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Using computer technology as an aide to teaching large classes

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Abstract*: Many areas of HE have recently experienced dramatic changes: class sizes have increased significantly; assessment techniques have changed; etc. Pressures like these make it more difficult than ever to provide quality teaching. Many "traditional" tasks like providing good coursework feedback, preventing plagiarism, etc, are being squeezed by sheer pressure of work. Simultaneously, changes in the student body (e.g. more students without traditional entry qualifications) make good teaching more essential than ever. This paper will consider ways in which staff can use computer technology to to reduce the burdens associated with large class sizes. Although many of these techniques have been developed within IT departments, they can be just as valuable in Arts and Social Science faculties.*

Keywords*: Formative Assessment, IT, Electronic Learning*

Introduction

Many universities have recently undergone, or are currently experiencing, very rapid expansion, owing to a variety of financial and political pressures. The University of Westminster, for example, is a fairly large institution (more than 10,000 students) situated in Central London, UK. Its student numbers have increased substantially in recent years, and lecturers in popular disciplines now face some very large class sizes — some undergraduate classes have in excess of 300 students. At the same time, the nature of the student body has changed. Many no longer have the traditional University entry qualifications, the age range has widened, and the ethnic mix has changed radically. One of the results of these changes is that many students need better teaching than ever before at a time when teaching staff, even in traditionally teaching-orientated (rather than research-orientated) institutions, are prevented by increasing student numbers from providing this. Typically, lecturers responsible for very large classes won't know many of the students by name, and will have little personal contact with most of them. These problems are naturally exacerbated when distance learning techniques are involved.

At the same time, there has been a shift in the emphasis placed on the work done by students during, rather than at the end of, their courses. This now generally contributes to the final mark a student gains for a module of study so that what was once an entirely formative exercise is now also a summative one, and the nature of the bureaucratic pressure placed on academic staff to produce marks and manage large classes means that the formative part of the

traditional educational process is increasingly, albeit often unwillingly, overlooked.

The use of IT to address the problems we outline is not new: it is widely recognized as a major contributor to flexible, student-centred learning (see, for example, Laurillard, 1993). However, we feel that all too often IT is seen as a method of solving problems in a way that actually focuses too closely on *teaching*, and too little on *learning*. Sound learning principles (eg Gagne 1970) are rarely addressed. Our objective throughout is to use IT as an adjunct to traditional teaching rather than as a substitute for it, and our emphasis is on making more time available for good teaching, and hence learning, to take place. The most obvious way in which individual lecturers can try to maximize the time they have available for good quality teaching is to minimize the time they spend on administrative tasks, and this is where we advocate the greatest use of computers. In the following sections we will consider how the use of IT can benefit the lecturer in the areas of formative assessment, general coursework management, teaching tools, and class management. Paul Douglas works in a department of Computer Science, so it's reasonable to suppose that both staff and students will be "computer literate". However, Ray McNamara does not, and little of what we propose is specifically Computer Science orientated, and most should be easily usable by both lecturers and students of any academic discipline.

Formative Assessment

We begin with this section because we regard it to be of paramount importance within the educational process. The student learns through a process of having his or her work commented on by an expert in the field (eg Tessmer 1993). For many academics, the old personal tutorial system remains the ideal, albeit one that can rarely be achieved.

The loss of the use of coursework as a primarily formative part of the student learning process thus represents the loss of one of our most significant teaching tools. Ideally, the student has an opportunity when doing the work to experiment, to go beyond the basics, to try out something that might not work. The best practise is for the work to be returned by the person who marked it, with an opportunity for the student to discuss the strengths and weaknesses of the work with the marker. The strength of this as a learning process is obvious.

Now, students are conscious that the mark they gain will contribute in some small way to their final degree classification, so the requirement for them has become to get the best possible mark. This pressure often leads to " playing it safe"; sadly, it often also encourages students to hand in work not entirely their own. The importance of gaining a good mark outweighs the importance of learning. From the marker's point of view, the important thing is simply to get a very large number of papers marked and grades produced. Marking is almost always effectively anonymous (which has a variety of implications). Writing lengthy comments on assignments is time consuming and frequently avoided. Students rarely complain about this so long as the mark is pleasing. All this reduces the learning value of the assignment; in some cases, to virtually zero.

Our main objective here is to make general feedback more widely available. Although we suggest below that work could be returned to students in electronic format, typing comments at the end of papers would be even slower for most people than writing them. However, it is possible to use some of the time made available by the techniques discussed below to produce more comprehensive general comments, and to use computers to make them easily available.

1. Sample Answers

   We almost all formulate sample answers, even if only mentally. However, these are less frequently made available to students, for various reasons — we might not want them to be handed back to us next year, for example. They can, though, provide an extremely useful form of feedback, enabling students to compare what they did (and the mark it received) with something the marker considers to be an "ideal" answer. As usual, it will be easier to be prescriptive in some areas than in others: there might be an ideal computer program for a specific task, and nothing like a single ideal version of an analytical essay. Nonetheless, a wide variety of analytical essays will probably employ much the same techniques, and these can be easily noted, perhaps with some possible variants.

   Although we have concentrated here on feedback in the context of coursework, this particular technique can also be applied to exams. Many of us prepare formal specimen answers for External Examiners, and these can often be made available to students with relatively little change. Lots of Universities now make past exam papers readily available to students; far fewer make sample answers available. Given the virtually non-existent feedback many students get for exam papers, this is a way of addressing a significant educational problem.

2. General Comments

   How often do we find the same mistake over and over again and quickly tire of pointing it out? Rather than completely omitting to do so, it is good practise to record these errors once, and make them available to all students. These can often be prepared in advance and re-used year after year: the mistakes students make vary little from year to year and, as professional educators, we often have a pretty good idea in advance what they will be. It is a simple matter to add or subtract material to cater for problems that occur (or don't occur) within any specific group. We are not suggesting that students be set the same coursework every year, simply that the general nature of their errors won't vary a great deal.

   Where very specific errors are commented on in general feedback information, it is even possible to key these to the actual submitted work. It can sometimes be useful to give out a list of common errors numbered from, say, 1 to 10, and just write the corresponding number on the student script where the error occurs.

   It is maybe worth pointing out here that the extra time it might take to prepare materials of this nature the first time they are used will be regained in future years when they can be re-used with only minor modification.

3. The Internet

   There are a number of ways of returning this kind of feedback to students. Many of us might take some time to go over major pieces of coursework in a lecture and use the occasion to provide the kind of general feedback we are proposing. However, not all students attend all lectures, so some will miss out. The same is true of printed handouts, etc.

   Although it would be extremely naïve to assume that all students actually read all the handouts they receive, we have to be aware that one of our major tasks is to *facilitate* learning. If we make these materials as readily available as possible, at least we enable

students to read them. We can encourage them to do so whenever possible. One of the best ways of making material available now is via the Internet.

One must be careful, of course, with electronic media to make sure that it is easily accessible to its intended audience. There is no point giving out learning materials carefully prepared in Postscript format to students who are only able to read those in PDF. The beauty of the Internet is that it is now very widely accessible, and many institutions are able to make a few dedicated computer terminals available purely for the use of students who need to access teaching materials. Thus, even students who don't have access to the Internet where they live, can download and print out material at a time that suits them, and read it when possible. The other advantage of the Internet is that it shares a common format in HTML and, where documents are in some other format, it's usually possible to provide tools that will convert the format easily. It's clearly not as simple as printed paper, but it's getting closer all the time.

Finally, one can make my material available on the Internet from anywhere one has access to a computer terminal. Just as students can electronically submit their assignments from anywhere in the world, we can do the same with our feedback, updating web pages just as easily from a different continent as from within our normal offices.

General Coursework Management

Here, we look at some of the problems caused by the increase in the amount of coursework many academics now have to deal with, and suggest some solutions to commonly experienced problems. Computers can be used in several ways to reduce the proportion of time that has to be spent on the actual marking process, thus making more time available for preparing feedback materials.

1. Electronic Submission

   Even if you insist on paper submission as well, consider the benefits of electronic submission of student papers. Many students now prepare work, irrespective of the discipline, on some sort of word processing system, and increasing standardization makes it less likely that you will be unable to read their work because of software incompatibility. Electronic submission has a number of benefits:

   - Deadlines can be more flexibly arranged and more rigorously enforced. All work received will be precisely time-stamped. Work can be sent by email from literally anywhere in the world. Submission via Internet technology can be easily set up and maintained centrally. Reliability levels are now as good as those of traditional methods.
   - It's easy to move copies from one computer to another: you should never have to carry around anything heavier than a "floppy disk". Dividing marking between home and work is much easier; with a laptop computer, it can be done anywhere, any time.
   - Work can be much more easily, quickly and safely returned to students if done by email. Consider the number of coursework assignments you generally have left over in a corner of your office at the end of the academic year, and what the value of those to the students who prepared them is.

- Automated assistance with the marking is only possible when the work is available in electronic format.

2. Detecting Plagiarism

   The ability of an automated process to contribute to this will depend on the nature of the discipline, and the type of plagiarism. No current computer software can reliably detect the unacknowledged use of someone else's intellectual property in an essay. Computers can, however, do very rapid searches of huge amounts of text, looking for any duplication. The occasions when something you mark reminds you strongly of something you have already seen and would like to look at again but can't, because you have no idea which of the 100 or so scripts you have already marked it occurred in, need no longer arise. For formal work like computer programs this can be taken to a greater level, where a large batch of submissions can be easily reduced to a common format and compared with each other in their entirety. Of more widespread interest is the current development of "web crawlers" which can track down the source of text that has been downloaded from web-sites (Parapadakis 2002). The current development of the Semantic Web (SWWS 2001) will make this process considerably easier.

   Is this important? We believe it is. Many educators we have spoken with are increasingly concerned that plagiarism is spreading. The use of computers, of course, hugely facilitates the process. If coursework is to be a useful learning experience, it is vital that it is done individually and, although using computers in this way (ie as plagiarism detectors) cannot guarantee that, their use as plagiarism detectors is often a good deterrent.

3. Automated Marking

   Once again, this will depend on the nature of the discipline. Even an essay, though, can be checked for spelling and grammar; where they are useful, statistics like word count, number of references, etc, are easily produced. Within disciplines like Computer Science, where assignments often have a strong practical element, automation can be taken to much higher levels. Programs, for example, can be run against test data, producing useful information for the marker which hugely simplifies (in some cases, replaces) the marking process. Nonetheless, many tutors still mark computer programs by reading them, which is slow and tedious and, for simple program correctness, far less accurate.

Teaching Tools

These can be very specialized, but deserve a mention here. In the context of feedback, one of the advantages of automated teaching tools is that they are able to provide it instantaneously, and as often as required.

The following examples all refer to the discipline of Computer Science.

- We suggested above that automated marking can be a useful tool. Possibly in a simplified version, it can also be a useful teaching tool. Let us give a very simple example. Novice programmers are often asked to write computer programs that perform simple arithmetic computations, eg dividing one number by another and displaying the result. Many students will, after several attempts, get a program which appears to work.

They type in “10” and “5” and the program responds with the answer, “2”. Everything seems fine, and they confidently hand it in. The marker tests it by typing in, say, “3” and “0” and it fails because it can’t handle division by zero — the student just didn’t think of it. They’ve lost something in the learning process through not working at solving a problem that didn’t occur to them. Automated program testers deal easily with this type of situation, so at least basic, common errors can be pointed out to students in time for them to attempt to solve them.

- It is possible to develop specific applications to teach specific subjects. Two such examples that were developed at Westminster are outlined here. SPITS (2002) allows students to test the serializability of a sequence of concurrent database operations by developing a schedule and testing it. The program uses Prolog to test the schedule and provide instant feedback on whether or not the schedule was correct and, if it wasn’t, why not. The number and variety of schedules it can test, and the immediacy of the feedback, is far greater than any textbook can achieve. Another allows students to visualize a commit operation in the context of a distributed database system, and to test specific scenarios of their own devising to see whether the protocol employed is able to deal with them.

  There are many more examples of such tools, covering a wide variety of academic disciplines, and many share this ability to act as a kind of intelligent tutoring system by actually commenting on students’ work.

Class Management

There are numerous ways that IT can offer class management support. One of the problems of large classes is that, in addition to the lecturing staff not knowing the students, they don’t know each other very well either, and opportunities for learning through peer interaction are lost. Consider setting up Internet Chat Sessions and Discussion Boards to help with this. These can be moderated or not, depending on their objectives. The use of email lists also facilitates communications between students. The Open University in the UK has done a great deal of pioneering work in this area (see, for example M206 1998).

It is also possible to develop administrative tools to help with the tasks involved with recording marks, calculating averages and totals, etc. With help, these can usually be made to interface with University-wide record systems, thus enabling lecturers to both enter and retrieve student data more simply.

Conclusions

As we have said, the use of IT in teaching is not a new one, and there are many papers extolling the virtues of the computer as a teaching tool. It has been our intention here to concentrate particularly on the use of IT to enhance learning. Where our examples show IT being used to facilitate teaching, this is still with the ultimate goal of enriching the individual student’s learning experience. We regard this as especially important at a time when, for many students, their experience of learning has been one of diminishing quality. We regard the use of computer-based teaching and administrative tools as an important way of reversing the trend away from formative and towards summative student work, and as helping to restore declining levels of communication between educators and students.

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