovation. Distributed units within faculties/schools will necessitate a further layer of communication and co-ordination, but will provide subject-specific expertise.

It may be appropriate to establish a CAA unit within an existing central services department, preferably with a pedagogical orientation rather than a purely technological one. An existing CAL support system may provide an opportunity to incorporate CAA, but it is crucial to be aware of the different issues surrounding CAL and CAA.

2   Establish a co-ordinated CAA management policy for the CAA unit(s) and each discipline on campus.

This enables the establishment of an infrastructure to support teaching staff embarking on CAA for the first time. To what extent support is central or discipline based depends on staffing, funding and institutional ethos. Centrally-based support allows effective co-ordination and dissemination and the establishment of a support network and focal point for all staff involved in the initiative.

CAA units should provide a safe initiation and reduce time lost by working alone for new staff. Some academics may not be prepared to submit to what they see as a loss of control of their studentsí grades. They may also fear the effects of technology upon their role in the institution (Times Higher, 1996). It is important to recognise that the CAA unit(s) will be managing change and to take account of this. The policy should give some recognition for the time and energy spent by academics working with the CAA unit to modify existing assessment materials or design new ones. It should clarify whether support will be available for summative and formative CAA, and consider the practical implications of supporting each of these activities.

3   Appoint discipline co-ordinators within departments

Discipline co-ordinators would provide discipline specific advice and guidance to academic staff and, where relevant, the CAA unit(s). They could also be responsible for publicising discipline related and general CAA developments. They could work with the unit(s) to:
- seek out and evaluate discipline material created elsewhere and provide a proper evaluation process rather than informal ad-hoc reviews;
- where appropriate, work with the central unit to find external funding sources and maintain databases of available material;
- ensure sound pedagogic practice.

4   Establish CAA discipline groups/committees.

CAA discipline groups/committees would provide an important link between schools/faculties, their units and the central unit. They would assist in:

- ensuring that student needs are meet;
- targeting key areas of the curriculum for CAA;
- establishing appropriate design methodologies;
- the management of project-based developments involving pedagogic, technical, operational and support staff to further the use of CAA;
- liaising and reporting to faculty or university teaching and learning committees;
- ensuring the integration of CAA with existing course assessment objectives and methods.

5 Provide funding

A CAA unit(s) must be provided with on-going funding and a budget. This will enable development and improvement to occur in pedagogic, operational and technical areas. Longstaffe (1995) emphasises the importance of the financial location of the CAL units, and management policy should establish how CAA units are to be funded.

6 Establish evaluation procedures

In consultation with discipline co-ordinators and discipline groups/committees, CAA units can establish good practice in evaluation. Co-ordination of evaluation and monitoring though a central unit can ensure consistency and allow comparison and dissemination of results and their implications. Consultation with CAA discipline groups/committees will ensure that assessment objectives and methodologies are appropriate and effective. Depending on the method of assessment, the impact of CAA can be measured quickly thus enabling rapid modifications to be made to the system.

7 Technical issues

It is important to evaluate existing software to identify whether it will meet your needs, pedagogically, technically and economically. It may be decided to invest in one product, several or to develop your own system. The cost of developing a system is high, but should meet your needs exactly. The cost of buying in software can vary, but a strategic approach would ensure that purchasing duplication does not occur.

Purchasing site license(s) for the most appropriate CAA software and ensuring centrally maintained computer labs are able to support CAA and possess hardware which is compatible, will encourage take-up and cross department expertise.

The software purchased may depend on the type of assessment to be undertaken, but there is a need to ensure whatever is purchased or developed is flexible and portable, and for summative systems, secure.

8 Organise staff development programmes

Staff development should be collaborative, involving the CAA unit(s), staff development, discipline co-ordinators and experienced individuals. This will allow the support of staff in the identification and development of good practice and design methodologies. It will also assist CAA unit(s) in dissemination of relevant information, operational procedures and help to ensure staff are aware of technical capabilities and limitations of software.

9   Establish operational and administrative procedures

Initially operational procedures and administration may be managed by the central unit, in consultation with the appropriate committees and administrative structures. However, with expansion the relevant administrative and service departments may need to take over some of the day to day administration and management of the system. The extent to which this is required will depend on the types of CAA which are being supported. Summative CAA will require the development of more rigorous procedures, maintenance of standards and effective integration within current examination procedures.

Computer-Aided Learning (CAL)

The use of technology to provide computer-aided learning (CAL) opportunities for students has moved forward in the past decade. Originally viewed with suspicion by sceptics and with fervour by adherents its take-up has been more fragmented than originally predicted and moved at a slower pace than expected (Darby, 1996). Strongly supported by initiatives such as the Teaching and Learning Technology programme (TLTP) and the Computers in Teaching Initiative (CTI), various strategies exist for inculcating CAL into the curriculum of individual modules and some subject disciplines, usually to first year undergraduates (McDonough, et al 1994). However despite this the provision of centralised institutionalised CAL support within universities has been less prevalent than forecasted by Brohn (1986) a decade ago.

Recent literature concerning the use of learning technology has turned towards the need for centralised support systems (McDonough et al, 1994; Longstaffe et al, 1995). The TLTP has acknowledged the need to support staff in the implementation of TLTP materials through the establishment of the Teaching and Learning Support Network (TLTP, 1995). Similarly abroad, the lack of policies and standards has led CAL to suffer, being viewed by some staff as a luxury, an add-on cost rather than part of the process of refining the delivery of materials and assessments, (Lieblum, 1992) and thus hindered its progress. The literature indicates that whilst some institutions have established new CAL units, others have incorporated them within existing central services, departments or faculties. As Longstaffe, et al note ë ... the problems, strategies and solutions remain the sameí (Longstaffe, 1996, p. 89)

Learning from a similar cycle of experimentation, development and implementation provides an opportunity to inculcate CAA into higher education systems with less delay and more effect than has been experienced with CAL.

Strategic Development: Comparisons between CAL and CAA

The development of CAL initially took place on an individual basis but has moved towards the development of resources which can be shared across the higher education sector (Neilson, 1996). The MacFarlane Report (CSUP, 1992) called for greater collaboration and sharing between institutions, and Laurillard (1993) highlights the need for consortia based development of resources. The TLTP progressed the work of the CTI as an information resource to providing funds for the development of consortia-based courseware in a number of disciplines. It aimed to emphasis the pedagogic aspect of development and counter the not-invented-here syndrome (Campbell, 1995).

Wide-scale academic acceptance of learning technology has been an uphill struggle, aided by rising student numbers and the availability of more cost-effective resources. Slater (1996) indicates that senior managers now view their role as promoting the uptake of TLTP material. It remains to be seen whether the necessary policies and resources are put in place to achieve this. Lessons can be learned from the development of CAL and applied to the development and implementation of CAA. Ad hoc, individual development leads to rejection of existing courseware under the not-invented-here syndrome. (Darby, 1992; McDonough et al, 1994). It leads to reinventing the wheel locally, which provided the impetus behind the TLTP, and has taken years to begin to decline (Laurillard, Swift and Darby, 1993).

The need identified for strategic support for CAL can also be applied to CAA. However, Hawkridge notes that ë New technology is as often a barrier to progress as it is progressive, and needs to face a political as well as a pedagogic critiqueí (Hawkridge, 1993). CAA can also be a contentious and emotive issue creating both practical and political problems. The combination of new technology and assessment can politicise the issues and problems which need to be confronted. Whilst there are similar development and implementation issues to be confronted, CAA is of a more sensitive and political nature than CAL and therefore requires a greater degree of co-operation, co-ordination and management across the institution if it is to succeed.

Recently the lesson which has emerged is that central support for CAL at university level is critical to the widest possible delivery, take-up, and acceptance by both staff and students. This is partly due to the need to provide suitable equipment and maintain it, something which is not always within the budget or operational scope of departments. It also requires training of staff in an ever changing choice of software and enhancements. Equally important is the guidance of staff in the most effective method of integration, without which such initiatives invariably fail (Laurillard, 1993; Freeman and Wells, 1994). All of these issues can equally apply to the development of CAA in higher education.

Conclusion

The development and use of CAA appears to be following a similar development cycle and maturity path to CAL. In order to hasten the emergence of good CAA practice and acceptable procedures the lessons learnt from the development of CAL should be applied, with due caution to the development of CAA. As with CAL within a single institution, staff maybe working on similar CAA developments. Without formal links to help optimise the discovery process progress maybe dependent on chance rather than being assisted by central co-ordinated policy.

In the absence of strategic policy and commitment to providing a service such initiatives may not succeed or fulfil their potential. Similarly, without the enthusiasm and drive of individuals and departments to carry forward the institutional objectives little may be achieved. The most effective promoters of new initiatives are often those who have tried it, found it worked and gone on to tell others in a non-official context. The balance between these two is crucial, too much institutional push and not enough pull and academics will feel cajoled and bullied and be able to find a range of excuses, not to become involved. Likewise push from below, without institutional commitment makes the process time consuming, subject to the whim of individuals, open to criticism, costly and discouraging for those engaging in it. It also focuses effort on the technology rather than the assessment, which may be detrimental to student learning. There is clearly a need for a strategic institutional approach to the implementation of CAA.

On an individual basis CAA cannot always provide the benefits that have been acclaimed to it. A university-wide strategy can maximise these benefits. The provision of effective security and staff development is an institutional concern. Staff working together given effective support and development can explore the impact of CAA on all of their assessments. Academic time can best be employed considering pedagogic issues not concentrating on the technology. CAA should be considered not simply as CAA, but as a range of assessment methods, such as objective tests, formative, self-assessment, the assessment of project and laboratory work. Through the appropriate use of CAA it is possible to extend the variety of assessment methods and the range of skills and abilities being assessed.

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