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A Pilot Programme into the Use of Blackboard to Support the Teaching of Engineering Undergraduates

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Abstract

Supporting engineering students throughout their studies places a heavy demand on academic staff. Increasingly, to meet the challenge of widening participation, it is necessary to provide help beyond the scheduled lecture and tutorial periods and to cope with a range of student abilities particularly in those topics which are mathematically based. An efficient and effective way of providing this is through E-learning and at Salford, the Blackboard Web portal has been used to provide this support. Through the use of Blackboard a convenient and effective means of enhancing and improving student learning has evolved. The visual impact of presenting teaching materials using PowerPoint has been evaluated and using this medium an opportunity for students to re-play a lecture in their own time has been provided. These presentations have been integrated into Blackboard.

Introduction

The teaching of engineering undergraduates is demanding with typical class contact hours being considerably greater than for other degree subjects. Level 1 on most programmes includes an element of revision as students from differing backgrounds and educational systems are brought to the same end-point in preparation for more demanding topics at levels 2 and 3. With widening participation high on the agenda of all Institutions increasingly disparate student cohorts are faced and increasingly the need to be able to cope with a wide student ability range is required. Unfortunately as these pressures are faced, both external and internal constraints restrict the time that can be devoted to the teaching of students as staff strive to meet other demands on their time, for example research and the increasingly financial imperative of generating more revenue. Thus, at a time when students need more direct support, it is likely that the majority of staff have less time to allocate to them.

The hierarchical nature of most core topics in Engineering means that any inherent weaknesses in the early stages of study are likely to be amplified later at the expense of the overall learning experience, thus the foundations laid at level 1 are of critical importance to successful future study. Even with well-motivated and dedicated staff, the demand for support and the varying nature of the needs of each individual student, stretch the limits of provision. E-learning systems are one means of bridging the gap between lecturer and student providing a convenient and practical way of both facilitating student learning and motivating students effectively. At the University of Salford a pilot scheme using the Blackboard 5.5 Educational web portal, has been conducted. As part of the pilot scheme it has been used as a student resource to support a number of level 1 engineering modules during the session 2000-2001 and extended further into level 2 modules in the session 2001-2002. Developments in 2002-3 focused on the conversion of teaching material to PowerPoint and integration with Blackboard. The main aim of this approach was to provide students with easily accessible materials which would encourage them to engage positively with the learning process.

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The First Step

The approach adopted was a simple one, the hard-copy material which was already provided for students in the form of printed material was simply re-packaged in small sections using Adobe Acrobat and posted to Blackboard. The advantage of this was that immediately any restriction to black and white was eliminated and colour could be retained. Thus in the E-learning environment it was possible to present material so that it had visual impact with important concepts or equations emphasised.

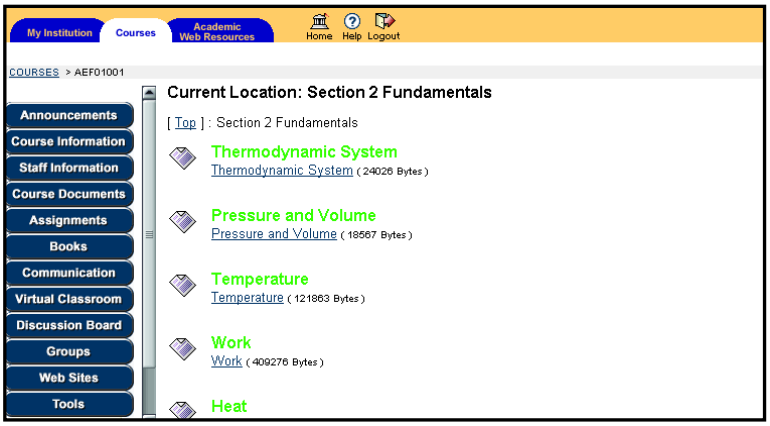

Figure 1: Blackboard 5.5 Entry Screen

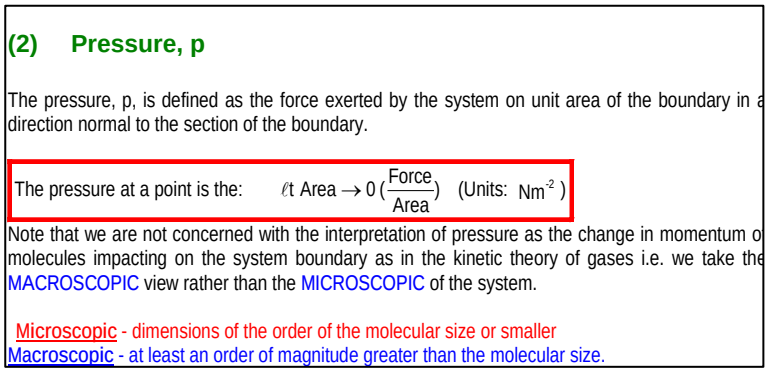

Figure 2: Sample Material Page

Another advantage of the Virtual Learning Environment (VLE) was, almost paradoxically, the relationship and rapport that could be developed between lecturer and student. Whilst on the one hand the move to a VLE distanced physically, the deliverer and the student the communication provided through the VLE had distinct and identifiable advantages over traditional delivery methods. For the lecturer it was possible to interrogate the system to find out who had (or had not,) done what and when. Through observation of the results of the on-line assessments provided it was possible to judge the progress of individual students and if necessary provide tailored support and guidance to address at an early stage areas of difficulty. For the student the facility to easily contact the lecturer via e-mail through the VLE to ask for help was a definite bonus enabling even the most reluctant student to seek help.

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For the two level 1 modules for which Blackboard was used in the academic year 2000-2001, Engineering Thermodynamics and Fluid Mechanics, the following priorities were identified:

- The provision of all the course notes packaged in a form readily accessible to students;
- The inclusion of the tutorial exercises followed some time later by the corresponding solutions;
- On-line assessments which were scheduled to fit in with the appropriate stage of the module delivery;
- Access to past examination papers as the end of module approached;
- A re-vamp of the site after completion of the module so that any student who failed could obtain support over the summer vacation in preparation for the re-sit examinations in September.

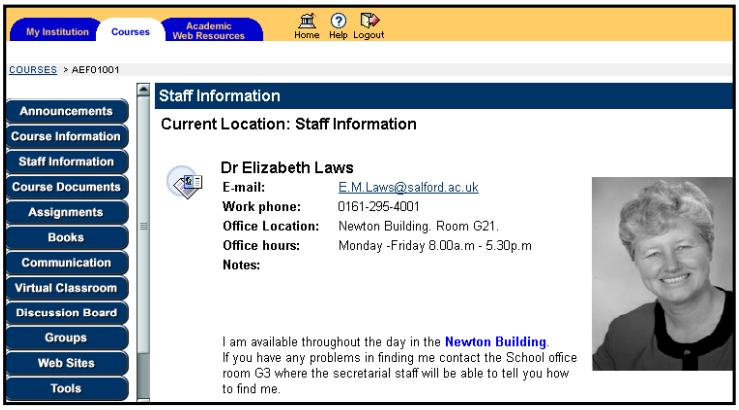

Figure 3: Staff Entry Page Blackboard 5.5

Early Feedback

The results obtained from the first module supported through Blackboard were encouraging. Many students commented favourably on the support they had received through Blackboard in the module evaluation. Whilst not every student with access to the resource used it the analysis of the examination results at the end of semester 1 was very positive. No user of Blackboard failed the module and the module average of those using Blackboard was 15% higher than those who chose not to use it. A steady use of Blackboard throughout the semester was evident with a definite crescendo prior to the examination date. Over the Christmas vacation period whilst students were at home and revising there was a continued use of the site.

Whilst considerable effort had been placed on putting on-line assessments on the site there was an apparent in-built reluctance for students to tackle these - even with the inducement of an end of session trophy as a reward. It was suspected that this was due to the fact that these assessments did not form part of the formal assessment for the module. This was overcome to a certain extent by printing out the tests and requiring students to undertake them in tutorial sessions. More latterly this problem has been addressed using the PRS system (Personal Response System), described later in this paper.

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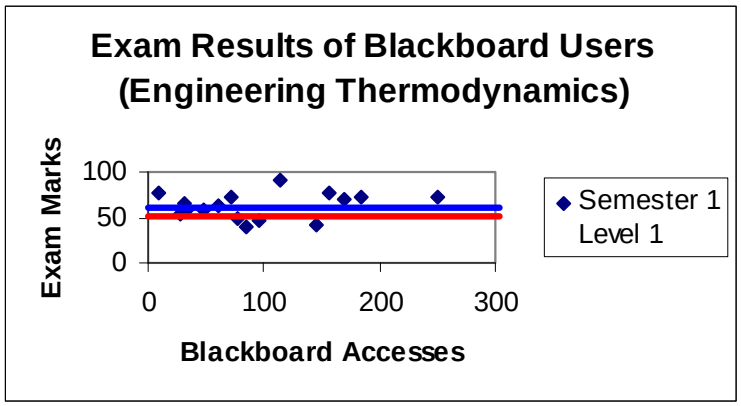

Figure 4: Correlation between Blackboard Usage and Examination Performance
Module Average 51% Blackboard Users 59.5% Non-Blackboard Users 45%.

Fluid Mechanics, taught in semester 2, was the second module for which Blackboard was used. A similar site was produced and slightly more adventurous assessments were attempted. In addition, the laboratory programme for which self-running PowerPoint presentations had been prepared previously was also built into the Blackboard site. This enabled students to study the laboratory exercises prior to the scheduled laboratory session and arrive fully prepared and able to make good use of their laboratory time. Again a steady take up of users throughout the module was established and a good correlation between Blackboard usage and module success demonstrated.

Further Developments

The summer vacation allowed some time for reflection and evaluation of the progress made to date and identification of any changes to be made in the academic year 2001-2002. Because of the benefits gained it was decided to continue with Blackboard and to extend the use to other modules. During the academic year 2001-2002 Blackboard sites to support the level 1 modules in Engineering Thermodynamics and Fluid Mechanics, were maintained and enhanced and new sites supporting Solid Mechanics at level 1 and Aerofluid Mechanics and Aircraft Design at level 2 were developed.

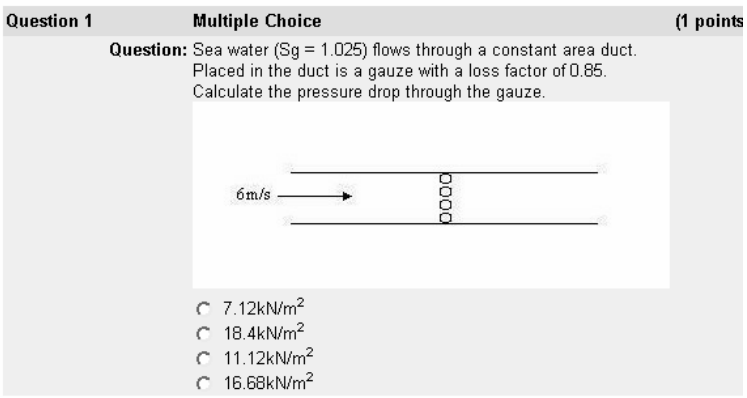

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Figure 5: Sample Multiple Choice Question Fluid Mechanics

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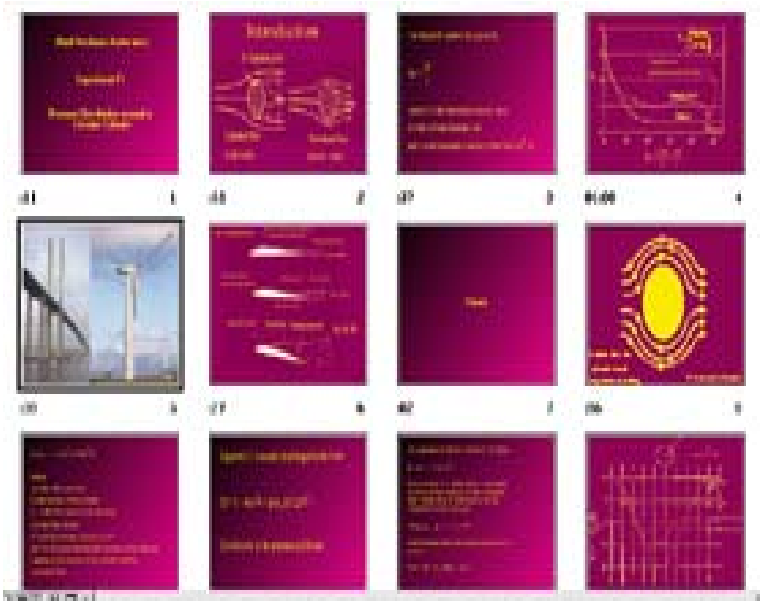

Figure 6: Fluid Mechanics Module Laboratory Presentation Available through Blackboard

There was also time to review other E-learning sites and to provide useful Web access links into the Blackboard sites to include an element of interactivity. Whilst the Web is a tremendous resource for students it can be extremely time consuming to locate a particular site and evaluate its usefulness. Blackboard provided a means of building in web links that dovetailed closely with the module content. This facility was found to be particularly useful in the support of the level 2 module Aerofluid Dynamics E2.1. This module, taught to both Aeronautical and Mechanical Engineering students, which ran for the first time in semester 1 for the academic year 2001-2002, replacing two previous modules - Fluid Mechanics E2.1, which was taught to Mechanical Engineering students and Aerodynamics E2.1 taught to Aeronautical Engineering students.

The essential elements of both of these earlier modules were the same, ideal potential flow and one-dimensional compressible flow theory. The economy of scale by teaching the two cohorts in common was considered to be advantageous hence the move to the common module entitled Aerofluid Dynamics. In preparing the Blackboard module to support Aerofluid Dynamics in addition to providing the course notes, tutorials and solutions and the PowerPoint versions of the laboratory exercises some effort was placed into finding appropriate web sites and links to which students could turn to easily. Through these links an element of interactivity could be built into the site which added both stimulation, interest and the ability for students to test out particular applications ‘live’. As an example the Fluid Mechanics site proved to be an ideal support resource allowing students to run Java applets covering both compressible and potential flows.

Most of the students using the sites at level 2 had been introduced to the use of Blackboard at level 1 thus it was found to be considerably easier to get them to engage with it and more of them appreciated the benefits to be gained. Since the level 2

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module was underpinned by the earlier modules of Fluid Mechanics and Engineering Thermodynamics the level 2 students still retained access to the level 1 sites so that if they needed to revise any level 1 material they could use Blackboard to do so. In addition to the site for Aerofluids, a site was also developed to support the Design Enterprise undertaken at level 2. In this activity students work in groups to fulfill a particular design brief. The ability provided through Blackboard to organise students in groups and to enable them to communicate via e-mail and to transfer material within their group improved the running of this module. Even when a student was absent from a scheduled group meeting (often a source of internal friction), they had no excuse for failing to produce the required deliverable.

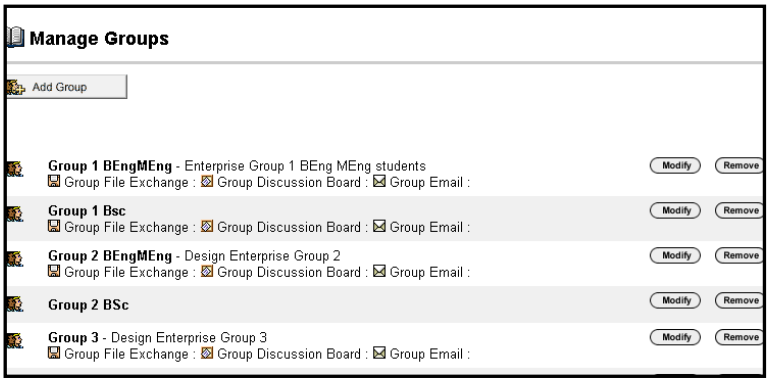

Figure 7: Group Management Facility Offered in Blackboard

Surveying the usage of the Aerofluids site during semester 1 of the 2001-2002 academic year showed a steady take up of use spread throughout the week with a reduced, though still significant, level of usage at weekends. Looking at the time of day that these accesses occur revealed the interesting phenomenon that a small number students used the resource either very late at night or during the early hours of the morning. Studying the parts of the site used by students on the Aerofluids module the majority confined their attention to the main content and communication areas. Whereas for the Aircraft Design Enterprise as might be anticipated much more use of both the group areas and communication areas was evident. Whilst the only material placed in the course document section was the project brief the students used the site to communicate and to engage and extract source information from the web sites built in to the site. A similar nocturnal trend to usage was displayed.

Further Developments

Once involved with e-learning the literature on the topic became relevant. As a newcomer support was obtained from Horton (2000). With the benefit of hindsight it was found that the strategy recommended in Horton had been followed, albeit inadvertently.

The iterative nature of the design process would appear to be inherent so that the e-learning material evolves over a number of iterations and phases. In the case of the work described here each iteration is spread over a fairly long time-scale as once the semester starts time pressures and other work demands prevent any major changes to be made until the end of the semester. Whilst Horton advocates the design cycle illustrated

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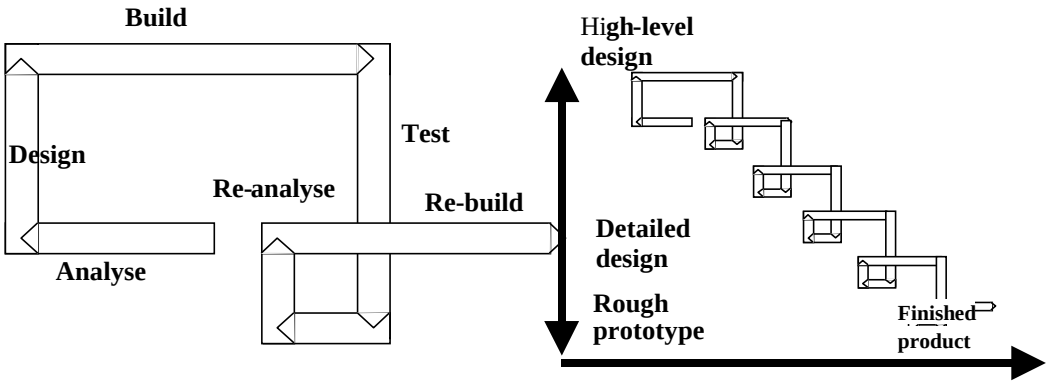
in Figure 8, it may be the case that the 'finished product' never fully materialises since continual changes to module content occur over time and a stable position will never be



wholly sustainable. In the author's experience this is the main advantage to be gained from the content developer being also the instructor/teacher of the module so that changes to material can be initiated easily.

Figure 8: The Design Cycle And Process (Horton)

The PRS System

Once tuned into alternate methods of engaging student interest, attention and stimulating student learning a more pro-active approach to teaching is created. For example in approaching the Blackboard assessments which, as has already been mentioned, students were reluctant to engage with, the PRS system (Personal Response System) marketed by Educue has been employed. Using this system students answer multi-choice questions posed in a lecture/tutorial context via hand-held personal remote control devices which they direct towards a transmitter linked to a computer running the PRS software. Through the software it is possible to set the time to answer questions and to monitor student responses 'live' before gauging whether to proceed further with a topic. In addition to maintaining a grade book it is possible to use the PRS system to monitor student attendance at scheduled events. Initial student feedback on the use of the system was largely positive though some were reluctant to feel exposed to scrutiny. Those students appeared to respond better when working more anonymously in pairs.

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Figure 9: The PRS System (Educue)

Evaluation of the Impact of PowerPoint

Having identified that retention of colour added impact to material a decision was made to deliver lectures through PowerPoint enabling the use of full colour and the ability to use animation and transition effects. This was used throughout the academic year 2002-2003 at both level 1 and level 2. The students' reaction was monitored through questionnaires issued on a regular basis throughout each semester. It was found that students responded favorably to this teaching medium and that even mathematically demanding material was well received when presented in this way. For example when cancelling terms in complex equations using Blackboard the terms could be made to vanish using animation effects which enabled the students to understand more easily the analysis being undertaken.

Many students expressed the view that both interest and understanding was enhanced throughout the delivery of the lecture. Some commented that the use of PowerPoint could restrict spontaneity and a solution was arrived at where lectures were delivered using PowerPoint but tutorials using overheads.

In producing the PowerPoint material it became clear that the module content was very demanding, both in terms of the mathematical skills required and the different concepts introduced. The difficulty faced by students who have only a semester to absorb the material before being faced with an examination on the topic was recognised. Thus, in addition to the version used in the lecture, a second PowerPoint presentation was produced in the form of a self-running lecture with embedded sound. This move was facilitated by the use of Office XP in which the PowerPoint package accepts the use of sound files in compressed .MP3 format enabling a sensible balance between sound quality and file size to be achieved. It was then possible to convert the presentations into a form that enabled them to be accessed through the World Wide Web and to integrate them into Blackboard.

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The integration was achieved by the use of a package which is part of the XP Office suite called MS Producer. This replaces the PowerPoint Viewer provided with earlier Office versions. Figure 10 gives a screen shot from MS Producer showing the import of PowerPoint with the corresponding sound files. It would also be possible to add video content. The advantage of packaging the presentations through Producer is that each title from a slide in PowerPoint appears as an itemised list as shown in Figure 10. When the presentation is 'produced' as shown in Figure 11 the list of titles appears alongside the PowerPoint slides with the sound playing in the background. The student would have the opportunity to click on a particular slide title and the presentation would jump to that point in the lecture. Therefore it was not necessary to listen to the entire re-run of a lecture, if only a part of it was unclear a particular section could be selected. Even if an entire lecture were to be re-played the time involved is typically 20 minutes. Thus the material presented in a 50-minute standard lecture when stripped of the additional material, digressions and explanations usually occurring in face-to-face lecturing reduces to a 20 minute recorded presentation.

For the academic year 2003-4 with the adoption of Blackboard 6 the sites have been changed again and the PowerPoint lectures have been added to the site as shown in Figure 12. Both the silent versions and the versions with embedded sound have been included to allow for students using a PC without a sound card or without a recent version of Windows Media Player installed with which sound was unavailable.

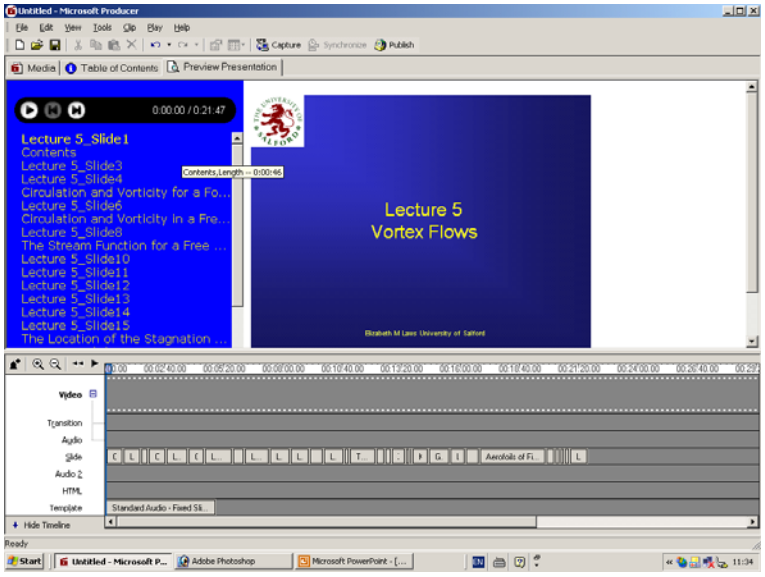

Figure 10: Importing PowerPoint with Embedded Sound to Ms Producer

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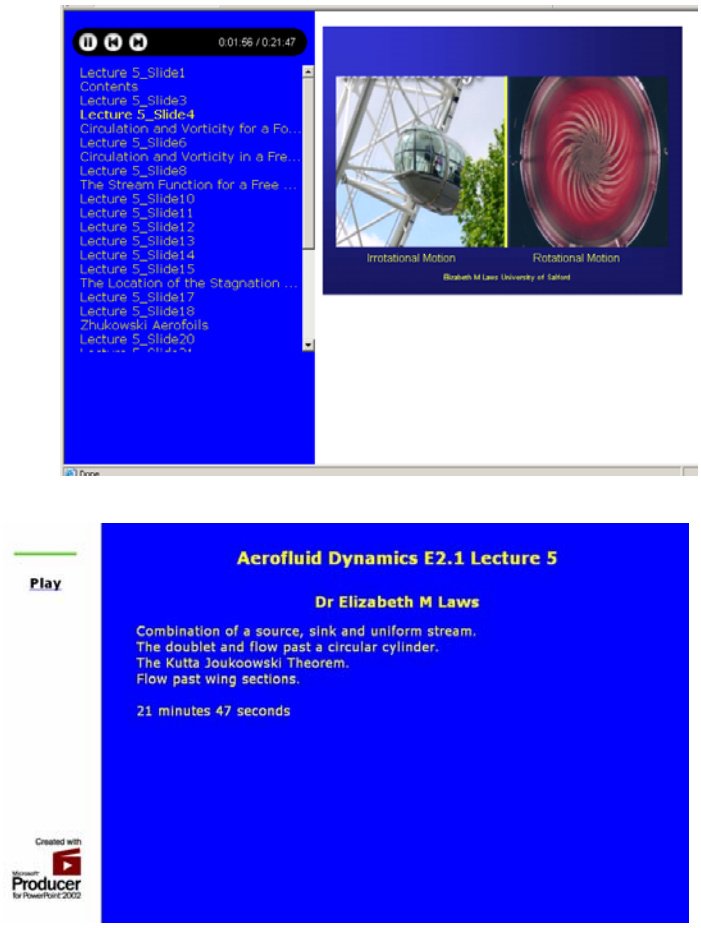

Figure 11: Produced Version of Presentations from MS Producer

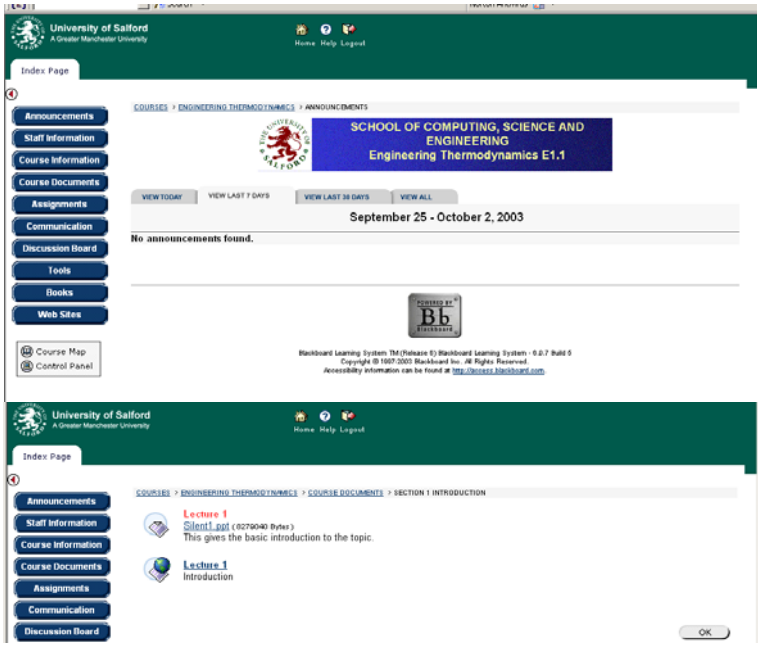

Figure 12: Embedding the Presentations in Blackboard

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Learning Styles

During the induction week new students were asked to complete two different learning styles questionnaires one developed by Felder and Silverman (1988) and the other termed the VARK developed by Fleming (1995,2001). Analysis of the results of these questionnaires in both the academic year 2002-2003 and 2003-2004 showed that the majority of students had a medium-to-strong preference for a visual style of learning. Only a minority did not demonstrate at least a mild preference for a visual mode of learning. This was considered to be one reason that explained why the PowerPoint presentations had been so effective.

Student Attendance

Throughout the academic year 2002-2003 regular monitoring of student attendance was maintained and an attempt to correlate this with student performance was made. This showed clearly that whilst regular attendance does not guarantee good performance, poor performance correlates strongly with poor attendance. Whilst student attendance is clearly to be encouraged, there may be certain valid reasons why students are not present, illness being one. For many students, the conflict between paid employment (an increasing financial necessity,) and regular attendance is real. Student ability to access material outside the timetabled class contact periods is one major benefit of the approach adopted here, which is likely to be of increasing use.

Conclusions

Positive benefits have been identified linked to the use of an e-learning support strategy to assist in engineering education. These benefits have been demonstrated both in terms of improved student performance, interest and in general engagement with the learning process. Whilst the initial work involved in adopting an e-learning strategy is considerable, the ability to re-use, enhance and further develop the material over time, gives lasting benefits which in the medium-long term more than repays the time outlaid in development.

The overall effectiveness of the work described here is intrinsically linked to the student learning process. Whatever the material provided by the lecturer, unless it meets the needs and engages the interests of the students, it will not be of any lasting practical benefit. Balancing the conflicts of teaching and learning and transferring ownership for learning from lecturer to student is the challenge facing our profession.

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