P099

Use of e-learning to encourage engagement and depth of understanding across engineering science and design within the first year of an engineering degree.

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Abstract: *Within the first year of an engineering degree there is great disparity in students' backgrounds, in terms of prior learning experience, preferred learning styles and knowledge. For some students this can mean that they struggle with particular aspects of the course as they do not have the same depth or breadth of experience as other students or match the teacher's expectation of prior knowledge.*

One approach to providing support to these students, and also to provide revision or deeper learning for other students, is to provide teaching in a variety of media and supplementary material. Experience shows, however, that those students who might benefit most from this material often do not engage with it.

By employing e-learning it is possible to simultaneously address a variety of learning styles, including ones that correspond to students' recreational activities. This has been shown to increase engagement across the spectrum of students.

This paper describes an approach used for engineering science and design based subjects at the University of Nottingham using Blackboard/WebCT. This allows on and off campus delivery of multi-media teaching material and the tracking of its use throughout the students' academic careers. Whilst the study presented here is an initial analysis within an on-going project it does show some initial trends albeit with low correlation coefficients, for instance that the higher attaining students are more likely to spend longer amounts of time using e-learning,

Background

The transition from secondary to higher education, and in particular the first year at university, is known to be a difficult time for many students (Yorke, 1999, Yorke & Longden 2007). For many students they are facing new teaching and learning styles as well as coping with moving to a new city or country.

At the University of Nottingham this has been addressed in terms of pastoral support by the use of second life (Wankel & Kingsley, 2009), facebook communities and pathways, a web based transition project at Nottingham. This paper will not look at pastoral aspects of student transition but will instead report on an ongoing project looking at learning support for engineering students across courses in the Department of Mechanical, Materials and Manufacturing Engineering. This paper will look at aspects of the use of e-learning to both supplement taught material and deliver self-learning for different modules. Initial analysis of usage versus attainment will be presented with benefits and issues highlighted. As the project is in its initial stages the final part of this paper reflects on the questions raised by this analysis, presents some initial trends and speculates on how the project should progress.

Within the following section, the background of incoming students and their perceptions are presented. The aims and objectives of this project are described and then the methodology employed in both delivering material and analysing student usage of this material presented. The final section reflects on the outcomes of the initial stages of this project, posing questions and speculating how these will be addressed throughout the remainder of this project.

This project is an internally funded University of Nottingham Faculty of Engineering teaching/learning development project.

Context

Within week one, students took part in an interactive session where a discussion on previous learning/teaching experiences and their expectations of university learning were explored. Interactive handsets (http://www.keepad.com/) were used in conjunction with turning point software (http://www.turningtechnologies.co.uk/) to allow students to submit and view the anonymous feedback to questions from their cohort. Several key questions were asked of students which prompted a discussion between the facilitator/module convenor and the 120 students present in the session. The students were first year (2009-10) Mechanical & Design Engineering students. The feedback from this session is given below to allow the reader to understand the cohort, their previous educational experience and expectations of University.

The students enter with the equivalent of AAA - BBB at A level, although there is a wide diversity of background and qualification type. For instance some students will not have studied Physics as a single subject at GCSE (16 years) and were therefore unable to access A level Physics (post-16 education). So for these students they will be meeting completely new concepts in the engineering science modules whilst other students may just be extending their knowledge for a concept. Other students will have entered University via other routes with for instance BTEC National Diploma or foundation degrees and may have studied a different syllabus so be very familiar with the engineering science but less familiar with mathematical concepts. There is also a wide diversity of motivations for attending University with some students struggling with the transition to a University learning style. This leads to a wide scatter on the data collected that is presented later in the paper.

In answer to the question “what class size have you previously been taught in” (figure 1) the overwhelming majority (86%) have said they have been in class groups of less than thirty, with very few of them having been taught in a lecture format previously (figure 2). Two key questions were asked of their expectations of lectures, whether they were expecting lectures to provide them with all the information they needed on a topic (figure 3), and how much time they should spend working for a module (figure 4). From this information it was clear that students had a wide range of expectations on what a lecture would provide and what was expected of them.

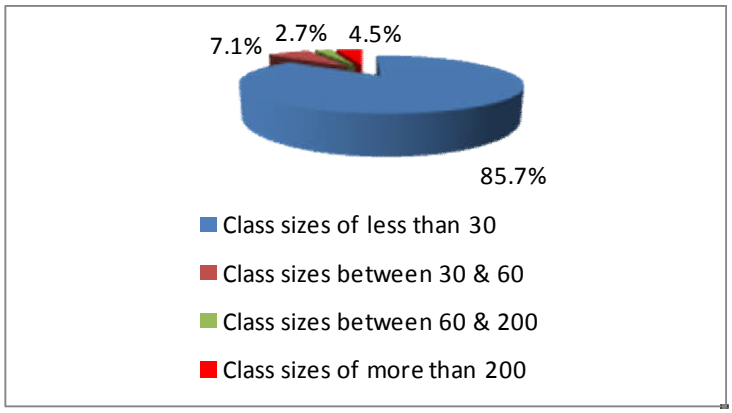

Figure 1: Previous learning experience, class size in previous education

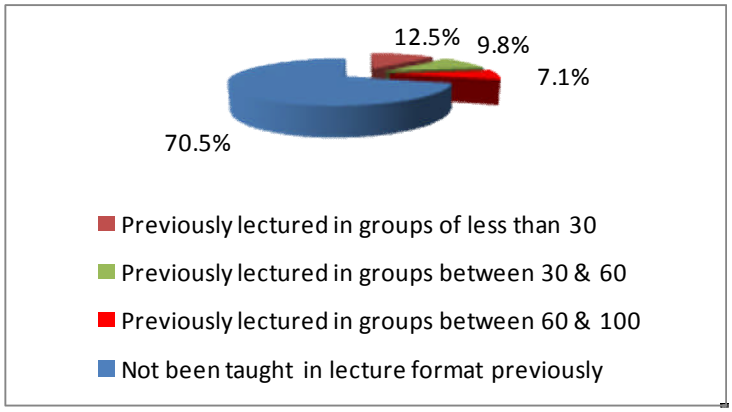

Figure 2: Previous learning experience, taught format

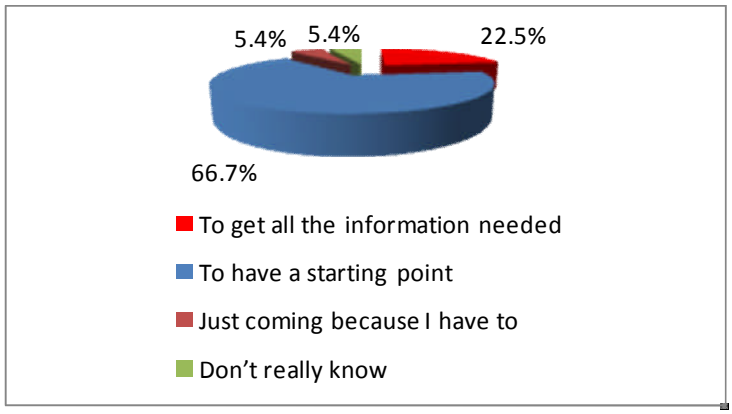

Figure 3: Student expectations of lectures, question asked "what are you expecting from lectures?"

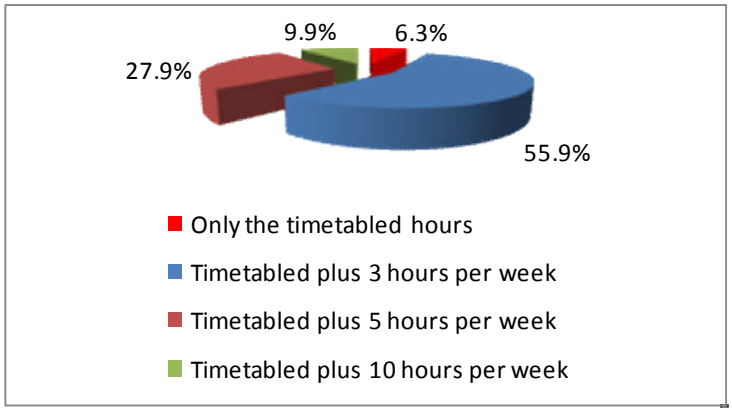

Figure 4: Student expectations of learning, amount of time per module

Students were also asked how they believed they learnt best (figure 5) and identified their preference to be via physical or graphical interaction with only a small proportion identifying oral or written as their preferred learning style. Whilst this is not a robust analysis of learning style it does indicate students own perception of their preference for material delivery.

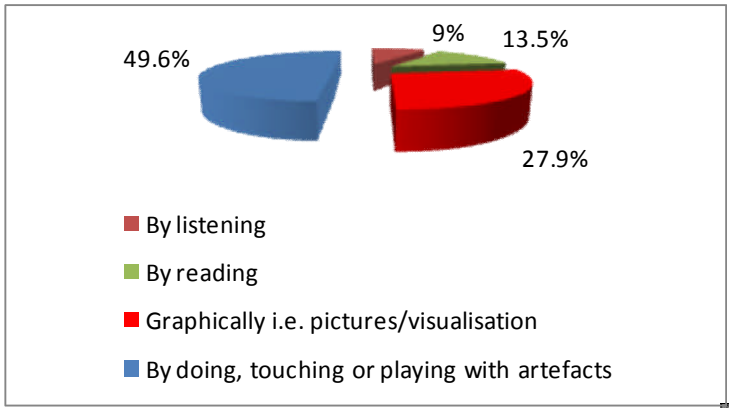

Figure 5: Students perception of their learning styles

A follow up session took place within week 5 to establish how students were coping and what issues they were identifying as blocking their learning. Figure 6 presents the results of this feedback session with the majority of students stating that the pace was too fast. Students fed back verbally that they felt they did not have the time they would previously have had in secondary education to assimilate new concepts. In particular several students identified that they wanted to go over specific topics from lectures in their own time and wanted a variety of support media to allow them to choose an appropriate media.

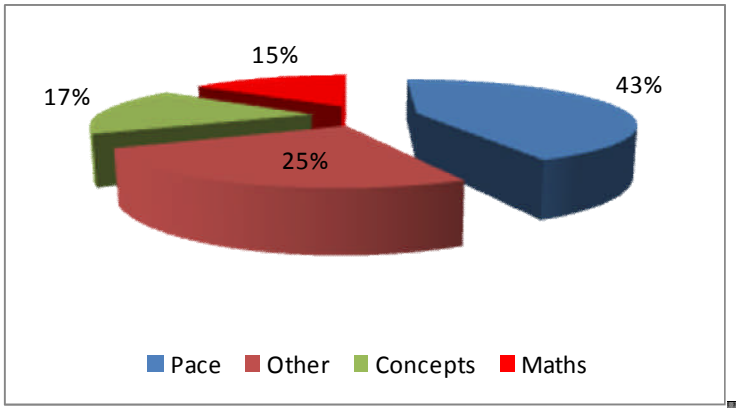

Figure 6: Student's perception of difficulties in absorbing material at week 5

This section has presented the background and perception of the 2009-10 cohort of first year students on mechanical and design engineering courses investigating their expectations and their perceptions of their own learning styles and issues blocking learning.

Aims & Objectives

The aim of this project is to investigate the use of e-learning, both existing and new material, in supplementing taught material and presenting self-learning material for use by first year engineering students within the Department of Mechanical, Material and Manufacturing Engineering within the Faculty of Engineering at the University of Nottingham.

To achieve this aim a set of objectives have been set for the project, these are:

- To collect an evidence base of usage of e-learning tools
- To collect an evidence base of attendance to compare with e-learning tool usage to establish whether students are using it to supplement or replace lecture attendance
- To measure usage of both e-learning and attendance vs attainment at multiple points across the teaching year

- To identify which media is most effective in supporting students for different subjects and for different student cohorts
- To use the evidence to target support

The project is on-going and will continue throughout the 2009-10 academic year and hopefully beyond.

Methodology

Across the first year there are many different types of e-learning employed across both design and engineering science subjects. Briefly these include

- Powerpoint files of both lecture and supplementary material
- Screen capture videos for usage of CAE software to allow for both self-learning and also answer of common student queries
- Screen capture videos of extended worked examples following presentation in lectures/support classes for engineering science subjects
- Interactive animated examples to supplement lectures and to allow students to re-examine concepts at their own pace (GKN Aerospace & University of Nottingham, 2004)
- Feedback after assessments and non-assessed exercises including text based worked solutions
- E-assessment points with automatic feedback on close of assessment for self and formative assessment
- Static “guides” for worked examples, e.g. pdf instructions on how to use software to match videos or pdf solutions for exercise sheets
- Web links to external sites to support generic software e.g. use of MSExcel/MSWord

For some topics multiple media to cover the same material is available to allow students to choose which media they utilise, for example CAE videos and pdf paper guides cover the same tutorial material.

E-assessments for formative usage are relatively new within the first year modules, having been trialled last year and used at multiple points in two different engineering science subjects throughout this year. The rationale being both to allow students to self-assess progress and also to trigger revision of topics at multiple points in the year to reduce the “just in time” learning that can occur in year long modules (Hewett and Wilgeroth, 2005). In order to reinforce the formative aspects of the tests, non-assessed dummy tests were made available for the students to practise their technique and gain familiarity with the material.

Following the e-assessments a transcript of the questions asked, the answers given and the correct answers obtained were available so that students could undertake a "post mortem" on their performance and study more closely the material which had given them problems.

Initial feedback has been collected from student in three ways, namely via anonymous interactive handsets (keepads and turning point), WebCT analysis of student usage reports including time used and number of files used, and verbal feedback from students. Feedback will continue to be collected throughout the academic year to supplement that presented in this paper.

The interactive handsets provide an anonymous feedback mechanism which allows students to be critical in a non-confrontational manner. It allows students to see their peers’ views in real time, allowing the prompting of discussions on learning styles and expectations. It also enables students who might not normally join a debate to feel able to participate without being overshadowed, plus the minority are able to express their opinion without any adverse reaction. Figures 1 – 6 are examples of data collected via the interactive handsets.

WebCT, the e-learning platform used at the University of Nottingham, provides a limited breakdown of student usage of e-learning media, examples of analysed data can be seen in figures 7 – 13 in the following section. The data was exported from WebCT and analysed using MSExcel to identify behavioural trends for the same cohort of students across Design, Solid Mechanics,

Electromechanical Systems and Thermodynamics & Fluid Mechanics subjects. Analysis of time of usage versus attendance at lectures, time versus number of files accessed, and time versus attainment was investigated. Whilst there was a great deal of scatter evident in the data there were some trends that could be identified and these are presented in the next section. One of the challenges going forward is to clarify students' usage of material against the final year end marks.

The final method for evidence collection, individual comments from students on using the material, has been collected from both standard feedback mechanisms used at the University of Nottingham and also from comments made by students within tutorials and classes. The comments are presented with the analysis in the section below.

Benefits and Issues

As mentioned in the previous section one of the challenges facing this project has been the difficulty in identifying behavioural trends from the data produced. There has been a great deal of scatter in the data, possibly in part due to differing mark allocation for assessments in different subjects throughout the year. It is hoped that when a review is carried out at the end of the year the results may be clearer, repeating the analysis with the overall assessment grade for each module.

However, there are some clear trends that have been identified in this initial study. Figure 7 shows the distribution of students usage of WebCT in relation to their grade in a mid year assessment in the thermodynamics and fluids mechanics module. The figure clearly shows that those students with higher attainment marks are likely to spend more time using e-learning resources against those with fail marks. A time of seven hours was chosen as there was a noticeable break in behaviour at this point. It was also possible to see from the data that the majority with very low marks were accessing e-learning material just before assessment points, whilst those with very high marks were more likely to be accessing over a number of weeks. It may be that the lower attaining students adopt a surface approach to learning (Marton et al.,1997) because the demands of the course place time constraints upon them (an issue considered by Case, 2004), thus they may merely access material to meet the requirements of a particular assignment – to 'find the answer' rather than gain understanding. Alternatively, a deeper approach to learning, gained by the students who regularly access the on-line resources may be converted into improved attainment through better understanding. However, clearly there will be many students who will be adopting a more strategic approach to their learning (Atherton, 2005) as the funding of their course may well depend on their performance, so their intention is to obtain the highest mark possible.

It was also noted when analysing the data that lower attaining students that do use WebCT for a significant amount of time tend to show high file access numbers but on deeper analysis show a tendency to re-access the same files. Whilst it is difficult to fully establish why this is via this analysis, it may indicate an inability to assimilate the information contained within; this is being followed up by obtaining feedback from the students concerned, as well as working within them to establish a more efficient working pattern. However, the tendency to access the same files fairly frequently but for very short periods of time, usually immediately prior to assignment hand-in or assessment dates, supports the assumption of an adopted surface approach to learning.

An analysis was also carried out on those using WebCT for less than two or one hour across the semester but the scatter in the data was such that no clear trend in behaviour could be identified.

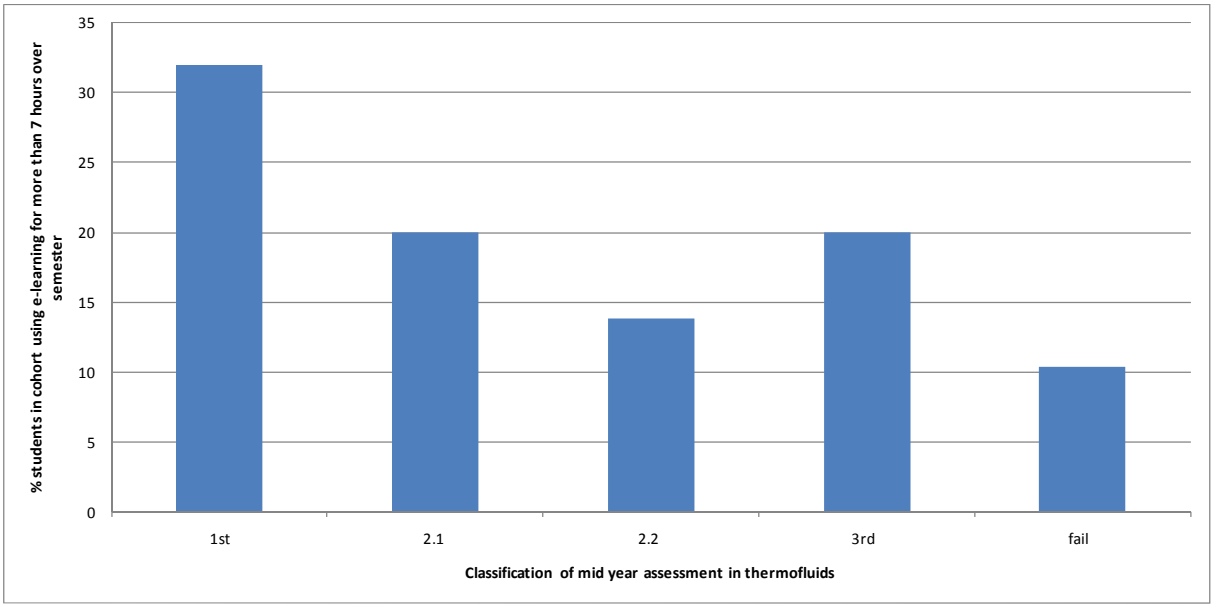

Figure 7: Proportions of students using e-learning material over semester for more than 7 hours vs classification of mid year assessment in Thermodynamics and Fluid Mechanics module

Following this analysis students were asked to fill in an on-line questionnaire about their use of WebCT. From this several highlighted that they were unaware of the full functionality of WebCT even though they stated they logged in on an almost daily basis. In particular they seemed to be unaware of the automated feedback set up on e-assessments, despite this being used in two different modules for revision, self and formative assessment. Many had merely been using the e-repository function and grade book to check their marks. Whilst they are given tutorial information and support on the use of WebCT at the start of the year it would seem that this may need to be revisited throughout the year.

E-learning is obviously only part of the teaching/learning support provided and students' usage needs to be set in context with their access and behaviour in relation to other teaching interactions. An argument that is often cited is that students may choose to abandon lectures and support classes in favour of e-learning but then fail to access the e-learning as they become distracted by social life or coursework demands. To understand whether student behaviour in accessing e-learning was in addition to lectures and other interactions or whether they were using it to replace these, an analysis of e-learning usage versus attendance for different cohorts of students was undertaken. It should be noted that attendance data is based on two registers per week across a three month period, so the data should be treated as an initial analysis only. This analysis will be repeated at the end of the academic year when a more complete attendance record will be available.

Figure 8 below shows attendance at lectures versus usage time for high achieving and low achieving students. Whilst there is an overlap in behaviour clearly the lower achieving group attend less regularly and are less likely to have extended usage of e-learning.

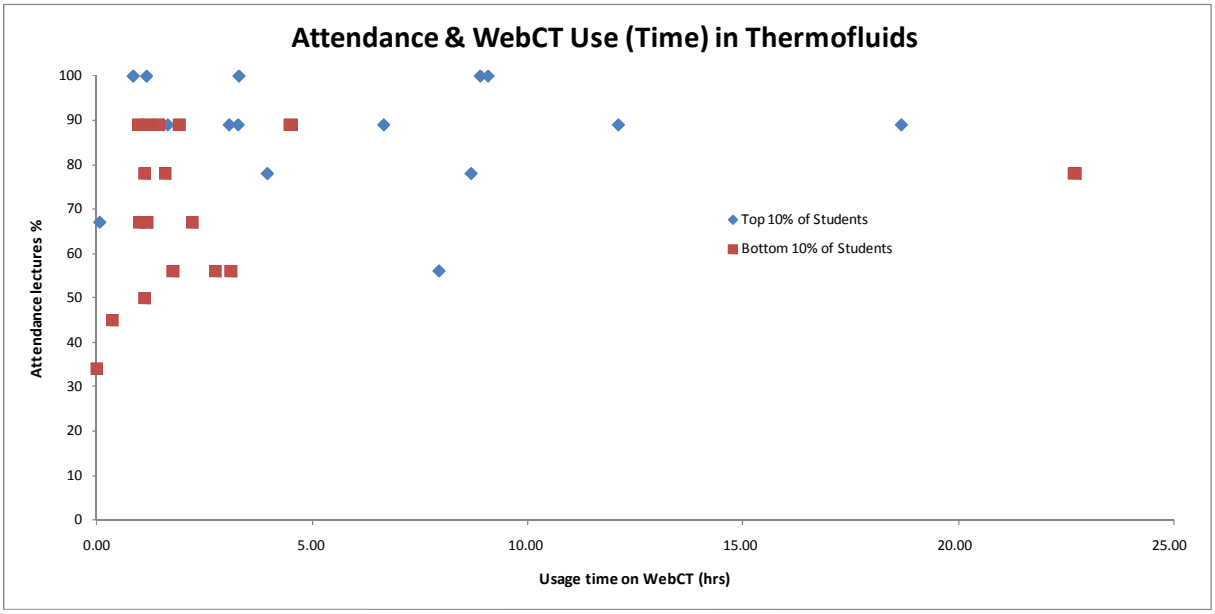

Figure 8: Student attendance at lectures versus usage time of e-learning material for the top 10% and bottom 10% of students in Thermofluids

Evidence of Success

This project is an ongoing project and only initial mid year attainment data is available at present. In figures 9 to 12 below an analysis of attainment versus usage time of e-learning is presented. It is clear from this data that there is a rising trend of attainment versus usage of e-learning material but whether this is cause or effect is impossible to establish. However it is clear that providing students with a variety of different media to allow them to self-study, whether for understanding of software usage or for understanding of engineering science concepts, is proving valuable to the students with verbal student feedback being positive.

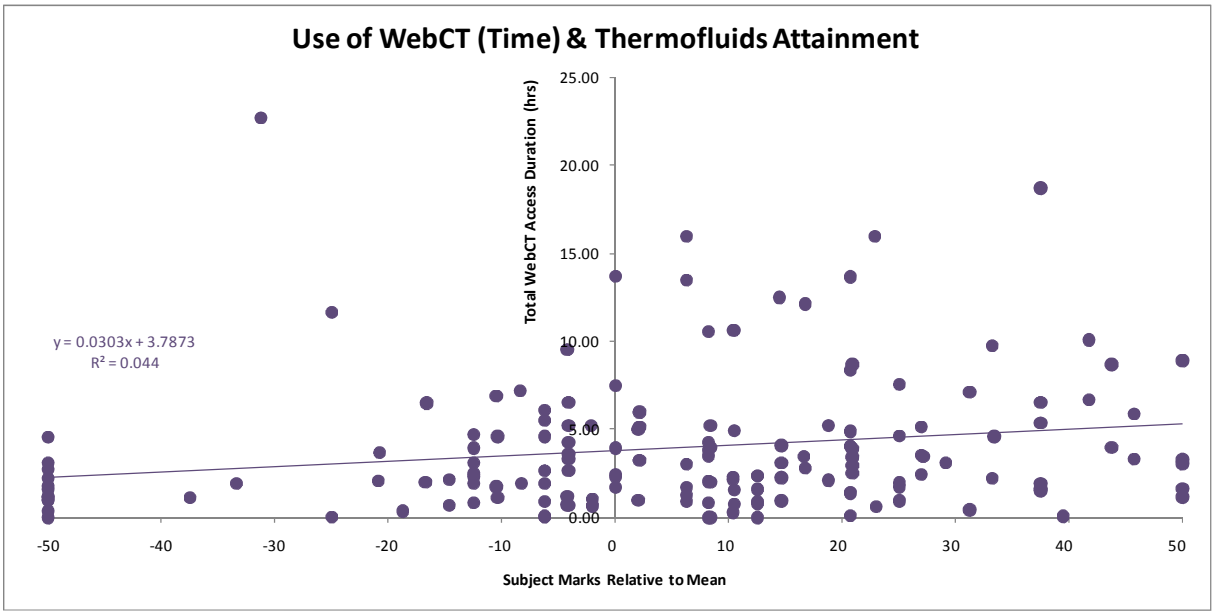

Figure 9: WebCT usage time versus attainment at mid year for Thermofluids

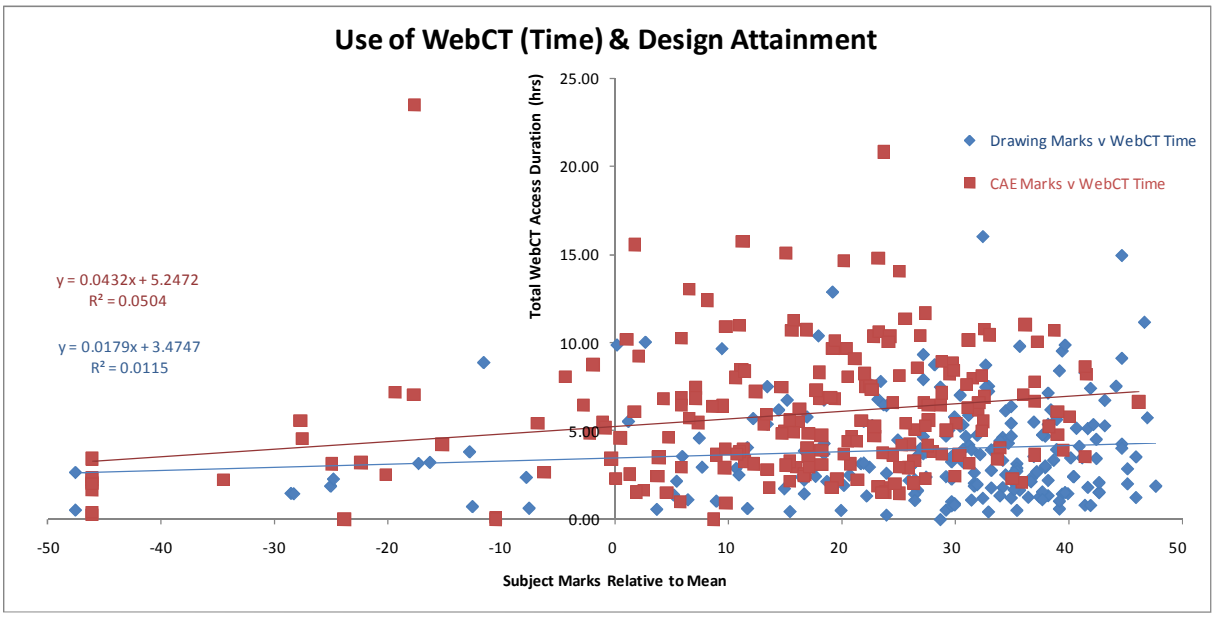

Figure 10: WebCT usage time versus attainment at mid year for Design

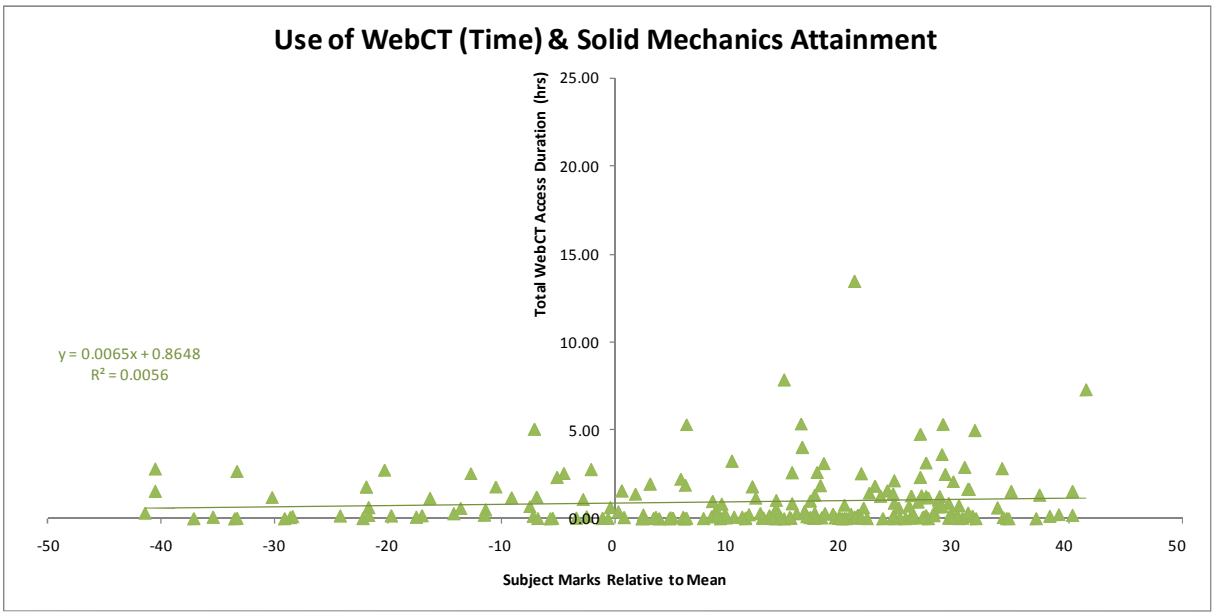

Figure 11: WebCT usage time versus attainment at mid year for Solid Mechanics

When comparing figures 9 to 12 it can be seen that students use WebCT far less for the Solid Mechanics than any of the other modules, although the teaching, tutorial support and attainment is good. This may, in part, be due to the nature of the material and the need to be on-line for any significant duration, e.g. an interactive application embedded within WebCT. However, further investigation into the files and links accessed by students within WebCT indicates that they did not appear to be making effective use of the solid mechanics Realism interactive CAL software that is available. There is much less formative assessment (as described by Sadler, 1989) in the Solid Mechanics module when compared with the other modules. Whilst the assessments in the other modules are 'marks bearing' they have very low weightings and have significant amounts of feedback which often lead into other assessments. Indeed, in some cases, there is a large amount of tutor contact which leads to 'feedforward' (Knight, 2006) on the assignment, e.g. manual drawing and CAE assignments. These sessions encourage teacher and peer dialogue around learning as espoused by Nicol & Macfarlane-Dick (2006), particularly in the student use of WebCT and the information and

tools contained there in. The use of the formative assessment here appears to be leading to productive learning activity (Gibbs and Simpson, 2004).

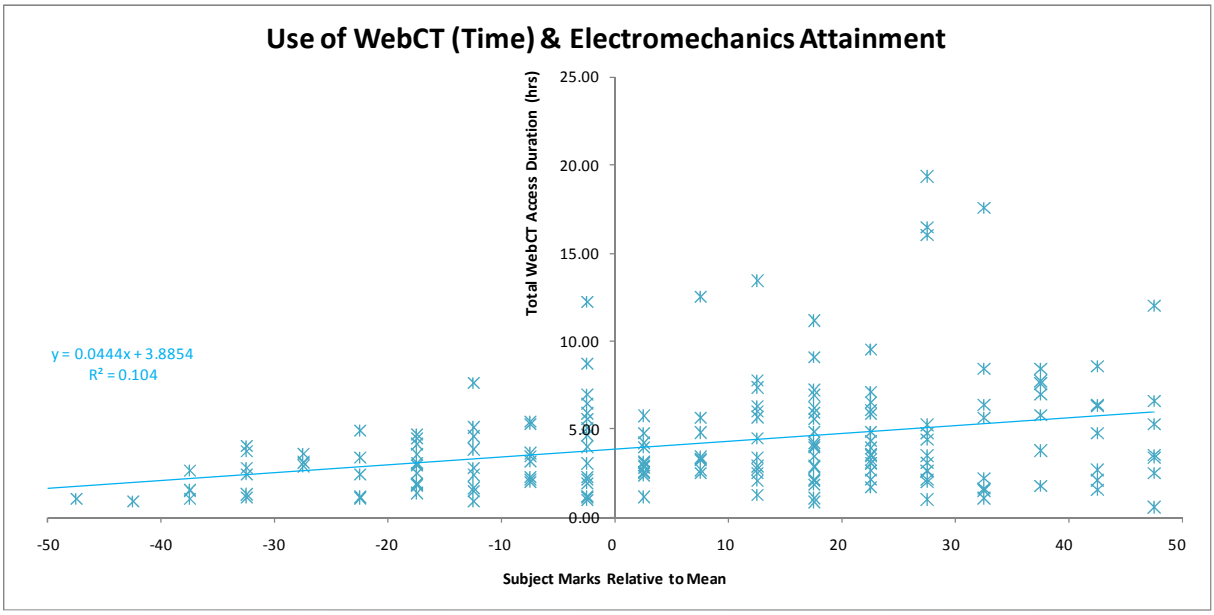

Figure 12: WebCT usage time versus attainment at mid year for Electromechanics

Reflections

This project has set a framework for the collection and analysis of e-learning usage by students at the University of Nottingham. Some initial trends have been identified which has proved useful in highlighting some issues but it has also raised a number of questions that cannot be answered definitively at this point. For instance:

- How effectively are students using the material?
- Which format of e-learning do they prefer, videos or guides, or is multiple media for the same material ideal?
- Do students see the material as a way of getting support in addition to lectures without having to ask?
- Do they see the material as a replacement for lectures/support class interactions?
- Does e-learning enhance their motivation?
- Does e-learning reach the lower attaining students?
- Do they use the formative feedback effectively?
- Is the large scatter in data due to the assessments being formative, i.e. low mark allocation or is it a true reflection?
- How does attainment vs. usage of teaching and e-learning resources relate to prior educational experience and quality of prior qualifications?

The analysis started in this paper will continue throughout this academic year and beyond, funding dependent, and answers to the above questions will be sought. A combination of student feedback from interactive lectures (via keepads) and from on-line surveys will be used with analysis of attendance and WebCT usage in a similar manner to that described in this paper.

Conclusions

This paper has described a project that set out to better understand how first year engineering students used e-learning to support their learning. The methodology used to capture and analyse

information has been presented along with initial results from this analysis. A large degree of scatter was seen within the data but some clear trends were discernable. Briefly these were

- those students with higher attainment marks are likely to spend more time using e-learning resources against those with fail marks
- whilst some lower attaining students are accessing WebCT for long periods of time they appear to be doing so only close to assessment points with multiple access of the same files for short time periods
- a rising trend of attainment versus usage of e-learning material can be seen for all modules investigated, although there is a low correlation coefficient for the data
- attendance vs usage of WebCT does not appear to be linked to attainment except for a group that have low lecture attendance and low WebCT usage.

These conclusions are initial trends distilled at the mid point of the academic year and this analysis will be repeated at year end to see if the same trends can be identified. A number of questions were raised during the analysis, which will be addressed over the coming months by targeted anonymous feedback points for students as well as continuing analysis of WebCT and attendance data.

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