The Influence of New Tools in Virtual Learning Environments on the Teaching and Learning Process in Chemical Engineering

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The recent downturn in the world economy has already had an influence on higher educational establishments. The recession has had a disproportionate influence on the employment rates of young people in the age range 18-30, and it has been increasingly difficult, even for well trained young people to find suitable employment. Consequently the number of young people entering higher education for the first time has shown a significant increase, both to seek increasing skill levels and to postpone entering the employment market. There have been similar increases for both full-time postgraduate programmes and part-time programmes. At the same time, support from government for education is likely to fall, or at best remain constant. This is likely to pose a dilemma for those involved in the educational process. How to maintain (or even improve the quality of programmes) in the face of larger class sizes and possibly less resource?

This paper looks at some of the potential solutions to these problems using tools available in Virtual Learning Environments (VLE's). The use of eAssessment has been carried out on a moderate class size of both full-time and part-time distance learning students. The eAssessment has made it easier for a large class size to acquire information on their progress in a course, and allows teaching staff to assess areas that require more resource, and those students who may need further help. The management of student submissions on larger items of coursework has been accomplished using the Blackboard VLE, and has further been checked for plagiarism (an increasing concern in UK universities). The VLE also allows staff to grade the submitted work, and provide contextual feedback related to the originally submitted work. In addition, the process allows easier administration and management of the overall process.

1. Introduction

Teaching and learning in engineering disciplines has been required to undergo significant changes in the past few years in response to factors, many of which are outside of the direct influence of staff involved in teaching and learning. The most obvious of these reasons are;

- Changing demands of the modern industry, most especially related to communication and collaborative/team working skills

- Increasing numbers of students applying for higher education, both at undergraduate and postgraduate level, and partly in response to the downturn in the global economy
- Changing IT skill levels of students entering further and higher education, and familiarity and use of high technology products
- Changes from teacher-led to student centred learning and the availability of teaching materials away from the traditional classroom.

Consequently Engineering related disciplines are adopting new and emerging learning technologies and methodologies (Perry, 2002, Perry and Klemeš, 2004, Perry, 2006). Increasingly e-Learning is being adopted as a means to achieve learning outcomes and provide a student centred learning environment. Many of these teaching methodologies are based on Virtual Learning Environments (VLE's). Dillenbourg (2000) describes the main features of a VLE as;

- A designed Information Space.
- The provision of an environment where Educational interactions can take place, turning spaces into places.
- A place where information/social space is explicitly represented. The representation varies from text to 3D immersive worlds.
- A place where students are not only active, but also actors. They are able to co-construct the virtual space.
- A place that is not restricted to distance education, but can also enrich classroom activities.
- A place that can integrate heterogeneous technologies and multiple pedagogical approaches.

Examples of most popular VLEs are Blackboard (2010), WebCT (now part of Blackboard), and Moodle (2010).

2. eAssessment

The Joint Information Systems Committee (JISC) defines eAssessment as "the end-to-end electronic assessment processes where ICT is used for the presentation of assessment activity, and the recording of responses (2010).

In our previous work (Perry et al, 2007), we evaluated the Respondus (2010) software which was selected for the creation and delivery of an eAssessment in an undergraduate chemical engineering course. This work builds on further Blackboard eAssessment features by developing an eAssessment for coursework in an Energy Systems unit.

Coursework for the Energy Systems unit has been posted in Blackboard for both full-time and part-time distance learning based students to be able to work with the tasks. In addition to describing the work that was required, and the type of submission, the coursework description also provided extensive information on the use of bespoke simulation software that was to be used to help complete the tasks. An example of one of the courseworks for the Energy Systems unit is shown in Fig.1.

Students were required to provide engineering solutions to the problems in the courseworks, to write and submit a report via Blackboard, and to undergo an eAssessment test related to work undertaken.

Figure 1: An Energy Systems unit coursework (Practical) posted in Blackboard

The eAssessment related to the work undertaken in the Coursework was placed in the Blackboard VLE (Fig. 2). It was compiled in a manner that would allow instant feedback to students and therefore provide them with an objective evaluation of their knowledge and correctness of the solution to the problem stated in the Coursework. It should be noted that in this prototype version of the eAssessment that the feedback to the student is rather brief, thereby making it a more summative rather than formative assessment. Later versions of the eAssessment will include more detailed feedback on both correct and incorrect solutions, in order that the eAssessment can be used more extensively as a learning tool. In most of the questions, it provided the correct answer and showed the answer selected by the student. The degree of detail in the feedback very much depends on the problem to be solved. If more detailed feedback needs to be provided, in the case of a wrong answer to the question, then a brief explanation (not a complete solution) can be provided, enhanced by links to a Glossary and links to a Discussion Board, which provides another channel for learner-tutor and learner-student communication, and a complete solution on request to the tutor.

Figure 2: eAssessment practicals (coursework problems) in Blackboard

The types of questions used in the eAssessment varied from "multiple choice" (Fig. 3), to "true/false", "short answer", "fill in the blank", "matching" and "combination" types depending on which was most relevant for the particular question. Depending on the question type, the answer field varied accordingly: checkbox, radio button or text (number) field.
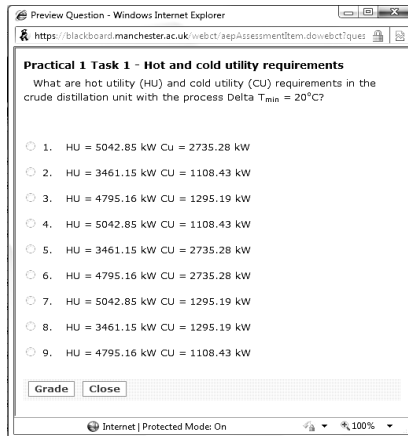

Figure 3: Example of a "multiple choice" type question

When preparing correct solutions for the questions in an eAssemssment it is important to avoid any possible misinterpretation of the student's correct answer by the computer. Consequently "short answer" type questions, where parameter values are required to be input by the student, have to be formulated in such a way as to avoid any misrepresentation of the value format. For example, the following question also provides guidelines to the student on the format of the value required: "The load of the largest utility exchanger in the section between the pinches is 1.----- kW, the load of the smaller one is 2.----- kW. Provide the answer to the nearest integer and do not include commas to separate thousands, eg 1234."

Feedback from students on the use of the eAssessments developed to date has been very positive, although a formal questionnaire has not been provided and completed for the latest prototype eAssessment. Perry et al (2007) provided a summary of the students' feedback.

3. Plagiarism checks

The availability of electronic resources through electronic journals and books, along with internet based resources, has made it much simpler to include these types of materials directly in student submitted reports and dissertations. The difference between evaluating available materials and summarizing and including in a report, and a direct copy of the materials, is often difficult for students to fully understand. The University of Manchester, together with other universities, has very clear guidelines as to what is and what is not plagiarism. The teaching staff ensure that these guidelines are available to all students, and that they are discussed in student induction sessions. To assist teaching staff in the task of recognizing plagiarism, various pieces of software have been developed. At the University of Manchester the software of choice is TuritinUK, which is either available as a stand-alone tool or can be integrated into the Blackboard VLE. A coursework assignment can be easily set up within the VLE, with various options available to assist the teaching staff with the task of plagiarism recognition. Submission dates can also be set, and the submission time recorded, to help with the management of the assignment. Although assignments can be submitted in a number of readily available formats, the production and use of pdf format has been found to

provide the simplest and least problematic method as it avoids differences in native formats used by the large number of word processing packages used by students. An example of the submission of an assignment in turnitinUK is provided in Fig. 4.

Various features of turnitinUK can be used to assess the submitted work, the most powerful of which is the Originality Report (Fig. 5). The Originality Report, summarised by the Similarity Index, provides the assessor with the instances in a student submission that corresponds to either other submitted work, or work that is available on the internet or other electronic resources. However, the findings of the report should be treated with certain amount of caution. It is possible that there are more than one instance of a student submitted report as the student is allowed to submit draft versions before the final deadline. The Similarity Index and Originality Report will indicate this as an instance of possible malpractice. Similarly, the submission may include the original questions required to be answered, and this will also be flagged by turnitinUK. Consequently any output from turnitinUK needs to be very carefully evaluated prior to any decision making as to the merit of the submitted work.
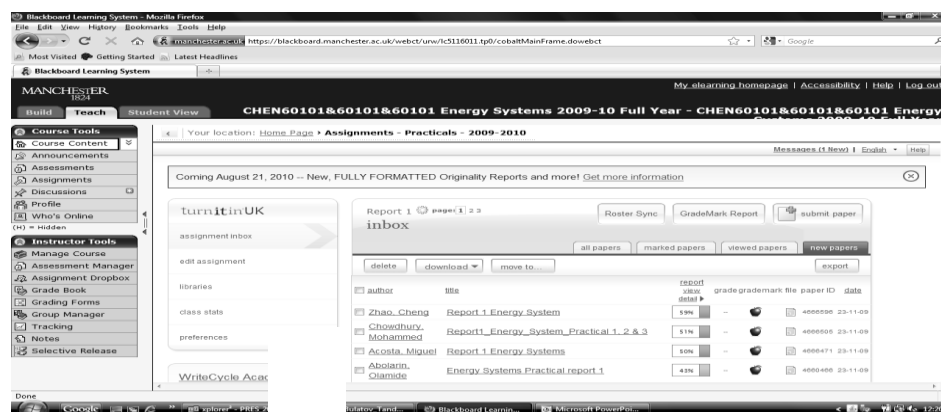

Figure 4: List of students' reports submitted via Blackboard and checked by turnitinUK

4. Conclusions

The use of Virtual Learning Environments and their associated tools has been demonstrated as providing assistance to teaching staff dealing with ever increasing student class sizes and the increased complexity of available resources. An eAssessment in an Energy Systems unit has been carried out using the Blackboard VLE eAssessement features. The pilot project has evaluated the potential of available software to format standard chemical engineering coursework assessments into an on-line eAssessment form. Malpractice, principally plagiarism, or collusion between students, has been shown that it can be detected using software tools available in VLE's. However, interpretation of simple scores is needed to be treated with caution, and guidelines on the use of such tools needs to be provided for assessment staff.

Figure 5: An example of a turnitinUK Originality report in Blackboard

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