CASE STUDIES OF THE RESOURCES STUDENTS USE

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Abstract: This paper discusses student behaviour and in particular focuses on their use of resources designed to help them learn. Preliminary observations suggest that students do not choose to use a resource because of its' quality or possible benefit as a learning tool. This has significant effects upon the optimal teaching style and effort used in creating learning resources.

Keywords: Web-based learning, student behaviour, engineering education

1. INTRODUCTION

The context of this paper is University Engineering Education within a UK control systems department. Perhaps as a direct consequence of there being proportionally fewer people taking A Level Mathematics (e.g. (EDEXCEL, 2003)), there are fewer applicants for university engineering than previously (IEE, 2004; UCAS, 2003; Engineering Cuncil, 2002). This, in combination with long term under funding, is forcing universities to admit a larger proportion of weaker students who, notably for engineering, often have poor ability in mathematics (Kent *et al*, 2003; Mathematics Education Centre, 2003; SETNET, 2003).

Universities through Learning and teaching Networks (e.g. (LTSN, 2004), the Institute of Learning and Teaching (ILTHE, 2004), and national teaching awards (National Teaching Fellowship, 2004) have recognised the need to improve teaching quality. However, this paper presents some case studies which seem to indicate that that quality itself is not enough, that is, the students can be very well resourced and supported by excellent lecturers and yet do not make effective use of the resources provided. This paper uses data from a Learning and Teaching Development project (Jackson, 2004) and evaluation of student activity on several control systems modules (all at the University of Sheffield) in an attempt to understand student behaviour. The authors department is now using this data as one factor in a larger project investigating a more effective pedagogy for future students.

The paper is organised as follows. Section 2 gives a brief outline of the background to the paper and the rationale behind the resources to be evaluated. Section 3 gives summative data on student usage and Section 4 gives some possible interpretations of this data and hence explanations of the students' behaviour. The paper finishes with conclusions and recommendations, as well as indicates what the authors' department intends to do next.

2. BACKGROUND

This section gives an overview of the context for this paper and how pedagogy influenced the resources developed.

2.1 Motivation

Academics had noticed the repeated poor performance and lack of motivation in first year undergraduate engineers [1]. Unsurprisingly this led to many students either dropping out, repeating the

[1] In the UK these degree studies usually commence in the September following your 18th birthday.

year or having a large number of resit papers; naturally this was not acceptable. Hence (along with changes not relevant here) a single module was used as a test case for innovative use of a virtual learning environment (VLE), (WebCT, 2003), to support teaching and learning. Following project evaluation, any successful components could potentially be rolled out to other modules. The project commenced in Autumn 2002 and the final part of the evaluation study was in Spring 2004 (Jackson, 2004). Two cohorts of students used the new resources, in semester 1 of Autumn 2002 and Autumn 2003. After a preliminary evaluation in December 2002, a report encouraged a greater departmental uptake of the WebCT environment and two other first year modules also made use of this in 2003-04 as well as minor use in two second year modules. These five modules form the basis of this case study.

2.2 Module context

The first module used for the project was a compulsory module for first year control systems engineers. The module '*systems modelling*' is taken in the first semester of an undergraduate programme. As such it is one of the first six modules encountered by the students and hence is at a time when handling the transition from school to university is a major challenge for many.

The modelling module (ACS111) covers an introduction to: (i) first and second order modelling, predominantly of electrical circuits and simple mechanical systems but also with a few illustrations outside of this; (ii) an introduction to time series models. Simulation of the models is not included. The module is delivered as two lectures per week over 12 weeks and an exam is taken in the remaining part of the semester.

Later modules supported by WebCT were:

(1) ACS107: Systems Engineering Methods (Year 1: using MATLAB for problem solving).
(2) ACS120: Engineering Design (Year 1: group project including design and management).
(3) ACS216: Software Engineering (Year 2: structured and object oriented methods).
(4) ACS211: Modelling, simulation and control (Year 2)

2.3 Pedagogical issues

A major difference between university and school is the lack of regular small group contact with the tutor and hence the student can more easily 'get away with' doing insufficient work. Moreover, even if the lecturer knows which students are not working enough, the only penalty for poor attendance/performance is exam failure as opposed to the more regular pressures that school teachers can use. Examining modules by exam only exacerbates this as staff may have no feedback on student performance until after the exam has been marked, at which point it is too late to act.

One might think that students have chosen to come to university and hence have an inherent desire to learn. However, anecdotal evidence suggests that degrees are often seen as a stepping stone to a good career more than an end in themselves. Some evidence of this paper supports that view, that is, many students are not interested enough to learn a topic for its own sake.

A pragmatic approach therefore could be to assume students will work where the incentive is substantial, that is they accrue marks towards their degree programme. Such an observation has enormous pedagogical repercussions on the way we teach, and was the main motivation for some of the developments in *Systems modelling*. More generally, one would expect greater success in helping the students if their motivations are well understood and teaching resources are aligned with these; it is hoped that the data presented here will help develop such an understanding.

This paper will present data for two approaches to teaching and learning: (i) an incentive driven approach to learning where students accrue marks for participation and (ii) a more traditional approach where good learning resources are provided but there is no direct credit for using them.

Remark 2.1. Any pedagogy that requires the tutor to perform large amounts of marking in short time scales (i.e. rapid feedback on submitted work) is unlikely to be workable. The exception to this is automated assessment such as is possible using web based delivery [2] In two of the modules discussed here, instantaneous feedback was provided by automated assessment. Naturally this was poorer in quality than personal feedback and limited in context so students still preferred direct contact with the lecturer where this was possible.

3. RESOURCES AND EVALUATION

This section gives a brief summary of resources developed for the five modules under discussion and some analysis of their usage by the students. Because the resources were all delivered via WebCT, it was possible to collect independent records of students' behaviour without recourse to questionnaires. However, questionnaires were also used to obtain student opinions.

3.1 System modelling module: ACS111

This section gives a brief summary of the evaluation (Rossiter *et al*, 2004; Jackson, 2004) of the resources undertaken in 2002/03 and 2003/04.

The resources developed were:

(1) Self assessment quizzes and matching coursework quizzes. These were based on a large database of questions from which a profiled

[2] Although even this takes substantial development time.

random selection was taken so that each student got similar but different questions each time they took the test. The self-assessments were always available and could be used to prepare for the courseworks which were available in pre specified weeks.

(2) A discussions board which was checked daily most of the term.

(3) Extra resources such as date released tutorial answers, past exams and solutions, data sheets, extra bits from lectures, etc.

(4) Animations with sound giving a different viewpoint on modelling of electrical circuits.

3.1.1. WebCT based records Courseworks: Over the two years the completion rate of the courseworks was approximately 95% with an average score around 70-80%.

Self assessments: The uptake of the self assessments (2003/04) was: Everyone did self assessment 1, 90% doing more than once. Nearly all did self assessment 2, 75% doing more than once. Nearly all did self assessment 3, 70% doing more than once.

3.1.2. Questionnaire based records The data in table 1 overviews student access to extra resources on the site.

Table 1. ACS111: no. of accesses

	0	5	10	more	No reply
Lecture notes	32	43	15	5	5
Empty boxes	55	24	10	2	9
Tutorial sheets	22	45	15	12	4
Tutorial answer	17	39	21	18	5

3.1.3. Student contentment (from text comments in questionnaires and surveys) The students appreciated (Rossiter *et al*, 2004; Rossiter *et al*, 2004) that the WebCT site: (i) provided familiarity with and opportunity to practice coursework assessment questions; (ii) supported understanding by the provision of lecture notes and additional material, enabling freedom of access; (iii) immediate feedback and access to a peer-learning environment; (iv) access 24/7 and (v) allowed the opportunity to identify weaknesses in understanding and to address them thereby improving learning (and obviously marks). The overall comment was that they liked the style of presentation of the module and did not suggest any major changes.

3.1.4. Post module survey for ACS111 In order to obtain some insight into student behaviour, a survey was carried out after the exam. This is summarised in tables 2,3.

Self assess	Past exams	Animation
97	88	50

Empty boxes	Tutorial answers	Discussion
50	55	25

Table 2: Usage of resources (%)

Credit	Credit and interest	Interest
57	32	25

Table 3: Motivation for usage (%)

What is most notable is that interest or learning potential does not score very highly as a reason for looking at a resource [3] ! When learning as opposed to assessment was the main purpose of a resource, its usage is significantly lower (max about 50% as opposed to nearly 100% where marks were gained). This is also clear from table 1.

3.2 Use of WebCT resources across five modules

Figures 1-5 show histograms of number of accesses (x-axis) to the web sites vs number of students (y-axis) for five modules. Data is given for access to the site (a), to discussions (b) and postings (c).

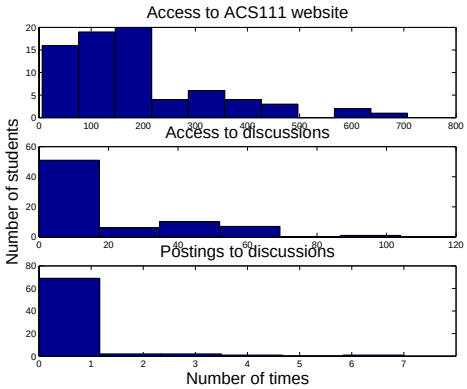

Figure 1: ACS111 data

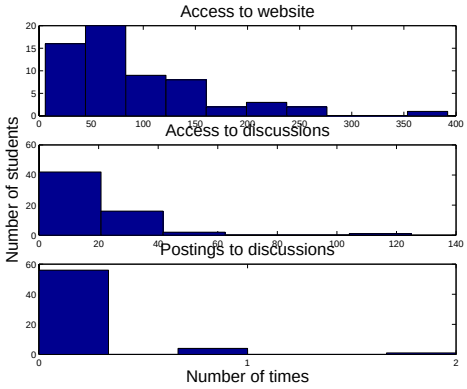

Figure 2: ACS107 data

3.2.1. Observations from ACS107 This course uses a problem based approach to learning. Students submitted assignments via the web site and the chat facility was used in lectures (held in the PC laboratory), hence the large number of accesses. During lectures the lecturer went through several programmes which could form a good framework for the coursework assignments and

[3] Anecdotal evidence is that students did not even bother to check out what was on the site and were surprised when shown at a later date.

these files were placed in the discussions for ease of access after the lecture. Nevertheless, despite being logged into the site every week for 2 hours, most students did not read or make use of these 'hints' (see figure 2) and moreover were surprised when reminded of their presence.

Also, despite providing:

(1) demonstrator and lecturer assistance for 3 hours per week, rarely more than 30% of the cohort sought assistance.
(2) a mechanism so that students could self-evaluate code before submission, a large number of students had not used it and hence scored poorly.

> Students did not even read the discussion postings and are not using the resources provided to help them learn and perform well.

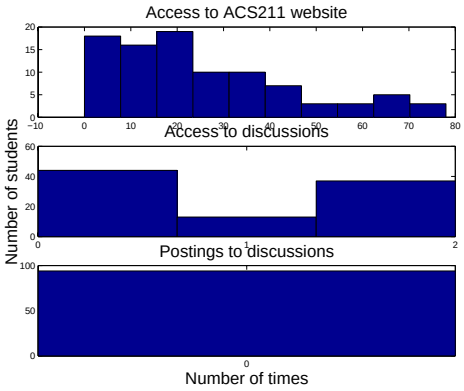

Figure 3: ACS211 data

3.2.2. Observations from ACS211 75% of these students had taken ACS111 the previous year and so were familiar with WebCT. Here WebCT was used as a place to store extra resources, some helpful code for learning and the assessed laboratory, tutorial answers, etc. and a discussions board. What is most notable here is that despite this module being considered difficult and many students struggling, nevertheless no students posted a discussion query (figure 3) and most did not read what was provided by the lecturer in follow up to points raised in lectures. They also came unprepared (the author is witness being present at all laboratories) for the laboratory and hence struggled, having not used the resources provided to help them prepare.

> Students are not using the resources provided to help them learn and perform well.

3.2.3. Observations from ACS120 In 2003-04 ACS120 provided only a small number of WebCT resources: lecture notes, a discussion board and a single assignment. Of the 57 students registered, all accessed this material, but only 3 students posted to the discussion board, with each of the 3 posting a single discussion item.

> Evidence here is inconclusive.

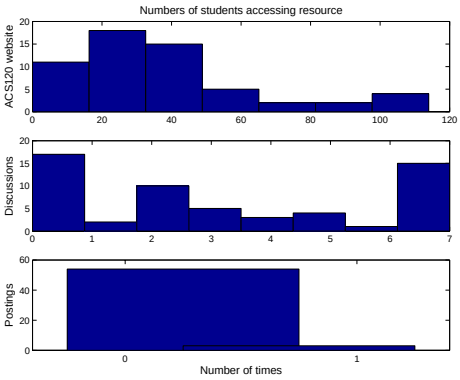

Figure 4: ACS120 data

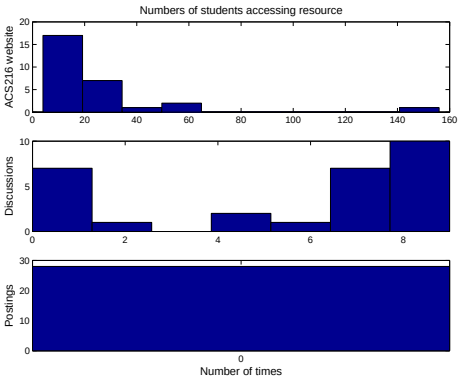

Figure 5: ACS216 data

3.2.4. Observations from ACS216 ACS216 provided these WebCT resources: lecture notes and supplementary material, a calendar, self-assessment questions, links to past exam papers and to relevant external websites, an assignment, and self-assessment questions. There were 29 students registered on the module. Of the 29 students, 28 accessed the ACS216 WebCT home page; 11 students accessed the home page more than 20 times. The lecture notes and supplementary material were accessed by 28 students, even though paper copies were made available during lectures. The calendar, self-assessment questions, assignment and discussions board were each accessed by 28 students. No students posted to the discussion board; all postings were made by the module leader. From this, one conclusion is that the students have watched the ACS216 WebCT pages, but that communication through the pages is one-way only. Students in this module were told that they could communicate with the module leader via WebCT, making helpful use of WebCT to share the question and response with the whole class. They were also told that they could email the module leader directly or come to the module leader's office if they preferred, and many students did ask questions via those two methods. It is also interesting to note that tracking the students throughout the semester showed that access to the

self-assessment resource occurred mainly at the end of the semester, when students were starting to prepare for exams. The intention was that these questions would be used weekly to ensure that the material was mastered incrementally.

> Students did make some use of the resources, albeit not as intended.

3.3 Summary

(1) The discussions board is under utilised, especially by way of student postings. With the exception of ACS216, many students did not read the postings, even those by the lecturer.
(2) Resources not directly related to summative assessment seem to be under or poorly utilised.
(3) Although some resources such as the lecture handouts (which they already had) were accessed frequently, many students did not surf the site to see what was there and did not access extra resources.
(4) ACS216 students were more likely to use the resources than other students. Possible reasons are this being a smaller group or a 2nd semester, 2nd year module (the students are getting older).

4. STUDENT BEHAVIOUR

4.1 Summarising student behaviour

The data gives an apparent contradiction. Most of the textual feedback (Rossiter *et al*, 2004; Rossiter *et al*, 2004) demonstrates that students are fairly happy with the use of WebCT and indeed welcome it. However, analysis of student usage (except ACS216) shows that a sizable proportion used mainly those resources which led directly to module credit and relatively few accessed resources which had the main purpose of aiding learning and hence improve marks (performance) only indirectly. It did not seem to matter how much helpful material was made available, many students did not even bother to ascertain what was there. For instance figures 1-5 show that: a large number of students never read a single discussion posting (despite frequent reminders in lectures) and very few students used the discussions to ask questions of the lecturer. Tables 1-3 demonstrate that nearly all students used resources directly related to obtaining module credit, but the majority did not use other resources effectively (revision being a less effective use).

They do not seem to be motivated enough by interest or the desire to learn. For instance: (i) observations from laboratories show that many students on ACS107 did not even look at the many worked examples designed as formative resources to to help them understand the courseworks assignments, and then struggled and (ii) half the students on ACS111 did not access the tutorial or past exam solutions.

4.2 Understanding student behaviour

A possible understanding of this is that the students are still struggling with how to learn and develop the skills needed for a degree programme. They cannot cope with open ended problems which do not have simple algebraic answers and seem unable to be systematic in using the provided resources to learn before attempting a problem. Some evidence for this would be the popularity and large usage of automated quizzes on ACS111 (which are largely simple questions requiring a numerical answer and knowledge of a single formula). Yet there was relative minor use of resources which were an aid to deeper learning (e.g. animations, past exam papers/solutions, self-test software). The students seem to lack the discipline, confidence and awareness to first assimilate basic knowledge and secondly use this knowledge to solve a problem possibly involving several steps.

5. FUTURE WORK

5.1 The challenge

The department has a major challenge. That is not only to provide excellent resources for the students, but also to encourage the students to use them. Unfortunately a simplistic view of such a task requires students to be conscientious and to work regularly which few seem to do by choice in the first year.

One obvious conjecture, is that students often need incentives beyond learning as an end in itself. The most obvious motivation is a qualification or in the case of a single module, the opportunity to acquire marks towards passing the module (UK Engineers Professors Council, 1992). However, in the case of longer assignments, such as those in the ACS107 programming module, it is less easy to encourage the students in doing the mundane learning required before tackling the assignment itself with the net result of student frustration and even failure.

Where a module is largely mathematically based, as many engineering modules are, a partial solution is to make good use of automated quizzes. However there are significant limitations in the learning that can be assessed this way and the generation of such a resource is a major task that most lecturers could not undertake unsupported.

5.2 Better integration of resources

The original premise of this paper was to try to understand students' motivation. Without this, any action taken may be misdirected. Discounting the obvious, 'I'll do it if I get marks', the most obvious summary here is that the students are not being fully engaged in the learning material. We need a strategy that engages them sufficiently so that they become more proactive.

It is not enough to produce and make available good resources or student support. Although mature students (e.g. ACS216) are more likely to make use of these, less mature students seem less likely to do so. Students need help in learning how to learn and how to use resources effectively.

One suggestion, which is to be pursued in the author's department, is to investigate how learning resources can be better integrated or interwoven into activities which the students are likely to do. Such an integration will give more exposure to resources and hopefully increase uptake and hence learning. The department is currently looking at good ways of doing this with the aim of performing some trials in 2004-05.

5.3 Specific proposals for development

Some possible strategies that the department intends to trial this year is an increase in two learning approaches:

(1) **Problem (or project) based learning (PBL) approaches:**
PBL is more open ended but also more student centred or student owned. With ownership, students may be more driven to produce good work. Some anecdotal evidence for this comes from ACS107 where students struggled through the first two course works aimed at acquiring key programming skills and yet were very enthusiastic with the third coursework producing work far more imaginative and beyond the standard expected. The third coursework was open ended (to produce a GUI driven learning tool related to their other studies) and obviously allowed them more individualism.

(2) **Group projects:**
Students typically fail to make good use of their peers for assistance. This is partly as the university accomodation provides no natural study base for students on the same programme and hence does not adequately encourage students to work together. We hope a greater use of group projects will increase student bonding and also provide more opportunities for mutual help.

The aim is to use a VLE as the main communication tool in the developments as this should unify students who otherwise meet only in lectures.

6. CONCLUSIONS

In this paper we have looked at some data on student behaviour and attempted to make inferences from that data. The data reinforces the view that students like feedback on their performance and on average do well if there is a coursework element in a module. However, more importantly, it is rather startling to notice that many students do not automatically access resources provided to help them learn, and as a consequence may perform poorly. Staff often produce very clear and factual notes (as they would like to have for themselves) but this does not seem to fulfil the students' needs.

Perhaps students either do not have a basic interest in learning itself or do not know how to go about learning. As a University, the aim is to help students into good learning practises, by providing excellent teaching resources to ultimately help them to learn. Hence, an important task within this department is to look at how we can better support students so that they become more conscientious and more skilled learners or from an alternative viewpoint, how do we create useful resources with which the students will fully engage and hence learn more effectively.

The onus is on the teacher to make the learning process more engaging and enjoyable and to integrate into this process well produced resources. With the increasing potential of the web, the authors' department has set itself a task of doing effective blending of web based resources with traditional teaching styles.

REFERENCES

Jackson, D., Final evaluation report of a project 77 funded by the Learning and Teaching Development Fund, 2004, The University of Sheffield, LDMU, 5 Favell Road.

Kent, P. and R. Noss, Mathematics in the University Education of Engineers, http://www.engc.org.uk/ publications

Rossiter, J.A., D. Rossiter and G. O'Brien-Diercks, Experiences in the use of web-based delivery for first year engineers, Proceedings of the Web-based Education Conference, Innsbruck, Austria, 2004.

Rossiter, J.A., and D. Rossiter, Student usage of web-based resources for engineering teaching, UKACC 2004

EDEXCEL website, http://www.edexcel.org.uk

IEE Review Careers, mid-February, 2004, p1

UCAS web site, http://secure.ucas.com /figures/archive/download/index.html

Engineering Council website, Digest of Engineering Statistics 2002, http://www.engc.org.uk/publications/statsdigest

Mathematics Education Centre, http://learn.lboro.ac.uk/ sci/mec/ index.htm

Science Engineering and Technology (SETNET) website, http://www.setnet.org.uk/news recent.html

UK Engineers Professors Council, Assessment Methods in Engineering Degree Courses, 1992, http://www.engprofc.ac.uk/op/op05.html

WebCT (Trademark), website http://www.webct.com

National Teaching Fellowship scheme, http://www.ntfs.ac.uk/index.html

LTSN, Learning and teaching support network, http://www.ltsneng.ac.uk

ILTHE, Institute for Learning and Teaching in Higher Education, http://www.ilt.ac.uk/