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WELCOME

Mentioning the city of Liverpool immediately conjures up thoughts of football at Anfield for the club with the city name, Goodison Park for Everton, Aintree for the Grand National horse racing event and the Cavern Club for the Beatles. However being awarded the European capital of culture in 2008 tells us there is much more to the city. This manifests itself in the many other attractions of concert halls, theatres, night clubs and numerous other outlets for cultural and social activity. Like many cities, developments in waterfront areas are adding considerable attraction to the ambience of the location. The Subject Centre endeavours to move the Annual Conference throughout the regions and hence the choice of Liverpool to host our 2008 Annual conference is appropriate in this significant year for the city. Again we are grateful to the local organising staff, this year in Liverpool Hope University, for the work that has gone into preparation for the event.

The main challenges for the subject communities of Information and Computing Science continue to be attracting the best students in adequate numbers to study the subjects. Whatever we might do and whatever experience we provide to the students whilst in Higher Education, the need to entice 18 year olds into our disciplines is paramount. Furthermore, reports such as Leitch[1] show the need for upskilling the workforce and the importance of Lifelong learning. There are many issues related to this of course that the Subject Centre cannot necessarily directly influence, such as students' experience and perceptions of the subjects prior to making their choice of Higher Education study. These attitudes can only change with the combined work of other agencies such as Professional Bodies, Education, Training and Employment sectors of government and schools. There is, however, the need for us to address many aspects of provision, including the nature and background of the student, the curriculum, the mode of delivery, the use of Technology to enhance learning and appropriate assessment methods.

In looking at the programme we have I don't think anyone can accuse us of neglecting any aspect of these issues. The workshops, papers and posters encompass access, curriculum, technology, delivery mode, assessment and many aspects to enhance the student experience. In addition, we have been very fortunate in attracting three internationally renowned keynote speakers, each bringing aspects of pedagogical argument, the use of technology and student insight.

It is again my pleasure to welcome all to this our 9th Annual Conference. I thank all who have contributed to the event, from the organising committee to all who have refereed papers and contributed in any way. I hope you get the opportunity to enjoy the experience of the city of Liverpool and find useful ideas to take back to your institutions and deploy in your own way.

Gerry McAllister
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University of Ulster

[1] http://www.hm-treasury.gov.uk/independent_reviews/leitch_review/review_leitch_index.cfm

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THE PRACTICALITIES OF USING SECOND LIFE FOR TEACHING

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ABSTRACT

This workshop aims to introduce the educational uses of Second Life together with teaching tools and sample resources. It draws on the authors' work for the the HEA-ICS funded project "Second Life Toolkits" and will demonstrate the use of a variety of Second Life teaching tools, together with other resources for teaching Information and Computer Science.

Keywords

Second Life, Virtual Worlds, Education, Toolkits

1. INTRODUCTION

Virtual Worlds provide a rich, multimedia environment which simulates the real world and provides a mechanism by which participants can interact with each other as if they were meeting face-to-face. Once in a virtual world (such as Second Life http://secondlife.com/) academics are faced by a new environment with novel ways of teaching and a wealth of potential resources to facilitate their teaching.

This workshop will have two strands, the first will provide participants with no previous experience in a virtual world an introduction to the use of Second Life for education and the second strand will enable participants with experience of Second Life to see and try out a range of teaching tools and sample teaching resources for ICS. In addition it will look at the development of a generic Second Life teaching toolkit (an easy to use package with incorporated instructions and details about how to customise the tools for particular activities) developed as part of the HEA-ICS funded "Second Life Toolkits" project.

2. WORKSHOP FORMAT

Delegates will be spilt into two groups depending on their experience of using Second Life.

2.1 Novice Users of Second Life

Inexperienced users of Second Life will be helped with creating an avatar and given practical support in using the environment. The format will be: 5 minute introduction, 15 minute account and avatar creation and demonstration, 40 minute familiarization by the delegates with Second Life

2.2 Experienced Users of Second Life

Experienced users of Second Life will be introduced to the teaching tools and resources discovered and developed as part of the HEA-ICS funded project "Second Life Toolkits. The format for these delegates will be: 15 mins overview of the tools & resources, 45 mins hands-on familiarization with the tools & resources.

3. RESOURCES REQUIRED

This workshop will require the use of a computer lab or wireless access plus around half of the delegates bringing a laptop with them or the authors successfully negotiating the loan of a suite of laptops.

4. ACKNOWLEDGEMENTS

This work is funded by grants from the Higher Education Academy-ICS and The ExPERT Centre CETL.

MEDIATING LEARNING IN OBJECT-ORIENTED SYSTEMS ANALYSIS & DESIGN USING AN EXTENDED BLENDED LEARNING APPROACH WITH ELEMENTS OF CHAOTIC LEARNING

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1. RATIONALE

A desk research study carried out by the author revealed that many pedagogic studies (e.g. Phelps 2003, Bloom 2001, Lee 2000, Doll 1993) indicate the value of less structured and more challenging teaching methods and suggests that the inclusion of e-learning materials with elements of chaotic learning would be beneficial to all stakeholders in the educational process. Flexible and blended learning is becoming increasingly important in education as many universities recognize that e-learning needs to be adopted for the right reasons, to improve the learning experience, and need to be based on sound pedagogies (Roscoe, 2002, Schank, 2002). An example of such a pedagogy would be Vygotsky's model of social constructivism. An extension of this is communal constructivism where learners actively build knowledge beneficial to other students, with help from global communities and in collaboration with their peers. New generations of web learners have adopted a more complex learning behaviour. This is more in line with our natural tendency to solve problems and accumulate information outside of traditional educational settings. Schank (2002) argues that there is a need to rethink our educational model and identifies 'learning by doing', adding realistic situations, goal-based scenarios, sometimes using practitioners, introducing fun and interactivity as potential motivators. All of these findings have been addressed in the project. This, together with the author's involvement in an international project which aims to combine three different types of learning and teaching (XBL) to form a single package, has led to the application of a contemporary online learning model to a specific discipline within computing addressing and incorporating the findings of the initial desk research study.

2. DESCRIPTION OF PROJECT AND SESSION

A contemporary online learning method for teaching Object-Oriented Systems Analysis and Design to second year undergraduate students on BSc (Hons) Computing has been developed, implemented and evaluated. Elements of 'chaotic (or self-organised) learning' have been incorporated to enrich students' learning experience. The Moodle Virtual Learning Environment and its social constructivist approach proved a suitable platform for this project. Students worked in teams, each team researched an area of the curriculum, produced a wiki and prepared and delivered a seminar on their subject. They participated in seminars, practical sessions and progress meetings with the tutor as well as with the industry contact. These teams continued to work on an assignment based on a real project provided by an industry partner, the UK Land Registry. Methods to evaluate the project included an 'initial thoughts' exercise, two questionnaires and a 'stop, go, continue' exercise. The majority of responses were positive. The highest number of positive responses related to team work and the resources provided by the tutor. The highest number of negative responses related to (the quality of) student-led seminars. Several students expressed preference for traditional teaching.

The Workshop session will be organized as follows:

1. Making the argument that e-learning materials should contain elements of chaotic learning;
2. Introduction of 'Extended Blended Learning' (XBL) which comprises e-learning, face-to-face learning and project-learning;
3. Description of application and summary of results incl. a demonstration of the website;
4. The audience is encouraged to ask questions throughout, particularly when evaluation results are shown. They are asked to note 2-3 aspects they liked, and 2-3 they would improve/change and how. This will help inform future developments.
5. Delegates are encouraged to share reflections on usefulness in their own disciplines.

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NATIONAL PROJECT COORDINATORS NETWORK – WORKSHOP "SUPERVISORY (MIS) BEHAVIOUR WITH PROJECTS"

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ABSTRACT

This workshop is planned as the second National Project Coordinators Network meeting. The workshop is a panel session on the theme "Supervisory behaviour coordinating projects" with the aim to identify common problems and good practice coordinating projects. The workshop will also consider establishing itself as a self-sustaining network of university computing project coordinators. Further objectives is to discuss issues currently dominating projects and in the foreseeable near future.

Keywords

Projects, Coordinators, Network, National.

1. INTRODUCTION

The goal of the National Project Coordinators Network (NPCN) is the furthering of project practise and to establish a self-sustaining network of university computing project coordinators. The first NPCN (2007) meeting focused specifically on Project Work Pragmatics with the title "*Why do Projects?*" and provided an overview of operational aspects. This panel session will focus on what supervisors do when managing projects, how problems are handled and solved and issues that dominate projects now and in the near future. The session will also be open to other issues addressed to the panel such as synoptic assessment, student engagement and group project based activities.

2. WORKSHOP OUTLINE AND LEARNING OUTCOMES

- To identify common problems coordinating projects
- To connect good practice with a detected need for good practice coordinating projects
- Issues currently dominating projects and in the near future
- Network sustainability and future meetings

3. PANELLISTS

Moderator: Professor Roger Boyle, Head of School of Computing, University of Leeds

Panelists: To be arranged nearer the workshop date.

4. REQUIRED PREREQUISITES

Participants are requested to complete an on-line questionnaire prior to the meeting – these will form the basis for discussion. Questionnaire: http://www.comp.leeds.ac.uk/projectnetwork/npcn08-questionniare.html

5.ALiC CETL

The ALiC (Active Learning in Computing) CETL (Centre of Excellence in Teaching and Learning) focuses on increasing the level of student engagement within the computing curriculum. ALiC is led from Durham University with the University of Leeds, University of Newcastle and Leeds Metropolitan University.

ALiC aims to increase levels of student engagement in the curriculum, better quip students for employability, better integrate research and teaching activities, and revolutionise the learning environment.

ANIMATION AND INTERACTIVE PROGRAMMING

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ABSTRACT

This workshop explores the use of animation to teach programming principles to first year University students studying Information and Media Technology. The motivation behind this work is to encourage students in higher education who do not see themselves as serious programmers to engage with some of the concepts and methods used in the teaching of programming. In addition this work was used in workshops to engage with local and regional secondary schools to run workshops on the use of animation as a tool for learning how to write computer programs and be creative.

Keywords

Program animation, Practices of using software visualization in education, Hands-On Learning, Engaging students in the learning of programming principles.

1. INTRODUCTION

The teaching of new concepts and hands on practical skills such us programming can be combined with animation and visuals to great effect. Previous research has shown that ActionScript can be used as a suitable tool for teaching introductory programming. In a recent study, ActionScript code was compared with more complicated code in Java for similar programs and concluded that ActionScript not only teaches the fundamental of programming and concept of object-oriented development to the students but also enables them to find the errors in the smaller tasks which is easier to solve. ActionScript has been recommended as a useful step up to high-level languages such as C++, and is seen to be easier to learn due to the immediate visualization it provides [2]. ActionScript uses traditional coding techniques but allows the user to see how each piece of code effects the running or execution of the program, allowing the user to have an instant visual understanding of what the code is doing, To help with coding errors, the software uses a syntax checker and will inform the user of errors either before or as they run a program. Feedback from undergraduate workshops has shown that a majority of students–with and without previous programming experience- have engaged well with an application environment where visualisation is involved.

2. WORKSHOP FORMAT

The workshop will provide participants with practical experience of using ActionScript for teaching programming. The workshop format will be as follows:

- 10 minutes introduction
- 40 minutes participation by delegates
- 10 minutes demonstration of student work, feedback and discussion

To run this workshop the following will be necessary

- Use of computer lab by delegates
- Availability of Adobe Flash software licenses (10 copies installed)

3. REFERENCES

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CONTRACT CHEATING

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ABSTRACT

'Contract Cheating' is a form of academic dishonesty in which students get others to complete coursework for them by putting the work out to tender. In short, students pay for a third party to complete their coursework.

This new form of cheating poses a problem. Most of the existing anti-plagiarism tools and approaches are based on the simple premise that the work plagiarised is accessible: it is in the public domain, or it is in some available corpus of student work. Now, work obtained through contract cheating is entirely original, and so it is not detected by any existing tools.

Keywords
Contract cheating, academic misconduct, plagiarism.

1. OBJECTIVES

We contend that Contract Cheating [1, 2] is a growing problem. There is a growing body of evidence [3, 4, 5], both empirical and anecdotal, that more and more students are putting their academic work out to tender, and are then submitting the results. There is a clear threat here to the integrity of any course that uses any form of assessment where the student is not closely invigilated at all times.

The workshop we propose to lead will be a forum in which those concerned about these issues can share their concerns with others.

Specifically, the objectives of this workshop are to:

- Publicise the issues surrounding Contract Cheating;
- Share current practice in the prevention and detection of Contract Cheating.
- Share current practice in dealing with Contract Cheating cases once detected.
- Start towards developing guidelines for best practice in combating Contract Cheating.
- Overall, to establish the basis of a community of those concerned about Contract Cheating specifically in the Information and Computer Sciences.

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BUILDING PARTNERSHIPS – THE DIPLOMA IN IT

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ABSTRACT

In this workshop, we will introduce the new Advanced Diploma in IT and describe the background to its development. The 14-19 Diplomas are new qualifications which blend general education and applied learning. Their purpose is to provide a valuable education in the context of a broad economic sector. At Level 3, they are designed to prepare students with the knowledge, understanding and skills for success in Higher Education and employment.

The Diplomas are created by Diploma Development Partnerships. Co-ordinated by the relevant Sector Skills Councils, these Partnerships bring together employers, Higher Education, Schools, Colleges and other stakeholders.

The Diploma has been developed with significant employer input and we will present examples of how employers plan to engage in the delivery of the Diploma. There are also significant opportunities for Universities to work with schools and colleges to support delivery of the Diploma and we will share some of these projects.

Keywords

Advanced Diploma IT University Engagement,Employer Engagement.

1. INTRODUCTION

The purpose of the workshop is to provide information on the new 14-19 Diplomas with a focus on the Advanced Diploma in IT, teaching of which begins in September 2008. The workshop will provide an opportunity to build new partnerships and share ideas for university and employer engagement in supporting delivery of the Diploma in IT.

The format of the workshop will consist of a series of three presentations followed by a facilitated question and answer session. The presentations will be delivered by individuals from the relevant stakeholders including e-skills UK, employers and universities. The presenters will describe their experience of the Diploma, highlighting what can be gained in terms of understanding progression routes as well as how it can help develop a better understanding between schools, colleges, universities and employers.

Presentation 1 will be delivered by e-Skills UK and focus on the background, development and content of the Diploma in IT.

Presentation 2 will be delivered by an IT and Telecoms employer involved in both the development of the Diploma and committed to contributing to the delivery of the Diploma.

Presentation 3 will be delivered by a university giving examples of projects where HEIs are working with their local consortia to support different aspects of the teaching and delivery of the Diploma ranging from endorsing progression routes through to joint development of the specialised learning elements

Each will talk for around 10 minutes, allowing 30 minutes discussion time.

Some discussion points of examples of ways in which universities might wish to help include the following:

- Providing innovative challenges or competitions as the basis for the extended projects students will undertake;
- Offering to deliver lectures or host workshops to support delivery of the Diploma in local schools;
- Helping to craft guidance for students on progression, for example helping to define simple ways to explain the diversity of Higher Education and career options related to IT;
- Creating new options for 'Additional & Specialist Learning', including level 4 options to stretch the most able students.

ROBOTS AND PROBLEM-SOLVING

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ABSTRACT

Mindstorm based robots have been used previously, not only for teaching programming to computing and engineering students.It has been stated that robots "…provide entry level programming students with a physical model to visually demonstrate concepts" and "the most important benefit of using ROBOTS in teaching introductory courses is the focus provided on learning language independent, persistent truths about programming and programming techniques. ROBOTS readily illustrate the idea of computation as interaction". These advantages also apply to problem solving where synergies can be made with the work on pre-object programming and simulation of robots for teaching programming. This workshop gives an opportunity to try out these robots with simple problems.

Keywords

Robots, problem-solving

1. RATIONALE

The workshop takes an approach where the focus is upon the development of problem solving skills and not on learning a new programming language from the outset. Therefore, initially, any programming is kept simple with the minimum of commands and objects are unknowingly used, these are introduced/learnt during the programming stage of the module. This approach has been developed further for engineering students.

Examples of how this crossed-over to an engineering course (and back in computing modules) will be shown.

This workshop will allow participants to try out some of these techniques using Mindstorms NXT and RCX robots, as well as Microsoft's Robotics Studio

TAKING UNIVERSITY TO SCHOOLS

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ABSTRACT

Nationally, in addition to falling recruitment, Computing/ICT undergraduate courses are known to have high drop-out percentages, particularly at the end of the first year. The results to date from the project reveal that: students leave their courses early in their first year due to their inability to manage the transition from school to HE, this is particularly problematic for first generation students; students' expectations of their courses are on the whole met but there are issues with some of the more technical aspects of their course; motivation and engagement tends to be subject specific. To address these issues a number of school and university based activities have been undertaken or planned, these include focus groups, short courses, A level conference, and support tools for specific subject areas.

Keywords

Computing, ICT, Programming, Expectations, Retention, Transition to Higher Education

2. INTRODUCTION

2.1 The Project Aim

The aim of this project is to investigate and inform the expectations and first year experiences of Computing/ICT students applying to or studying at the University of Glamorgan with the aim of maintaining recruitment and improving retention. It is envisaged that some of the outcomes maybe relevant to HE courses in other disciplines.

The objectives are:

- to investigate and compare the expectation/perceptions and actual experiences of new students on HE courses;
- identified factors critical to improving first year undergraduate student retention on ICT/Computing courses;
- the development of support materials and activities such as focus groups, conference and short courses, to be undertaken with school teachers and pupils engaged in delivery of Computing/ICT to assist their preparation for HE learning;
- the deployment of a specific subject area support tool and pedagogy to be used with its delivery.

2.2 The Problem Identified

Following a sharp rise in applications and acceptances on to Computing and Computer related courses in consecutive years to 2001 they have declined each year from 2002. From 1998 to 2001 overall recruitment increased from 18,918 to 26,160 and then decreased from this peak to 16,130 in 2005 [1]. Coupled to this Computing and Computer related courses traditionally suffer from retention problems. The House of Commons Report [3] highlights that there has been 'little improvement in retention of students since 2001-2002'. This is even though there has been an increase in participation in Higher Education from approximately 40% to 43% of 18-30 year olds.

The report also states that widening participation in HE attracts more students from under-represented groups and these students are more 'at-risk' of withdrawing from their courses. The first year progression rates for students studying Mathematical Sciences, Computing and Engineering subjects is 3% below the national average for all subjects [3]. Also within Wales the overall retention of first year undergraduate students is the lowest in the UK and it has the second lowest rate of young entrants from low participation neighbourhoods [3].

The Government's widening participation agenda has led to the recruitment of many first generation university students who have no peer experience for guidance. This leads to a problem as these students have little or no expectations of HE study, while this is not unique to this current generation, their range of abilities is far greater than that of what were effectively the high achievers of the past generations. Introduction of new funding requirements has also led to a change in student demography for many universities.

School pupils' perceptions of HE courses have been identified as a critical factor in recruitment and retention of students on HE courses, there is a need to recruit the right students [5]. This is particularly evident in undergraduate ICT/Computing courses that have seen declining numbers nationally [1,7]. Maintaining and increasing student numbers can be addressed in two ways: improve recruitment to the first year and improvement of student progression particularly from first to second year [2].

Universities can be proactive in addressing these issues through establishing strong links with its school constituency by taking the university to schools. This project is focused on the work being done in the Department of Computing and Mathematical Sciences at the University of Glamorgan.

Research being carried out in the Faculty of Advanced Technology on attrition across all the courses within the Faculty shows that the Department of Computing and Mathematical Science has the highest percentage of withdrawals and suspensions during the academic year 2006-2007. The Faculty's analysis of withdrawals has often indicated critical periods when the withdrawal rate is high are very early in the course, after the Christmas vacation and during the exam period in May.

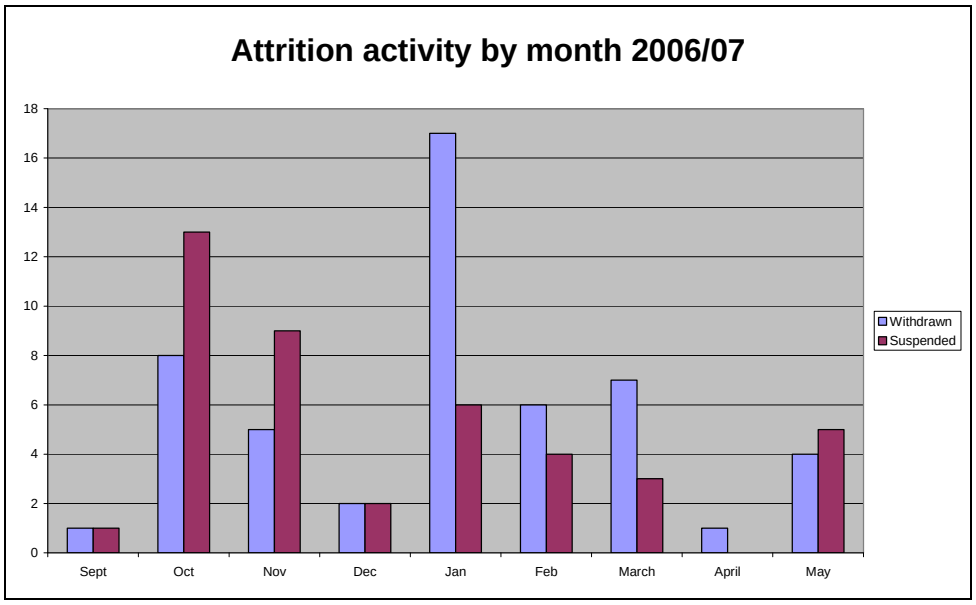

Figure 1

While student withdrawals and suspensions occur throughout the academic year from October to May analysis reveals that of the students withdrawing or suspending out of the Faculty, 44% did so before the end of the first term and almost 34% of the total withdrawals took place in January. This indicates the importance of the strategy to 'front-load' information, support, help and guidance. The Faculty's pattern indicates that supporting students through their first term and their initial return after the Christmas vacation, the majority are likely to complete their first year of study. Withdrawal rates in subsequent years of study are much lower, confirming the premise that if students are successful in their first year of study they are more likely to achieve a qualification.

Information gathered by the Faculty Advice Shop show that there are three leading categories of withdrawal for ICT/Computing students, these are employment, personal and course unsuitability. There is little the

Faculty can do to address the first two but it can work with pupils in schools and applicants onto its courses to enable them to make more informed decisions and facilitate the transition process to university.

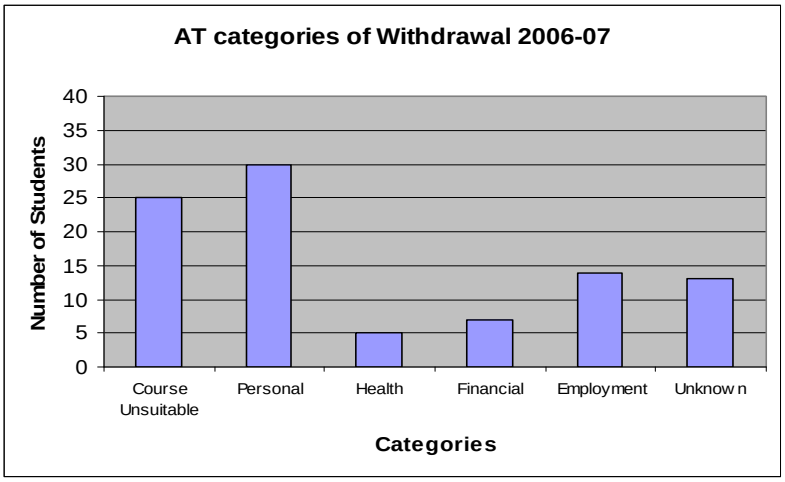

Figure 2

3. METHODOLOGY

This research was carried out using focus groups and questionnaires for school pupils, teachers and first year students. A selection of schools throughout South East Wales was chosen to host focus groups. The pupils involved in these focus groups came from a variety of socio-economic backgrounds. The number of focus groups held in each school varied depending on the number of students available to participate in the groups and what subjects were offered by the school (not all schools teach ICT and Computing).

The purpose of these focus groups was to identify the pupils' expectations of ICT/Computing courses in Higher Education. Separate meetings were held with Computing/ICT teachers within these schools to ascertain their perceptions of the HE courses available at the University and to discuss ways in which they can work with the University to inform their pupils' expectations of HE courses.

University first year student experiences have been obtained using a questionnaire. These were distributed to all first year HND and degree ICT/Computing students in the Department of Computing and Mathematical Sciences.

Focus groups with first generation students are to be held to ascertain if their expectations and first year experiences differ from other students.

Within university and schools workshops have been held, an example of which is pupil engagement with a tool to support the teaching and learning of computer programming. This has been deployed and evaluated with a number of school pupil groups and their subject teachers.

4. FINDINGS

The focus groups revealed that the pupils had varying expectations of what University life and the Computing related courses offered by the University entailed. Many of the pupils had no clear understanding of the difference between Computing and ICT courses. Others stated that they expected 'more of the same as A level and GCSE'. One pupil felt that HE computing courses would be 'all spreadsheets and word-processing'. A number of the female students had no clear understanding of what career opportunities would be available after studying a computing related course, 'office work or secretarial work'. However the male pupils were aware of careers such as web development, programming, network management and systems analysis. These results align with those presented in the CPHC report 'Investigation into the decline in BSc Computing/IT Applications to British Universities - July 2006' [1].

Interviews with teachers in local comprehensive schools also highlighted their confusion between the computing and ICT courses and many of them did not have a clear understanding of the different courses and subject areas offered by the University.

The survey of first year university degree and HND students in Computing/ICT was undertaken to ascertain if their expectations of the courses they studied were met. In preparing for the survey it emerged that due to the number of courses offered at the university it was often the case that the first year students were unsure of the actual award they were enrolled on.

Table 1 shows the profile of the students surveyed with respect to gender and previous Computing/ICT qualification.

Characteristics	% of Students
Studied Computing at A Level	22%
Studied ICT at A Level	71%
Studied neither Computing or ICT	7%
Males surveyed	84%
Females surveyed	16%

Table 1 - First Year Student Profile

Subject Area	% of Students that found subject as expected
Programming	7%
Networking	9%
Professional Development	55%

Table 2 - Subject Expectations

The survey indicated that there were particular subject areas of the course that were very different from what was expected (Table 2) and this varied across the different courses. Students on all courses found the Computer Networking module more difficult than expected. On Computer Games Development and the Information Systems courses students found the Programming module more difficult than expected. The degree students found all other modules as they had expected and in the main were satisfied with all other aspects of their programme. However, 36% of the non degree students agreed that their course had not met their expectations as many aspects were more difficult than expecteFor all but the best students a HE first year programming module can prove to be a very confusing and daunting experience, especially during the first term. HE programming modules are generally regarded as difficult and often have the highest drop out rates [4]. Evidence from the schools' focus groups revealed that engagement with programming in Computing/ICT courses is also an issue with many pupils either having no involvement or if they did have finding it very demanding. This is also an issue for many of the teachers delivering these courses at schools.

In order for a student to be successful in introductory programming they must simultaneously acquire many new skills and concepts. These include the development environment, the syntax and semantics of a programming language, an understanding of programming concepts and also the problem solving skills and strategies that will enable them to solve programming problems in an effective way.

Progranimate, a web-based interactive e-learning environment was deployed with an aim of overcoming the issues faced by novice programmers in schools. It focuses on problem solving using flowcharts and enables visualization of programming structures from which it generates syntactically correct program code. During execution of the code the tool's animation and inspection features coupled to the interaction between the visual and code representations re-enforces the pupil's understanding of both the visual solution and program statement flow. To assist teachers and to provide targeted support for the pupils a set of contextualised problem solving exercises and pedagogy have been developed and deployed with the tool. This tool has been evaluated (Table 3) with school pupils and first year students [6].

Aspect	%
It is suitable for beginners.	74.66
I learnt something using it.	71.74
It was useful in my studies.	72.53
It enhanced my understanding of programming	69.57
The flowcharts aided my comprehension.	70.78
The use of color in the flowcharts was beneficial.	73.18
The relationship between flowchart and code was clear.	69.26
I gained some understanding of the code generated.	65.43
The animation features were helpful.	71.76
The problem solving exercises were fun.	68.62
The problems were at the right level of difficulty for me.	68.73

Table 3 - Evaluation Results

5. CONCLUSIONS

This project is on-going and the analysis of first generation students' expectations is still to be carried out. However, focus group discussions revealed that both pupils and teachers had varying expectations of what the University Computing related courses would offer and it was clear that there were a number of

misunderstandings about the relationship between GCSE, A level and HE Computing courses and what studying at HE level involves. This is not helped by the proliferation of award titles offered by many university computing departments. In the University of Glamorgan prospectus there are 12 such named awards and this often leads to confusion on the part of first year students.

The principal confusion in schools is between ICT and Computing. It is felt that teachers often do not understand the difference and this results in pupils making inappropriate subject choices. Computing includes programming, which can be a stumbling block for many who wish to take a Computing course, whereas ICT does not. 'Sexy' titles often attract students who have little knowledge and understanding of the course contents and what they will be expected to engage with for example the strong programming element of Games Development. Many students are happy to take business-focused computing courses rather than technically-focused courses such as network management and programming, but even these courses have programming and technical elements. It was found that many students found the technical areas of their courses more difficult than they expected especially those students on the HND programmes. This has lead to higher drop-out rates for these students where the Department's first year retention rate for Computing/ICT courses is over 80% for Honours degree students and less than 60% for HND students. However, if pupils do not understand the basic choice between ICT and Computing at school, mistakes will be made and pupils will discount the idea of taking Computing courses later on.

Results of the first year questionnaires reveal that many level 1 students have problems making the transition between school and HE. The Department can work with local schools to improve this transition process by improving links with the subject teachers and pupils, by provision of targeted course specific information in a timely fashion, such activities will then inform pupils' expectations and improve their personal skills to engage in HE teaching and learning activities. More work is to be carried out on the identification and support of first generation students. An online questionnaire is being developed to profile out first year students in the next academic year which will enable us to identify these students.

It is also important that the Department encourages and support engagement with prospective students. Initial evaluation of the programming tool with school pupils and first year students showed a positive response with 70% of respondents finding that the tool enhanced their understanding of the topic. This shows that the tool would be useful to support prospective and first year students in this problematic subject area. Additional activities such as delivery of targeted subject support sessions for teachers, for example Web enabled databases, university based taster sessions for prospective students and a 6th form conference for pupils and teachers focusing on A level material and preparation for the examinations have been organised.

The Department is now in the process of developing focused career event materials linked to courses delivered at the University, this will then be used at open days and in career evenings within schools. Strengthening school/university links by taking the university to schools using subject based presentation of courses and resources available and highlighting career prospects and pathways.

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UNDERGRADUATE INDUCTION: WE DID IT OUR WAY

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ABSTRACT

This paper discusses the new department-led undergraduate induction process (known as Welcome Week) at Worcester Business School (WBS). WBS is made of up of two main areas: Business and Computing. Prior to September 2007 the induction process was organized centrally. Using a decentralized system gave the department the opportunity to implement an innovative and fresh approach to induction. The authors were particularly keen to incorporate some of the recent research findings from the Student Transition and Retention Project (STAR) coordinated by the University of Ulster. Particular areas of interest were the development of improved social interactions between the students and improved communication between departments and students. Early indications suggest the Welcome Week was a success. This paper aims to share the approach taken by one school. It outlines an approach which culminated in the department being seen as an exemplar by the University, and also suggests further areas for research.

Keywords

Undergraduate, induction, social interaction, communication, Welcome Week

1. INTRODUCTION

Prior to September 2007 the transition into higher education for the new cohort of undergraduate students at the University of Worcester had been organized centrally via a Welcome Week induction programme. Registry Services had provided the timetables, delivered sessions on rules, regulations and where to find information. They also provided support and guidance on such areas of concern to students as living away from home, joining clubs and activities, plus financial support. Academic Departments had a minimal role with minimal contact with new students; it merely consisted of a session for them to meet the staff and learn about specific modules along with a short personal tutorial. Feedback from the new students suggested that a sense of belonging was not engendered by this approach. Students wanted to get to know key personnel in their department and wanted to get to know fellow students with whom they would be studying. Many also suggested that mass generic sessions was not the most appropriate format. Academic staff via a Student Induction Forum reported that they would like longer access to their students earlier in Welcome Week and before module sessions commenced the following week. At that time no preparation for study was included and both staff and students felt that much of the week was not particularly productive in helping the process of settling in and preparation for forthcoming modules. The authors were motivated to assess the impact of the new format. They wished to ascertain both student and staff perceptions and to analyse the impact. Although this paper is presented at a computing conference, the authors feel that new students from any discipline could benefit from the experiences.

2. BACKGROUND

Recent research has identified that the areas of concern outlined locally were also experienced by other UK universities. The Student Transition and Retention Project (STAR) coordinated by the University of Ulster culminated in a set of 6 Induction Guidelines [1]. Of note were guidelines 4 and 5 of the section relating to induction and the smooth transition of students into higher education:

2.4 Induction events should provide the foundations for social interaction between students and the development of communities of practice.

2.5 Induction activities should promote the development of good communication between staff and students

These two areas are explored in further detail in the context of our experiences. Irrespective of an individual's previous learning experience, as part of our strategies for the week the authors and colleagues wished to add value for all students regardless of background.

Past experiences reported by students via a post-induction questionnaire suggested that they did not feel that they had received enough information to engender a sense of belonging to the department. Whilst they reported that they felt well-versed in the university policies and procedures, the initial enthusiasm at starting university had waned for some respondents. They put this down to a lack of specific orientation within the department. Academic staff, via focus groups, reported that they would have particularly welcomed an opportunity to spend more time with their personal tutees before modules started. However, when the new system was mooted, staff concerns were centred on time. Time was viewed as valuable in the immediate pre-semester period and concerns were voiced regarding the transition from having a short personal tutorial to having a week of activities centred within the department. Current Level 4 and 5 students were canvassed for their opinions concerning the proposed new format. They were enthusiastic in their support and some offered to help during the event. They also made suggestions about the format they considered would work effectively such as activities to check logins and to find the lecture theatres booked for the first lectures the following week. They also suggested ending the week with a social event.

3. METHODOLOGY

The planning for the new Welcome Week format (2007) initially commenced in October 2006 campus-wide. The new philosophy was devolved by senior management and overall control, hitherto the remit of Student Services, would be in the hands of departments. This was met with dismay by some, who felt that Student Services were the experts and should remain in control. However, the three members of the planning team for the Welcome Week under review welcomed the challenge and felt that the early development of a sustainable programme should be the way forward.

Regular meetings were held between stakeholders including Student Services, Learning and Information Services, Registry Services and academic staff to exchange ideas and best practice. The WBS Welcome Week team took a proactive approach and wholeheartedly embraced the initiative. Following consultation with interested colleagues the format for the department's Welcome Week was decided upon as were methods of evaluation and reflection.

Existing Business Management and Computing students and current WBS staff were to be canvassed for their opinions. During the event itself a questionnaire would be available for all students and time was to be set aside for completion. There were likely to be up to 300 participants so this method was deemed the most appropriate. Over the subsequent months the Course Leaders for Business Management and Computing would meet with the new cohort of students to ascertain how they were settling into higher education. The opportunity would be taken to include the induction process as an agenda item at these meetings so that any opinions and suggestions could be voiced. These meetings had previously been held during the mandatory modules for each subject, thus it was envisaged that a maximum response could be expected. Further meetings with students were already planned for the end of the academic year in order that a period of reflection could be facilitated. Integration was central to the chosen approach and therefore it was not deemed appropriate to separate responses into Business Management v Computing, male v female, etc. This also reflected the integrational aims of the department who view themselves as a coherent whole, adopting a holistic paradigm, rather than fostering an ethos centred on disparate groups. Course committee meetings were considered to be a further appropriate medium for feedback. These are held once per semester and representatives from the academic and support staff as well as the student body are in attendance. Finally, focus groups where staff and students would be invited to reflect on the impact of the induction process would be held towards the end of the academic year under review ie May 2008.

4. PLANNING FOR CHANGE

It became apparent from the initial feedback that there were two important emergent themes particularly from students, these being the importance of social integration and effective communication.

4.1 Social interactions

Feedback from both departmental staff and previous cohorts of students had been gathered prior to the change currently under review. Current students reported that they considered there had been no sense of

belonging within the department when they joined the university. They reported that they knew their way round the campus but not the department. Staff had briefly met their new tutor group members but did not really have an opportunity to get to know the students individually and did not feel there had been much preparation for study.

Building on the STAR project recommendations, the Welcome Week team introduced group activities:

- The first session of Welcome Week gathered all the new undergraduate students whether on a Computer or Business Management route for the departmental welcome event.
- Students were put into blocks of approximately 30, overseen by one member of academic staff and according to their chosen degree route.
- Within these blocks students were further divided into teams of up to 5 to work on activities for the week and beyond. The block tutor provided work packs including a treasure hunt and logo competition brief and students were expected to work on these as a team. This tutor also provided a guided tour of department facilities such as the computer labs, staff offices and notice boards, and also encouraged the team members to get to know each other.

4.2 Communication

The University is on a single campus enabling staff and students to meet regularly. Relations are generally open and friendly. However, the new format for Welcome Week gave the opportunity to reinforce this relationship at an early stage. During Welcome Week:

- Two teams of 5 students had an appointment with one member of staff for a tutorial later in the week to ensure individual questions and concerns were addressed and also to field last minute questions about the logo competition, the deadline for which was later that day. At this stage not all Personal Tutors had been allocated.
- The final day was a social gathering with lunch, an interactive walk-around-the-room quiz, voting on the logo competition and presentation of prizes. The day also gave the students the opportunity to meet the Vice Chancellor, who delivered a welcome speech and presented the prizes.

Business Management students stayed in their blocks of 30 which became a seminar group when modules commenced. However, the Computing cohort was smaller in number (70) and therefore no formal arrangements were made to keep students within these blocks. However, they did they stay in their groups of five.

5. RESOURCES AND FORMAT

During the week a number of resources were utilised for team activities. This section outlines the resources and also gives an overview of the format for the week.

- Timetable for the week
  - Monday – Welcome meeting for the whole department, staff and new students, to communicate events for the week and arrange teams of students. The Computing students were in teams of no more than 5. Teams would work together during the week on the treasure hunt activities and the logo competition.
  - Tuesday – Meeting to communicate the course requirements and modules, to introduce students to the library systems and personnel, Student Union and language centre. Later in the day a session was arranged to meet current students and check login arrangements were working successfully.
  - Wednesday – campus-wide activities including those arranged by Student Services and the Student Union.
  - Thursday – teams meet with a member of the computing academic staff. Two teams (therefore a maximum of ten students) were allocated to each member of staff for a personal tutorial. Personal Tutors had not yet been allocated so this meeting was to provide personal contact. Later in the day there was time to complete the logo competition as the deadline for submission was 4 pm.
  - Friday – this day was set aside for social events, including lunch, quiz, voting on the logo competition and prize giving.
- Logo competition
  - Each team of 5 students was given a briefing sheet asking them to design a logo which portrays the image of WBS in a positive way.
  - Each team had to incorporate the logo into a PowerPoint presentation.
  - The PowerPoint slides must contain a rationale as to why they used particular colours and designs.

- The slides had to contain a set of academic reasons as to what makes a good logo
- The presentation must contain at least two academic references which must have been sourced via electronic journals.
- Prizes were presented by the Vice Chancellor on the Friday of Welcome Week.

- Treasure hunt activities
  - Finding out who their personal tutor would be together with their contact details and then making contact to arrange a personal tutorial in the following week or two.
  - Listing their modules for semester 1, naming the module leader and finding the lecture theatre or classroom to be used for the first session.
  - Finding the library, completing the self-directed tour and finding the location of the computing texts.
  - Locating the vending machine in the library and finding out what is available.
  - Finding the Student Union Reception, asking about becoming a student representative and about the clubs available.
  - Locating Student Services and obtaining a pack of Item Report Forms for assignment submissions.
  - Details of when a lab is available during the week to try their login, find the e-resources, guide to Harvard referencing and email their personal tutor.
- Contact details for Computing staff
  - This was provided so that students could locate their personal tutor and module leaders.

6. FINDINGS

As part of their seven principles of good practice Chickering and Gamson [3] concluded that good undergraduate education encourages student/faculty contact and encourages cooperation among students. Kuh, Pace and Vesper [4] also explored these areas and list suggestions for good practice, many of which we have encouraged, for example: active learning, cooperation among students and students' faculty contact. Feedback from students via questionnaires during the immediate post-induction period and at focus group meetings both reported that students were happy with arrangements. They rightly said that this was their first experience of higher education and were not aware of the previous induction process. They felt that they had had a good experience which prepared them for their forthcoming studies. Our findings suggest that as the first semester progressed it became apparent that many of the friendships formed during Welcome Week were enduring. Mortimer and McLaughlin [2] also found this to be the case. WBS students have reported that they have stayed in the teams forged during Welcome Week 2007. At a focus group meeting in early June 2008 students were still reporting that those early friendships were enduring. Students also reported the effect this had on their modules. Responses include "I did not know anyone when I arrived but was asked to sit with a group of other students. We worked together that week and then when I walked into the first lecture I recognised some people and went to sit with them. We are still friends" and "I was nervous about going into the first lecture, but then I realised I knew some people's name so it was better".

In the previous system there was little involvement by academic staff, rather it was the Course Leader who met the students albeit briefly. Expenditure of academic staff time was seen as an area of resistance and the new suggestions perceived as onerous before the event, but on reflection, colleagues reported that it had been a worthwhile experience and one that should continue to be implemented in future years. Some appeared surprised when they reported "It worked very well, much more engagement from both staff and student " and "Engaging students early on in a light-hearted and community-spirited way worked well. However we should also include more academic work during induction to prepare them for the coming weeks". Overall it appeared that the extra workload was justified and the semester started on a high note. The authors, as the induction team were given time allocation within their wider duties but not specifically for the increased time expected of Welcome Week.

The retention of students, particularly in their first year, has been a topic of much discussion [5] [6]. Whilst the yet to be confirmed non-continuation rate of 10 per cent (70 students) during the academic year 2007-08 is similar to the university rate 2006-07 the full analysis is not yet available. [7]

The team feel confident in reporting that there has been a positive impact on the department, the staff, the students, and institutionally. Experiences gained supported these contentions and the monitoring of the 2007 cohort is continuing, not only from social interaction and communication perspectives, but also in terms of engagement with their studies, contentment and retention.

7. THE FUTURE

The team are now engaged in planning the 2008 events. A decision was made by the team to keep the format of the week similar to that of the previous year. The reason for this was that they wished to consolidate events and build on successes. Minor changes will be made, for example the study skills element will be given a higher profile so that students can have their competition submission marked and thus gain feedback early in the semester. Whilst a small part of Welcome Week 2007 was devoted to study skills, Mortimer and McLaughlin [2] suggest that students could write up a practical activity they have undertaken during Welcome Week for their study skills module and therefore their work would be accessed in the first few weeks. They would then be able to receive early feedback and thus form an action plan for future engagement in their own learning, particularly study skills.

Academic staff members were of the opinion that this would benefit students during modules, particularly as they would be able to highlight areas for further development before embarking on assessed work. When the focus group met in May 2008 it became apparent that many students were still working in the same teams as the one formed during Welcome Week. They reported that this had strengthened their interaction with other students and helped them greatly when settling in. This is something which will be continued during the next event. September 2008 will give the team an opportunity to review feedback received over the year and ask more in-depth questions about students' feelings when joining the university.

Conscious of currently being seen as an exemplar within our university, the team are looking forward to 2008 and the opportunity to disseminate good practice. It is the intention to build upon recent success and consider the issues and advice raised at other Higher Education Institutions (HEI).

8. CONCLUSION

In conclusion, the authors are delighted to report that the changes implemented as a result of the university wide initiative brought about positive responses both from departmental staff and from the new cohort of students. This is seen as a sustainable approach which continues to be celebrated.

Further research is planned to reflect upon and to review actions for the future and build on good practice at other universities. Without further knowledge of what happens at other HEI it is difficult to be sure that all good practice is fully networked.

Our aim for this and future years is to widen the research into the widening participation aspect of the induction. As a University we have ambitious expansion plans which are likely to involve catering to a wider market. If these plans materialise we will have to gear our induction to reflect a wider diversity within the student cohort.

We, as a department, are keen to continually broaden and improve the first year experience. We passionately believe the first year experience impacts on the rest of the students' academic studies and possibly their future careers. To this end we aim to use the experience of last year's induction process to help in our delivery of the induction for the coming year.

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EMBEDDING INSTITUTIONAL CURRICULAR PRIORITIES IN THE FIRST YEAR – A CASE STUDY FROM RGU

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ABSTRACT

In 2006, the School of Computing at the Robert Gordon University redesigned its First Year with the twin key aims of engaging students in academic life and empowering them to make progress on the difficult process of becoming autonomous learners. The changes sought to place recent curricular developments and pedagogical best practice at the heart of the student experience, and to engage, at a deep level, with the findings of the Scottish Enhancement Themes, especially those coming from the First Year Experience, and Assessment studies.

We describe the main feature of the RGU First Year development project – an integrated structure which emphasises an active-learning pedagogy coupled with a range of assessment practices aimed at promoting student reflection on their learning experiences. We also make some observations on the relationship between the results of the Enhancement Themes and evaluation methodologies.

Keywords

Curriculum development, enhancement themes, first year, case study

1. INTRODUCTION

There is widespread evidence that the first year of study is a critical time for university students. Extensive research, undertaken both throughout the UK and abroad (e.g. see [1] and references therein), makes it very clear that issues surrounding the transition to higher education, the accommodation of diversity of intake, the clarity of curricular objectives and the importance of support for learning, all have a major impact on student engagement and empowerment, and hence on retention, student achievement and graduate success. While it is clearly too simplistic to claim that "if we get the first year right, the rest of the undergraduate programme will fall into place", it is certainly true that the first year should provide a solid foundation for a student to develop as an autonomous and independently-motivated learner, and that the absence of such development would seriously disadvantage the student in subsequent stages of the course.

Recognition of the importance of this part of the undergraduate programme by the higher education sector has been swift, and has been followed by an extensive re-evaluation of first year provision by many university departments in order to meet the needs of undergraduate entrants. In Scotland, institutional efforts at improving teaching and learning have benefited greatly from the work of the Enhancement Themes initiative [2] which aims at enhancing the student learning experience by identifying, and directing resources to, specific themes for development. Among the important areas addressed in recent years are assessment practices, employability and flexible delivery while the subject of the most recent reporting theme was *The First Year Experience*. These themes were further subdivided into specific subprojects of concern and the collaborative sectoral effort has generated a significant body of work directly applicable to the academic programme development taking place in the Computing and Information Systems community. In 2006, the School of Computing decided to redesign its First Year undergraduate programme taking account of recent curricular developments and pedagogical best practice, in particular, attempting to articulate with the results of the themes of the First Year Experience, Assessment and Employability with which RGU has an institutionally strong association. This report details some of the efforts that were and are being made, and outlines some preliminary evaluation of the results.

2. AN IDEAL CURRICULUM?

In their report on the "Curriculum Design for the First Year" enhancement theme subtopic, Bovill et al [3] identified a number of key features of an "ideal" first year abstracted from previously published literature and case studies, as well as from the perspective of those staff and students interviewed directly by the project.

Investigation of the published research suggested that important aspects of good curriculum design include student-centred active learning using problem-based, project-based and group-learning approaches, the structured development of learning skills facilitated by learning communities, orientation and induction processes which increased social and academic engagement and led to a sense of belonging and connectedness to university, and formative assessment and feedback which yielded progressive skills development. These features also occurred in the analysis of staff concerns, but were augmented by other operational factors such as the need for a co-ordinated, programme level approach which makes use of the most experienced staff to teach first year students, clear communication and personal contact between staff and students about all elements of the curriculum, the design of which may indeed involve input from students. Student input on an enhanced curriculum centred on genuine participation in the design process and operational outcomes, more attention to assessment and timely feedback, as well as a need for more challenging work. These concerns are reflected in the ubiquitous twin motifs of the First Year theme – student engagement and student empowerment – which were taken as central elements in a number of the subtopics.

While clearly not giving a direct recipe for success, the points described do give a series of perspectives on the curricular features that should emerge in the process of pedagogical enhancement, and so can underpin an agreed evaluation mechanism. This is important as many of the conventional quantitative measures of success used in learning enhancement initiatives, such as achievement results, retention rates, and the like, are often not the only criteria (or even those criteria considered most significant) that proponents of the changes would choose as appropriate metrics. Such terse numerical measures, which have a complex relationship with increased learning, can be deceptive as the comparisons they induce are often based on an assumption of curricular continuity before and after change that is simply not warranted. Furthermore, control processes which implement change in one part of the cohort while reserving it in another are often impossible or ethically dubious. It is doubtful that implementation of a hypothetical enhancement activity would take place unless there was real expectation of benefit and consequently it is questionable whether there is good reason to withhold it for some students who would otherwise gain advantage. A robust evaluation methodology would be based on comparison of the student learning experience before and after change. It would lead to an assessment according to satisfaction of appropriate criteria abstracted from the previously mentioned features and it is conjectured to lead to qualitative measures of success which are more applicable given the changing nature of the curriculum and the student experience.

Curricular planning should also take into account the subject benchmarks produced by the QAA for HE [4], as well as other international research into the core computing curriculum which describe a number of pervasive themes that are characteristic of good programmes of study. On a subject level, these are identified as a concern "with analysis and design, problem-solving, the nature of information and its processing, and the wide range of levels of abstraction from which computation can be viewed".

3. THE OLD RGU FIRST YEAR STRUCTURE

The pedagogical features of the redesigned First Year are best understood with reference to the structure of the previous first year (figure 1). That particular configuration was highly modular with four modules taught in each semester, contributing 15 credits apiece to an annual total of 120 credits.

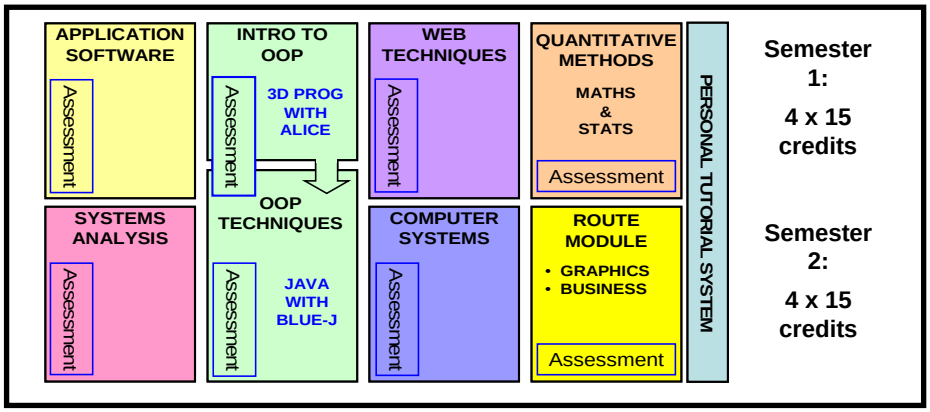

Figure 1: The Previous First Year Structure

Each module was taught over a twelve-week teaching block with the majority being assessed wholly by coursework within the teaching period. There was little integration either horizontally across the modules within a semester, or vertically from the first semester to the second. One minor exception to this was the pair of first year programming modules where some change to the duration of the teaching period in semester one had been made. However, in this case, changes to the overall structure had been implemented in order to gauge possible difficulties with the introduction of the prospective (better designed) new first year in the subsequent years. In any event, there was no change to the 15 credit assessment structure for these modules. The personal tutorial system, which had evolved over a number of years, lay out with the curricular structure rather than being embedded in it and there was considerable separation of the delivery of pastoral provision from the delivery of teaching and the majority of first year personal tutors did not actually teach the first year students.

There were a number of areas in which this structure was considered problematic:

- The historic emphasis on modularity in course design had given rise to a particular form of the curriculum which relied on disconnected teaching units. One result of this fragmentation was that students were often left with the impression that Computing as a discipline was extremely disjoint with little interaction between the different areas of study. Despite significant attempts to highlight the connections between the various parts of the first year syllabus, this had proved largely ineffective because of the lack of a pedagogical structure which stressed the unified nature of the discipline.
- The 15 credit one-semester module was invariably assessed within the teaching period of that module, whether by coursework or by examination at the January or May assessment periods. As well as contributing to the amount of (over-) assessment which the student faced, there was strong evidence that weaker students were often so disenchanted with their performance at the end of the first semester that they disengaged completely from their course, and often did not even attempt to revise seriously for the summer resit opportunity which was their best and often their sole, realistic chance for progression. This was a major worry in the face of low recruitment numbers and university management concerns about retention figures.
- Day-to-day (ambient) contact between personal tutors and tutees had often been cited as a positive factor in studies of the student first year experience. This was very difficult to achieve unless the staff who managed the personal tutorial system for the Foundation Year also taught the first year syllabus. In reality, formal contact between personal tutors and students, although maintained at a weekly level for the first semester, tended to tail off considerably in the second semester at precisely the times when students needed to be reminded of the importance of continued and steady academic study. This too had an impact on levels of student engagement and subsequent retention figures.
- There was no provision for the development of “soft-”, “professional”, “collaborative” or “transferable” skills such as study skills, group or team working, and personal development planning. It was felt that these were desirable skills for students to acquire at an early stage but the curricular structure made it difficult to incorporate them in any specific module.

It was generally felt that the current academic year was not conducive to student learning. In particular, the first semester, which comprised a straight 12 week teaching session without any breaks, was felt to be far too long for new undergraduates to cope with, given that most came directly to university from schools which had a teaching break at the half-term. The relentless teaching schedule was considered to be an important factor in early (first semester) student disengagement. Moreover, the concentrated semester-long teaching sessions made activities such as structured formative feedback and assessment difficult due to time constraints.

4. THE RGU PLAN – INTEGRATION AS CURRICULAR MOTIF

As indicated above, a starting point for curriculum design was the desire to provide students with a suitable transition experience from school to university. Prospective applicants to HE Computing degrees frequently make course decisions based on a superficial appreciation of the discipline, often informed by their experiences at school. However, interviews with students entering the department often demonstrated a fragmentary and disconnected model of Computing as a discipline. As a consequence, it was decided to place strong emphasis on the idea that, as a subject studied at university level, Computing should be seen as a unified and self-supporting whole and that the introductory teaching in the First Year should, wherever possible, reflect and convey this notion to the student. Consequently, importance should be placed on the concept of an ***Integrated Curriculum***.

This emphasis on integration should manifest itself at the structural, pedagogical and pastoral levels:

- Integration of delivery of teaching across more fluid thematic boundaries to highlight fundamental aspects of interconnectivity and interdisciplinarity within areas of the syllabus;

- Integration of modes of assessment to attempt to balance the types (individual and group), purposes (e.g. formative and summative) and focuses (convergent and divergent) of such activity (i.e. *integrative assessment*);
- Creation of assessment opportunities which simultaneously allow measurement of competence and achievement across a number of different themes (i.e. *partnered assessment*);
- Development of instruments of assessment that encourage students to combine elements of their learning from different parts of the programme and to show their accumulated knowledge and understanding of a topic or subject area (i.e. *synoptic assessment*);
- Integration of Student-Support, embedding academic and pastoral support for students, especially *at-risk* students, within mainstream contact time.

4.1 The Structure of the Curriculum

The new first year attempted to overcome the difficulties outlined above by directly addressing the most important structural aspect, namely the excessive modularity of the syllabus. Instead of 15 credit one-semester modules, the curriculum was built around a series of interlocking (hence the jigsaw imagery), 30 credit "themes" which were delivered over two semesters (figure 2). This gave substantially greater freedom for teaching staff to develop and manage a more balanced and engaging educational style which incorporated appropriate breaks in the teaching session (where pedagogically warranted). For example, it allowed the reservation of the first week of the semester for team-building exercises and a mid-semester break in delivery teaching to allow for group-based coursework exercises.

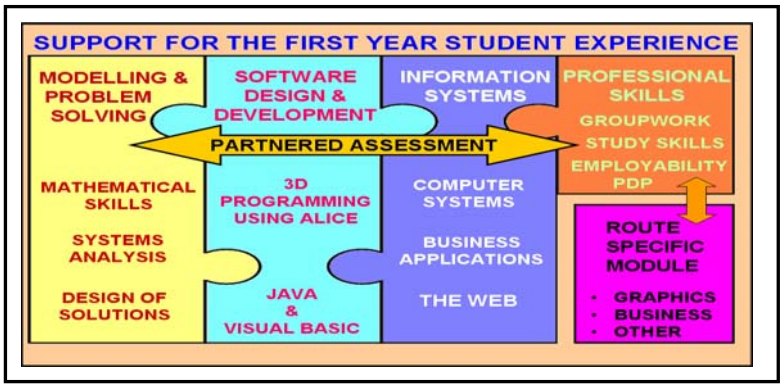

Figure 2: The New First Year Structure

The academic syllabus consists of three major themes, Software Design and Development, Problem-Solving and Modelling, and Information Systems, together with a smaller unit which addresses so-called soft-skills, group-working, PDP, entrepreneurial skills, etc, and a final unit which allows for some specialisation in the student's chosen Computing degree route.

One of the central themes is that of Software Design and Development which begins with a nine week introduction to object oriented programming using Alice before moving on to the acquisition of coding skills in either Java or Visual Basic depending on the specific route that the student is taking. The majority of students (Computer Science, Graphics and Animation, Internet and Multimedia) take Java which is taught using BlueJ while the Business Information route takes VB. This theme is closely integrated with the Problem-Solving and Modelling theme which includes content on the mathematical and statistical skills necessary for further study, as well as the analysis, modelling and design of information systems and their description in UML. There is clear synergy between these two themes and a close level of integration in teaching has been developed here.

The remaining major theme is that of Information Systems and includes content on the use of the Web as an information system, an introduction to various business applications as well as elements of the current computer systems module. There is also scope for making a strong linkage between material from the computer systems section (e.g. data formats) and its application in the later programming topics (e.g. manipulation of image and sound files) from the Software Design theme although this has not yet been done. In addition, it is anticipated that there will be a strong integration between content from the Web and Business Applications sections and the various aspects of the Professional Skills unit.

The planned reformulation of content with its emphasis on the three broad themes of modelling (including problem-solving, analysis and design), information systems and software design and development clearly reflects the prominence of these benchmark skills stressed by the QAA. In terms of pedagogical development,

the predominant concern was to embed and promote the learner-centred approach to course design and delivery which is the primary component of the RGU Teaching and Learning Strategy.

4.2 Assessment Aspects

It was anticipated that there would be a specified First Year team which would be responsible for the delivery and assessment of the majority of the teaching in the first year (with the possible exception of the route-specific module). This team would theoretically also be responsible for managing the personal tutorial system for the First Year, promoting the day-to-day contact between tutors and tutees. In practice, the logistics of this arrangement proved extremely difficult to sustain beyond the first semester, although the degree of continuity of staff-student contact in semester 2 was still higher than in previous years. Coupled with very strict monitoring of student absences and proactive attempts to intervene when faced with possible disengagement, departmental procedures to manage this and re-engage students has become more effective.

Assessment in the majority of themes was accomplished by coursework. The major vehicle for this was a series of group projects which proved extremely popular with students. Not only did they allow the introduction of structured peer and self-assessment for the collaborative work, they also greatly enhanced the degree of peer socialisation in the cohort and seemed to promote the "connectedness" described in [3]. The two-semester modules allowed the first semester to be used mainly for "quasi-formative" assessment (which was passed solely through participation in the process) while summative assessment was reserved for semester 2. There is obviously some concern that long modules, if badly managed, simply allow students to fail 30 credits at a time rather than 15 credits, but evidence from 2007-8 suggests that this fear may be allayed by rigorous module administration. As planned, individual occasions of assessment were used to demonstrate and record competence and achievement in a variety of outcomes across the different themes. Subsequent assessment occasions also allowed students to exhibit competence in prior learning outcomes which they may not have acquired at their first attempt.

5. RESULTS

There is a clear need for careful appraisal of many of the changes outlined in this case-study but identifying (and implementing) a pedagogically-valid but rigorous evaluation methodology based on suitable educational parameters has been problematic. The "headline figures" such as achievement and retention rates are easy enough to state. In terms of First Year students who were not failed for non-submission, the 2007-8 pass rates for the three 30 credit modules, based on a similar size cohort (~75), were, on average, 5% higher than the corresponding 2006-7 figure for equivalent pairs of 15 credit modules. The headline figure for non-submissions for the 30 credit modules were somewhat higher than those for pairs of 15 credit modules, but the narrative changed from that of slow disengagement throughout the 2006-7 session, to one where students did not submit because they failed to engage from the outset. The majority of these were non-progressing students referred from the previous first year cohort who simply did not attend after the second or third week (and who, for administrative reasons, could not be withdrawn). In fact, there were few students who progressively disengaged throughout the year and none who did so solely in the second semester. This is in contrast to previous years where failure in the first semester modules was a major trigger for disengagement in the second semester.

While these statistics have some value and support the contention that, at the operational level, these initiatives have had some success, they do not themselves address the key issue of whether learning has improved, or the student experience has been enhanced. Qualitative analysis based on staff and student interviews do suggest that both student participation and engagement has been improved but further investigative work in this area needs to be done to confirm the effectiveness of this approach.

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DEVELOPING ONLINE ACTIVITIES FOR POSTGRADUATE STUDENTS IN COMPUTING

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ABSTRACT

This paper describes the preliminary stages of a project whose purpose is to investigate the use of a virtual learning environment (VLE) to provide opportunities for distance learners to support each other through online study groups. The specific area under investigation was the development of academic literacy skills by postgraduate computing students. A pilot study was carried out with a group of Open University (OU) students taking a course in software requirements engineering. These students are expected to read and critically evaluate recent work in this field. In this pilot study online activities were provided for a group of volunteers who had access to a VLE that incorporated tools such as wikis and discussion forums. Such an environment presents rich opportunities for various kinds of feedback. An initial exploration provides evidence that students employ a variety of strategies to tackle activities online, including an element of vicarious learning.

Keywords

Collaborative learning, academic literacies, virtual learning environments, peer feedback, requirements engineering, assessment

1. INTRODUCTION

The project described in this paper is designed to look at ways of supporting students through online study groups in a virtual learning environment (VLE). Its specific objective is to help students on a postgraduate course in computing to develop appropriate academic literacies. There is increasing concern about overall standards of academic literacy amongst students, including those studying computing [7]. At the same time, online technologies provide a range of opportunities for helping students to develop different types of writing and learning [9]. In particular they support feedback from fellow students as well as from tutors.

1.1 Background

The Centre for Open Learning of Mathematics, Science, Computing and Technology (COLMSCT) at the Open University (OU) currently supports a variety of projects including areas such as online communities and assessment. This study focuses on groups of OU students taking a postgraduate course, Software Requirements for Business Systems, which is presented twice a year, from November to April and from May to October. The course is taught through a mix of printed and online materials. Although students are allocated to tutorial groups for support and the marking of assignments, there are no face-to-face tutorials. There is limited contact with other students through an online conference. In addition the course makes use of some features of the Open University's new VLE, including a wiki and a reflective journal [13].

From an educational viewpoint, there is a need for tutorial work to develop the academic literacies appropriate to postgraduate study. The learning outcomes state that, on completion of the course, students should: "understand the state-of-the-art in requirements engineering, leading to a deep and systematic understanding of the subject area." They are expected to achieve this "through the use of books, reference papers (e.g. conference and journal publications) and other audio/visual media" [12]. These outcomes are assessed both in three tutor-marked assignments and in the examination. In each case students are expected to write a critical evaluation of one or more papers in the field of requirements engineering. General guidance on how to do this is provided in the assignment booklets. However, there are at present no tutorial sessions to assist students in developing the appropriate skills.

The students on this program are part time, physically separated from the University and from each other. Most of them are in full time employment in the general area of software development. Although this provides good practical experience, it can be difficult for them to acquire the appropriate techniques of academic discourse. Unlike full time students they are not immersed in an academic environment. How therefore do they learn what is expected of them? Many academic tasks make little sense to students [5]. They need to engage actively with these tasks in order to test their understanding of what is required and develop their ability to apply the appropriate criteria [1].This understanding may be achieved through taking part in dialogues [7], and even through the observation of the dialogues of others [10]. One objective of the project therefore was to look for ways to make the learning outcomes more explicit, by creating dialogues around a set of relevant tasks.

1.2 Online Tools

The Open University has recently adopted a VLE based on Moodle, an open source course management system that supports a variety of online tools, each of which provides a different way of communicating online [2]. These include Chat, which provides synchronous communication, similar to MSN, amongst students and between students and tutor; Forum, which provides asynchronous discussion, amongst students and between students and tutor; Wiki, which provides a collaborative website that all students and tutors can edit, retaining a history of all the changes; Blog, which provides a website generated by a student or tutor to which other students and/or the tutor can add comments; and Journal, which provides a space for individual students to write down thoughts and reflections about a topic that are visible only to the student and the tutor.

1.3 Project Structure

The project was designed in three phases. In the first phase, which followed the presentation of the course that ended in April 2007, students from one tutorial group completed a questionnaire about the five different tools described above. They were also asked to identify up to three requirements (functional or non-functional) that might be important for the success of online activities.

The results of this survey were used to plan the second phase of the project, a pilot study with a group of volunteers drawn from the body of students for the presentation that started in May 2007. These volunteers undertook to take part in one or more online activities during the presentation and to provide feedback on these activities at the end of the course. They were offered the opportunity to carry out some short exercises designed to help with developing appropriate skills in writing at Masters level; to gain experience with some of the tools available in the VLE; and to help to identify how best these tools could be used to support future students of this course (and other OU courses). A separate VLE space was provided for these students. Access to this space was limited to the researcher and the volunteers, who were told that all data collected from contributions to the activities and from feedback would be held anonymously and used for research purposes only.

The final phase of the project will be a full study, open to all students on the May 2008 to October 2008 presentation. This paper reports on the initial findings from the first two phases.

2. LEARNING ONLINE

2.1 Academic Literacies

The concept of literacy deals with how skilled we are in the use of language. The term itself is comparatively recent, introduced in 1883 in opposition to illiteracy – ignorance or lack of education, especially in reading and writing. However, this basic concept has expanded to handle a much wider remit, including views of literacy as social practice and literacies that involve non-verbal as well as verbal communications.

Academic literacy practices in higher education have been a central topic of research at the Open University and elsewhere amongst those interested in academic written genres. Distinctions may be drawn between different types of academic content, between the different contexts in which writing takes place, and the different practices associated with these contexts [9]. One context that is especially relevant here is the use of electronic bulletin boards, which provide a way in which dialogue may be reintroduced or expanded for students who might otherwise miss out on this aspect of higher education [10]. There are a number of ways in which tutors and course designers may assist students who are using online conferences. These range from understanding the academic content that is being explored, through understanding the nature of the contributions that students make to conferences, being clear about the kind of environment that the conference represents (e.g. seminar, lecture or tutorial), recognising the contrasts and differences between writing in the conference and writing for assessment, to recognising the institutional relationships of power

and authority that exist between student and tutor [9].

The development of academic literacy is particularly important for distance learning students because assessment is firmly based on their written assignments, which often take the conventional essay form. In many cases this will be their only means of communication with their tutors.

2.2 Feedback and Assessment

In order for students to identify whether they have met the appropriate standards for the task in hand, they need to receive feedback from peers and practitioners. Indeed, the more complex the learning, the less likely it is that it can be accomplished in isolation from others [1].

Nichol and Macfarlane-Dick [11] propose a framework of seven principles for good feedback practice that supports self-regulation. These include helping to clarify what good performance is, for example, by providing suitable examples and increasing discussion and reflection about criteria. This is often difficult to achieve with distance learners. However, online forums provide a supportive environment for such discussions.

Gibbs and Simpson [5] identify several conditions under which assessment can support student learning. Tackling the assessed task engages students in productive learning activity of an appropriate kind. The only way to gain facility with the discourse of a discipline is to undertake plenty of practice in using it, for example, though writing. It is important to develop the learning activities of reading around the topic and constructing arguments. Timing is also important: imperfect feedback from a fellow student that is provided almost immediately may have more impact than better feedback from a tutor several weeks later. Such peer dialogue enhances in students a sense of self-control over learning. It also provides information to teachers that can be used to help shape teaching. For example, a group of students can be asked to identify a question that they think is worth asking about a paper [11].

2.3 Barriers to Participation

Concern has been expressed that some groups of students may not benefit from participation in online discussions. Individual students may feel at a disadvantage because of their age or gender, or because they are not native speakers of the language used. In the latter case, Goodfellow and Lea [6] report that non-English-native speakers believed that they were at a disadvantage even in an asynchronous conference because of the time that it took them to read postings, compose a response and check it for mistakes. However, over time they gained in confidence, not least through noticing that native-speaking students often made mistakes in their writing.

A number of studies have reported that women tend to make fewer postings to online conferences than men, although they may read more items than men do. There is also some evidence that there are gender differences in the style of posting, with women being less confrontational than men [3]. Jeong examined interaction patterns between men and women and the effects of the patterns on gender participation in online debates. His findings suggest that differences in male and female communication styles do not necessarily lead to gender differences in participation in online collaboration [8].

Lack of active participation by some students should not necessarily be seen as negative. Amongst the unintended effects of remote interactions are the possible benefits of vicarious learning. In other words, lurking can be valuable for some students. They can see their peers and tutors modelling the process of interpretation and can compare their own understanding with that of others [9.] Other studies confirm that students find it useful to read other people's comments in a discussion forum, even if they themselves do not contribute [7].

3. INITIAL FINDINGS

3.1 Student Preferences: Tools and Requirements

Responses to the initial questionnaire were received from nine students (out of 13). The first set of questions dealt with five tools supported by Moodle: Chat, Forum, Wiki, Blog and Journal. Students were asked to say how useful each tool might be in helping them to carry out a set of ten tasks. These tasks, which might form part of an assessment, included describing the main features of a requirements elicitation technique, based on a given paper or evaluating the relevance of a requirements elicitation technique to a given case study. Each tool was rated on a scale of 1 (very useful) to 5 (not at all useful) for each task. Responses showed clear preferences for the use of certain tools to carry out specific tasks. In general, Chat – the only synchronous option – was less popular than the other tools. This is consistent with Devlin's finding that most students preferred asynchronous communication because it allowed them more time to think about what they were going to say [4]. Wikis were the most favoured choice, although this may be because this group of students had used a wiki to collaborate on the writing of functional requirements earlier in the course.

Students were also asked to identify up to three requirements (functional or non-functional) that might be important for the success of such online activities. Responses to this question were received from eight students and analysed using NVivo. They demonstrate a set of concerns for the student as an individual, for example, support for developing creativity, and as part of group, such as the ability to identify the contributions of others in that group. The latter can be difficult to achieve using a wiki. Another set of issues relate to the online system, in particular its availability and the importance of usability. Finally there is a set of requirements related to the task: these include the need for a clear description of the task, a clear structure and clear criteria for completion. This last group is consistent with the findings in [4] – it is better if students understand how to go about the task they are engaged in, especially if this understanding is shared.

3.2 Variations in Student Activity

For the pilot study, the volunteers were provided with a set of short formative activities centred on developing the academic analysis and writing skills required for postgraduate study. Two of the activities used wikis and the other three discussion forums. The selected activities were designed to encourage the development of appropriate strategies for approaching tasks such as evaluating a paper and writing a critical summary. The latter activity, for example, was based on a series of structured points, each of which was posed as a question in the Forum:

1. What is the main question that the authors address in this paper? Is this question important? If so, why?
2. What is the significance of the findings in this paper for requirements engineering?
3. Do the findings help explain the phenomenon under study and make predictions about it?
4. Are the findings only true for the particular example(s) studied? Or is there reason to believe they will apply in other cases?
5. Does this paper provide a significant contribution to the subject area?

This structure is described in the assignment handbook given to the students, so it should have been familiar to them. Despite this, their comments indicate that some of them did not follow the expected approach:

> Student M (male): “Well I've had a go, and yes, it would probably have been better to do questions 1 and 2 first! There is a logical structure here! You need to identify the main question and the findings before you can comment on the implications.”
>
> Student K (female): “Wish I’d answered them in order and read them through first to make sure they flowed into a complete critique”

In addition to recording the contributions made by students, Moodle maintains user activity logs that can be sorted by user, date/time and activity. These provided a way of monitoring the activities of the volunteers over the entire period under study. The log entries could be divided into active contributions by students, which included adding, deleting and updating discussions and posts, or editing the wiki, as opposed to the passive viewing of discussions and resources. The different patterns of behaviour observed are summarised in Figure 1. In five cases the proportion of active contributions is around 5%. However, student A’s active contribution is 16%. In comparison, student C’s active contribution is only 4%, although his total number of logged activities is greater than A’s.

	A	C	H	K	M	R
Active	27	7	1	8	21	1
Passive	145	186	18	119	385	15
Total	172	193	19	127	406	16

Figure 1 Number of student activities logged between 12 June and 9 October 2007)

This disparity in behaviour may reflect their reasons for volunteering. For A the principal attraction of taking part was to “develop and practice skills in writing at Masters level”, whilst C was “looking forward to some study tips and skills; which I have learnt is very important when submitting [assignments]”. The log supports this latter observation, showing C accessing the site to reread the forum discussions shortly before the third assignment was due.

3.3 Patterns of Participation

Further analysis shows that individual students approach a task in very different ways. The activity described

in section 3.2 involved a series of questions posed by the tutor, based on the guidance given to students for carrying out critical evaluation. Students were invited to post responses to these questions but were not able to read what other students had written until they had made at least one contribution themselves. A separate forum was provided for comments and queries about the activity itself.

Five students responded to this activity in some way, four of them taking an active part. Student A (male) accessed the VLE intensively over a short time period that includes 10 active contributions, but did not revisit the discussion later. In contrast both M and C (both male) contributed over a longer time. M made five active contributions and revisited the discussion on several occasions to read and comment. M's motivation for taking part in the study is both broader and vaguer than the others "(I find it hard to say no to things... "). Student K (female) made six contributions on the same day, with short periods of activity before and afterwards. H (female) made only one cursory visit to the site in this period.

It should be noted here that these contributions were undertaken by the students in addition to their normal work on the course, their paid employment and social activities. Time was undoubtedly a constraint on the level of participation in some cases.

4. CONCLUSIONS AND FUTURE PLANS

Feedback from the volunteers indicated that they had found the activities helpful in preparing for the assignments and examination. Ease of use, together with the ability to see who wrote what and when, was again identified as the most important requirement for the success of online activities. Their preference was for three or four activities over the lifetime of the course, using discussion forums.

The current results, based on a very small number of self-selected students, cannot be considered typical. The final phase of the project will provide information derived from a study of a larger group of students (approximately 50). The course team has agreed to the introduction of a set of three activities, timed to support preparation for assignments. These activities will be made available to all students on the presentation starting in May 2008 but will remain optional. They will be planned to allow students to contribute in a variety of ways over a period of time. In particular students will be encouraged to return to and comment on each other's work.

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GROUP WORK IN HIGHER EDUCATION COMPUTING COURSES

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ABSTRACT

This paper considers some of the aspects and issues involved in including group work within Higher Education Computing courses. These include the context as to why group work is important, the approaches that can be used including different types of learning and some of the problem issues that can arise. The paper reports on some research in to prior experience of and perceptions of group work by students, and also gives details of the use of some recent technologies which can support group work and deal with some of the aforementioned problems.

Keywords

Group work, teamwork, Collaborative Learning, Emerging Technologies, peer assessment.

1. INTRODUCTION

The Dearing report [5] established key skills as a recognised concept and their relevance to Higher Education (H.E.) but did not define exactly what constituted these. However, group and teamwork are generally recognised as a core skill and within the context of Further Education is included under the key skills as "Working with Others". The Quality Assurance Agency (QAA) benchmark for computing states "demonstrate transferable skills and an ability to work under guidance and as a team member" [10] as one element of the threshold level for the benchmark. Similarly, professional and industry bodies expect these skills to be developed – for example the British Computer Society (BCS) accreditation requirements include transferable skills, including "working with others" in their criteria [1] and there is also a strong focus on these skills in the e-skills Information Technology Management for Business (ITMB) based degrees [2] and are teamwork skills generally seen as key parts of the make-up of an I.T. professional.

A further outcome of the Dearing report was the need for Personal Development Planning (PDP) to be available within H.E. courses and team and group working fits naturally into the personal development records that form part of the PDP progress file. Furthermore, a number of employer surveys over recent years and informal discussions have established that employers rate these skills highly as they are the kinds of skills which mean that graduates can apply the technical skills they have developed in their studies.

Having established some of the drivers for group work to be included in H.E. courses generally, and in Computer Science courses specifically, there are a number of practical issues which then arise. These include organisational issues, assessment and learning outcome issues and in particular the issue of justifying the inclusion of these skills to students.

This work is based on current practice of the author and has led to changes in the way that group work is managed and delivered. The summary of approaches to group work should provide ideas for different methods that can be used, and the information on technology to support group work may be useful to colleagues who are looking for new ways to develop group work and potentially make it more practicable. The distinction between group work and team work can be identified as the transition from non-organised to organised (team) behaviour – but in the following the terms group work and team work will be used interchangeably, although in practice the design of an assessment can encourage a team focus.

2. PRACTICAL ISSUES IN GROUP WORK

Group work and team work can be considered as types of cooperative or collaborative leaning. Whilst collaborative learning tends to focus more on the intellectual learning process, the type of group work and team work identified in the computer benchmark appears to fall in to the category of cooperative learning [2], where learners are required to work in planned groups working on structured tasks. This cooperative learning model provides a good match to the kind of practical application that would be expected of computer science

graduates as they worked in industry, with large programming and I.T. system development requiring large teams in order to design and implement full systems.

2.1 Developing suitable tasks

When setting assignments for groups to work on, it can be beneficial both to the students, and to avoid problems, to ensure that the assignment tasks are designed to ensure that there are natural ways in which to subdivide the work. The dependencies in the tasks should ensure that the task is a true collective activity, and not merely a set of separate assignments which can be submitted individually. This also requires identifying and specifying suitable learning outcomes e.g. evidence of group working, coordination of activity, common format for group submissions etc. and providing a suitable introduction to the activity and support once it is in progress.

For example, in the context of a Professional Skills and Information Technology module for first year students (level 4), one practical example is a team project involving a number of coordinated deliverables based on a set of source data. By generating realistic data unique to each group, the same scenario can be used, and each team has to develop a range of I.T. solutions (e.g. database, spreadsheet, website) that are linked, and document this in word processed reports and with a digital presentation. This type of problem allows the team to subdivide work, but requires coordination, management skills and team work in order to complete it. By using a suitable collaborative environment (which is considered below) students can apply I.T. solutions in multiple layers.

2.2 Setting Groups

There are a number of approaches to setting groups which can be adopted. Here a few different ones are summarised along with some of the pros and cons to each:

- Self-selection: students are given the specifications (e.g. group size, any special requirements) and self organise, possibly with any stragglers being assigned to groups by the teacher. This can work well with established classes and with small cohorts, but is less viable with larger cohorts or where the class is newly formed. These groups can be more susceptible to relationship problems e.g. where a group of friends form a group, along with one or two extras who are required
- Groups organised by the teacher. These fall into other subcategories which include
    - Random assignment (perhaps by surname or student registration number);
    - Assigned according to degree type, with a mix of students from particular degrees to ensure a mix of knowledge and skills within the group;
    - Grouped according to ability as measured by previous assessment within the module or prior to it. The grouping here may be designed to either mix abilities or to group students of similar ability.

Special educational needs for some students can mean that group work needs to be suitably adapted and groups including students with special needs can need extra support from the teacher.

2.3 Assessment

One of the major concerns with students regarding group work (see section 3) is that some students will not “pull their weight”. To attempt to ensure that a group assignment is successful, it is important to set clear learning outcomes which identify that group coordination and work is part of the marking scheme and to indicate to students the weighting attributed to this. There are numerous approaches to how a group mark is assigned to students – one ideal approach is simply to assign the group mark to all the group members. This can be perceived as fair, but does not allow for any differentiation in input by the individual group members – something that does concern many students (again see section 3).

Where a group activity has natural subdivisions, each part can be marked, and attributed the student who developed that particular subtask, potentially with a group mark attached to all of the students.

An alternative approach is to allocate a group mark, and then weight that according to some weighting factor. This weighting factor could be determined by the teacher, perhaps based on objective measures such as the time spent by a student on their tasks or by the student group or even by the students individually (see section 4.1 for details).

2.3.1 Reassessment

Reassessment of group activities can be a problem, particularly in cases where reassessment is due in a resit period and where the opportunity for group work is limited. One approach to this is to ensure that the

reassessment requires students to demonstrate that they have considered the practical aspects of group work – such as explaining how they would subdivide a problem and manage the dependencies of it, potentially using technology to address communication and other issues (see below).

2.4 Organising and supervising group meetings

For successful group work, it is often useful to be able to ensure that students have no excuse in terms of not all being available together, or having anywhere to meet. This can require booking rooms and ensuring the students are timetabled for the group activity, even if in practice they do not need to attend a formal class.

With well defined tasks – as described earlier - groups can be left to work quite independently, but a mechanism to supervise progress and to intercede where there are problems needs to be included – ideally with all group members brought together to address the problems.

3. STUDENTS PRIOR EXPERIENCE OF GROUP WORK (FROM SURVEY[1])

The following data from first year students on a computer science degree indicates prior experience and perceptions of group work amongst new students. Figure 1 provides the summary data for this particular sample.

Question	Percentage who said yes
As part of your pre-University education, have you worked in groups with other students?	92%
Did you enjoy working in groups with other students?	71%
Have you ever used computers to work online in groups with other students? 'Working online' includes things like communicating and sharing work with other students through discussion boards, email and other computer technology.	58%
Did you enjoy working online in groups with other students?	46%
Have you ever been assessed by self and/or peer assessment?	71%
If you have undertaken self and/or peer assessment, do you like it as a form of assessment?	71% of those who said yes, (50% of all respondents)

Figure 1

This data indicates that a large majority of students have experienced group work in their studies prior to entering H.E. Empirical studies of other cohorts have given figures of 100% for the first question, but then correspondingly lower answers for the second question. Interestingly, an ad-hoc sample of postgraduate students who had come from a range of other disciplines showed that several had not done any group or team work in their undergraduate studies. Experience with computer mediated and supported group work prior to H.E. is more fragmented although still over 50% in this particular cohort.

From the figures it is clear that students' experience with the online group work is not always positive, with a majority not enjoying the experience. However, a majority did enjoy working in groups. The data for experience with peer assessment shows that the majority had experienced it and actually liked it as a form of assessment.

Note: whilst there was a correlation between group work and peer assessment this was not complete i.e. some students had experienced group work but not peer assessment and vice versa.

4. TECHNOLOGY AND GROUP WORK

Technology to support team activities is well established in industry. Moreover, in the context of computer science technology can give us a means to support group work in the educational environment whilst developing the technical skills and real world knowledge that students will require and which employers and accrediting bodies expect. As identified earlier, when considering collaborative learning it is natural to look at collaborative software to support the learning process. Systems that support group work include Virtual Learning Environments such as Moodle, Sakai and Blackboard, GroupWare and Intranet technologies such

[1] Based on questions used in a similar survey by Paul Chin of the University of Hull and the H.E.A. Physical Sciences Centre on *perceptions of group work* amongst university students.

as Novell Teaming or Microsoft SharePoint, and Web 2.0 technologies such as Wikis. Whichever technology is used, they can provide solutions to a number of the issues identified above. These are summarized here:

- Ensuring students contribute: the date and author stamping of documents and posts to group sites provide evidence if for investigations if there are complaints and appeals related to group work;
- The ability to develop discussions and forums: allows groups to communicate even if it is difficult to get the entire group together;
- The ability to access content online through the Internet means that individual students have fewer excuses for not participating;
- The use of calendar and other management tools to coordinate meetings and provide a record of organized meetings;
- Where teachers have the permissions to monitor a site groups can be supervised to ensure that the group work is progressing and that students are all contributing.

4.1 Peer assessment: issues and technology.

Peer assessment – the marking of students by (some of) their fellow students - is well established in educational practice. As shown in Figure 1, many students are familiar with and have experience of peer assessment when they enter H.E.

Peer assessment offers a number of benefits to both the teacher and the students [3]. One particular benefit for students in using peer assessment is that students are required to consider and apply marking criteria. This is particularly useful for first year students who may be unfamiliar with the kinds of marking criteria used in the U.K. – especially students who have come through non-traditional routes or from overseas. For the teacher, it can reduce the marking burden. However, this is not always apparent in practice – since work may need to be marked or moderated by the teacher in order to provide a check for peer assessment. The teacher can be assisted with this problem by minimising the amount of data which they have to deal with – for example by requiring that each group agree on the weighting of contribution to the group submission. This naturally provides a summary of the group's view, but as it requires agreement by the group it cannot be anonymous, and requires that the group can agree on the weighting. If there are disagreements these then require mediation by the teacher.

Another approach is to get each student within a group to assess the other students within their group – and potentially assess themselves (self-assessment). However, with a large class and many groups, the practical tasks of collating and summarising marks from multiple students for each individual student is a non-trivial task. Later we describe briefly a tool to automate this last approach.

A somewhat different take on peer assessment – which can reduce the volume of data – is to get groups to mark other groups. This is particularly useful with presentations and demonstrations. However, even here the volume of data for the teacher to handle is not insubstantial. For example, with just ten groups, each group assessing the others generates 90 data sets – which can include a number of marks against each criteria and comments. The tool we consider below can be used in this mode too.

These forms of peer assessment can be used together within a module, but the marking burden on students can then become an issue.

4.2 Student views of group work and peer assessment

As well as the questions reported in Figure 1 a number of open questions were asked to attempt to provide a fuller perspective of the student views. These can place a different context around the issues considered in section 2. Responses to the question "In general what do you feel about working in groups, whether you are working face to face or with the help of technology" identified a number of concerns, in particular that

- Some students would not contribute, and those who were active would end up doing all the work;
- A desire to be able to choose their own groups, so they were confident that people would put in the effort;
- Concerns about random groups, where members do not contribute fully and the workload is unbalanced;
- Concerns about having to rely on others;
- Acknowledgment that group work is essential in the software industry;
- Concerns that criticising the work of a fellow student may mean that student gives them a low mark in the peer assessment;

- Perceptions that it is more fun than working alone, but more complex.

Regarding peer assessment, the students were asked “Regardless of whether or not you have undertaken self and/or peer assessment do you like the idea of this form of assessment”. This question generated more negative responses, reflecting the number of students who had not experienced it in practice – indicating that those who had experienced peer assessment had more confidence in it. The most common concerns were about biased marking or other students not taking it seriously. Several students felt that as long as the teacher was involved in the marking process, then it would be acceptable.

4.3 WebPA: a tool for peer assessment

WebPA [12] is a tool which provides a way to automate much of the peer assessment process described above. Developed at Loughborough University, this tool allows teachers to set up modules and groups of students within these modules, and provides an interface for students to mark their peers within their group against the criteria defined by the teacher. The impact of these marks provides a weighting that is used to attribute the weighted version of the overall group mark to the individual students. The teacher has flexibility to determine what proportion of the group mark is subject to the peer weighting.

This system provides an efficient way to manage the peer assessment process, and provides the anonymity in input to give students the freedom to potentially give truer assessments of their peers. Whilst requiring a separate installation and systems support issues the practical value for large classes makes it a worthwhile technology to investigate.

As mentioned above, by defining groups rather than individuals, this could equally be used to provide a facility for group on group assessment.

5. CONCLUSIONS

As has been considered in this paper, group work – by which we include team work and the notion of working with others – is a key feature of the professional skills of a practising computer scientist or I.T. specialist. This paper has described some of the issues that arise in using group work within computing courses in H.E. One particular aspect is the use of peer assessment within the context of group work – where students can reflect the contribution of their peers. The paper has also documented some of the technologies which can assist the teacher in supporting group work and peer assessment. The use of WebPA and group work discussed above is still ongoing, and will be subject to a further evaluation which should form the basis of a future publication.

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THEMATIC ANALYSIS OF GROUP SOFTWARE PROJECT CHANGE-LOGS

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ABSTRACT

This paper looks at the types of development activities that take place over the lifetime of a collection of software projects in an academic environment. Because these projects are not open-ended, nor are they expected to receive any maintenance after submission, it is expected that the patterns of developer activities will not be the same as for a real-world project. This paper uses the process of thematic analysis to investigate the development processes used by the students in collaborative, cross-site software development projects carried out by 2nd year Durham and Newcastle University students to determine development patterns, whether these change over time, and whether they are affected by the campus of the developers. The analysis also evaluates students' usage of software tools provided to aid groupwork and collaboration.

Keywords

Groupwork, Thematic Analysis, Revision Control Systems, Software Maintenance, Project Management

1. INTRODUCTION

Each year, second year computer science students from Durham and Newcastle Universities carry out cross-site, collaborative software engineering group (SEG) projects[2][4]. Groups consist of a team from Durham and a team from Newcastle. Each group has a similar requirements specification; in the academic year of 2006/07 the project consisted of a desktop application and a corresponding mobile application. The Durham teams worked on the desktop aspect, while the Newcastle teams developed the mobile portion. Each Durham team is managed by third year students from a Project Management module, and these managers attempt to facilitate groupwork, collaboration and communication, as well as guiding the development process.

The implementation phase was facilitated by a SubVersion repository[3] and every change to a project was reflected in the group's repository. Each time a revision is submitted, the student is prompted for a message or comment to describe the changes. It was these comments that formed the data for this analysis. There were 12 SEG projects, with over 4,000 revisions in total. Of these 4,000 revisions, 1,035 revisions had associated comments (a ratio of 25% compared with 100% for real-world projects). Each of these comments was associated with other data - the gender and campus of the student who performed the revision, the time of the revision and the group number.

2. RESEARCH QUESTIONS

The main aim of this analysis was to determine how development activity changed over the lifetime of a project, and how this compares with real-world projects. Sub-questions include whether or not these activities are affected by campus, and if they are consistent throughout the project or change over time. A secondary aim was to determine how well students made use of software tools to facilitate their projects, and whether this could be improved in future years.

This study addresses these issues in the context of the SEG projects, but the findings are equally applicable to any academic, group-based projects, especially cross-site or cross-campus projects.

3. THEMATIC ANALYSIS

3.1 The Process

Thematic analysis[1] is a qualitative analytic method which aims to uncover patterns or "stories" in data. It is conducted over several stages; firstly a set of codes is defined and each data item is labelled with one of these codes. This code scheme checked by a reviewer to determine if it is balanced, repeatable and unambiguous. The codes are refined and reviewed until the researcher and the reviewer reach a pre-determined agreement rate. In this analysis, given the vagueness and ambiguity of the comments being analysed, it was decided that an agreement rate of 80% would be desirable.

3.2 The Codes

The first instance of the codes was derived directly from the types of software maintenance: perfective, preventative, adaptive and corrective[5]. This set of codes did not fit the data however, and a new set was defined. Following several refinements and reviews, the following codes were devised that had an agreement rate of over 90%:

- *Perfective*: Includes testing, cleaning, refactoring, deleting, restructuring, commenting and JavaDoc
- *Developmental:* Addition or expansion of features or functions
- *Corrective*: Fixing bugs and errors in the project
- *Ambiguous*: When progress or changes have clearly been made and are being reported, but it is not clear which activity type was carried out. It is also applicable when there are clearly two or more codes applicable (e.g. *Corrective* and *Developmental*)
- *Misc*: Irrelevant or out-of-scope comments

4. EVALUATION

4.1 Limitations

Although the data set is large it is only a quarter of the total set of activities. Therefore a large amount of potential data is missing, which could theoretically impact the results. In some cases, the comments were primarily from one student within the group, and in others the comments came from a larger body of students who commented less frequently. If the distribution of comments is random or arbitrary then this would not be a problem - each activity would be impacted equally. On the other hand, if people were systematically not commenting minor bug fixes (for example) then that activity would be under-reported. Looking at the data more closely, there seems to be no systematic bias or selection occurring with comments - in some cases it is random and in other cases it is determined by the individual student. When data is included from subsequent SEG projects, this will help to mitigate any unseen problems.

4.2 How are Development Activities Distributed?

Overall, the spread of activity types appeared as follows:

- Developmental: 53.8%
- Perfective: 14.3%
- Corrective: 13.2%
- Misc: 10.5%
- Ambiguous: 8.3%

Some groups were almost entirely focussed on developmental activities, while other were much more balanced. It is probably not a coincidence that the highest scoring group had the highest proportion of corrective maintenance and fewer *Misc* and *Ambiguous* codes, although there is little correlation between any particular activity and final group score. Any correlations which do exist are just as easily explained by better developers as opposed to better practices. There was great variance of these categories within groups (standard deviation ranged from 6.1% to 13.2%), reflecting the varied developmental and commenting practices adopted by each group.

4.3 How do Development Activities Change Over the Course of a Project?

Figure 1 shows how the various activity types changed across the course of the projects' lifetimes.

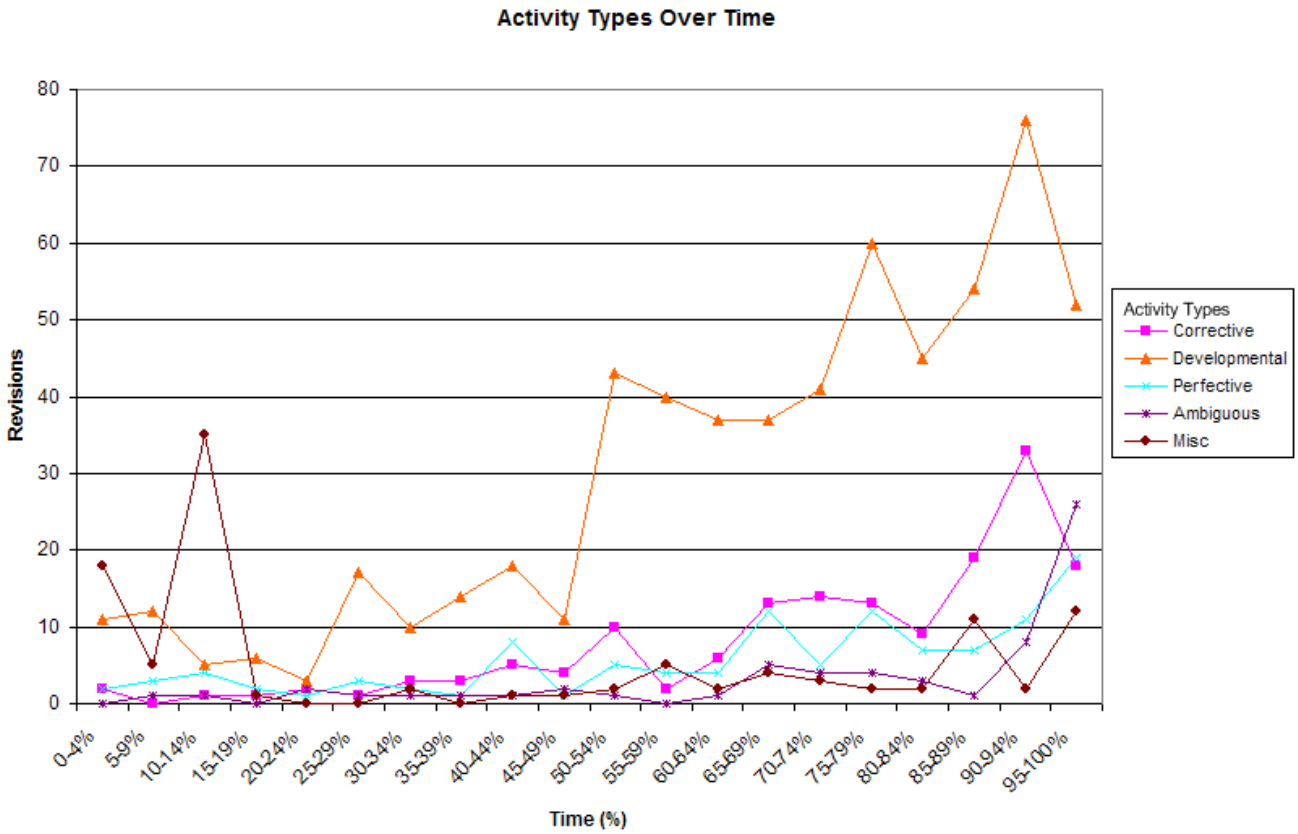

Figure 1: Activity over time

Corrective is, as expected, low for the first 20% of each project, around 3-4%. As development continues, *Corrective* rises to 15-20%, where it remains for the life of the projects.

Developmental varies quite widely, between 42% and 67%, with a low of 20% (this anomaly coincides with the Christmas holidays). Overall, developmental activities - adding, expanding and improving features - form the majority of the work for the entire life of the project.

Perfective activities hover between 8% and 13%, with a very low variance. In other words, students consistently appear to spend 10% of their effort testing, documenting, commenting, cleaning and refactoring their code - low compared to the ideal proportion, but expected in the context of inexperienced developers working to a strict deadline with no scope for their code to be maintained subsequently.

Ambiguous activities range between 1% and 13%, with no apparent pattern - this is also to be expected as *Ambiguous* is not an activity in itself but the inability to classify an activity based on the comment. Only by requiring better commenting practices or by time-consuming investigation can this group be reduced.

Misc begins very dominant, 42-64% in the first fifth of the project cycle, then dropping off to much lower values of 0-14% for the remainder. This is caused by several factors - students are still learning to use SubVersion and the commenting system, and students are still working on other aspects of the project, which crosses over into SubVersion when things like documents are committed. Combined with the lower amount of revisions at that stage of the projects, this makes *Misc* more pronounced before being overshadowed by other activities.

4.4 Does Campus Affect Activity Distribution?

In total Durham committed 63% of the revisions - considering that the project was worth twice as much to Durham students as Newcastle students, this is an expected proportion. However, Durham accounted for 78% of the comments - noticeably above the expected proportion.

Most activity categories were evenly matched between campuses, but Durham appeared to do significantly more developmental work than Newcastle, while Newcastle performed twice as much perfective work as Durham. This could be due either to differing software engineering practices fostered by the respective universities, or it could be a result of the nature of the different aspects of the project each team was working on. Therefore, when talking about the difference between campuses, it is also possible that we are talking about the difference between project domains.

Figure 2 shows an overview of how the work levels of the two campuses changed over time. Both campuses increased their work rate towards the end of the projects, but Durham hit a peak much earlier on and maintained it, whereas Newcastle spiked much closer to the end. This had the result that for the middle third of the project (40% - 70%) Durham were doing the majority of the work, even above the two-thirds ratio expected. Lastly, Durham began work much earlier, and then dropped off again around the Christmas holidays.

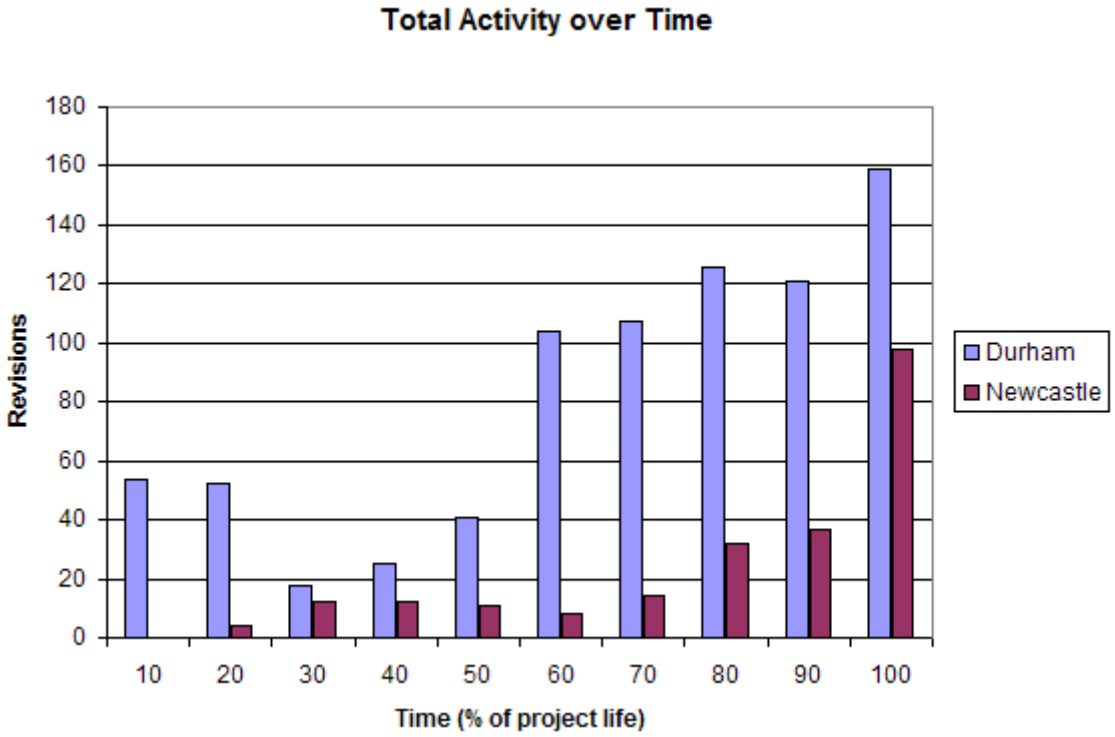

Figure 2: A broad comparison of work levels on each campus over time

4.5 Project Management and Use of Software

The fact that only a quarter of all revisions were accompanied by a comment suggests that students did not, on the whole, make full use of the tools provided to aid them in their project. Equally, the prevalence of *Misc* and *Ambiguous* activities shows that even when comments were supplied, SubVersion was not being used properly. *Ambiguous* codes occur in two situations; either comment was ambiguous, or the revision itself consisted of more than one maintenance activity. *Misc* codes occur when the comment is irrelevant to the project implementation (e.g. flippant remarks, or work relating to other project phases such as requirements). The fact that nearly a fifth of all comments were Ambiguous or Misc suggests that students require further training in the use of SubVersion, and a deeper education of the benefits of proper software development practices.

5. Conclusions and Future Research

Thematic analysis, by manually attaching additional information to a data set, allows us to see patterns in that data that quantitative analysis itself could not uncover. In the case of SEG, by analysing activity types it is possible to gain a better understanding of the development processes and how students collaborate, especially cross-site.

In comparison to ideal development practices, where feature development is stopped prior to release to allow for bug fixing and "polish" to take place, SEG projects actually saw an increase in developmental activity as the projects drew to a close and while corrective activities did increase too, it was not as significant as it should have been. There was also a marked increase in ambiguous comments towards the end of the project, possibly caused by increased frustrations, or deadline pressure.

Overall, it is clear that students' use of SubVersion is not optimal. In an environment where there is no scope or requirement for future development or maintenance of their projects there is little incentive to make proper use of the software provided. Unfortunately communication is often cited as one of the groups' main problems in collaborative work. During the implementation phase, when communication and cohesion are highly important to the development of a high quality, well-integrated software application, students largely ignore the facilities provided by SubVersion which could aid communication within groups. This is likely due to a lack of students' awareness of the features offered by SubVersion, and how they could use them to their advantage. As one student said in a SubVersion comment, "WHERE DOES THIS MESSAGE SHOW UP?"

This has led to a tendency for students to be much less formal and rigorous in their use of SubVersion comments. While this makes analysis in terms of development activities difficult, it is a useful mine of information with regards to social dynamics. There is scope for further thematic analysis using different code groups to uncover more patterns. An example of this might be to code based on the tone or mood of a comment, and investigate how flippancy, competitiveness, aggression and frustration vary over time and between demographic groups.

Considering that the SEG projects are intended to introduce students to participating in a large project and being part of a development team, this study has revealed some problems with the current system. Because of the limited scope of the projects it is difficult to convince students of the importance of good software engineering practices and of the benefits that the provided tools can provide. These benefits are not immediately obvious – or even applicable – in SEG projects, and so the time and effort required are often viewed as not being worth the cost.

To reinforce the findings of this study, data from the 2007/08 SEG projects can be added to the current data, and a repeat of the same analysis would be of great help in minimising the problems caused by low comment ratios. It will also help to uncover whether campus differences are caused by the environment or by the project domain.

The implementation of the SEG projects is just one phase of many, and it would be instructive to carry out a thematic analysis on other phases to assess whether implementation is anomalous in its poor processes. For example, if documentation was created in a wiki or a collaborative document environment which could track revisions, a similar study could be performed.

Ideally, this research will be compared with other such analyses which cover either a similar context (in order to confirm, refine or refute the findings of this analysis) or cover a different context, such as a software development company, or a truly distributed open source project, which would provide interesting comparisons between the development habits of students with those of real-world software developers. It would also be instructive to compare the analyses of closed-scope projects such as SEG with those of open-ended, ongoing projects.

Thanks to the presence of open source projects with full SubVersion repositories available for public download, it is entirely feasible to perform a similar analysis on such projects.

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GROUP-BASED ASSIGNMENTS IN COMPUTING COURSES

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ABSTRACT

Group-work plays a significant part in computing courses and is one of the most important common skills students need to gain at university in preparation for their future working lives [1]. In this paper we consider the challenges presented by the extrinsic factors that impact on the success of group-based assignments against the background of formal summative assessment of group-based assignments on BSc Computing courses in the Department of Computing at Canterbury Christ Church University.

Keywords

Group-work, assessment, fairness, coursework, peer-assessment.

1. INTRODUCTION

Group-work skills are one of an important of a set of common (generic) skills that all students need to develop. In the case of computing courses, this is particularly important since students' working lives will often be collaborative-based [4]. As such, group-based assessment is a highly valid form of assessment. Student performance, learning and higher level cognitive skills are all held to benefit from group-work as long as it increases student engagement and reflection upon the subject itself as well as the mode of learning. Interpersonal, leadership and organisational skills, as well as self-motivation and self-esteem are typical of the many non-cognitive areas that are held to benefit from group-work [11]. Students who work in groups also tend to be more satisfied with their course and appreciate the value of group-based learning [3]. Group-work, with its associated peer pressure, can sometimes encourage students who have not previously done so to engage with a course. Group-work also allows students to undertake larger more complex/realistic tasks than they could do individually, not just as a result of additional manpower but also due to the associated economies of scale and division of labour. Often educational establishments are expected to expose students to group-based activities. For example, the Quality Assurance Agency for Higher Education honours degree computing subject benchmark statement states “[each Higher Education Institution] should be expected to be able to show that … in practical coursework there is an opportunity for students to gain experience of working both in groups [and] students will adopt a disciplined approach to their tasks [including] the related practical and transferable skills, including relevant approaches to group activity” [8].

Many of the stakeholders involved in group-based assessment have reservations. The most significant issue [9] is that students, lecturers and external examiners alike all question whether individual group members are appropriately rewarded based on their individual contribution to group-work.

The success of group-work is dependent on extrinsic factors, such as assignment design, group allocation, management and assessment, as well as intrinsic factors, such as the knowledge, skills, motivation, personalities, experience, etc. of individual group members. The extrinsic factors are considered in this paper against a background of over fifteen years of formal summative assessment of group-based assignments on BSc courses in the Department of Computing at Canterbury Christ Church University.

2. DESIGNING GROUP-BASED ASSIGNMENTS

As with any assignment, group-based assignments must have a well defined task, must be perceived as an integral part of the course and must match students' skill/ability levels including, of course, those required for group-working. Additionally, while individual students must be held accountable for their own actions, a group-based assignment must also necessitate mutual dependence between group members if learning is to be effective. In this way, individual group members feel that they succeed or otherwise as part of a group and not as individuals. The fact that the group as a whole is relying on individuals within it is strong motivationally [5]. Mutual dependence can be achieved, for example, by setting assignments that force group members to divide the work into mutually interdependent parts or that force group members to reach a consensus [3].

Group-based assignments must facilitate a potentially even work load between all members of the group so that every group member has the opportunity to make an equal contribution. One way to achieve this is to design assignments that have clearly identifiable activities which can be easily distributed between group members who must then each individually make a success of their activity in order for the group, as a whole, to succeed. Unfortunately, this approach takes away part of the rationale and learning process of group-work in that the group members themselves do not break the work down into activities.

Finally, assignments that allow group members to compete with each other should be avoided since they tend to reduce the benefits of group-based coursework.

3. ALLOCATING STUDENTS TO GROUPS FOR GROUP-BASED ASSIGNMENTS

It must be recognised at the outset that students are often concerned about working with others with whom they are unfamiliar. Students can be randomly assigned to groups thus maximising the groups' heterogeneity [10]. Alternatively, lecturers can choose the groups, taking into account various factors, to produce either homogenous groups or, at the other extreme, to spread the various student talents around the groups as evenly as possible [12]. The Department of Computing course team's experience is that some students find either of these approaches rather intimidating. An alternative, when students are known to each other, is to let them select with whom they want to work. This approach, however, is not a good match with what students will eventually experience in their future careers in computing where they will not generally be allowed to choose with whom they work. Walvoord [12] suggests yet another option where students express their views regarding potential group-mates but the final allocation is left to the lecturer.

In the Department of Computing, group-work on database courses first occurs in year two so the majority of students are reasonably well acquainted with each other and, as such, they choose their own groups. There are, however, always those students that for various reasons do not find a group and in these cases lecturer intervention is required to either parachute them into an existing group or form a new group of such students. In year three the students are much better acquainted with each other, including an awareness of how their fellow students performed in group-work, and generally, during the previous academic year. The result is that students' selection of each other is more considered and consequently groups tend to be much more homogenous, happy and harmonious. For example, hard workers/high achievers will often tend to group together. This results in less, if any, need for course team intervention to form groups, less group problems, more positive student feedback and much less variation in students' perception of their team mates contribution to the group effort.

In general, groups should be neither too large nor too small. Large groups tend to reduce an individual group member's ability to participate actively and provide the opportunity for those who do not want to participate actively to *free ride* without being noticed. Very small groups, while presenting fewer opportunities to free ride, tend to reduce the benefits of group-based coursework. In the Department of Computing even numbered size groups are generally avoided to reduce the risk of groups being unable to achieve majority decisions in a timely manner and group size is normally set at three so that it is hard for a *slacker* to hide their lack of effort.

4. MANAGING GROUP-BASED ASSIGNMENTS

Lecturers should formally/informally maintain regular contact with groups in order to monitor progress, provide formative feedback, check for (potential) problems and, of course, provide appropriate assistance if required. Groups should be encouraged to plan their work, including task allocation along with planned completion dates. Such planning will inevitably be crude because of student inexperience but this can, to some extent, be mitigated by help from a lecturer. Planning is critical as it allows both lecturers and groups themselves to identify timescale slippage at an early stage.

Some groups may experience problems, including difficulty in allocating tasks fairly, disparity of motivation, work ethic and ability between group members, group members who take control of their group and group members who do not contribute because of their innate quietness or absence due to illness, etc. It is the Department of Computing course team's experience that most problems can normally be resolved with little more than minor lecturer intervention in the form of an individual and/or group discussion and a little direction. The major cause of problems, however, is slackers who do not fully contribute to their group by not attending meetings, not delivering their allocated tasks on time (if at all), etc. Students must be made to realise that slacking is not an option that will go un-penalised. Walvoord [12] suggests that after completion of a piece of group-work each student should submit a confidential report detailing their perception of the group's achievements, effectiveness and problems, along with their perception of their own and their fellow group members' individual role/contribution. This form of peer assessment is employed in the Department of Computing where each student completes a standard "Individual Report" that has become known to students, for obvious reasons, as a "rat sheet"! The system generally works well and reduces a lot of intra group tension because if a group has a slacker the other members know that they have the opportunity to report this and, if substantiated, the slacker's mark, as well as their own, will be adjusted. Walvoord suggests that such reports are also produced during the group-work. In this way group members who, by consensus, appear to be slackers realise that their behaviour has been recognised and they thus have an opertunity to change their behaviour. This practice is not adopted in the Department of Computing because the course team feels that it could cause discord within groups and additionally undermine the well recognised confidential nature of the "Individual Report".

If a group is having problems then breaking the group up and distributing its members to other groups should normally be avoided for two reasons. Firstly, the whole point of group-work is that the group succeeds or fails as a whole and dealing with problems in this way does little to foster group-working. Secondly, distributing a problem group's members to other groups may disrupt the receiving group [12]. In the Department of Computing, group members are not normally distributed to other groups if problems occur. Since group-work in the department is generally short term such reallocations are often impractical since a large proportion of the assignment may well have already been completed, resulting in a less than welcoming reception for the reallocated student and problems in assessing the work of individual group members since the newcomer will normally have contributed much less. Another reason is that group-based assignments are well established in the department and, as such, if students became aware that problem groups were reallocated to other groups then there would be less incentive to make their group succeed. The approach normally taken in the department is for the lecturer to meet the problem group and attempt to resolve the problems.

5. SUMMATIVE ASSESSMENT OF GROUP-BASED ASSIGNMENTS

Assessment of group-based assignments is a potentially difficult issue. What exactly are we trying to assess in group-based assignments? Is it the end product, or the process by which the end product was produced, or the non-cognitive skills employed, or a combination of all three? In computing courses the emphasis is normally on assessing the end product in the knowledge that the process by which it was created and the non-cognitive skills employed in its creation must have had an influence on the end product and as such are also being assessed albeit indirectly.

Having assessed the end product, how should marks be allocated to individual members of a group? The easy option, of course, is to assign all group members the same mark. This obviously promotes mutual dependence between group members and collective responsibility for the group's achievements/failures, potentially motivating students to work together as a team. Unfortunately, this approach is an open invitation for slackers to get a free ride. It is also problematic in that the performance of group members within a group can vary widely, and in such cases awarding equal marks to all members of the group is plainly unfair [7]. If this approach is taken then a group assignment should have a lower weighting in the overall assessment for a course, than would otherwise be the case, in order to minimise such unfairness [3]. If, however, the weighting is too low then, it is the Department of Computing course team's experience that, students will not engage with group-based assignments because it has little effect on their overall course mark.

On the other hand, assessing group members individually, especially if it is norm-referenced [10], plainly introduces intra-group competition in order to gain higher marks thus negating some of the benefits of group-work. One approach to assessing individual group members is to base it solely on "Individual Reports". Generally group members are better placed than their lecturers to know what actually happened within a group and also to assess the process by which the deliverables were produced, although student produced diaries, meeting minutes, etc. can make this less opaque to the lecturer. On this basis, it is generally considered worthwhile and acceptable to make use of peer assessment in group-based assignments [2]. With such an approach, however, there is no check, apart from possible unanimity of group members' views, on the reliability of group members' perception, honesty, judgement, lack of bias and the absence of

reciprocation [6]. It is the Department of Computing course team's experience that individual group members often have difficulty quantifying individual contributions and often base their assessment on just one element when a basket of different elements (for example, effort, achievement, leadership, team spirit, helping others, etc.) would perhaps be more appropriate, and as a consequence students sometimes need guidance in this area.

In the Department of Computing the end product is assessed and each group is awarded a mark that becomes each individual group member's mark. Individual group member's marks can, however, be increased/decreased depending on the contents of "Individual Reports" in which, amongst other things, students specify what percentage of the total group mark they believe should be allocated to each group member, including themselves, and whether they would like a group and/or individual viva voce examination (viva). If all group members specify an equal allocation of marks then all group members are always awarded the same mark on the basis that the group has plainly taken collective responsibility for its work, the group has probably worked well together and that group members' individual efforts have probably been mutually appreciated which is a highly desirable outcome for a group-based assignment. If group members don't specify an equal allocation of marks but that allocation is not significantly different and is consistent between all group members then an adjustment is made to individual group members marks. If group members don't specify an equal allocation of marks and that allocation is significantly different and/or is inconsistent between group members (such variability being an indication of lack of reliability in peer assessment) then a viva of the group and each individual group member always takes place where an equitable distribution of marks is thrashed out. Vivas have proven very successful because, in the Department of Computing course team's experience, while students are often unrealistic or even lie in their "Individual Reports" they very rarely do so to a lecturer in front of their fellow group members.

Data[2] is collected yearly in the Department of Computing for all course-work for both summative and analysis purposes. Analysing the year two data it is noticeable that the spread of marks for individual assignments is much greater than that for group-based assignments as shown by the percentage relative standard deviation (%RSD) of 46.5% and 27.4% respectively. Statistically, the cause can be seen very clearly by a detailed analysis of individual student marks. If students' individual marks are taken as a reasonably accurate measure of their ability, then it can be seen that for students who are above average on this basis their group-work mark is generally lower and for students who are below average on this basis their group-work mark is generally higher than their individual mark. In practice, the course team believes that the cause is partly because a high proportion of groups decide that all members of their group should receive equal marks thus masking the full variability of actual individual performance. In addition, the correlation coefficient (r) between individual and group-based assignment marks, at 0.41, is at best medium. Is assessment failing to discriminate accurately between individual students within group-based assignments? This is a difficult question to answer and the simplistic statistical analysis above gives little help. Firstly, it must be pointed out that individual and group-based assignments are not assessing the same thing, the latter is assessing students' ability to deliver as part of a group, which involves a different skill set, and as such, perhaps a high correlation between the two should not be expected. Secondly, by allowing groups to award the same mark to all group members will also reduce the level of positive correlation, again because the true level of individual performance within groups is masked. Finally, there is the possibility that group-based assessment is to some extent unreliable given the variability of students' performance within groups. Further analysis plainly needs to be carried out in this area.

Analysing the year three data, the difference between the %RSD for individual and group-based assignment marks at 28.7% and 26.0% respectively is not marked while the r between individual and group-based assignment marks, at 0.60, is high. This is perhaps surprising since a much larger proportion of groups in year three decide that all members of their group should receive equal marks. This should, ceteris paribus, result in a larger difference in the %RSD and a lower r between the year three individual and group-based assignment marks than those for year two, if the masking effect detailed above for the year two data is correct. In fact, the exact opposite has occurred. Something more significant has plainly changed between the two years. The course team believes that the major difference is that the year three groups are much

[2] The "data" discussed here is the most recent available being for the 55 students who completed the 2005-6 year two BSc Database Systems I course and those who, a year later, followed this up with the 2006-7 year three BSc Database Systems II course. It could be argued that data collected over a much longer period would be more reliable but changes in assessment practice (e.g. the number of assignments and their overall course weighting, etc.) vary from year to year, particularly after revalidation of courses every five years, making any aggregation potentially problematic. Similar analysis of other cohorts has yielded broadly similar patterns. Note that the raw data has been scrubbed, for example, students who did not complete all the assessments in a year have been omitted. Finally, note that group-work marks refer to marks awarded to individual students *after* consideration of students' "Individual Reports".

more homogenous than those in year two. It is believed that less thought goes into group selection in year two. In year three, however, students are much more careful in that, for example, the more able and/or motivated students tend to group together. This results in both a lower difference in the %RSD and a higher r between the year three individual and group-based assignment marks than that for year two because, in terms of ability, the groups are more homogenous and as a result the masking effect, previously described, is less pronounced. It is also, of course, possible that collaborative working (even to an unacceptable level) on individual assignments rises in year three as a result of closer friendships and improved student ability at hiding such collaboration from the course team thus blurring the difference between group-based and individual (collaborative) coursework. Finally, it could be a combination of all of these factors. Again, further analysis needs to be carried out in this area.

Given the doubt over the fairness, and even the reliability, of assessing group-based assignments, they should never be a major weighting in the overall assessment of any course.

6. CONCLUSION

In the Department of Computing student feedback from standard course review/evaluation procedures, contained within "Individual Reports" and that received informally shows that while a few students have poor experiences of group-based assessment for most it is very positive. It is also notable that there has been only one formal appeal against a mark awarded to an individual for a group-based assignment in the last fifteen years. The department's approach to group-based assignments has evolved over the last fifteen years, not just to improve the teaching, learning and assessment process itself, but also to meet changing student skills, motivations and expectations as well as internal/external regulatory requirements.

Finally, there is every indication that group-based assessment is worthwhile in terms of both improved learning and the development of non-cognitive skills, but there is also a significant risk in terms of assessment fairness. There is plainly a trade off between the two and course teams must strike a balance while also minimising the risk of unfairness in assessment by careful assignment design, group allocation, management and assessment.

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ANALYSIS AND VISUALISATION OF SUBVERSION REPOSITORIES IN GROUP PROJECTS

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ABSTRACT

Revision control software is an important tool in any team-based software development project. In academic group projects however, there is little emphasis on the use of these tools to provide additional information on students' work habits, group dynamics, application of skills or use of technologies. This paper presents Perceive, a system to data-mine version repositories and to generate a range of information from them. This system has been used to assist in the management and assessment of group projects at Durham and Newcastle Universities, and this paper describes the early experiences of use of Perceive in the context of academic group software development projects for a range of tasks including development, project management, maintenance and academic assessment.

Keywords

Groupwork, Revision Control Systems, Software Maintenance, Project Management, Software Visualisation

1. INTRODUCTION

Group-based software development projects are a common feature of Computer Science degrees. These projects typically cover the full lifecycle of a real-world software project, from requirements specification, through design and implementation to evaluation. One of the tools usually provided during these projects is a revision control system such as CVS [1] or SubVersion [4], which is used to provide a single storage area for a group's source code, and to control the versioning of that code.

While some tools are included explicitly in the assessment of these projects, implementation tools often are not. Instead, the code produced and the quality of the teamwork is used in marking, with little emphasis placed on use of technology or tools. This paper shows that the revision control system used by students in their group projects can be a useful source of information, which can be used for deeper assessment, better project management and also provide useful advice or practices to feed forward to future projects.

As part of their second-year Software Engineering courses, Durham University and Newcastle University Computer Science Departments collaborate on a Software Engineering Group (SEG) project [2]. This two-campus project creates groups which include students from both universities, requiring extensive use of collaboration technology and practices [5].

Each group is supplied with a SubVersion repository, which each group member has access to. Use of this repository is not mandatory or assessed, but students would find it exceedingly difficult to carry out cross-site software development without it. This paper shows that a great deal of information can be mined from these repositories, which could have applications during the project (as an aid to project managers and to programmers), during assessment (better insight into group dynamics, work division and use of software engineering practices) and for aiding future projects (better guidance for teams, avoiding previous mistakes, better explanation of use of tools and practices).

Perceive is a tool which analyses SubVersion repositories and generates a broad range of information, metrics, graphs and visualisations based on the history of the project being analysed. This analysis is designed to produce results useful to a range of users, such as project managers, maintainers, instructors or assessors.

2. THE SEG CASE STUDY

2.1 INTRODUCTION

Twelve teams, each comprising a number of students mixed between Durham and Newcastle universities were challenged with producing a project comprising a desktop application and a mobile application. When it came to the implementation phase, each group typically split the development so that one campus would work on the mobile side while the other would work on the desktop side. Not every student was directly involved with the implementation phase; in the 2006/07 project the number of active developers in each team ranged from three to eight, with an average of five. In the 2007/08 project however, the number of developers ranged from six to 13, averaging 10. This number was skewed by a number of students making a very small amount of contributions to the project – the number of students significantly contributing remained similar to 2006/07.

When the implementation of SEG projects are being assessed, marks are given based on the quality of code, accessibility of the finished product, the graphical interface, and how well the project meets the requirements specification. The development process is not assessed, although overall collaboration is assessed. Each member of each team fills out a form for each phase measuring how much they felt each team member contributed to each section of work, as well as a form stating people's contributions to each section based on whether they created, modified, reviewed or tested. A cross-reference of these assessments paints an overall picture of various contributions.

However, analysis of the SubVersion repositories through Perceive allows for a much more in-depth look at the implementation phase. As well as revealing much of the information looked for in the student-completed contribution forms, it can also open up a new area for assessment – the development process. As previously stated, the tools the students use to develop their projects are not assessed, they are merely provided as aids. Perceive allows assessors to look at work patterns, proper use of tools and documentation at a level previously unavailable.

This section shows how Perceive can be used in a variety of tasks relating to an academic group project. The 2006/07 and 2007/08 SEG projects form a case-study to show how Perceive can be used in project management, program comprehension, assessment and investigating student behaviour.

2.2 Project Management

The Durham half of each project group are assigned project managers from the third-year Project Management module. Perceive is designed primarily to aid these managers in their roles. The main problem that Project Managers encounter in SEG is in keeping track of who has worked on what, when they did it and how much they did. Perceive provides a simple and flexible solution to this by creating an overview of the whole project, as well as an overview of a subset of the project (for example, all revisions since the previous team meeting, or all revisions by a particular student).

In SEG, managers typically have a difficult time getting reliable information from the students about what work has been done. One manager said that the only way he could get a reliable indication of work was to actually go to the labs they were in and see for himself. Not only that, but he rarely saw the Newcastle team members and had to rely on the Durham students to be fair and impartial about progress and responsibilities. This manager believes that Perceive has addressed these major problems.

Interviews with managers have revealed that Perceive correctly assesses the relative contributions from students – meaning it can typically show that "Jill did more work than Bob", but not show that "Harry did 23% of the work". The software will need to be tested against a larger amount of groups before any statistical significance can be drawn from these results, but anecdotally Perceive matches the assessments of project managers.

2.3 Student Behaviour and Development Processes

The implementation phase of the project is typically only a few weeks long - the emphasis in the project is heavily on requirements, design and evaluation. In fact only around a small amount of the total marks include the actual finished software. However, given that the programming phase is easily the most popular among the developers in each group there is a tendency to begin earlier than the allotted start time. Perceive shows the date and time of each revision, which makes it trivial to see the start and end date of the projects, even the

start and end dates of individual student contributions. Analysis of the SEG projects shows that a number of them began before the official start time, while some others began at the proper time. Some of the groups which began using the repository at the official time are revealed to have begun with a large initial check-in (See Figure 1 for an example). This may be due to students developing the project by themselves and then committing their work at the proper time, but it is also likely that the early revisions consist of demonstration or example software. This analysis also shows that effort tends to be skewed towards the deadline, as one would expect.

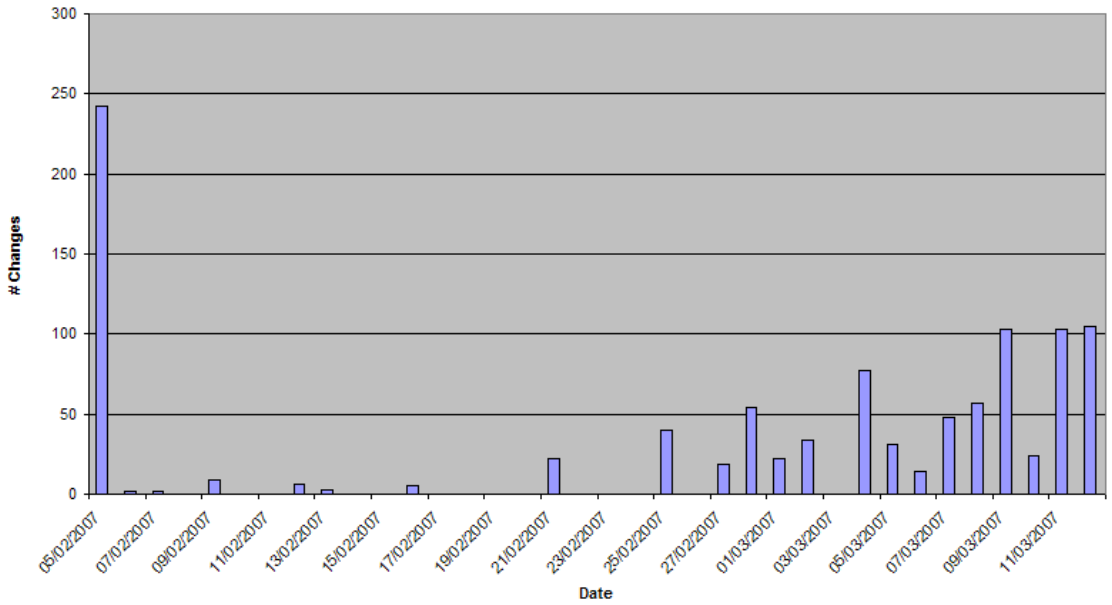

Figure 2: A chart of the number of changes per day

Another analysis provided by Perceive was the distribution of revisions/changes aggregated by time of day (See Figure 2 for an example). There is a definite skew (evident in most projects) towards later in the day, but this is to be expected due to a submission being the culmination of a period of work. However, most projects also show a number of revisions being submitted "out of hours", even as late as 2:00 or 3:00am. Combined with the previous analysis, the number of submissions that take place out of hours increases as the deadline approaches, and groups start to feel pressured.

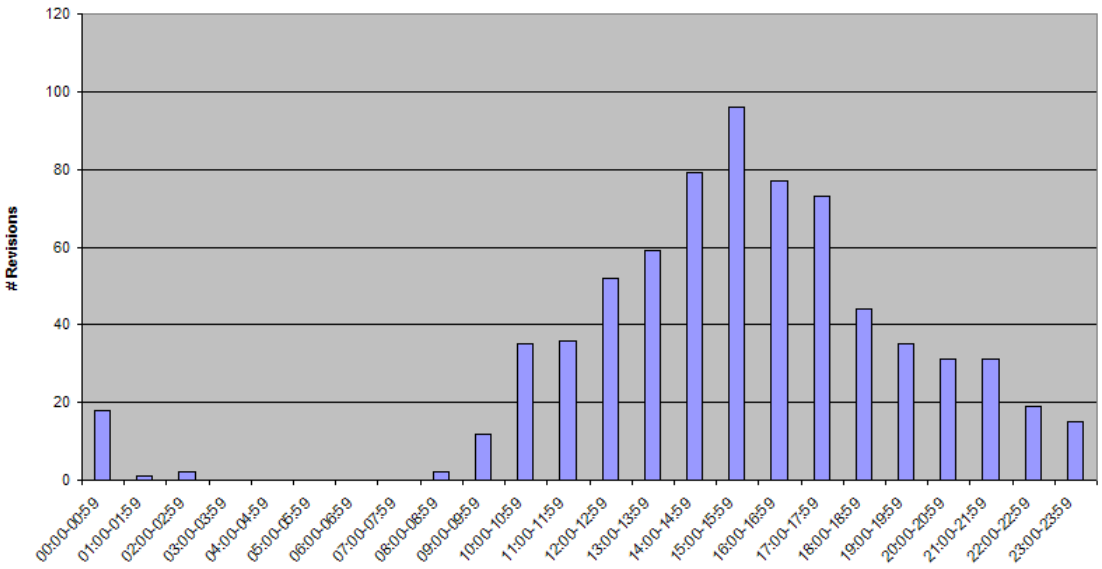

Figure 3: Number of revisions aggregated by time of day

A feature of SubVersion is the ability to leave a message log with each revision, giving other users an indication of what was changed. Analysis of a sample of open source projects shows that real-world software development projects have a 100% message/revision ratio – every single revision, no matter how small, has a message attached. In SEG projects however, this ratio was rarely approached. One group had an 83%

message/revision ratio, but only one other group had higher than 50%. The average ratio was a mere 31%. By enabling us to compare the behaviour of SEG students with that of professional/experienced developers, we have gained some useful feedback for current and future SEG groups, enabling project managers and supervisors to more easily encourage better use of good practices and use of tools - such metrics provide an easily assessable new element to the mark scheme.

This low usage of messages, combined with sometimes lacklustre communication between groups led to some interesting methods of communication between developers. In at least one case, on finding that messages were unlikely to be read by anyone else, directories were being created and renamed as messages on such topics as project names and module responsibilities, evidence of increasing frustration between students. This demonstrates that if something like Perceive were to be available to students during the project, features that they demonstrably need and desire, but which remain underused, could be more easily taken up.

In any project where development is split between sites, especially with tight, stress-inducing deadlines, there will inevitably be some friction between subgroups, with accusations of others "not pulling their weight", "being lazy", etc. This is natural, if unfortunate, but Perceive has shown that it is also not necessarily unfounded. The visualisations Perceive uses, as well as simple numbers, show that there is a frequent imbalance between the number of changes/revisions committed by different users. In the case of SEG, users are identified by their email addresses, so it is trivial to analyse how work was split between campuses.

It is important to note however, that implementation is only one aspect of the project, and it is entirely possible that a group simply had more programmers from one campus than the other, leading to an imbalance that could have been made up for elsewhere in the project. It is also important to know that SEG is a full module in Durham, but only a half module in Newcastle, so some disparity is to be expected. Feedback from the groups themselves as to how they thought the work was divided and how fair they felt this was would be invaluable, and will be an important part of future research on this topic.

It is also worth reiterating the metrics Perceive uses to measure “work” in a project. Firstly, there is the number of revisions committed, then there is the number of changes within each revision, and finally there is the size of the change. Individually each of these metrics is easily skewed by routine and standard tasks, or even simply by developers’ habits. However, taken as a whole and compared to each other, these metrics provide a good estimate of the amount of work done.

On a very simple, numerical level, over all 12 projects in 2006/07, Durham totalled nearly 3,000 revisions including over 13,000 changes; Newcastle had over 1,500 revisions and 9,000 changes. However, data from more projects is required before the sample is large enough to draw more meaningful statistical results from.

There is little consistency in how effort was split between campuses; in one group, 95% of the activity belonged to the Durham students, while in another group less than a third of the activity was carried out by Durham students. Finally, it is interesting to count the "champions" in each group - those who did the bulk of the work, and how they are divided between campuses. In many groups there was either one champion for the group, or one per campus.

2.4 Perceive’s Effects on Students

One project manager stated that while she did not make significant use of Perceive, the very fact that students were aware that she had the ability to monitor their work in such detail was useful to her. Because they were conscious of the added level of supervision, the manager felt that the students tended to be more open and honest about their contributions. Whether it affected their actual work is unknown.

Some project managers expressed an interest in having the tool – or a similar tool – made available to the students. The potential drawbacks of this (primarily that if they are aware of the metrics they will be able to skew them in their favour) are seemingly outweighed by the improvement in group dynamics and communication. A trial is planned for a future SEG project to allow some or all of the groups to make use of Perceive to assess how they feel it affects their group and their work.

3. ASSESSMENT

Only a small part of the assessment of SEG focuses on the implementation, and the bulk of that section concentrates on how it meets requirements, the accessibility of the software, and how well it works. Only a small part of the implementation mark is on the code itself, in part because code is a difficult thing to mark, leaving assessors to fall back on coding style, comments, class design, error-handling and readability to derive marks. Perceive assists marking in three ways. Firstly it allows the assessor to quickly see which files were primarily worked on by the campus being marked. Secondly it allows assessors to focus on files that have had most activity, and therefore would likely prove more interesting – a file that was created and then

ignored would be unlikely to reveal much, whereas a file that has been in continuous development would be much more likely to show how good the team was at programming. Thirdly, it allows assessors to look at the whole project, rather than the final version, enabling an assessment based on how the project was created and maintained – a much more indicative view of the project than one from the sanitised final submission.

4. Conclusions and Future Research

Perceive has been developed as a model for analysis and visualisation of revision control system repositories, with a wide range of applications in mind. This paper has shown that Perceive can be applied to group-based software development projects in an academic environment to provide both additional support to students and addition tools and feedback to assessors.

Perceive also has a place outside of group projects – other research [3, 6] has demonstrated the potential for revision control systems in introductory programming courses to aid in assessment and the development of good programming practices. Typically, revision control systems are used from a terminal, and potentially viewed through a web interface, neither of which is particularly conducive to further, deeper use of the system for anything more than committing changes and storing code.

One further use of Perceive in a teaching environment is that it allows instructors to see the development of a project. By enabling instructors to see the history of a project – and even to assess it – it cuts down the potential for plagiarism and cheating (for example, the use of online services where developers will code students' assignments for a fee). Requiring the revision history of a project makes it much harder to include someone else's work in your own without attribution.

Perceive is a work in progress, and the results presented in this paper are reports of experiences thus far. There are a number of possibilities for future work. Firstly, project managers will continue to be given access to Perceive, and their feedback will be used to improve the tool. Secondly, team members will be given access to the tool so that we can assess whether it improves their development, communications or group dynamics. Finally, the extent to which Perceive can be used to improve assessment will be explored, by running a parallel assessment alongside the current assessment process.

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COMPUTING STUDENTS AND LEARNING DISABLED STUDENTS: BENEFICIAL PARTNERSHIPS

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ABSTRACT

A partnership project investigated if pairing university computing students and learning disabled students in a practical project can benefit both sets of students. After a social introduction, partner student pairs met fortnightly over a four month period in an IT area in the University's School of Computing. They developed computer-based material about a topic of mutual interest, and demonstrated the completed product to each other and involved staff. Skills development and perceptions of the project's benefit by all participants were observed and measured via questionnaire and interview. A range of benefits were identified for both sets of students, including those relating to transferable skills relevant to computing.

Keywords

Outreach; inclusive society; collaborative learning

1. INTRODUCTION

A number of learning disabled patients from the remaining long-stay hospitals in Scotland are in the process of being moved into the community, as Health Boards work to provide less institutionalised forms of care. One aim is to allow learning disabled people "to live a full life and be included in society while providing privacy and allowing them to develop" [1]. Achieving this requires consideration of important issues such as how to support the development of social and communication skills. With this in mind, work is currently underway to set up projects that will assist in the process of resettlement or socialisation.

Coincidentally, the School of Computing at the University of Dundee is enthusiastic that its students develop a broad set of social skills to complement their technical skills, including communication with a wide range of client groups and awareness of user interface issues. A study was organised to see if mutual benefit could accrue from linking the two missions. The aim of the study was to find out whether partnerships between university computing students and people with learning disabilities would prove fruitful for both partners, for example in developing their social, communication and computer skills.

2. METHOD

The objectives were to identify (i) what benefits, if any, the learning disabled students gained from the partnership; (ii) what benefits, if any, the computing students gained from the partnerships; (iii) how best a partnership can be managed to maximise any such benefits.

Ethical approval for the study was obtained from the regional NHS research ethics committee. Partnerships resulted from pairing a learning disabled patient with a computing student, drawn from two sets of students who had volunteered to participants. Note: since each person was a learner of some sort during the project, each participant is referred to hereafter as a "student". Four learning disabled students were recruited, and five computing students. The additional computing student was asked to join in the project as a reserve in case one of the partnerships broke up because of personal circumstances.

The two groups of volunteer students had an initial social meeting as an “ice-breaker” and to identify potential pairings and topics of mutual interest, e.g. football or music. The pairs then worked for six hour-long meetings over a period of four months to use Information Technology to develop a piece of software relating to their mutual interests. The venue for the meetings was a public but very quiet lab area in the School of Computing. The choice of software to be produced was the decision of the pairs, with initial suggestions including a PowerPoint presentation, or a Flash animation, or a set of WWW pages. Each week the pairs developed their partnership, both in terms of social interaction and IT development. They presented their software product to all the participants at an informal end-of-project show.

The students were interviewed before the sessions started to find out what their expectations were and a first questionnaire was completed during this interview. All the students were asked to complete a short evaluation sheet immediately after each working session. A week after the project ended each student was given another questionnaire to discover whether his/her initial expectations had been met. In order not to over-burden the students with paperwork, all the questionnaires were made short and simple, using a 3-point scale and leaving space at the end for any other comments they wished to make. As the learning disabled students had limited literacy skills their questionnaires were illustrated with Boardmaker symbols [2]. The member of staff who accompanied the learning disabled students (a clinical nurse specialist) was asked to keep a checklist record of his perceptions of how they were responding to the sessions, and the academic staff member managing the project recorded her perceptions of how both sets of students responded during the sessions. Results described here relate to engagement, productivity, observed benefits, and measured benefits.

3. OBSERVED RESULTS

Engagement was judged via weekly attendance: since both sets of students were volunteers, any lack of engagement would be evident by absence at the working sessions. Attendance by both sets of students was regular and good. Only four absences were noted, due to one unavoidable circumstances (learning disabled student), two medical circumstances (university students), and one interview (university student). Where necessary the reserve computing student was used to ensure that a learning disabled student always had a partner.

Productivity was judged in terms of materials developed. All pairs did develop materials (documents and PowerPoint slide shows) of interest to themselves with a rich variety of topics: mobile phones, Eastenders, hot-rod cars, and salaries in law-related careers. Learning disabled students made printouts to take back to their residential care rooms. They each received a certificate, CD-ROM of all materials produced and souvenir photographs of their pairs and of the whole group.

Observed benefits were recorded by both members of staff. Learning disabled students were noted to have increased interaction with the community as a result of their travel to the university. Social interaction and communication increased as a result of the mixing with academic and support staff, and the students during work sessions and coffee breaks. During the period of the work session, the learning disabled students were the centre of attention, and discussions in pairs or larger groups were focused upon topics of direct interest to them. The computing students were observed to be punctual and sympathetic to the needs of their partners. It was noted that they gained some understanding of people different to themselves. As an example, the computing students began to appreciate the constraints of limited literacy skills whilst helping their partners with the printed symbol-based questionnaires or with the QWERTY keyboards. Other benefits observed were: (i) learning some tutoring skills; (ii) developing an awareness of the ethical approval process and comprehension of ethical and professional behaviour with respect to vulnerable people; (iii) appreciating the difficulties that complex interfaces can have for people with low levels of literacy; (iv) learning to take responsibility, i.e. taking the lead when working with someone less able to take responsibility himself or herself, and consistently presenting a positive strong image.

4. MEASURED RESULTS

Pre- and post-project questionnaires were examined. The expectations of both sets of students before the sessions began were overwhelmingly positive. They unanimously reported being happy and excited about the project and none were anxious at the prospect of this new activity. Similarly, both sets of students were looking forward to trying something new, meeting people, making friends and working hard together. Most were also hoping to develop their IT skills but their main expectations were to have fun and socialise.

The post-project questionnaire showed that, in the main, these expectations were met. The learning disabled students were again overwhelmingly positive and had clearly very much enjoyed the experience, both socially and in learning about computers and their chosen topics. The computing students were also very positive in

their answers with all reporting that they found the project interesting and not at all boring. They enjoyed the social interaction, although some had found this challenging at times. Most felt they had not developed their own IT skills much, but had learned how to explain to others, who were less skilled than themselves, how to use various IT systems.

After each session the students were asked to complete an evaluation sheet to rate the session using a 3-point scale ('yes', 'sometimes', 'no') on the following attributes: 'fun', 'exciting', 'boring', 'interesting', 'hard', 'frustrating'. In order to more easily compare the results the points on the rating scale were given numerical values: Yes =3, Sometimes = 2, No = 1. The average rating for each attribute across all the students and all the sessions is given in Table 1.

Table 1
Average Ratings over 6 weeks

	Learning Disabled Students (n=4)	Computing Students(n=5)
Interesting	3.00	2.92
Fun	3.00	2.83
Exciting	3.00	2.62
Hard	1.45	1.25
Frustrating	1.28	1.13
Boring	1.00	1.20

It can be seen from these results that the Learning Disabled Students (LDS) were extremely positive, rating every session as 'fun', 'interesting' and exciting' and none of the sessions as 'boring'. Evaluation sheets completed by the learning disabled students' supervisor were similarly positive, confirming the students' own evaluations of their experience. Reported instances of disappointment and frustration for the learning disabled students match with occasions not unusual in a computing laboratory (such as a laptop being moved to a different table, or the printer running out of ink) but which broke the regularity of the work pattern. The Computing Students (CS) were a little less enthusiastic but still very positive about the sessions. For the learning disabled students there was no substantial reduction in the positive indicators (interesting, fun, exciting) as the 6 weeks progressed (Figure 1).

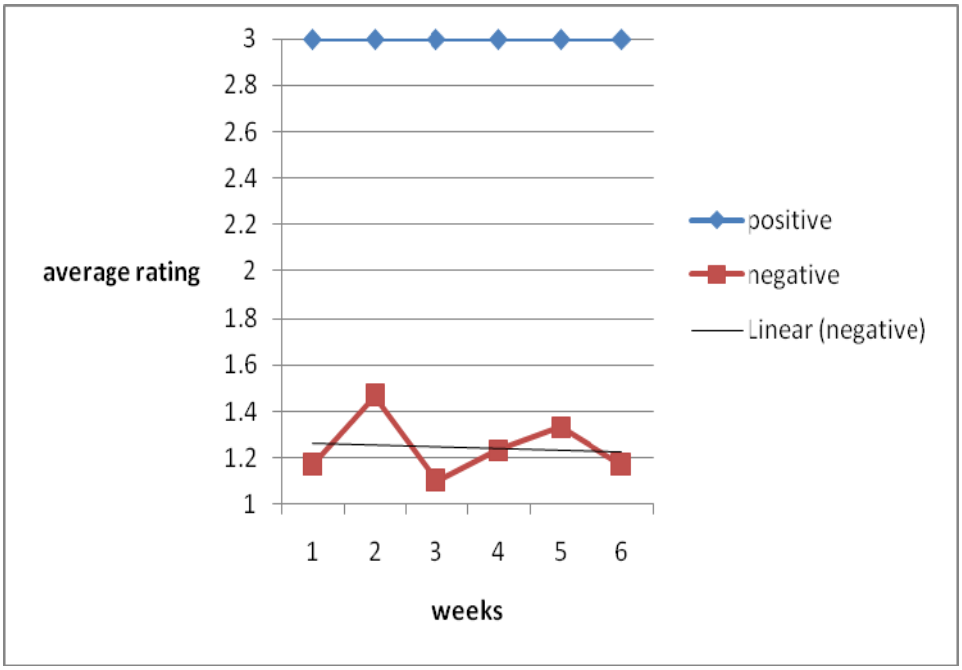

Figure 1: ratings of learning disabled students over 6 weeks (n=4)

However a slight overall reduction in the positive indicators for the computing students was noted as the project progressed (Figure 2). All students were reassured by the consistent and regular presence of the two same two members of staff (clinical nurse specialist and academic member of staff) and unvarying pattern for each of the meetings: same time, same day, and same venue each week.

Despite their simplicity, the questionnaires show clearly that the project was judged by **all** the students to have been both enjoyable and beneficial. Both sets of students reported getting on well in the partnerships (an example of some of their comments being: 'brilliant, lots of laughter', 'we had a nice conversation', 'got on well') and this seems to have been the most enjoyable aspect of the project. The results do not show, however, exactly how much students gained and in what skills.

In the post-project questionnaire the Computing students' comments showed their reflection upon the value of the experience. Three categories of comments were noted: relating to IT skills, to tutoring skills, and to communication and social interaction. IT skills comments were least common, and generally related to the change of circumstance, such as: 'I am more competent on PCs than I was before, I am generally a Mac user'. Learning from tutoring had been anticipated [3], but this element was not a key feature of the project. Students were clearly aware that their tutoring skills improved, as evidenced by comments such as: 'I acquired some pedagogic experience that may help in future team projects', 'how to teach PowerPoint', and 'I gained experience in the sort of teaching role which helped me to explain things and generally communicate better about computing to users with less experience'. However, more common comments were those relating to communication and social interaction. Examples of these are: 'gained understanding of how computers can be difficult to people less trained and experienced than us', 'learned about working with people' and ' I developed people skills', 'it's interesting to talk to non-students when you're always in the student atmosphere'. Most students did not find the large disparity in educational achievement to be an overly challenging divide, although one student observed: "I don't think that I have the necessary level of patience and amiability for this kind of partnership'. The learning disabled students did not make any comments of this sort, possibly because of their limited communication skills.

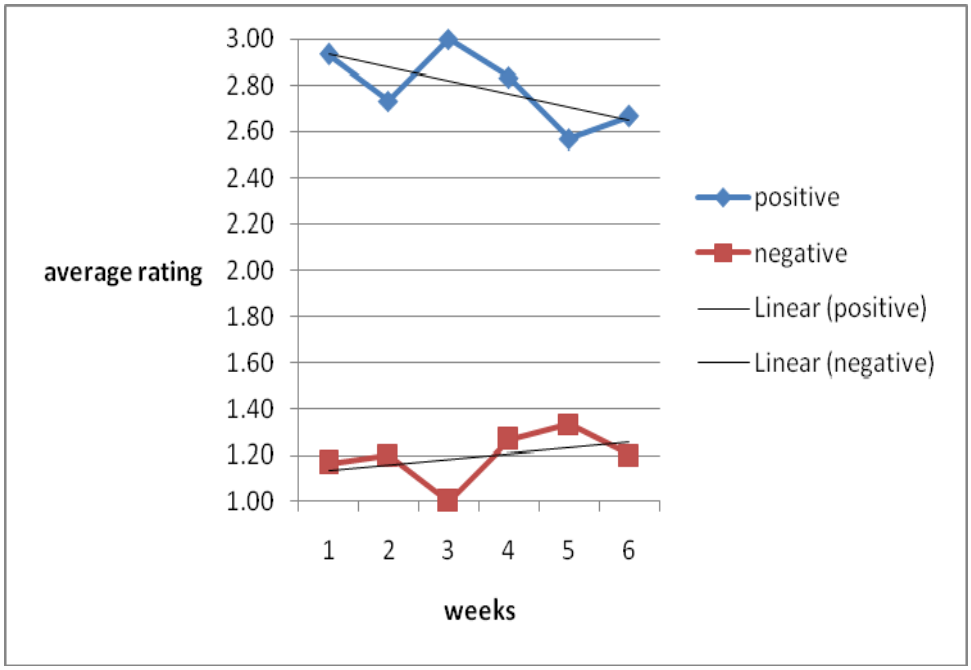

Figure 2: ratings of computing students over 6 weeks (n=5)

5. CONCLUSIONS

This study set out to determine what benefits there would be, if any, to the students participating in the partnership project. Results showed that learning disabled students' IT skills did improve over the six week period, according to their own and their staff supervisor's reports. However, improvements in the computing students' IT skills were limited. Interactions between the student pairs increased and became more extended and natural as the project progressed: this was most evident to the supervising staff. Computing students reported improvements in their "people skills". However social and communication skills were not directly measured and so quantitative evidence of improvement cannot be presented.

Other benefits to the computing students included (i) the raising of awareness and understanding of other people different to themselves; (ii) improvements in their teaching and tutoring skills; (iii) a comprehension of ethical issues relating to working with human subjects; (iv) an appreciation of interface issues as they relate to the diverse needs of a range of computer users; (v) increased experience of taking responsibility.

6. DISCUSSION

The main success of the study has been in demonstrating that inclusive projects of this sort are practical and can bring benefits to both mainstream students and those with learning disabilities. Other researchers have reported similarly results, e.g. [4] and "the positive impact of classroom-based strategy instruction on students with learning disabilities as well as their normally achieving peers" [5]. In the current climate of increasing inclusion of people with disabilities into mainstream society [1], this can be seen as a step in the right direction. The students with learning disabilities were able to come to the sessions on campus, thereby widening their experience of the mainstream community and raising awareness of their needs and abilities amongst people who might not normally come into contact with them. Hopefully this will be extended in future projects with the disabled students gaining supported access to other activities such as the university sports facilities, shops and cafes whilst they are participating in such a project.

In future projects, an alternative method of evaluation might be preferable, such as more in-depth individual interviews before, during and after the working sessions. It might then be possible to find out what skills the students would like to develop, so that the working sessions could be better tailored to meet their individual needs. Another in-depth interview at the project conclusion would determine how successful this had been. Records of sessions could be kept via photographs and videos of the activities, although such records cannot be publicly viewed, for ethical reasons. In other respects, the project management was successful. Six meetings were sufficient for relationships to develop between the student pairs without disruption to university students' studies and without dependencies developing for the learning disabled students. Regular and unvarying arrangements were also noted to be important, to prevent disappointment and to maximise the limited amount of interaction time available.

The computing students clearly learned about the difficulties experienced by others. The positive relationships developed during the project will hopefully have overcome any prejudices or anxieties they may have felt initially about interacting with people with disabilities. In addition other students and members of staff not directly involved in the project became aware of the learning disabled students, thus raising the profile of learning disabled people in a positive way. Ultimately, the project allowed the university to provide its students with something more than an academic toolkit for the computing profession but also to experience a different type of human-computer interaction that should inform their future software development projects.

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THE VENTURE MATRIX: A VIRTUAL BUSINESS CONCEPT TO DELIVER WORK-BASED LEARNING AND ENTERPRISE EDUCATION IN HE

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ABSTRACT

In this paper, we describe how we have attempted to synthesize developments from a number of national agendas through a virtual business concept called the Venture Matrix (VM). This concept is now embedded in a number of courses in the Computing Division at Sheffield Hallam University (SHU) and will meet the requirements for Work-Based Learning as well as promoting enterprise and links with employers.

The concept is currently being broadened to encompass all 4 Faculties, local employers and partner colleges. A dedicated team is now in place to administer the Venture Matrix and to disseminate ideas nationally.

Keywords

Work-Based Learning, enterprise, employers, virtual

1. CONTEXT

The Venture Matrix is a concept which addresses three of the key agendas to have emerged nationally in the area of vocational education at HE level.

1.1 Foundation Degrees

The introduction of Foundation Degrees was a key component of the of the government's policy of widening participation.

One of the main intentions was to provide vocational education through Work Based Learning (WBL). Hence to ensure that students were ready to take up technical roles in the local economy as soon as they left HE.

The QAA benchmark states: "Authentic and innovative work-based learning is an integral part of Foundation Degrees and their design."[3]

[3] Foundation Degree Qualification benchmark, Oct 2004, No. 23

The provision of this WBL has proved problematic with regard to Full-Time students studying Foundation Degrees in colleges and universities.[4] At Sheffield Hallam University, a number of attempts have been made, in partnership with colleges, to provide opportunities for Computing students to work in a computing environment. However, these have proved less than ideal due to:

- initial low level of skills
- unprofessional approach in some cases
- employers not committed
- inappropriate nature of work

Hence the Computing Division, along with other vocational areas, requires a more effective approach to the delivery of WBL for FT students.

1.2. The Emergence of Enterprise Education

In 2005 The Government funded, via DfES at £60m pa, a new focus on enterprise education for all Key Stage 4 pupils. Enterprise education, as a key element of work-related learning, has been a statutory requirement at KS4 since 2004. The emphasis here was not on setting up your own business but on the development of enterprising skills and attributes which are "best located in a coherent provision for work-related learning" [5].

Despite the evidence that you cannot create entrepreneurs in the classroom[6] there appears to be a lot of activity in the UK in this direction. It seems many universities are starting to do the same.

The National Council for Graduate Entrepreneurship (NCGE)[7], in a recent publication entitled "Towards the Entrepreneurial University", presents three alternative models for a university. The one most appropriate to SHU, *Model 2: The Intermediate: University led model*, has been most useful in helping SHU navigate its way forward with the Venture Matrix concept.

1.3. The Role of Employers in HE

The Leitch Report has built on previous initiatives to strengthen the voice of employers in course development in HE. In particular, the role of Sector Skills Councils will be:

- *Taking the lead role in developing occupational standards, approving vocational qualifications;*
- *Taking the lead role in collating and communicating sectoral labour market data;*
- *Raising employer engagement, demand and investment; and*
- *Considering collective employer action to address specific sector skills needs.*

Hence a key aim of the Venture Matrix is to involve employers more effectively in course development and course delivery.

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[5] 'Developing enterprising young people' Document reference: HMI 2460

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[7] www.ncge.org.uk

2. The SHU Approach

SHU has a very pragmatic approach to embedding employability and enterprise into its courses which capitalises on its history and culture. This approach is, however, built on a strong theoretical base and has developed from work on constructivism[8]; experiential learning[9]; transfer[10]and situated learning[11] . The approach is to

- Embed skills and experiential learning into its course provision;
- Develop basic skills on an ongoing basis;
- Support Personal Development Planning through the curriculum;
- Progressively develop autonomy;
- Develop careers management skills;
- Prepare for specific Professional Areas;
- Provide opportunities for experiential learning (For example: *in-course* such as FT and PT placements etc);
- Increase the use of Enterprise specific modules in courses;
- Provide opportunities for entrepreneurial activities (The Enterprise Centre with a range of offerings such as the Enterprise Challenge, the Hatchery, etc).

SHU believes in an educational provision with a focus on developing enterprising students with the skills and aptitudes to be entrepreneurial and/or intrapreneurial, with experiential learning a major feature of its provision. A focus on producing entrepreneurs is not one which engages with the majority of students in HE and is, therefore, less effective than the SHU model.

This is in line with the findings of the project "The impact of Entrepreneurship Education in HE"[12]. Some of the findings are summarised below:

- Applied, experiential learning is more effective than traditional methods for skills development;
- Most students perceive benefits of enterprise education for entrepreneurship and for employment within existing organisations;
- Students who aim to start firms are more likely to report higher quality ambitions if they have completed an enterprise module;
- Graduate start-ups are likely to be a longer term outcome.

The VM provides an impetus to develop and change; helps to keep the University at the forefront of Employability and provides a much stronger culture of enterprise.

3. The Venture Matrix Vision

The VM vision is for the University to provide experiential, work-related learning with a focus on employability and enterprise for over 20,000 students.

This is an inclusive vision which can be realised across the majority, if not all, of its courses. It would result in SHU being a truly enterprising community of both staff and students founded on a common goal embedded in the culture of the University.

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[12] L Galloway, M Anderson, W Brown, G Whittan, funded by Business, Management and Accountancy Subject Centre Teaching Research Grant

It provides students with a range of opportunities to develop their skills, a core set being mandatory with some as options and others optional, covering a whole spectrum of skills and experiences right through to the full entrepreneurial experience of setting up a commercial business or a voluntary organisation.

The VM concept also aims to capitalise on the diversity of the subject provision at SHU. This means that in developing the enterprise provision, there is an emphasis on creating cross disciplinary staff development teams to tease out opportunities which bring students, from different subject areas of the University, together on work-related activities - as in the 'real' world.

4. The Venture Matrix

The VM is: an environment where a series of student led ventures form a trading community that offers the possibility to move from the virtual simulation to the real world. It allows SHU to deliver meaningful, sustainable and realistic work based learning. The concept will also be scaled up so that partner colleges and other institutions will become involved, along with external agencies.

The VM is a "Virtual Business Park" where ventures can interact in a "safe" (internal and *external*) trading environment - to create the Venture Matrix Community. To access the Venture Matrix Community, ventures submit outline business proposals that are recorded and registered by the Venture Matrix administration. This provides the venture with the ability to trade with other registered organisations and ensure that ventures operate in a realistic and legitimate way.

Trading ventures are provided with a Venture Matrix Bank account, allowing them to offer and buy services from other ventures in the Community.

The VM publicises the ventures and brokers introductions via the Venture Matrix website. This allows:

- the recruitment of students offering expertise to ventures
- support requests from ventures
- invitations to form consortia to respond to larger opportunities.

The VM develops and promotes external links with business and other organisations. External opportunities are being promoted via the Venture Matrix.

The Venture Matrix protects both the students' and University's interests and those of the external community.

The VM provides the opportunity for genuine peer-assisted learning. Students will eventually manage the ventures or even the whole programme and benefit from the associated horizontal (integrate learning from their current programmes of study) and vertical (experience support or mentoring of students on other levels of their programmes) integration.

4.1 The Process

Ventures can enter the Venture Matrix through one of two separate pathways:
• *via* taught course modules: supported and resourced through their host Faculty
• *via* an independent idea: this could be via an Independent Study Module (ISM). These ventures are also tutor supported.

For the taught course modules, the lead academic/ course tutor is responsible for resource requirements; students respond to real scenarios, and write up their learning as a credit-bearing exercise. The course tutor is expected to provide a "fallback" position in the event of the venture not securing sufficient custom from the Venture Matrix Community.

For the independent ideas route, students can approach the VM with a venture proposal. If accepted, the student's venture is then free to trade with other registered ventures in the Venture Matrix Community. Ventures are dependent on market demand for their services within the Community.

Ventures registered with the VM are free to trade with all other registered ventures in the Community. Ventures are required to operate ethically within a set of guidelines that have to be accepted before trading can occur. This guidance explains how ventures can operate and interact; ventures deemed to be not operating within this guidance will be de-listed from the Community register.

The Trading Unit of currency is the Venture Matrix Currency Unit (Squids). Ventures receive a start–up loan of Squids upon registration, the amount of which is dependent on the business case presented.

The ventures exchange Squids with other ventures for services bought and sold. All Squid transactions are recorded by the VM Bank and statements can be printed off to allow Ventures to record transactions and keep a formal set of Accounts. The currency is related to real money and ventures are expected to value their services etc at "market rates". No actual money changes hands as real expenditure is controlled by the course tutor or through the VM administrator.

4.2 Outcomes for the Student

This approach allows the students that engage to develop the following **behaviours** that employers value, (in addition to any subject specific learning that may accrue):

- Opportunity seeking and grasping;
- Taking initiative to make things happen;
- Solving problems creatively;
- Managing autonomously;
- Taking responsibility for, and ownership of developments;
- Seeing things through;
- Networking effectively to manage interdependence;
- Putting things together creatively;
- Using judgement to take calculated risks.

Students can expect to develop the following **skills** that employers value:

- Creative problem solving;
- Persuading;
- Negotiating;
- Selling;
- Proposing;
- Holistically managing situations/projects/businesses;
- Strategic thinking;
- Intuitive decision making under uncertainty;
- Networking.

In addition the students develop the following **attributes** – also highly valued by employers;

- Achievement orientation and ambition;
- Self confidence and self belief;
- Perseverance;
- High levels of autonomy;
- Action orientation;
- Ability if not preference for learning by doing;
- Determination;
- Creativity.

This initiative allows students to get the “feel” and enjoyment of their chosen lifestyle. It also allows them to **experience;**

- Living with uncertainty and complexity;
- Working under pressure;
- Building know how and trust relationships;
- Learning by doing, copying, making things up, problem solving;
- Managing interdependencies;
- Flexible working.

4.3 Progress

The implementation strategy is outlined in Figure 1.

Progress so far is encouraging with a number of IT and other courses now validated which embed the VM concept into modules. There is a full-time administrator in place to manage the Venture Matrix and the website which hosts offers of work and work requested in the manner of an agency.

http://venturematrix.shu.ac.uk

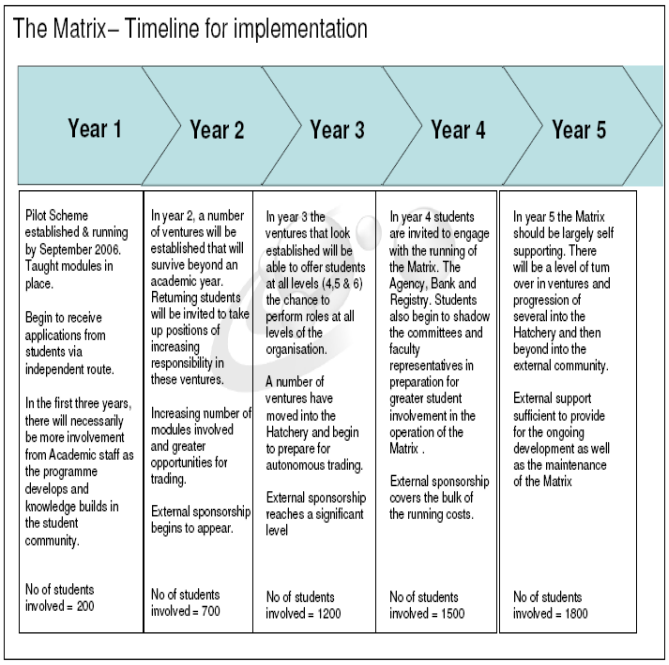

Figure 1: Timeline for implementation

There are currently around 450 students and over 110 ventures registered which is ahead of target numbers for Year 1. New opportunities are constantly coming in and being advertised on the website (Figure 2).

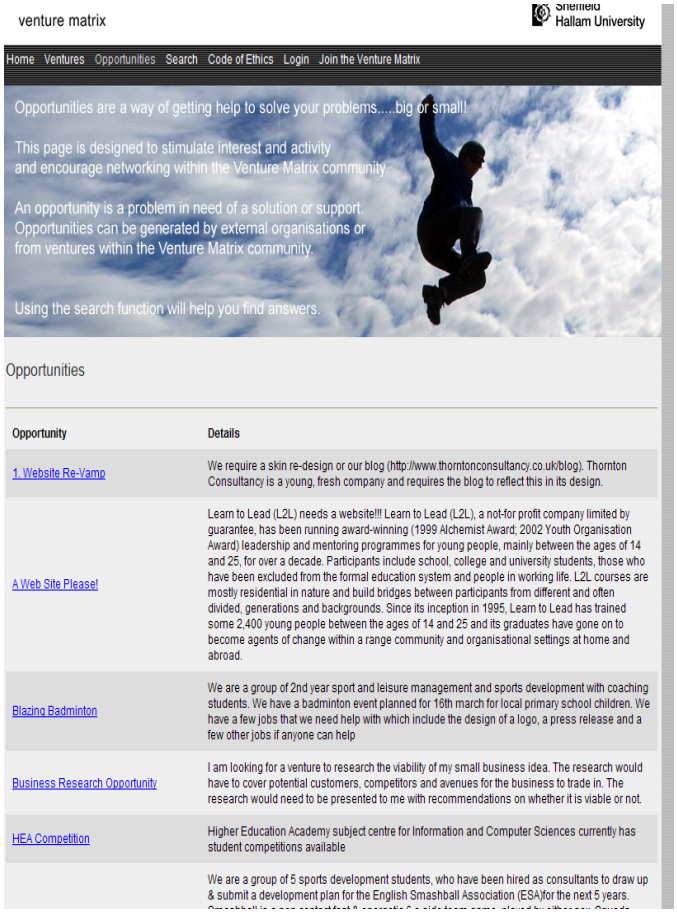

Figure 2: Website - Opportunities page snapshot

Operational teams are established in the areas of:

- Accreditation - To devise the guide lines and methods for assessing a student's learning from their engagement in the VM;
- Planning and Development - has produced a business plan presented to the VCG;
- Venture Matrix Concept Development. - To develop the protocols for the organisation and the structure of the VM;
- Venture Matrix Bank Development - To develop appropriate mechanisms for dealing with the currency and advising students on costing their time, skill and resources;
- Venture Matrix Opportunities Development - To develop a mechanism to gather, access, monitor and advertise appropriate contacts, projects and opportunities;
- External funding - To ensure the long term sustainability of the VM.

A newsletter is now published to update the VM community on developments.

Feedback from staff has been very positive:

"Provides my students with expertise of sub-contracting resources by buying services in the VM."

"Provides a framework from which students can operate businesses as learning experience in a relatively fail safe environment and not get into debt."

5. EVALUATION

As mentioned earlier the pilot year attracted around 450 students from across the University. These came from levels 4, 5 & 6. They formed over 110 separate ventures and ended up exchanging tens of thousands of "Squids" for products or services that were traded.

A formal evaluation of this pilot year is being conducted by the e3i CETL (Embedding, Integrating and Enhancing Employability CETL). These findings are not available at the time of writing this report; however preliminary findings are very positive.

As part of the pilot year for the Venture Matrix a group of final year students were invited to act as observers for the pilot and to interview fellow students, observe the operation and to produce a series of recommendations for the development of the Venture Matrix.

One of the students involved in this student led evaluation had worked for the e3i CETL as his placement year and was familiar with educational research and ensured the evaluation was done as rigorously as possible.

The findings from their interviews, observations and surveys are summarised in a number of key findings and recommendations.

1. The vast majority of the students believed that engagement with the VM had not only enhanced their employability skills but exposed them to the life of an entrepreneur. (As a direct result of their experiences four student ventures are bidding to join the University business start-up incubator and others have entered the University Business planning competition.)
2. Communication is key to the development of the VM. It has become apparent that many students experienced serious problems with communication with other ventures. Many emails went unanswered. This led some to feeling ignored and rejected. Many took the silence as an indication that they should try other means to make contact and their perseverance ultimately paid off. What was universally appreciated were the face-to-face networking events that were offered at the start of each semester. These gave students the chance to develop their communication skills but more importantly to actually meet potential clients and employees. Here they could exchange "business cards" and arrange to meet to develop contracts and finalize projects. Based o the student feedback next year we plan to run networking events much more regularly to reduce the reliance on email and to avoid the problems students had in matching meeting times to busy timetables.
3. Assessment was felt to be a major factor in maintaining motivation. Most students involved in the pilot had two assessments linked to their activity and learning in the VM. One was typically at the start of the year to gauge their initial feelings and to highlight any issues with the activity. The second was a summative piece to record the learning over the whole year. A significant number of the final year students expressed their concerns that the long gap between the two assessments meant that their attention drifted as other module assessments appeared and found it hard to maintain their focus throughout the year. Finding that their engagement dipped after the first assessed element and only rose mid way through the second semester. This impacted on the lower levels as the direction and encouragement to get involved dipped around Xmas time. The final year students recommended that they should be set a number of smaller hurdles to maintain their attention. They felt that if they were regularly focused then this would benefit the lower levels and provide consistent activity across the year and years.
4. Funding for the ventures was felt to be too easy to obtain. In the pilot year the VM bank handed out "loans" based on the outline business cases. After these were awarded the bank did nothing until the end of the "year" when it called in the loans and looked at how many ventures ended up making a profit. Many students felt that the "bank" should have required evidence of activity throughout the year and fed out the funding based on venture progress. This link with the point above would have kept attention across the whole year and forced some ventures that secured work immediately and then coasted through the year to look for follow on work and not assume that they had done enough to "pass".
5. Many students requested a feedback system as found on e-bay. Many wanted to be able to rate their experiences with ventures. Many included feedback in their contracts and it has been pleasing to read the solicited and unsolicited testimonials that have been generated. It has to be said that some of the experiences have been less successful and some ventures have let their clients down by not delivering or delivering unsatisfactory service. The ability to record this was felt to be an essential development for the VM. IT was proposed that groups that underperformed should be "named and shamed" and this would act to motivate them to deliver their best work each and every time.

The student evaluation and the 120 summative reports from the students involved all agree that while the pilot year has had some teething troubles, it has been a success and delivered the ambitious goals outlined at the start of this paper.

6. CONCLUSION

Whilst the initiative can never be a replacement for real work placement, it provides a very rich experience of a real work environment - often where no such opportunities existed before. It has already enabled students to develop skills and gain confidence in their ability to enter work.

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AUGMENTING LEARNING THROUGH FILMED INTERVIEWS AND SCREEN-CASTING

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ABSTRACT

Use of video media in learning and teaching has received much attention, particularly in the context of podcasting. There are both benefits and problems associated with the adoption of podcasting in learning and teaching in its strictest definition. This paper presents an alternative, simplified approach, by considering video media as a solution to two explicit learning and teaching problems. In starting this work from a learning and teaching point of view rather than a technology point of view, the solution adopted was not that of a conventional podcast. Instead, the approach used was online video support materials accessible from web browsers. This paper presents the motivation for this simplified approach along with qualitative and quantitative results that support the work.

Keywords
Video, media, podcasting.

1. BACKGROUND

As forms of media delivery such as radio, television, DVD and the Internet, have been introduced, their use as a means for learning and teaching has always followed (Bernard et. al, 2004). For this work, it is the role of video in learning and teaching that is under consideration.

Much of the early research on the use of video media in learning and teaching has predominantly considered the role it can play in *instruction*, for example with Just-In-Time-Lectures (Dannenberg & Capell, 1997). One driver for this direction of research is in the evaluation of video-based instruction in distance learning courses. This has sparked a long-running debate on the effectiveness of technology for use within education programmes that involve distance learning (Russell, 1999; Phipps, 1999; Bernard et. al, 2004).

More recently, with the consumer adoption and proliferation of portable computing and media devices, studies have examined the potential uses of such mobile devices to assist learning. Research in this m-learning area has extensively examined the use of PDA devices (Attewell, 2003; Attewell, 2005) and MP3 players, such as the iPod (Brabazon, 2007; Malan 2007; Copley 2007; Harris 2008) as devices that might support traditional learning techniques. Many of the studies into the use of video within m-learning show that students are much more likely to access materials on their desktop computer rather than a mobile device.

For example, Evans found that 80% of students studied listened to audio podcasts through their desktop PC via a web page in comparison to 20% on some portable device (Evans 2008). Copley examined both audio and video podcasts finding that 94% of students played audio podcasts on a PC, despite 74% owning portable media players, in comparison to all students playing video podcasts via a PC (Copley, 2007).

Another dimension to the use of audio and video materials in learning is that of the reason for students' use of those materials. To the relief of educators who fear that podcasting might discourage lecture attendance, studies generally find that students are not using podcasts to replace lectures. Clark found that 41% of students used podcasts to reinforce learning whilst only 4% used them to replace lectures (Clark, 2007). Malan found that 45% of students used podcasts for review, and 18% valued podcasts as an alternative to lectures, despite there not being a detected 18% drop in attendance (Malan, 2007). Laurillard offers an explanation as to why podcasts are not generally being used as a replacement for lectures in the discussion of *narrative media*.

It is that the limitation of such media forms 'cannot respond to their audience's enquiries, and the learner must make what they can of them' (Laurillard, 2003).

For this work, two problems needed to be solved, and it is against this backdrop of the application of video media in education, that a solution was found.

2. PROBLEM DESCRIPTION

Within the Computer Science department, two modules are closely related. A level two Software Engineering (SE) module requires teams of students to build a software system over the course of two terms. A level three Project Management (PM) module requires pairs of students to act as project managers for those teams formed in the level two SE module. Problems were identified in both modules, each of which is discussed in turn below.

2.1 Project Management Problem

For the Project Management course, the instructional design centers on weekly lectures with practical sessions that allow students to perform their duties as project managers. The relationship between the Project Management course and project management practice is, therefore, built on the study of project management theory along with case studies of project management practice in the real world. Beyond the experiences of the project managers with their teams, there is little exposure to practitioners who manage software or IT projects in industry. Without this linkage, there is a danger that students will not be able to relate the theory with practice in a meaningful way.

2.2 Software Engineering Problem

As part of any software producing team, it is essential that each contributing individual have the appropriate

tools that are configured in such a way that they can access central resources. In the case of the academic year 2007-2008, these level two software engineers were required to use the Eclipse development environment in conjunction with a central Subversion repository. The problem here is to inform students how to install and configure the software, without having to write lengthy instruction sheets that would have to explain each menu option, dialog box and procedure.

3. SOLUTIONS

Video media, made available online, was identified as a potential solution for the problems identified above. In both cases, the problem is not concerned with the delivery of examinable course material, but is related to supporting students in the modules as a whole.

The chosen solutions will be outlined, whilst justification for the decisions taken is presented afterwards. In both solutions, Flash Video (FLV) was used for its cross-browser, cross-platform support.

3.1 Project Management Solution

To support the project managers, the solution adopted was to film interviews with a number of project managers. Interviewees were chosen from different sectors of industry, including consultants, product companies, games developers and entrepreneurs. These interviews are structured on themes that can be found in typical undergraduate project management courses in the context of ICS degrees. The interviews have been edited to collect together relevant parts of the interviewee's responses into a coherent set of short films where each film has a single theme. The themes chosen were:

- Advice
- Agile Methods
- Business Case
- Cost Estimation
- Outsourcing
- Politics
- Risk
- Skills
- Starting a Project
- Structuring a Project
- Tools

Figure 4 - Project Management Video

Each film has a short duration, typically less than 15 minutes, and has been made available via the web. The web portal can show each film in the browser and also allows the user to click the 'full screen' button to watch the film in full screen mode. There is also a facility to download a high quality version that can be used for embedding in presentation software such as PowerPoint or Keynote.

This allows for the following forms of use:

1. Students can watch the films in the browser, as shown in Figure 4.
2. Students can watch the films in the browser, but in full screen.
3. Staff can play the video in a lecture by visiting the web page, and displaying full screen.
4. Staff can download the higher quality version and embed this in a presentation.

A significant advantage of allowing full-screen video from within a web page is that the barrier for entry is much lower, potentially avoiding 'techno-stress' (Al-Fudail, 2007) that sometimes deters from adopting technology and media in lectures or classrooms. Teachers are able to present the videos by using the web page.

3.2 Software Engineering Solution

In a similar manner to the Project Management solution identified above, the Software Engineering solution used online web-viewable media as the primary means for delivering support material. In a technique sometimes referred to as 'screen-casting', software is used to record the activity on a computer's display directly, without the need for a camera, and to make that available as a video. In this workflow, staff members would use screen-casting software to record some activity on their computer, for example, showing how to configure an IDE for use with a subversion repository. This would then be encoded in a format suitable for a web site, and uploaded. The web portal is driven by WordPress – blogging software that also allows for video

content. Here, students can watch the videos in full screen mode, or in windowed mode. Students can also comment on entries.

4. JUSTIFICATION FOR THE SOLUTION

At this stage of discussion, it is reasonable to allow the term 'podcast' to be used to describe the potential solution, as this word is typically use to describe the distribution of audio and/or video material. In allowing for a loose interpretation of the word 'podcast', a set of relevant literature is made available for discussion.

4.1 Teaching-Driven

Podcasts' usage characteristics can be characterised as being (i) Teaching-driven; (ii) Service-driven; (iii) Marketing-driven or (iv) Technology-driven (Harris and Park, 2008). For both of the identified problems, the intended use is to *augment teaching*, one of the *usages* of the *Teaching-driven* category; more specifically: in providing *additional lecture content*, one of the five identified activities in this area. Where this work differs from the standard view of podcasting is that the material is not principally concerned with lecture material, but in material that supports student learning. In the case of the SE problem the intention is to assist students in setting up their working environment, and in the PM problem, to provide a means by which students can relate their studies to real project management activity in industry. This subtle difference between instructional (possibly examinable) material and support material, a difference not typically identified in the literature, can allow for the adoption of podcast technology as a means for fixing particular problems whilst remaining relatively low-risk, in terms of learning and teaching.

4.2 m-Learning?

It is important that consideration is made for the mechanism by which video media is distributed along with consideration of the devices for which the content should be targeted. Again, attention is turned towards the recent trend of research in the area of podcasting. Podcasting, as a word that is formed from the product name 'iPod' and the activity of 'broadcasting', suggests that the target for podcasts is a mobile device. However, as research has shown (Evans 2008, Copley 2007), the likelihood of students viewing video content on a mobile device is low.

For the SE problem, this is critical. Mobile devices typically have a 'small' display, in comparison with desktop computers. For example, the iPod Touch has a pixel resolution of 480 by 320 pixels at 163 pixels per inch whereas a typical 17" desktop display is 1280 by 1024 pixels at 90 pixels per inch. This means that both display real-estate and physical display size are much smaller on a mobile device, and necessarily so. However, making a video of how to configure software through a screen-capture recording of a desktop computer would make watching the same video on a mobile device untenable.

4.3 Subscription

Podcasting has two characteristics that differentiate it from other forms of media distribution; that there is regular addition of new content and that there is an ability to subscribe to such content (Brittain, 2006). For the Project Management solution, the element of subscription was not required as the content was well defined from the outset, and once the materials had been produced, it was not expected that further content would be added in that academic year.

For the Software Engineering solution, however, the intention was for content to be added throughout the year, particularly when materials are produced in response to student feedback. WordPress, the chosen platform for the SE solution, allows students to subscribe to the blog, and can therefore see when new content is made available without specifically having to visit the website to check.

5. EVALUATION

Quantitative evaluation was made for the Software Engineering solution whereas a qualitative evaluation was made for the Project Management solution. For the Software Engineering portal, visitor-tracking software was used. Table 1summarises some of the statistics reported by the tracking software.

Measure	Value
Total Hits	2965
Unique visitors	424
Visits to most popular entry	346

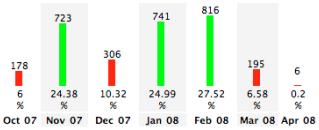
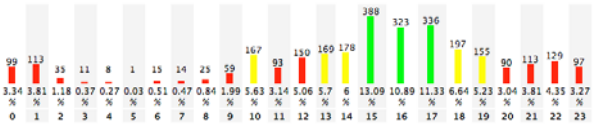
Visits per month	
Visits per hour of day	

Table 1 - Software Engineering Portal Statistics

Software Engineering students mostly visit the portal during term time, and during the early afternoon, although there is significant traffic late at night.

For the Project Managers, a simple student-survey was used with 14 respondents. Key findings are:

- All respondents believed the quality to be sufficient.
- 93% (n=13) believed that the material taught them something new.
- 86% (n=12) believed that material gave them some further insight into project management.

The free-text feedback did indicate that the aim of the video material was successful:

> *"As a student, it is very interesting to see actual project managers talking about the techniques we are learning about."*
>
> *"It reinforces that project managers do think about PM issues in the real world - although I knew they did anyway it was kind of alien in that it was a separate entity which I had never seen (PM type people in industry talking about PM stuff) before (if that makes sense!)"*

An interesting finding was that students would have been very much interested in being involved in defining what questions were asked of the Project Managers. This poses an interesting direction in which to take this work.

6. Conclusions and Recommendations

The cost in producing these video support materials was not onerous, and other research also indicates that the software and hardware available today makes the process relatively straight-forward and does not incur large costs (Larraga, 2007).

Filming and distributing recorded lectures is not the only way in which students can be supported by podcasting technology. In the case of the Project Management module, filmed interviews were a good way to bring the experiences of industry into the learning and teaching environment. The opportunity here is to extend this by allowing students to contribute their own questions or queries to such a project.

A key barrier to entry for using video materials in-lecture is that of video formats and the ability to play different formats in different software. Using web-based video, particularly Flash Video, these issues can be avoided, but at the cost of requiring the in-lecture computer to be connected to a stable network.

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CONCEPT MAPPING IN LECTURES

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ABSTRACT

Concept maps are an aid to a deep learning strategy. Developing concept maps would help students understand the relationships between concepts both within a domain and across related domains. To encourage students to explore the use of concept maps, we have integrated concept maps into a module's lectures. We have trialled: a concept map developed by experts and given to students; another concept map developed collaboratively by the students in an interactive lecture supported by a free-text response system; and finally a concept map developed incrementally in a series of lectures.

Keywords

Concept maps, Free-text response, Interactive lectures

1. BACKGROUND

The Computer Systems level-one module is concerned with the historical, technical, and social issues surrounding complex distributed computer systems and is composed of four discrete sub-modules Machine Architecture, Databases, Operating Systems and Networks. The sub-modules are taught consecutively and assessed separately. To achieve a meaningful understanding of the concepts covered in the module students must apply a deep learning strategy [1]. We believe that concept maps introduced and used within the lectures of the module, will support students to achieve a deeper understanding of distributed computer systems. The funding for concept modelling software and a personal digital assistant (PDA) to enable experimentation with different styles of concept modelling techniques on a small range of hardware devices was provided by Durham University's 'Enhancing the Student Learning Experience Awards'. The Centre for Excellence in Teaching and Learning Active Learning in Computing (ALiC) has purchased a large number of PDAs for exploring the use of mobile technologies in learning. We used these PDAs with interactive lecture software as a free-text response system. We have introduced three variations of the development of concept mapping: expert developed, cohort developed, and incrementally developed over successive lectures.

1.1 Concept Maps

Biggs [1] recognizes the usefulness of concept modelling techniques as an aid to deep learning. Concept maps are a graphical representation of knowledge within a specific domain. Concepts are represented by labelled geometric shapes, each representing a single concept, linked by labelled lines which illustrate the relationships between the concepts. The overall structure of the map conveys meaning as to the concept's relationship with each other and within the domain [2-4]. Concept maps support a deep learning strategy as they force students to scrutinize concepts and the associations between different concepts [1, 5]

Concept maps are a versatile learning tool as they support the capture of the tacit knowledge held by experts and the means of sharing that knowledge with students [3]. Concept maps generated by experts within a domain are expected to accurately depict the concepts and their associated relationships. Concept maps developed by experts in a domain have been proven to be good study aids [3, 6].

However, study materials prepared by a lecturer have a lecturer's imposed structure. Horgan [7] maintains students will learn more when allowed to structure their own understanding of the domain. Students may take a great deal of time to develop a concept map because often students will have to be trained in the practice of using and developing concept maps while trying to gain a deep understanding of the domain [3, 6].

Wingate [8] advocates embedding the teaching of study skills in the teaching and learning of subject content. For the Computer Systems module this meant using the concept maps initially as a study aid and to demonstrate expert knowledge then ensuring that students were able to add their own understanding to their personal copy of the concept map. Students need to be helped to recognise that concept maps are never finished [6] but instead are something that can be modified and grown as understanding of a domain increases. By allowing students to download and control their own version of a concept map, they can decide the rate and extent of growth of their own concept maps.

Collaboration is a key part of the constructivism theory of education where working with peers and contributing to a community's learning will improve the depth of an individual's learning [9]. A learning community's knowledge should be developed in a democratic manner where everyone has the right to access, correct, and increase the community's collection of knowledge [10]. Concept maps can be used to capture and share the knowledge held by a community of learners. A central concept map developed by the community can be used to share understanding. However it must be recognised that the shared understanding does not impose agreement or compromise [4]. Individuals within the community need to be able to structure and control their own knowledge and therefore need to develop their own version of a concept map developed by a community of learners.

A concept map can represent only so much knowledge [3] and it may be sensible to provide concept maps that can support additional objects, for example links to more traditional text information, podcasts or other concept maps. The software used to support the creation and continual development of concept maps in this work has mechanisms for linking to additional learning objects (video, text documents, and web pages) without detracting from the visual clarity of the concept map.

Inspiration [13] has been developed to support people building graphical representations and visual structures of their knowledge. It provides facilities to build concept maps as well as a mechanism to translate from text to diagram or diagram to text to aid those people who prefer text-based learning. It also provides mechanisms for linking to additional knowledge objects such as videos or web sites. Inspiration version 7.5 is available to our students through the university network.

1.2 Interactive Lecture Software

Lectures are a proven means of providing background information and discipline-specific concepts to students who are new to a discipline and do not, as yet, have the learning skills necessary for study at a higher education level [7]. However, lectures are considered difficult learning environments. Lecturers use a range of methods to increase student engagement during lectures including 'guided notes' [11] which encourage students to focus on specific concepts; and 'interactive windows' [12] where lectures have pre-determined breaks to allow students time to work on problems or exercises. One of the difficulties in providing in-lecture exercises is determining the level of success achieved by students. Deep learning is improved in lectures where lecturers can adjust the pace and content to reflect the students' needs [13].

On-line sets of Multiple Choice Questions (MCQs) have proven useful for providing students with quick formative feedback [1]. Higher education (HE) virtual learning environments (VLEs) usually provide facilities for lecturers to develop MCQs for use by students wishing to assess their own abilities [14]. Personal response systems (PRS) expanded the use of MCQs, allowing lecturers to set MCQs as in-lecture exercises that capture and display the students' responses during the lecture. Lecturers can use the responses to support students' deep learning with timely feedback and correction of misconceptions [13]. A richer, more meaningful dialogue could occur if the PRS provided a mechanism for less controlled responses, for example a response-mechanism that would allow students to respond using their own words.

The arrival of wireless technologies in HE Institutions has enabled the use of mobile technologies such as PDAs and laptop computers anywhere on campus including lectures. The wireless infrastructure enables students to access learning materials anytime and virtually anywhere [15]. ALiC has purchased a large number of PDAs to explore the use of mobile technologies in learning. We have used some of the PDAs to mimic student-owned mobile devices that would allow students to provide lecturers with spontaneous text responses to questions posed during lectures.

WIL/MA (Wireless Interactive Lectures/ Mannheim University) an open source software [16] was developed to allow the lecturer to get instantaneous feedback from the students to see if they had understood the concepts under discussion. Interactive lecture technologies are generally accepted as a good way of maintaining student attention and supporting student assimilation of knowledge within lectures[17]. The software is fully programmed in Java and has versions that run on PCs and PDAs. We were able to use the PDAs to allow students to: anonymously respond to preset multiple choice questions; use the SMS facility to respond to preset questions using free-text; ask impromptu questions based on earlier question/response exchanges; and gauge the opinions of the students using a feedback slide meter. In addition, the software WIL/MA has a mechanism that can allow the lecturer to select whether or not they want to share the collection of responses with the students. For example a lecturer may want to ascertain how many different examples of a concept a class of students would supply when not specifically challenged to find different examples. The PDAs used are not single purpose devices and, like any student-owned mobile device, contain software that can distract students from the lecture if the students choose to be distracted.

2. EXPERT DEVELOPED CONCEPT MAP

The first sub-module to be delivered in the Computer Systems module is Machine Architecture; a sub-module intended to introduce the students to concepts such as Boolean algebra, logic circuit design, binary arithmetic, and computer hardware.

2.1 PDAs and WIL/MA

Lectures in the Machine Architecture sub-module usually include one or more in-lecture exercises for students to perform and then compare their answer to a model answer supplied by the lecturer. Students will interact with peers while working on the in-lecture exercises. However, exchange of insights is usually confined to students sitting near each other. The lecture rooms are structured so that a lecturer cannot walk around looking at student work making it difficult for the lecturer to determine if the class is ready to progress. This lecture environment afforded an opportunity for an initial trial of the PDA hardware with WIL/MA. It was

[13] Inspiration Copyright 1988-2006, Inspiration Software Inc.

decided the initial trial would occur over a single lecture. We designed four multiple choice questions based on the in-lecture exercises intended for the lecture. As the students have a tendency to engage with their peers while working on in-lecture exercises, we decided to provide PDAs primarily to pairs of students. We distributed 39 PDAs to the 68 students in the lecture. A member of ALiC acted as observer during the trial, thereby allowing the lecturer to focus on the delivery of the lecture and the exchange with the students. Another member of ALiC was given the responsibility of liaising with students to get the PDAs distributed and running. It was explained to the students that this was a trial to see if the technologies would hold up in a live lecture and that they should be prepared to hand back the PDAs quickly if the trial had to be abandoned.

It took eight minutes to get all the PDAs active and connected to the university wireless network and calm the students down sufficiently to start the lecture. It was observed that initially the students' reaction to the technology was positive. Answers came from 32 PDAs for the first two multiple choice questions. Three PDAs had technical difficulties and four pairs of students had difficulty with the interface. The tally of the responses was shown on the screen at the front of the lecture room and it was possible to see that most students had achieved the correct result. It was also possible to correct the misconception that led to some students choosing the incorrect response. It was observed that a significant minority of students then disengaged from the lecture to explore the other software available on the PDAs. This caused some disruption to the lecture as students could exchange messages through the PDAs. One pair decided to play solitaire while another pair experimented with Bluetooth [14] technologies by uploading files from their mobile phone.

Those students who had not disengaged from the lecture were not rewarded for their efforts. The university wireless network had rebooted and closed the connections to all inactive PDAs. The capacity of the wireless network at the time was insufficient for our needs. Re-establishing the connections proved too disruptive and it was decided to abandon the trial in favour of completing the lecture.

Most Computer Science students enjoy the prospect of exploring new technologies. It might be that, once students are given the opportunity to explore the uses of the PDAs, the newness will fade and students will use them as intended during lectures. However, students using laptops in lectures are the minority in our Computer Science department and informal observations indicate that students are more likely to engage with software unrelated to the lecture occurring around them.

2.2 Concept Map

Level-one Computer Science students have a varying range of study skills that may or may not include the use and development of concept maps. Therefore an expert-developed concept map for the Machine Architecture sub-module was created and then demonstrated to students at the end of the last lecture of the sub-module and a week prior to the assessment for this sub-module. It was explained to the students that two copies of the concept map were available on the VLE, a static version stored as a Word document and a modifiable version stored as an Inspiration file. Students were invited to review the concept map, and download a copy to alter to suit their own learning. Students where told where to find the Inspiration software and its associated user support documents. It was explained that it was possible to translate the graphical concept map into a text based outline for those students who prefer text.

3. COLLABORATIVELY DEVELOPED CONCEPT MAP

The second attempt, using concept maps to improve students understanding of distributed computer system foundational concepts and the links between them, was done at the end of the series of Operating Systems lectures. We used interactive lecture technology, the PDAs and WIL/MA, to encourage the students as a community of learners to engage in the development of a concept map for Operating Systems. The map was developed a week before a written assessment exercise for the Operating Systems sub-module was due. It was intended that the development of the concept map and its subsequent use by individuals would contribute to an improvement in answers to two questions in the assessed work, which require students to understand several concepts and how the concepts link together.

Thirty-nine PDAs were distributed to pairs of students. A router, separate from the university network, was used in the lecture room to support the wireless technology and ensure that PDAs stayed logged on for the duration of the concept map development. It was estimated that it would take twenty minutes for the students to make a generous contribution to a concept map. The estimate was based on knowledge of the students' attention span and time constraints in the lecture schedule. A member of ALiC was asked to observe students during the exercise and another member of ALiC was given the responsibility of liaising with students

[14]

to get the PDAs distributed and running while the lecturer focused on the dialogue with students. It was explained to students that the intention of the exercise was to develop a concept map that demonstrated their collective understanding of concepts within Operating Systems. It was further explained that there did not have to be complete agreement and that the lecturer would present a majority view for inclusion in the VLE that students could subsequently modify to reflect their individual knowledge structure.

The lecturer started the Operating Systems concept map with two Machine Architecture concepts (RAM and the CPU) and one Operating Systems key concept (the Process). There began a dialogue where the lecturer asked students for key concepts then, based on the students' responses, added concepts to the concept map. WIL/MA's SMS functionality allowed the students to send free-text responses via their PDAs in reply to the lecturer's questions. The dialogue continued and a concept map emerged that contained key concepts, labelled relationships between key concepts and some sub-concepts. The structure that emerged was web-like for key concepts and hierarchical in sections with sub-concepts.

The lecture room contained one screen that was used to display the evolving concept map. Students submitted short descriptions of key concepts quickly. The student responses were displayed on a laptop seen only by the staff in the lecture. The lecturer selected a description of a concept based on the submissions from the students. Students also responded quickly when asked to supply locations of links between key concepts. The submissions from the students slowed down and the number of participants decreased when the questions became more probing, for example meaningfully labelling the links between concepts.

Twenty minutes proved to be insufficient time to complete the map. The sub-concepts that had been submitted by students but not entered on the map were saved for later and used in the finished map. Generally, students' attention to the task lasted slightly less than twenty minutes. As the questions got more difficult, students disengaged and a significant minority began to explore the different software on the PDAs.

Informal discussions with students over the next two weeks indicated that they preferred submitting free-text response to selecting from predetermined responses. Staff and students both feel that more students would have responded to the more probing questions if example phrases from student responses had been displayed. It should be noted that it was difficult to regain control of the class after the concept mapping exercise.

4. INCREMENTALLY DEVELOPED CONCEPT MAP

For the final sub-module, Introduction to Networks, a concept map based around the 5 Layer Internet model was used at the start of lectures. The concept map was used as the foundation for a summary of concepts discussed in previous lectures. The map grew incrementally over the 10 lectures. Students were encouraged to comment and contribute to the development of the concept map. However, we did not use the PDAs as they take a significant amount of time out of a lecture to distribute and retrieve. Contributions from the students were few.

5. RESULTS

Analysis of the impact of the concept maps on students' achievement in the module will be based on the results from the questionnaire that was distributed to students at the end of the final term, and the detailed analysis of several pieces of assessment including the end of year exam.

Students were asked to complete a short questionnaire about their use and adaptation of the concept maps at the end of the final term. There were 57 replies to the questionnaire (84% of the cohort). Of those that replied, 28% have made use of one or more concept maps in their note taking or assessment preparation; 37% have not used them but indicated that they plan to use them as part of their revision for exams; 12% have opted not to use them; 2% have created their own; and 21% selected the 'What concept maps?' option on the questionnaire. Only two students copied and personalized one or more of the concept maps.

6. FURTHER WORK

The collection and analysis of the rest of the data associated with the module will be completed over the summer. Decisions on the further use of concept mapping in lectures will be based on the outcome of the data analysis. Decisions on the further use of the PDAs to elicit free-text responses from students will be based on the confidential end of year module questionnaires and comments made by students to the departments' Staff Student Consultative Committee.

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AND NOW FOR SOMETHING COMPLETELY DIFFERENT: LEARNING PROGRAMMING WITH PYTHON

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ABSTRACT

This paper is about using Python as an introductory programming language. It starts by considering the rationale for using Python to teach programming, and describes how Python can be used across the computing curriculum. It then describes the experience of teaching programming using Python, and presents some of the outcomes.

Python is a language that appears at first sight to have much to offer for teaching. It has a clear and readable syntax. It is possible to write reasonably impressive programs with a very small amount of Python code. Users in industry include Google, YouTube and NASA. It is a little surprising that Python's adoption as a teaching language is not already widespread.

Python was adopted by the School of Computing at the University of Leeds in 2007 as the main language for teaching programming. It replaced Java. After the experience of this year there are certainly no plans to change back.

Keywords

Teaching programming, Python, retention.

1. PYTHON

Python is a mature, well established, very high-level programming language renowned for its clear, readable syntax and for the significant productivity gains that it brings to programmers brought up on lower-level languages such as C or Java. It has been used successfully in thousands of real-world business applications, including many large, mission-critical systems, by companies such as Google, IBM, Hewlett Packard, Industrial Light and Magic, Disney and Nokia. It is also increasingly popular in academic and industrial research, where it has been used for space shuttle mission design, biomolecular modelling, control of large-scale physics simulations and the analysis and visualisation of weather radar data, to give but four examples.

Python is free, and is available for all major platforms.

1.1 Python in Education

Python has a long history as a language of interest to educators, dating back to 1999's DARPA-funded Computer Programming for Everybody (CP4E) [1] project and beyond. There are many resources dedicated to the teaching of Python in high schools and the language plays a central role in the One Laptop Per Child project.

Unsurprisingly, Python has also been gradually making inroads into the teaching of programming in universities. It has been used to teach programming to physicists at Oxford and at Caltech. It is used to teach computational neuroscience at Berlin's Humboldt University and is the programming language of choice for the Informatics in Biology course at the Pasteur Institute in Paris. Within the realm of computer science, Python is now being used by some institutions to teach introductory programming (for example, in addition to Leeds, Coventry, Glasgow, Michigan State University and, notably, MIT) and by others as the vehicle for practical work in more advanced topics, (for example Natural Language Computing at the University of Toronto or courses on the Semantic Web at the University of Maryland).

Python has also been seen as an ideal language to use to introduce young people to programming [3]. Children as young as 8 have been able to use Python to write simple programs.

Python is now also the first programming language that students encounter in the School of Computing at the University of Leeds.

1.2 Not a Language War

It is not the intention of this paper to provoke a language war, even if some would like to have one. Suffice to say, the traditional first program rendered in Java is something like:

```
public class Hello {
  public static void main (String args[])
  {
    System.out.println ("hello, world");
  }
```

In Python, the same program is rather shorter, more elegant and more comprehensible to the novice programmer:

```
print "hello, world"
```

The observations that can be drawn from this are obvious, and will not be laboured here. Our experience is that these observations scale to larger programs.

Other features of Python that point to its suitability as an introductory programming language have been discussed at length elsewhere [6].

1.3 Python at Leeds

Python was first used as a teaching language at Leeds in 2002. It was initially used as an introductory tool before moving the students on to a different language, first C++ and later Java. The main motivation behind this approach was the need to find a way to introduce basic programming concepts (loops, variables, functions) before having to teach a language where these concepts were to an extent obfuscated.

Experience was that this approach gave improved results with C++ and Java [5].

Python was also core to a programming project introduced into the first year in 2005. This project gave the students the flexibility to develop any application (within a few constraints) that they chose; they were required to do so in Python. The results were impressive and encouraging, with many students quickly able to produce work of which they could be proud. They were certainly able to produce much more impressive work with Python that they were with their other programming language, at the time Java.

This result provided the motivation (and also the ammunition) for a change in the main programming language taught. A proposal was made in 2007 that Python should be used as the first programming language. This was approved, perhaps a little surprisingly, *nem con*, with no need for a language war.

So, from the start of the 2007/08 session, Python was adopted as the main teaching language.

2. PYTHON IN THE CURRICULUM

A potential risk in changing first programming language is that the new language cannot be used in other areas of the curriculum. Happily, Python benefits from the availability of a huge number of add-on libraries and modules that means it is possible to use Python across most, if not all, areas of a modern curriculum.

To illustrate this, some examples, focussing on important areas of the curriculum at Leeds, follow.

2.1 Computer Science

Python's clean, high-level, indentation-based syntax and provision of fundamental data structures such as lists, tuples and dictionaries make it a compelling choice for the teaching of algorithms. Chou [4] reports significant success in using this approach with graduate students at the University of California, Irvine. He has found that algorithms printed in textbooks can be translated with relative ease by students into working Python code.

The following example is taken from Chou's paper. On the left is an insertion sort algorithm, from Cormen et al's *Introduction to Algorithms*; on the right is the corresponding implementation in Python:

```
Insertion-Sort (A)
1  for j ← 2 to length(A) do
2      key ← A[j]
3      i ← j – 1
4      while i > 0 and A[i] > key do
5          A[i + 1] ← A[i]
6          i ← i – 1
7      A[i + 1] ← key
```

```
def InsertionSort(A):
    for j in range(1, len(A)):
        key = A[j]
        i = j-1
        while i >= 0 and A[i] > key:
            A[i+1] = A[i]
            i = i-1
        A[i+1] = key
```

The implementation is compact enough to be typed in during a lecture, and demonstrating it in action is trivial, thanks to Python's interactive prompt:

```
>>> x = [2, 7, 3, 8, 1]
>>> InsertionSort(x)
>>> x
[1, 2, 3, 7, 8]
```

That makes 11 lines of code in total (8 to implement the algorithm and 3 to test it). The equivalent in Java is over twice as long (too long to reproduce here) and harder for programming novices to understand. This difference in complexity becomes even more marked when implementing graph algorithms, a task shown by Chou to be trivial in Python but distinctly unpleasant in C, C++ or Java.

There are other resources available that may help in the teaching of more advanced CS topics; compiler design, for example, could be taught in Python using tools such as PLY or PyParsing.

2.2 Artificial Intelligence

Stuart Russell and Peter Norvig's *Artificial Intelligence: A Modern Approach* is the leading AI textbook, with over 90% market share. Python is one of the three officially supported implementation languages for the algorithms presented in this book, the other two being Lisp and Java. Interestingly, Prolog is not supported officially by the authors. There is also the suspicion that Java may be included because of its ubiquity as opposed to its suitability.

Peter Norvig has published a fascinating detailed comparison of Python and Lisp [7], containing examples that further demonstrate its suitability for teaching aspects of AI. He describes Python as "an excellent language for my intended use" and goes on to say:

"Python has the philosophy of making sensible compromises that make the easy things very easy, and don't preclude too many hard things. In my opinion, it does a very good job."

Norvig presents side-by-side listings of Lisp and Python code to generate random sentences from a grammar and comments that "both languages seem very well suited for programs like this".

Python is being used to solve many different problems in AI, providing useful source material for AI teaching. Pyro, the Python Robotics project, is one example. Another is NLTK, a popular toolkit for natural language processing used at over forty other institutions worldwide. The latest release of this software comes with 50,000 lines of code, 300 MB of data and a 360-page textbook that teaches both Python and NLP. Image processing and computer vision can be supported by various Python toolkits, including: PIL, the Python Imaging Library; SciPy, a framework for scientific computation that rivals Matlab and includes image processing capabilities; and OpenCV, a library for real-time computer vision applications that includes Python bindings.

2.3 Networking

Socket-level programming in Python is straightforward, but it is with the higher-level protocols that Python really shines. A famous example is that, using modules provided with the standard library, it is possible to implement a functioning web server in just a few lines of code (in fact, it can be done in one line).

Python network programming was in fact introduced in the first year that Python was being taught. On learning that the students were learning Python, a colleague teaching networking was easily able to get the same students implementing simple network applications and protocols.

For demanding applications such as final-year projects, the Twisted framework provides much more extensive protocol support, along with facilities for asynchronous, event-driven network programming.

2.4 Web Development

Java has traditionally dominated in this space, but there are clear signs that the messiness and complexity of J2EE and related technologies is driving developers away from Java [8], towards cleaner, lightweight solutions based on Python or newer languages like Ruby. Significant web applications such as YouTube are implemented in Python; a software architect at YouTube has explained that it enables the production of "maintainable features in record times, with a minimum of developers" [4]. Google make substantial use of Python, and currently employ the language's creator. Teaching web development concepts using Python therefore makes sense not just from a pedagogical standpoint, but also because there is likely to be a growing demand for these skills from industry. Nor is it difficult to persuade students to learn the technologies behind Google and YouTube.

Python-based web development frameworks such as Django offer a complete web application stack, including an object-relational mapper, an automatically generated administration interface, template system, caching system, and so on. These features enable the rapid development of database-driven applications such as Hewlett-Packard's innovative Tabblo photo-sharing site, videolectures.net, a repository of over 1,200 computer science lecture videos, and ResearchPages, a social networking site for scientists.

3. "PYTHON IS COOL"

Previous experience had shown that students often become disillusioned with programming. This leads to a loss of engagement and, in some cases, failure. Conversely, many experienced programmers greatly enjoy developing applications. A key reason underpinning the change to Python was that it would enable students to get to the stage of developing interesting applications as soon as possible. A student is unlikely to be passionate about a program that calculates the average mark on a test, but they just might be passionate about developing a game to show their friends. And the students needed to get to this stage as quickly as possible.

A key aim, then, was to convince the students that Python, and hence programming, and indeed computing in general, was Cool. In practical terms, this translated into the aim that all the students should be able to develop something they were proud off within ten weeks of starting the course.

4. TEACHING PYTHON

Designing an introductory programming module using Python is not much different to designing one using any other language, so there is no need to dwell on the details. The framework was a module lasting the entire session and intended to occupy about a sixth of each students' time. There were about 100 students, ranging from those who had chosen hard-core computer science to those for whom computing was a small part of their degree.

The thorny issue of when or whether to deal with object-orientation does not really arise. Python is an object-oriented language, but initially objects can be ignored as they do not appear in simple programs, which can essentially be written procedurally. The need for objects emerges naturally when more advanced features and particularly add-on libraries are introduced, when the students end up writing object-oriented programs without perhaps realising they are doing it.

The main difference in the module design was more in the speed at which it was possible to proceed. Following an introduction (featuring plenty of "cool stuff" and a good deal of name dropping of users of Python), the basics of programming were covered in about six weeks. This formal contact time involved here consisted of 12 one-hour lectures, and a weekly two-hour lab session. All the evidence from meeting the students in the labs was that they were "getting it", so it was then possible to start introducing the required extras to allow them to develop something.

To allow them to develop something cool, two libraries were then introduced to the students, and they were given the choice of using either or both to develop a project of their own choice. Pygame is a library for developing graphical applications, as the name suggests, usually games. PySQLite is a Python interface to the lightweight SQLite database engine. A lecture and a lab session were provided on each, and the students were left to develop their projects. Students were also encouraged to make use of the substantial standard library of modules that ships with the Python distribution.

5. RESULTS

The results, in terms of the standard of the projects produced, were impressive. To those who had proposed and promoted the change of language this was something of a relief.

Not surprisingly, the vast majority of the students developed games[15]. There were multi-player networked games, platform games, puzzle games, and games that defied classification. Some of them were very good indeed; as might be expected these had often, but not always, been produced by those students who had previous programming experience.

But even those who had no previous experience had managed to produce something of which they should have been proud. Some of the games produced by students from groups who have traditionally struggled with programming (those on joint honours courses, for examples) were still of a high standard. It was this aspect that was especially pleasing – there was little evidence that these students were becoming disillusioned. They seemed to be enjoying it.

Thinking back, the equivalent cohort of students the previous session (learning Java) had at this stage been writing programs to process sequences of numbers to calculate averages and the like. A year later, a group that can reasonably be assumed to have been of a similar academic standard was producing graphical and database applications. What had changed was the language they were using.

[15] The stereotypical view that male students prefer "shoot 'em up games" set in space while female students are more likely to develop puzzle or non-violent games is very true indeed.

There is obviously more to evaluating the programming ability of the students than simply looking at some coursework. A mock exam was set half way through the module; with a very few reservations this was set to be of the standard that a student would have been expected to attain by the end of the year. This was admittedly a risk, but the results were thankfully reassuring. Two thirds of the class passed, most comfortably. Most of the fails were marginal, with hardly any disastrous results. This provided clear evidence that this year's class could "program better" then in previous years.

This success did raise an issue. What was there to do in the remainder of the module? Object-orientation as covered more formally, and then there were sessions on design and testing. There was also the chance to introduce some more cool stuff; for example Python has some very cool ways to automate program testing, and there were also sessions introducing the Django web framework and WxPython toolkit for developing GUIs.

6. CONCLUSIONS

We are not claiming here that using Python to teach introductory programming would solve all the problems usually associated with this part of the curriculum. We are claiming that, for us at least, it does seem to have worked remarkably well so far. There is certainly no way that we would currently consider returning to a lower-level language such as C++ or Java.

There remain some issues to overcome. The main one is that there is still a lack of good textbooks that use Python. There are plenty aimed at the more professional programmer end of the market, and we used these with some success, but there is little suitable for programming novices. There is also a vicious circle, whereby publishers refuse to commission Python books on the ground that few places teach Python, and institutions are reluctant to adopt Python due to a lack of books.

But overall this has been a most encouraging start.

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MAKING BEST USE OF A VLE IN THE DELIVERY OF A FIRST YEAR DATABASE MODULE

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ABSTRACT

This paper briefly considers a small case study indicating some simple but effective ways of using technology to enhance students' learning in the context of a first-year face-to-face introductory Database module. The team responsible for the module chose to incorporate a selection of the facilities that were readily available within the institutional Virtual Learning Environment, and their reasons for such inclusion together with their conclusions are presented here.

Keywords

e-learning, Technology-Enhanced Learning, Virtual Learning Environment, Feedback, Self-Assessment, Audio

1. INTRODUCTION

The delivery pattern for the first year Database module at Leeds Metropolitan University has changed over the past few years in several ways. There have been variations in delivery length (7 or 14 weeks) and the length and nature of face-to-face sessions (large-group lectures, small-group tutorials or laboratory sessions).

The current pattern, begun in September 2007, consists of two three-hour sessions per week for 7 weeks, delivered in rooms that are flexible as to their use for tutorials or practical work. (Discussions about flexible learning spaces are ongoing at Leeds Metropolitan, as elsewhere [4].) This new pattern, with no lectures, meant that the module team needed to rethink the delivery strategy. At the same time, a decision was taken to review the recurring difficulty of ensuring that students engaged with the module outside the scheduled contact sessions.

To accomplish these objectives, and in accordance with the suggestion by Skill and Young (2002) that "the creation of new learning environments should embrace both virtual and real spaces"[11], the module team looked closely at the opportunities currently offered by the Virtual Learning Environment (VLE), Blackboard Vista [1], and sought to take advantage of them in a way that would provide benefit to the students whilst minimising the staff time and effort required. One of the aims was to provide greater flexibility, with learning materials being available "at any time from many locations" [2]. Some use has been made in the past of the capabilities of a VLE in relation to this module, particularly with respect to Computer-Assisted Assessment [6], and this use was reviewed and built upon..

The attitude adopted was also influenced by the presence within Innovation North (the Faculty of Information and Technology) of a Centre of Excellence for Teaching and Learning whose aim is to promote Active Learning in Computing (CETL ALiC [3]). The other partners in this CETL are Durham University (the lead site), Newcastle University and the University of Leeds.

2. USING SELECTED FEATURES OF THE VLE

The 3-hour face-to-face sessions took place in a room where both tutor and students had access to the VLE. Tutors could make use of content placed there, including material formerly used in lectures, as they saw fit, in a formal or informal way. The VLE features available for supporting student learning were considered by the module team, and a choice was made of what was considered appropriate and useful. The choice also took into consideration the amount of staff time available to provide and support these features.

2.1 Learning Modules

VLEs generally offer units of learning structured around a Table of Contents. Each week of the Database module was given its own learning structure, known as a Learning Module, based around a Table of Contents that contained references to files and to items of other kinds such as self-assessment tests. This was designed to provide a useful organisational overview for students, inside and outside their 3-hour sessions, to help them to keep on track for their weekly tasks. The module team felt that it was especially important to provide clear structuring for first year students, who may have difficulty in ascertaining exactly what they are expected to do and when they should do it.

2.2 Using Audio

The use of audio files, including voice recordings, is receiving much attention at Leeds Metropolitan University currently. A JISC project entitled "Sounds Good: Quicker, better assessment using audio feedback" [7] is under way, and trials of audio (and video) podcasts are taking place. From the pedagogic point of view, approaches such as VARK [5] suggest that students may have different preferences for the way in which they receive information. Thus there may be advantages for students if some material is presented in audio form instead of or as well as in written form

A decision was taken to make some use of audio files in the teaching of one aspect of databases, the interpretation and implications of the Data Protection Act. There were two reasons for this decision: to support module team members (as explained below) and to provide some variety of input for students, aural as well as textual. The topic had formerly been presented in a lecture to the whole cohort of students studying the module by one member of the module team, but it would now be the responsibility of each module tutor to introduce it to a small group of students within one of the 3-hour sessions. To give some support to the other tutors, the person who had formerly lectured on this topic made several voice recordings, between 2 and 3 minutes long, giving a commentary on the different sections of a handout document summarising the Act. These could be played, through the VLE. A question sheet, with two or three questions about each section, was also available. Tutors could use these resources as they wished, typically getting the students individually to listen to a voice file whilst looking at the handout, and then as a group to answer the related questions and discuss any points arising.

The material was available within a Learning Module as shown in Figure 1.

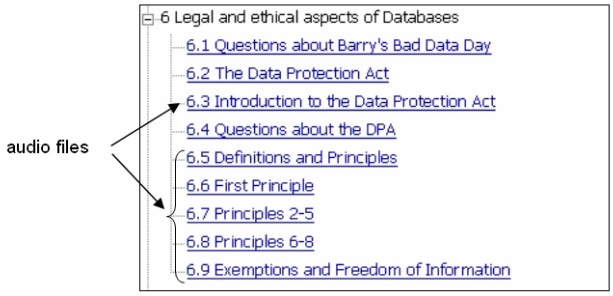

Figure 1: Learning Module

The audio files were informal and very short, and the provision of this facility was welcomed by the module tutors. Even the tutor who had recorded them played them to the students during the tutorial sessions. The module tutors who had not previously taught this aspect of the module found the use of the audio files invaluable, as it allowed them to deliver detailed content whilst not having to rely on their own still developing knowledge of the Data Protection Act. The recordings also offered a useful opportunity for students to review the material at their leisure, and supported their revision of the topic. A small number of students made use of this facility.

2.3 Assessment with Rapid Feedback

The summative assessment for the module, which took place in the final seventh week, consisted of two parts, a computer-based test containing multiple-choice questions, worth 40%, and a practical test of SQL (Structured Query Language), worth 60%.

2.3.1 Computer-Based Tests

Integrated into each week's Learning Module were two formative tests containing multiple-choice questions of a kind similar to those that would appear in the final summative test. These were to be used by the students week by week, and contained feedback against the different options. Such tailored feedback is recognised as being very helpful in supporting students' learning [10]. A typical question testing the student's understanding of data modelling notation for Entity-Relationship Diagrams is shown in Figure 2.

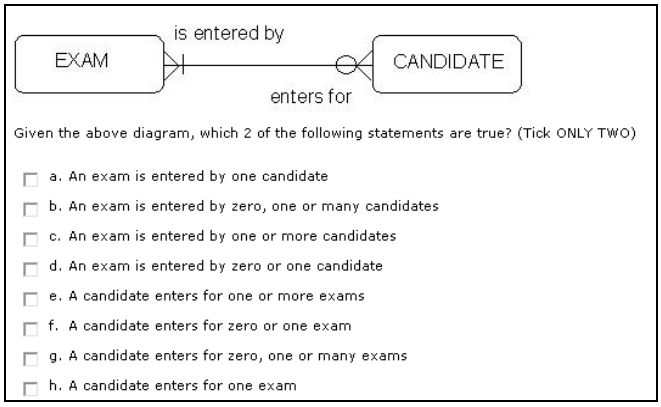

Figure 2: Example of Formative Question

Immediate feedback and a grade were available after taking each formative test, and tailored feedback was provided for each option within a question. For example, if the student selected the two incorrect options d and g, the feedback would be as shown in Figure 3.

> d: There is a crowsfoot at the right hand end of the relationship line, so many candidates are possible
>
> g: Reading the relationship line from right to left, there is a bar and a crowsfoot at the further end of it, signifying one or many without the possibility of zero

Figure 3: Example of Feedback to Computer-Based Formative Test

The final assessed test took place during a tutorial session in the final week of the module, and the grade was immediately returned to the student.

2.3.2 Analysis of Use of Formative Tests

The reporting facilities of the VLE allowed the module tutors to view what students had done. An analysis of the use of the formative tests against the classification achieved in the module showed that students gaining the higher grades in the module were much more likely to have completed the tests and few students with a third class or fail in the module had completed the tests at all. Furthermore, there was a clear difference in the number of tests completed at the different classifications, with a link between number of tests taken and the classification achieved. In the first class category, 50% of those who took part in the tests completed more than 5 and about a third completed all the tests. In the lower classifications, e.g. third class, the students had completed at most one test.

Classification	No tests	Up to 5	More than 5
1st	9%	41%	50%
2:1	54%	22%	24%
2:2	53%	31%	16%
3	89%	11%	0%
Fail	100%	0%	0%

Figure 4: Analysis of usage of Formative tests against module result

A questionnaire was issued to students to find out how they used the tests and the reasons for not using them. The most frequent reasons the students gave for not using them were split between forgetting about them and having their own study plans. There were also a small number who said they could not find them. In view of the clear link between the tests and getting higher results, these reasons seem to suggest that these students were the less motivated ones, although a few students still achieved well without them so may have had their own successful study plans. All students who used them said the tests were quite useful or very useful.

The students used the tests in a variety of ways, some as they were working through the module but most at the end as preparation for the assessment. Many students completed the same test multiple times, sometimes up to 6 times. They stated the reason for this was to understand the material better, to try to gain a

pass or 100% in that test, or to repeat a test that had already been completed earlier in the block in preparation for the assessment.

Students who did not complete all the tests did not appear to actively choose particular tests to complete; fewer students chose tests based on an area they were weak on than chose tests at random or in the order they appeared on screen.

All students said either that they would definitely use or that they might use tests again in modules if they were available.

2.3.3 Practical SQL Test

Feedback is recognised as an important element of students' learning. Feedback should ideally be rapid, and formative feedback that may help students to perform better on a subsequent assessment (sometimes called "feed-forward") is particularly useful [10]. To accomplish rapid formative feedback the assignment submission and return facility was used as follows.

Students were required to write and run some SQL in a time-constrained test in their final week. To help them to prepare, a very similar practice test was run in the previous week. At the end of the practice test, the VLE was used to upload a script containing the results of their work. The module tutors collected these scripts, marked and graded them supplying supportive feedback comments designed to help the students improve their performance (see Figure 5 for an example), and returned them through the VLE within 24 hours. The students could then view this feedback at any time from one day after the practice test until the real test a week later.

> A good submission and well done for creating a form. Putting in join conditions next time would increase your mark.
> In Task 3, you've only supplied 3 animals when 4 are asked for. This lost you 1 mark.
> In Task 6, you have left out the join conditions, which is why you have far more lines of output than you should have. (This lost you a total of 6 marks.) You need to ensure that primary and foreign key values match to get sensible output - see the example from practical Session 4 in your pink book, and the example in the summary pages 81-84 at the end.....etc.

Figure 5: Example of Feedback to Practical SQL Test

The final assessed test was dealt with in a very similar way, scripts being submitted to the VLE at the end of the test, then being marked and returned with grade and comments within 24 hours. Generous feedback was still provided as to what the student had done and how it might have been improved. This fast return of grade, together with the instantaneous return of the mark for the computer-based test, meant that students very quickly knew what mark they had attained overall for the module.

2.4 Reviewing What was Learned Each Week

The students were encouraged to reflect on their learning on a weekly basis by including in each week's programme of work (Learning Module) a section named "self assessment". Mok et al [9] suggest that encouraging students to develop their self-assessment prepares them for life long learning competence. The self assessment section gave the students 5 questions to ask themselves based on the week's materials, e.g. in the part on normalisation, "Do I know how to identify repeating groups?". This was for students to complete outside the contact time, was not revisited during contact hours unless a student had an individual question and was mainly to encourage students to become more independent learners and reflect on their learning.

3. WIDER APPLICATION

Leeds Metropolitan University, like other universities, is carefully considering how best to make use of Technology Enhanced Learning throughout its assessment, learning and teaching activities. This applies to all types of course delivery – face-to-face, online, blended, on campus or distance – and embraces activities both inside the VLE and outside it, for example in Second Life [8]. The question of Staff Development is being considered, and something similar to the Carpe Diem workshops of Leicester University [12] may possibly be adopted. Examples of the use of technology in relatively simple ways (and without huge time burdens) to support students, such as those described in this paper, may be useful in encouraging the adoption of available tools by staff who may be diffident or lacking in confidence.

4. CONCLUSIONS

A considered use of technology to enhance students' learning within a first-year module has worked well from both staff and student points of view. A selection of the facilities readily available within the institutional VLE were used to benefit the students, for example by facilitating the provision of rapid formative feedback on an assessment, whilst consideration was given to the staff time and effort available to support the module. Feedback from students through their Module Evaluation questionnaires at the end of the module has been positive, and the reactions of the module tutors regarding their workload in relation to the e-learning aspects of the module has also been favourable. The approach taken in the module could perhaps be used in a Staff Development context to illustrate some simple uses of technology to enhance learning.

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A WEB-BASED LEARNING ENVIRONMENT FOR IMPROVING PROGRAMMING STUDENTS' MENTAL MODELS

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ABSTRACT

Recent research has found that many programming students often hold non-viable mental models of basic programming concepts such as assignment and object reference. To improve those students' mental models, a constructivist-based learning model, integrating a cognitive conflict strategy with program visualisation, was proposed by the authors. In addition, a web-based learning environment has been developed to offer a practical tool for instructors and students to use the proposed learning model for teaching and learning. This paper describes this learning environment and also presents a preliminary study that was conducted to investigate the performance of this learning environment. The results of this study reveal that the learning environment is effective in helping students construct viable mental models of a relative simple concept, namely value assignment. The current aim of this work is to extend the environment to cover a number of key programming concepts and to make it available to fellow researchers and instructors for further investigation in their own teaching contexts.

Keywords

Programming Learning, Mental Models, Cognitive Conflict, Program Visualisation

1. INTRODUCTION

Given the rapidly increasing influence of IT technology and its associated high demand for skilled programmers, programming education is of significant global concern. However, current programming education seems far from successful, with many first year programming students performing much more poorly than expected in programming tasks [11]. This poor performance is undoubtedly a major contributor to the relatively high dropout rates, of around 30-50% [6], associated with Computer Science courses. While lack of problem-solving ability is viewed as the main cause of failure in programming learning (e.g. [1]), previous studies (e.g. [3]) found students often hold inappropriate understanding of key programming concepts which

may cause difficulties in solving programming problems. Unfortunately, traditional approaches to learning how to program are less than ideal when trying to ensure students develop appropriate mental models of key programming concepts. Early investigations by the authors [9] found that a large number of students still held non-viable mental models of basic programming concepts, even after experiencing a one year programming course under traditional learning approaches. To improve students' mental models a constructivist-based learning model that integrates a cognitive conflict strategy and program visualisation was proposed. The early evaluation of this learning model reveals that a cognitive conflict driven learning approach is indeed able to encourage students to engage with the learning materials and motivate them to construct viable mental models [10].

Based on the proposed learning model, a web-based learning environment has been developed to improve students' mental models of key programming concepts. This learning environment is intended to support instructors when employing the proposed learning model in their classes and provide students with a practical tool to learn key programming concepts. The authors have been conducting a series of studies covering a range of key programming concepts aiming to investigate whether or not the suggested learning environment is able to improve novice programmers' mental models. This paper gives an overview of the learning environment and also presents the initial results from a preliminary empirical study that focused on the value assignment concept.

2. RELATED WORK

A study was conducted by the authors [9] to investigate the viability of mental models held by novice programmers based on the concepts of simple value assignment and the more challenging concept of object reference assignment. The results identified a variety of mental models of value and object reference assignment held by participants. Many of these models were seen as non-viable, meaning that they could result in a flawed understanding of the programs using these concepts. A quantitative analysis revealed that, at the completion of the first year course, only two thirds of the students held viable mental models of value assignment, with only 17% of students holding viable mental models of object reference assignment. This result is of significant concern. Both assignment and object reference are key concepts in object-oriented programming. The high failure rates in programming courses are not surprising if students still do not understand these basic programming concepts at the end of their introductory courses. The results also show that students with viable mental models performed significantly better in the course examination and programming tasks than those with non-viable mental models. This underlines how important it is to help novice programmers develop appropriate mental models of key programming concepts.

To facilitate novice programmers constructing viable mental models it is proposed that an approach to teaching programming that emphasizes constructivism [4] rather than objectivism [12] might be helpful. Objectivism claims that there is one true and correct reality. The learning process is to transfer the objective knowledge to a learner's mind [12]. Constructivism argues that traditional approaches to teaching based on objectivism are too passive and do not do enough to challenge pre-existing ideas or to help students create viable mental models. Instead constructivism argues that students actively construct knowledge by combining the experiential world with existing cognitive structures [4].

One of the key teaching strategies based on a constructive perspective is *cognitive conflict*, which challenges students' pre-existing ideas, motivating them to adopt more appropriate understandings. However, it should be noted that cognitive conflict alone is unlikely to be sufficient to achieve a change in non-viable models. Students must be supported to create new viable models, and concepts must be presented in an order and fashion that allows the correct construction of inter-dependent models. This is not an easy task, especially for programming students. As Lui et al. [7] have highlighted, "*Computer programming is all fabricated that finds few parallels in the physical world*". The novice programmer lacks the necessary base knowledge for constructing viable models of programming concepts. Hence they often misuse their previous knowledge or adopt intuitive models. To address this, Ben-Ari has suggested that program visualisation has the potential to create a suitable learning environment [5]. Visualisation techniques have been used for over 20 years and have, arguably, not been as successful as hoped for. A possible reason for this is that they have been used from a traditional, objectivist perspective, ignoring a student's pre-existing models. It is therefore proposed that a potential way forward is to adopt an approach based on cognitive conflict that helps students realise that there is a problem with their current understanding, and to use a visualisation-oriented learning environment to support them in adopting viable models.

The proposed learning model integrates a cognitive conflict strategy together with program visualization. There are four stages in the model:

- **Preliminary Stage:** Instructors investigate the pre-existing mental models held by programming students and identify typical inappropriate models;
- **Cognitive Conflict Stage:** Trigger a discrepant event to explicitly challenge students' pre-existing mental models and push students into cognitive conflict status;
- **Model Construction Stage:** Help students construct viable mental models by using visualisation
- **Application Stage:** Students go on to solve a programming problem using the newly constructed mental model.

To evaluate the effectiveness of this learning model, an initial study was carried out by the authors [10]. The results revealed that the model was effective in enhancing a student's interest in, and engagement with, the learning materials and helped them to construct viable mental models.

3. THE LEARNING ENVIRONMENT

To support instructors using the proposed learning model in their teaching and to give students easy access to the model, a web-based learning environment has been developed at the University of Strathclyde. This learning environment currently supports Java, but other languages may be supported in the future. The system logs each student's progress and provides an easy way for students to monitor the viability of their mental models. When a student logs into the system, a concept roadmap (Figure 1) is displayed showing the key programming concepts students have to understand. The order of learning the programming concepts is presented to the students using the routes, shown as footprints, on the concept roadmap. The previous study [9] suggested that a student would not be able to understand a concept if she or he could not properly understand the base knowledge that supports that concept, e.g. understanding value assignment is essential before approaching reference assignment. It is therefore suggested that programming concepts have to be learned in an appropriate order. For example, students should first learn the concept of scope before learning the concept of parameter passing. Without a proper understanding of scope, students will have difficulty understanding parameter passing properly. Alongside the button for each concept on the roadmap a red cross indicates that the student has not yet demonstrated an understanding of that concept. When the student appears to have constructed the appropriate mental model, by passing the test associated with the concept, the red cross will turn to a green tick symbol.

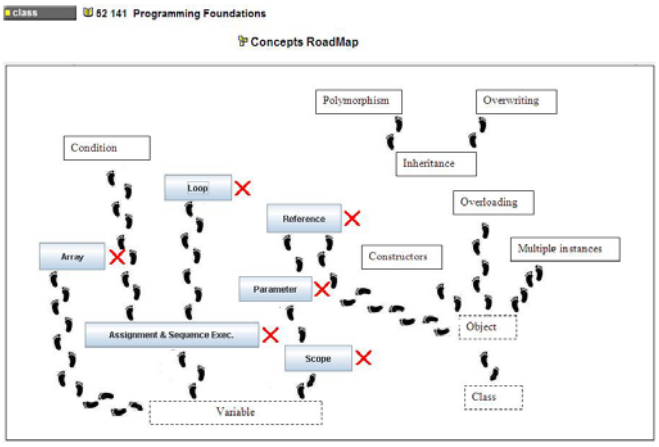

Figure 1: The Concept Roadmap

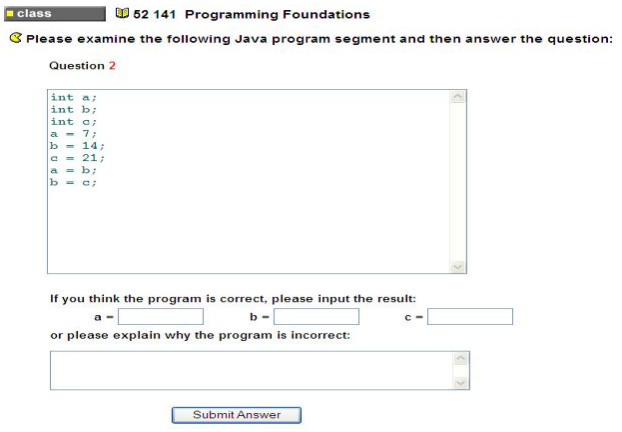

Figure 2: The Cognitive Conflict Question

When a student enters each concept, the student's history of exercises with this concept will be shown, covering the date of performing the exercise and the apparent viability of their mental models before and after the exercise. For each concept, there are three exercises. Each exercise contains a question to trigger cognitive conflict, the corresponding visualisation materials, and another question students need to answer using their constructed mental models, to check their understanding. Initially, the cognitive conflict question asks students to mentally execute a program fragment and predict the result (figure 2). The students' answers are then mapped to a collection of pre-defined mental models that were identified in a previous study

[8]. If the student's answer maps to an inappropriate mental model the student is informed that their prediction is incorrect and there may therefore be some problems with their understanding of the concept. The student is then asked to run a visualisation of the program fragment that they mentally executed to try to identify potential problems in their current understanding and to help them construct an appropriate mental model. The Jeliot visualisation tool[16], developed by the University of Joensuu, is currently employed as the visualisation mechanism within the teaching environment. Jeliot dynamically animates Java program execution. After students experience the visualisation, their new understanding is tested by a new program fragment that demonstrates the same concept, typically using different data values.

4. AN EARLY STUDY

4.1 Method

4.1.1 Participants

44 students who were in the introductory Java programming class in Computer Science at the University of Strathclyde took part in this study. The course was based around the BlueJ teaching environment[17] and used the associated textbook "Objects First with Java - A Practical Introduction using BlueJ" [2]. The test was conducted in the week 9 of the course when the participants had already covered the variable and assignment concepts.

4.1.2 Procedure

Interviews were carried out to investigate the effectiveness of the learning environment. An interviewer sat side by side with the participant who was asked to talk aloud as they answered questions on their reactions to each stage of the learning environment. Five interviewers were involved in this study - one post-doctoral research assistant and four academic staff from the University of Strathclyde. All of the interviewers were intimately familiar with the proposed learning model and the learning environment.

The interviews can be divided into three stages. In the first stage, the participants were asked to mentally execute a program fragment (i.e. tracing what would happen when each statement was executed) and describe their understanding to the interviewers. Prior to being informed by the learning environment as to whether their predicted result of execution was correct, each participant would inform the interviewers how confident they felt that their answer was correct. The interviewers then investigated the participants' feelings and reactions when they discovered whether their prediction was correct or incorrect. At the second stage, the participants went on to use the visualisation materials. They were then asked to explain their understanding of the visualisation to the interviewers. In the third stage, the participants were asked to mentally execute another program fragment and describe it to the interviewers. Finally, at end of the study participants were asked to comment on the perceived strengths and weaknesses of the learning environment.

4.2 Results

25 out of 44 (57%) participants were found to be holding appropriate mental model of both the value assignment process and sequential execution flow. Most of these participants (22 out of 25) claimed that they were either confident with their understanding (7 out of 22) or very confident (15 out of 22) prior to being told whether or not their answers were correct.

11 out of 44 (25%) participants held an inappropriate mental model of the value assignment process. 6 of them viewed the assignment operator as a comparison operator - they understood that the variables held different values which were not equal. Another 5 out of the 11 participants held a model of assigning from the left-hand side to the right-hand side. After the exercise, all these 11 participants changed their mental model to an appropriate one. 2 out of them changed their mental models by themselves during the period of explaining their answers to the interviewers before they knew their answers were incorrect. The remaining participants changed their mental model after experiencing the visualisation materials. For the 9 participants who experienced the cognitive conflict event, i.e. being told their answer was incorrect, 2 participants claimed that they felt less confident with assignment concepts as a result. 1 participant stated that they were disappointed as a result. Another claimed to be surprised. 1 participant was sure their answer was correct and

[16] http://cs.joensuu.fi/jeliot/

[17] http://www.bluej.org/

was very curious to know why their answer was incorrect. 2 participants stated that they did not care whether or not their answer was correct. 1 participant claimed they were not surprised and, lastly, the final participant felt happy when they were told that their answer was incorrect. When these participants went on to use the visualisation tool, they were all able to understand the visualisation easily. They did not appear to misinterpret the visualisation and after viewing the visualisation, they appeared able to understand why their original mental model was inappropriate. 11 out of 44 (25%) participants held an inappropriate mental model of sequential execution flow. 3 of these participants held an inappropriate mental model for both the value assignment process and execution flow. All of them changed their mental models to an appropriate one after using the visualisation tool.

20 participants made comments on the strengths and weaknesses of the visualisation environment. 13 participants stated that the visualisation was able to expose what happens when the program was executed. 2 participants viewed the graphical representation as better than the textual representation. 4 of them emphasized that the 'line by line' or step running mode was especially helpful. 1 participant claimed that they did not understand whether Java programs executed 'line by line' or 'all at once'. The visualisation clarified this for them. 1 participant suggested that the visualisation tool should be used at an earlier stage in the programming course. Another participant stated that they would like to do more exercises of this type. Lastly, one participant identified the fact that the cognitive conflict event prior to viewing the visualisation was better than viewing the visualisation alone. However, 5 participants suggested that they needed a textual explanation of the visualisation to support their understanding of it. 1 participant stated that they needed more time to get used to the visualisation while another participant thought it would be hard to follow the visualisation when used with a longer program.

5. Conclusion and Future Work

Having viable mental models is critical when learning to program. Ideally, programming students are expected to hold a mental model which is close to the model of how a program actually works. Unfortunately, the fact is that many programming students acquire non-viable mental models of basic programming concepts. The high failure rate in programming courses is not surprising if students cannot construct viable mental models for fundamental programming concepts, such as value assignment. This paper introduces a web-based learning environment that is designed to help students improve their mental models of programming concepts using a constructivist-based learning model that integrates a cognitive conflict strategy with program visualisation. The preliminary study for a relatively simple programming concept, namely value assignment, found that all the participants who held a non-viable mental model before using the learning environment changed their model to a viable one after experiencing the learning environment. In addition, most of the participants made positive comments on the learning environment, though some suggested that a textual explanation may be required to explain and support understanding of the Jeliot visualisation.

It should be noted that the results presented in this paper are derived from a preliminary study that only focused on value assignment, a relatively simple programming concept. Developing a visualisation of this concept was reasonably straightforward. However, students might encounter more difficulties understanding visualisations for more complex concepts, such as parameter passing or reference manipulation. To investigate these issues further, the authors have planned and designed a series of studies for evaluating the performance of the learning environment for a number of key programming concepts, including scope, parameter passing, loops, conditions, arrays, and reference manipulation. We also plan to make the environment and the associated materials publicly available for other researchers and teachers to investigate, modify and utilise in their research and teaching.

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SYNOPTIC LEARNING AND ASSESSMENT: CASE STUDIES AND EXPERIENCES

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ABSTRACT

Students appreciate active learning exercises in which knowledge is obtained by sharing, problem-solving and creating rather than passive listening. Synoptic assessments are used at Durham and Leeds Metropolitan Universities in both individual and group assessments to meet those demands; to foster project-based learning; and to encourage the adoption of professional working practices. This paper presents how the synoptic assessment differs from traditional assessment practices and offers findings from case studies that have explored student and staff views at both institutions. The paper then shares the implementation of the synoptic assessment in different contexts derived from different setups in each institution, and provides recommendations for introducing a synoptic learning scheme that establishes connections between modules.

Keywords

Learning, Assessment, Synoptic Units

1. INTRODUCTION

The assessment for two or more modules may be combined to form a single assessment. Such an assessment, often designated "synoptic", may help students to make connections between modules, may increase the level of student engagement and may provide teaching staff with the opportunity to adopt a holistic approach to delivering modules. Synoptic assessments are introduced initially to address the "lack of coherence in a student's understanding of a subject or the connection between elements of the subject" [1]; for more background literature on the synoptic assessment approach see [2, 3, 4, 7]. Although assessing as synoptic units makes assessments more significant and broadens the students' understanding of the connections between elements of the Computer Science subject area, the implementation of synoptic assessments can be challenging for both students and staff members. Traditionally, designing a task for a single subject area is relatively simple and requires little creativity to derive a solution. In contrast to this, staff members are faced with challenges when designing synoptic assessments based on problem-solving tasks that require students to transform factual knowledge to their own conceptual organisation. Such problem-solving tasks enable students to elaborate on the relationships between concepts and simulate the structure on the information they already have [5]. The synoptic assessment approach was adopted at the Innovation North Faculty of Information and Technology at Leeds Metropolitan University (Leeds Met), and at the Computer Science Department at Durham University. This learning and teaching approach is currently being evaluated as part of the CETL ALiC project (Centre for Excellence in Teaching and Learning - Active Learning in Computing), which is a collaborative project between the universities of Durham, Leeds Metropolitan (Leeds Met), Leeds and Newcastle [6].

The use of the synoptic assessment aims to foster peer-learning in a project context and to ensure deep learning by enhancing the student learning experience through encouraging the more active engagement of students. Other potential benefits include reduced staff and student workload.

2. APPROACHES TO SYNOPTIC LEARNING AND ASSESSMENT

Different institutions may have variations in management style, curriculum, and teaching environment. Therefore before discussing the detailed implementation process of the synoptic assessments, it is important to address the setups of the two institutions studied in this paper. Both Durham and Leeds Metropolitan Universities introduced the synoptic assessment approach in the students' second year of study (Level 2) in the academic year 2006/07, and have since continued to use and evaluate this learning model. Table 2 provides a schematic overview of the elements of the implementation of the synoptic assessment at both universities. It needs to be noted that the context in which the assessment approach has been introduced differs significantly between the two institutions in terms of scale. For example Leeds Metropolitan University has introduced this approach to significantly more students (approx. 900), than Durham (approx. 50) and this has also impacted on the range of modules involved.

In [2], Kyaw identified two approaches to synoptic assessments, namely the 'top down' and the 'bottom up' approaches. At Durham, the synoptic approach was developed and introduced by members of the CETL ALiC team teaching on the respective modules. In other words, Durham has taken the 'bottom up' approach where the decision to integrate the assessment is based on the nature of the subject area and resources available. At Leeds Met, the decision to integrate the assessment and module selection was made by the management team, and the synoptic strategy was rolled out across the 45 staff teaching on the module and 900 students. Hence, the use of the term 'top-down' approach.

Variables when applying synoptic assessment	Leeds Metropolitan University	Durham University
How the assessments are deployed	Top-down – Faculty wide (driven by management)	Bottom-up – Selective Modules only (driven by subject area and resources available)
Students and staff numbers	Large scale (over 900 students, over 45 teaching staff)	Small scale (over 50 students, 2 teaching staff)
Paired CS Subject areas	Modules in 4 academies (Computing, IT systems, Interactive Media, Music)	Advanced Databases (AD) and Software Engineering
Timeframe, i.e. when synoptic assessment was introduced	Academic year 2006/07, and following year, at Level 2	Academic year 2006/07, and following year, at Level 2
Evaluation approach	10 interviews with student groups (5 students per group), 14 staff interviews, 14 completed staff questionnaires	A qualitative survey to students and staff members (32 completed).

Table 2: Variations in providing Synoptic Assessments at Durham and Leeds Metropolitan University

The differences in the process of applying synoptic assessment in two institutions highlight the possibility of forming a variety of assessment frameworks that can change students' perception of learning and assessment as well as the context of learning at university.

3. SYNOPTIC LEARNING AND ASSESSMENT: CASE STUDIES

The following sections describe the synoptic assessment approaches taken by Leeds Met and Durham universities in the Computer Science subject area.

3.1 Case study 1: Synoptic assessments at Leeds Metropolitan University

At Leeds Metropolitan University, synoptic assessments are used during the second semester of the second year of study (Level 2) at Innovation North Faculty [4]. The Faculty is divided into four Academies (Computing, IT Systems, Interactive Media, Music), and each of those uses a different case study to implement the synoptic assessment. The students typically work in groups of five.

In the first four weeks of the second semester (Semester B), a Project Management module is delivered and partly assessed by a group presentation. This is followed by the delivery of three modules in parallel, which are assessed through a single assessment [3].

One of the modules studied specifically relates to the student's particular degree scheme (or award), and is referred to as the Award-Specific Module. For instance, students in the IT Systems Academy have the module on 'Database Design and Implementation', and students in the Computing Academy will attend 'Software Solutions'.

The module 'Group Project A' (see Table 2) develops the students' professional and entrepreneurial skills by participating in group work to design, develop and present a solution to a case-study based problem. The skills assessed by this module involve researching and presentation.

The ‘Group Project B’ module encourages the adoption of professional working practices at an individual and team level and develops skills related to research and project management.

Module	Requirements	Individual or Group?	Draft Project Plan	WIP Presentation	Final Presentation
Project Management	Management **Documentation**	Group	40%		60%
Software Solutions B	Software product & documentation	Individual		40%	60%
Group Project A	The **Product** & Developmental Work	Group		40%	60%
Group Project B	The **Product** & **Evaluation**	Group		40%	60%

Table 2: Marking Scheme synoptic assessment - Computing Academy 2007/08 (Leeds Metropolitan University)

In the following, the Computing Academy is taken as an example to illustrate the use of the synoptic assessment. The computing students work on a case study based scenario as a development team for a (fictional) software company. The company specialises in the development of educational software to design and produce a number of educational software packages for use in Schools, Colleges and Universities. The students groups are free to decide what type of educational product they want to develop, for example a graphical program to teach secondary school children geometry or a simple Computer Aided Software Engineering (CASE) tool for use in university computer science courses.

When creating the product, students utilise appropriate skills from Semester 1 modules. In addition, the award-specific module ‘Software Solutions’ allows students to, for example, extend their existing Java programming knowledge, and to learn about a professional design technique (UML). Each student needs to contribute to both the content of the product and the project management of the group, providing evidence of each individual’s contribution in a Group Project Portfolio. The assessment of the product takes place at three points of product development in the form of an early draft project plan, a work-in-progress presentation, and a final product demonstration and presentation (see Table 2). The students are assessed on subject knowledge, communication skills and project planning in the three group presentations. Lecturers may request additional written reports as supporting evidence.

3.2 Outcomes and Evaluation Leeds Metropolitan University

To evaluate the newly introduced synoptic assessment approach in the second year of study at Leeds Metropolitan University, 10 interviews with student groups, 14 staff interviews, and a staff questionnaire (14 responses) were conducted. Students mentioned the peer-learning they had experienced as a positive feature of the synoptic approach, as the following student interview quotes exemplify:

Student1: *“It’s quite good, because it’s ongoing and it’s on your mind and you can relate back this. Like we had to plan our tables (ERDs), so it was always work in progress, so you were always working on the same thing. Instead of stopping and starting and changing.”*

Student2: *“It was good doing it as a group, as well. There is things that you don’t know but other people do or that people are better. We have learned from each other. That was one of our strongest points.”*

Peer-learning is seen to be a useful approach in maintaining quality in an environment of increasing group sizes and pressure to increase productivity [9]. In addition, cross module connections introduced by the synoptic assessment may provide extra opportunities for peer-learning. Some students believed that Semester B enabled more creative working, as they were free to choose the exact nature of the project but “it was hard to plan”, as a student described it.

Academic staff also perceived the use of synoptic assessment as positive:

Staff1: *“The concept of four modules, separate but linked, is an excellent idea. In the ‘multimedia area’, this model gives the students an overview of the whole development process in terms of: they got a product, a brief, a team and project management”.*

Staff commented that students who engaged across all modules had learned many new skills and believed that the synoptically assessed project was worthwhile. Another believed that in the database area the students quickly gained a good understanding of what was required for all modules and worked hard both as teams and individually to produce good work. Also mentioned by staff were the “excellent attitude by most

students", and students' "very good attendance". The main outcome of this first part of an on-going evaluation strategy was that combining elements of learning from different modules and applying it to a project, were perceived as generally beneficial by staff and students.

3.3 Case study 2: Synoptic assessments at Durham University

In the academic year 2007-08, the Computing Science (CS) department at Durham University carried out a synoptic assessment exercise that integrated the assessment of two modules. Figure 1 presents an example synoptic learning and assessment scenario. It shows the problem scenario that was set for the Software Engineering Group (SEG) project as part of the Level 2 Software Engineering (SE) module. Students were asked to design and develop a logistics system for Proctor & Gamble (P&G) as a real life problem scenario. It also depicts the mapping between the modules they are studying and acquire knowledge and skills against the challenges and requirements of the SEG project.

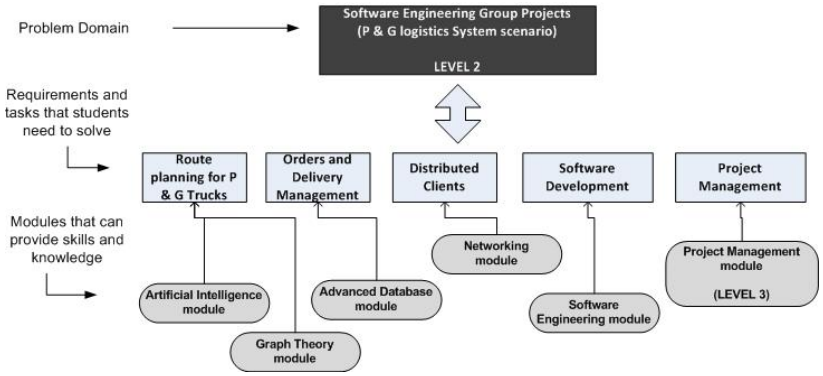

Figure 1: An example of applying Computer Science concepts in a single assessment

The SEG project problem domain includes a number of challenges and requirements that students need to solve from different Computer Science areas. To assess the understanding of data modelling concepts and database design, students are asked to construct a database design using the SEG problem scenario instead of providing a new problem in the Advanced Database (AD) module. The deliverables are assessed and students are given feedback. Students reuse the deliverables that they make for the AD module in the SEG project documentation and hence reduce their workload. Furthermore, as the feedback for their database design is given back before the implementation of the SEG project, students are able to act upon the feedback in order to improve the database design during the implementation of the system. To achieve the synoptic assessment, a synoptic learning environment was introduced that allows students to conceptualise how database design methods that they learn in the AD module can be applied in Software Engineering [2]. For instance, examples described in the AD lectures were derived from SEG problem domain. In contrast to the approach implemented at Leeds Met, Durham's 'bottom up' approach resulted in the pairing of just two modules (Software Engineering (SE) and Advanced Database (AD)) to form a single assessment. Although the synoptic assessment is specific to these modules, students can use the skills and knowledge that they have acquired from many other modules to design and development the SEG project.

3.4 Outcomes and Evaluation Durham University

To evaluate the synoptic assessment approach and the implementation process at Durham, a study was conducted based on two data sets.

Firstly, student questionnaires were used to evaluate if the synoptic assessment has an impact on students' perception of learning. Secondly, a review was made of the quality of student submissions to evaluate if the synoptic assessment provides students with better understanding of the Computing Science subject area or the connection between elements of the subject. Over 65% of the students responded to the questionnaire and gave 90% positive feedback.

These results enabled staff to improve the implementation process.. This includes better scheduling of submission times, clearer assignment wordings, providing synoptic learning environments, and improved integration of modules overall. One of the key questions asked in the questionnaire was *"What do you think of using the problem statement from SEG in the Advanced Database assignment*?" and some of the responses were:

Student1: *"Nice to see how the theory fits with the 'real world'"*

Student2: *"Very good idea since it gets you thinking about SEG at the same time"*

Student3*: "Less work. More engaging. Better support from more members of staff. SEG members who aren't designing/implementing that database still can understand it."*

Student4: *"It proved very useful as we were able to integrate both assignments together".*

There were also a very few negative comments such as:

Student5: *"I would have preferred a separate problem statement as it was hard to ensure that the work was done individually, as a lot of the database design for SEG was done before the assignment was set."*

The AD assignment was summative, the assessment was an individual exercise and the SEG project was a group exercise. Such comments indicate there can be problems with the 'bottom up' approach where the modules were not initially designed for synoptic assessment in the curriculum. There were also a few students who did not want the result of one module to affect the other. The other key question asked to the students was *"Do you want more modules to be using the synoptic assessment approach? If yes, which modules can you think of?"*. Over 65% of students suggested various other modules. Some of the responses were:-

Student6: *"Perhaps Software Applications as it may help in SEG implementation."*

Student7: *"Possibly the AI module (for route optimisation)"*

These responses indicate that synoptic assessment provides students with better understanding of the Computer Science subject area and the connection between elements of the subject. Ramsden [8] shows that students who do not engage in deep learning often have a hidden agenda relating to the narrow requirements of assessment. Based on these responses, the main outcome of the evaluation was that synoptic assessment may be used as a way to help those students to develop deep learning and provide intrinsic motivation.

4. GUIDELINES AND BEST PRACTICE

Several recommendations can be drawn from this exploratory case study about the introduction of a synoptic assessment approach at Durham and Leeds Metropolitan University. Prior to the start of a new scheme careful thought has to be given to the preliminary organisation and establishment of assessment criteria. Particularly when a synoptic approach is introduced to a large number of students, it is important to ensure the early availability of shared documentation in order for teaching staff to prepare for delivering the module. This also helps staff to fully brief students about the style and the requirements of the synoptic assessment as early as possible. Frequent communications and collaboration amongst staff members who are involved in a synoptic learning exercise are necessary to provide a coherent structure for the students. In addition, it may be useful to provide teaching staff with examples of how the assessment operates prior to the introduction of a synoptic learning approach. It is also important to make the synoptic assessment as transparent as possible by carefully wording the problem statements or questions as well as timing the release of the assessments correctly. Institutions can apply different levels of synopticity in their assessments such as formative assignments to synoptic examinations. Furthermore, they may focus on different styles of synoptic assessment such as analysis and referring to shared concepts, essay and report writing, case studies, problem solving exercises, software implementation, etc. depending on the faculty and subject area.

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TCP LIVE: ACTIVE LEARNING FOR TCP

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ABSTRACT

As the importance of computer networking in the curriculum continues to grow, so does the challenge of creating engaging and effective learning environments for networking students. Although there are several excellent textbooks published on this subject, the traditional mix of books, lectures and coursework often fails to fire the students' imaginations and leaves an impression of networking as dull, filled with acronyms and static protocol descriptions. In TCP Live we seek to bring the Internet's most heavily used transport protocol to life for learners by allowing them to create, monitor, replay and analyse TCP connections, on a planetary scale. It is particularly important for networking students to see TCP operating outside of the confines of their own network as the increased variance in delays and packet loss probabilities show the dynamic nature of the protocol in action. This paper provides context for the development of exploratory learning facilities and describes the design of TCP Live, a pedagogic innovation for teaching and learning computer networking.

Keywords

Exploratory Learning, Computer Networks, Planet Lab, Experiential Learning, Active Learning

1. INTRODUCTION

The development of the Internet and the growth of distributed applications have significantly increased the importance of the study of computer networks. Today's Computer Science and Information Technology graduates are expected to have a deep understanding of modern networking technologies, protocols and applications. In keeping with a broadly socio-constructivist theory of learning we believe that an important component of the learning process is the ability to learn through doing, sometimes referred to as experiential learning. Experience comes from interaction rather than passive presence, and students are more likely to be engaged with, and seek to understand a topic such as computer networks, if they can *interact* with some artifacts or manifestations of it. The traditional mix of textbooks, lectures, tutorials and coursework does not guarantee student engagement with networking and it is not unusual to try and introduce some form of "hand-on" components into the course. Our aim in expanding the learning opportunities for computer networking has been to create "anytime, anywhere" exploratory learning environments [1] that can be used for teaching and learning in lectures or lab sessions, for remote learning, and most importantly, whenever the student is really motivated to experiment and learn. To that extent we have created TCP View [2, 3] , WiFiVL (WiFi Virtual Laboratory) [4, 5]and ALWPO (Active Learning with Planetary Objects) Explore V4 [6, 7].

There are of course many potential means of providing an engaging learning environment for networking students outside of the traditional mix. Figure 1 gives a brief comparative overview of the respective features of TCP View, WiFiVL, and Explore V4. We distinguish between the interface characteristics, the computational resource, and the interaction possibilities. TCP View concentrates on making aspects of textbooks such as graphs and diagrams interactive and animated. It aims to complement established textbooks such as [8-10] by avoiding lengthy textual descriptions and focusing mainly on graphical features. For example, the TCP state transition diagram (see Figure 2) is made interactive, something that cannot be achieved in a textbook. Similarly, a three-way handshake can be viewed from two different animated visual perspectives and a 3D Resource Utilisation Ratio graph can be modified by inputing parameters. TCP View necessarily simulates protocol behavior when constructing graphs or animating protocol exchanges, but this is relatively simple, ad hoc simulation. By contrast, WiFiVL exploits an established and widely respected network simulator, ns2 [11], to create animated scenarios. Learners can input a wide variety of parameters,

from basic to advanced. ALPWO Explore V4 is different again in that it does not make use of simulation of any sort – it provides a graphical interface to creating, sending and monitoring IPv4 datagrams, from any Planet Lab [12, 13] site selected from across the world, thereby allowing the learner to experiment well outside of the normal constraints of the local, campus and academic networks.

		TCPView	WiFiVL	ALWPO Explore v4	ALWPO TCP Live
User Interface (View)	Hypertext	✓	✓		
	Interactive Diagrams	✓	✓		
	Simple animation	✓	✓		
	Alternative representations of simple animations	✓			
	Graphing tool	✓			
	Forms		✓	✓	✓
Computational Resource (Model)	Built-in simple ad hoc simulation	✓			
	Sophisticated external simulator		✓		
	Unconstrained real world network access (Planet Lab)			✓	✓
User Interactions (Controller)	Point, select, click	✓	✓	✓	✓
	Video playback style controls	✓	✓		
	Basic Parameter Input	✓	✓	✓	✓
	Advanced Parameter Input		✓	✓	✓
	Automatic parameter value selection and simulation generation	✓	✓		

Figure 1: Comparative Overview of Exploratory Learning Environments for Computer Networking

2. TCP LIVE

TCP is a rich and complex protocol which carries the majority of modern day Internet traffic and will probably do so for the foreseeable future. TCP is popular with Internet applications because it provides a very simple abstraction: a two way reliable byte stream. The application developer or programmer simply reads and writes to the TCP connection, and all the hard work of maintaining in-order, reliable data connection is carried out by the underlying protocol. TCP has been likened to the proverbial duck, apparently gliding effortlessly across the water, whereas in fact its feet are paddling furiously. The TCP state transition diagram is shown below in Figure 1 to convey some of the richness of the protocol.

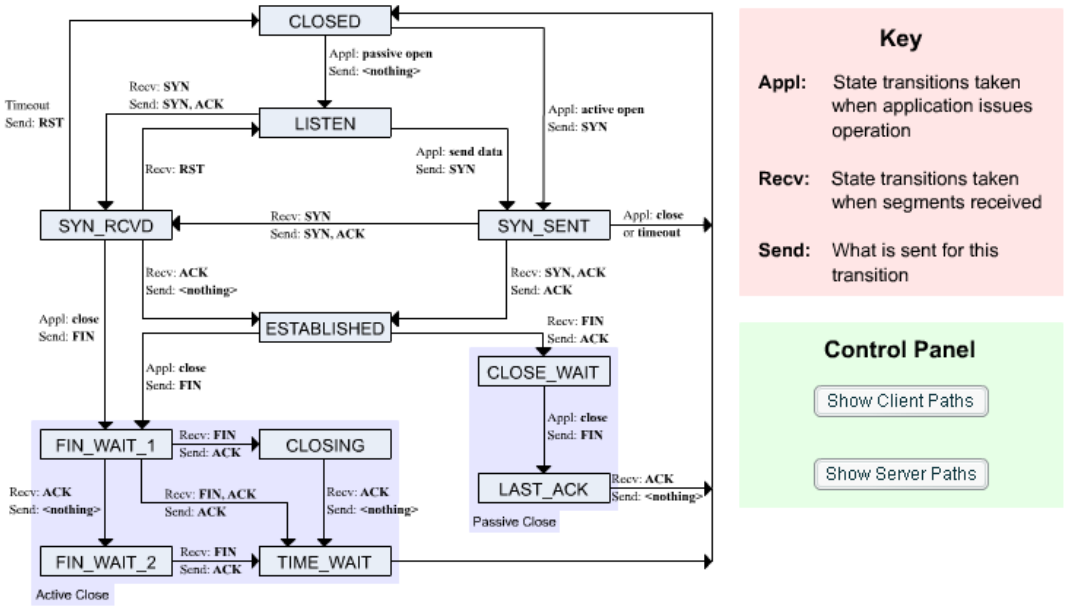

Figure 2: TCP State Transition Diagram (reprinted from tcp.cs.st-andrews.ac.uk)

The development of TCP Live was motivated by the need to introduce a serious element of reality into TCP learning in order to better engage students. The ALWPO framework was chosen as a basis for this effort, as it already offers unconstrained real world network access (see Figure 1) by exploiting the Planet Lab network for educational purposes. When a student enters the ALWPO environment they are prompted to select nodes from a choice across the world. See Figure 3.

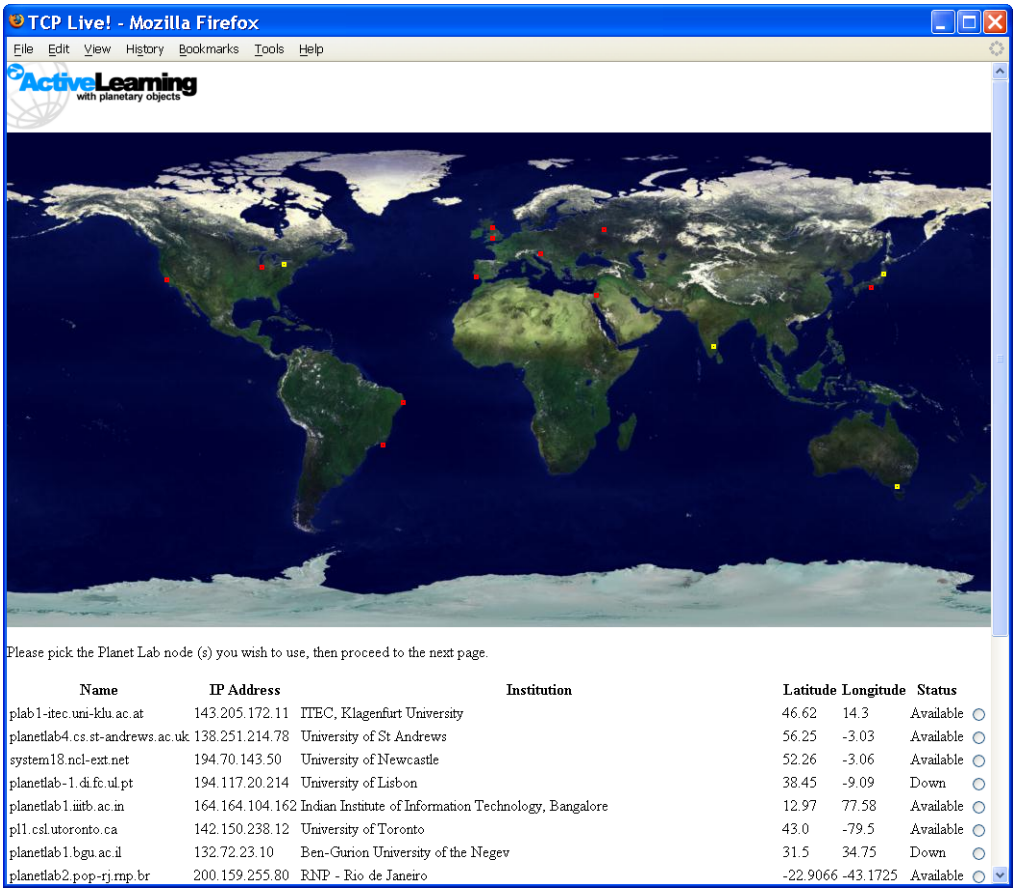

Figure 3: ALWPO Node Selection page

The existing ALWPO facilities (dubbed “Explore V4”) comfortably support the creation, sending and monitoring of individual IPv4 [14], UDP[15] and ICMP[16] datagrams through forms interfaces. Some support for TCP [17] is provided in Explore V4, but this is relatively limited as TCP is a *connection-oriented* protocol and the others are *connectionless*. The differences between IPv4, UDP, ICMP and TCP are shown in Table 2.

	IPv4	ICMP	UDP	TCP
connection oriented	no	no	no	yes
duplex	no	no	no	yes
message boundaries	yes	no	yes	no
data checksum	no	no	opt	yes
positive acknowledgements	no	opt	no	yes
timeout and retransmit	no	no	no	yes
duplicate detection	no	no	no	yes
sequencing	no	opt	no	yes
flow control	no	no	no	yes
congestion control	no	no	no	yes

Figure 4: Differences between IPv4, UDP, ICMP and TCP

As TCP is a duplex, connection-oriented protocol the manual construction and sending of segments is not meaningful as the abstraction provided by the protocol is one of a two-way *stream*. The reliability provided by TCP also means that there are timeouts and retransmits and that the learner cannot respond quickly enough to maintain one half of a TCP connection! All of this presents TCP Live a significant technical challenge.

3. INTERFACE DESIGN CONSIDERATIONS

TCP can be described both in terms of its Macro and Micro states, with the Macro state being the state of the connection at either end in terms of handshaking, establishment and closure. The Micro state is more subtle and describes the state of the internal mechanism of the protocol to handle reliable order delivery with flow and congestion control. There are two features of TCP that are much more clearly illustrated by exploring global paths: time-outs and congestion control. Time-outs feature in most reliable communication protocols, but the variance found through exploring the global Internet brings this home. TCP adjusts its sending window size when time-outs occur. Similarly, packet loss is taken as an indication of congestion, and TCP adjusts its sending window accordingly when it believes that a time-out has occurred as the result of packet loss. Through observing the TCP packet headers flowing across TCP connections TCP Live tracks progress in real time, reconstructs the connection and provides a visual representation of it for learners. Both the evolution of TCP's Macro state and Micro state are monitored. In the case of Macro State graphical sequence diagrams and state transition diagrams which show the actual transitions of real connections are made available. These are supplemented by annotated packet level textual output. Thus exploration of the set up and tearing down of connections is supported.

Although the TCP Live system is available “anytime, anywhere” it is appropriate to organize introductory use in a Lab setting, where, for example, groups of students are provided with worksheets which guide them through a number of scenarios and link their activities to supporting materials such as lecture notes, books and other web sites.

Figure 5 shows a screen shot of a component that provides an interactive sequence diagram generated from traces of TCP connections. It also shows the timestamp for each sending or receiving packet. On the right-hand side, all the raw traces are listed. When the connection is played forward, the new trace together with the timestamp and sequence number is displayed on the sequence diagram and the current trace from the traces list will be highlighted. When the connection is played backward, the last trace on the sequence diagram is eliminated and the current trace will be highlighted.

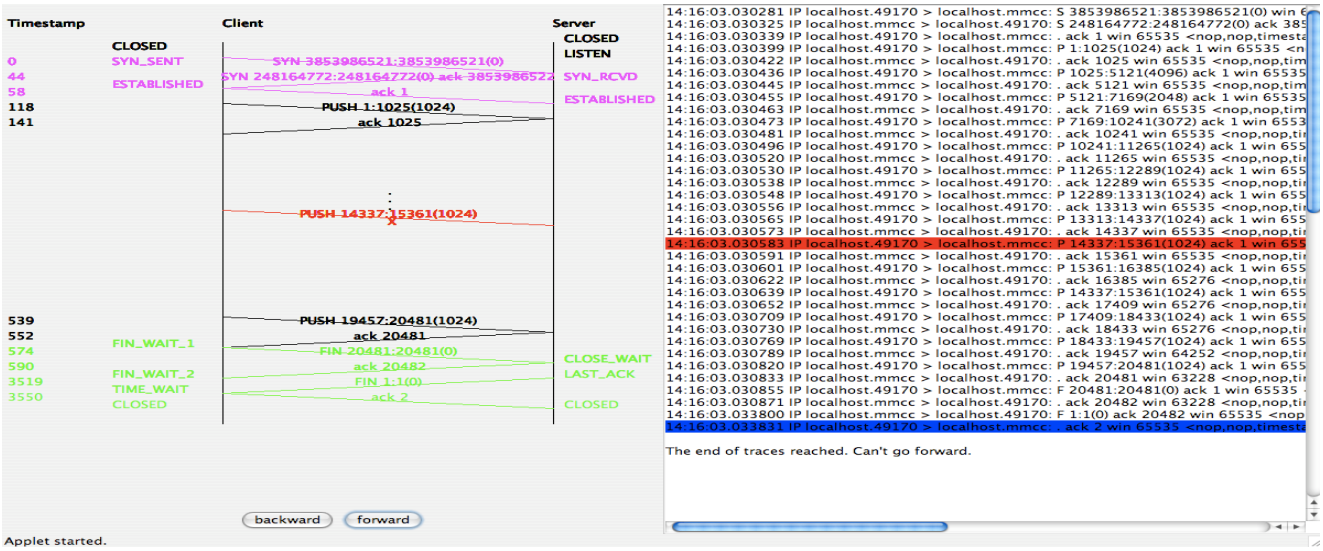

Figure 5: A TCP Live Sequence Diagram and Corresponding Packet Trace Window

On the left-hand side of the window, there is a sequence diagram of the TCP connection. It has one time line for the Client and one time line for the Server.

At the side of each time line, it shows the current Macro state of the client or the server respectively. It starts from the state where no TCP connection has been made. The learner is able to play the history of a TCP connection forward and backward. In this way, the learner can explore the change of the Macro states of a TCP connection and better understand the traces using visualisation provided by the time-event diagram. The traces are in the same format as those produced by tcpdump [18], a widely used monitoring tool, so this facility has the useful side effect of teaching students how to read tcpdump traces.

4. CONCLUSION

The development of TCP Live has been motivated by both the continuing growth in importance of computer networking in the curriculum and the increased need to engage and motivate students within the subject area. Several features of the TCP protocol only come to life when real connections are set up and studied. It acts as an essential complement to the TCP View web site, which lacks the possibility of interaction with real network connections. It is important however, in order to appreciate the richness and subtlety of the protocol, that it can be seen operating outside of the constraints of local, campus and academic networks, which are relatively staid compared with the global Internet. Accordingly TCP Live has been developed using the ALWPO framework, which in turn exploits the Planet Lab facility for global networking research.

5. ACKNOWLEDGMENTS

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IS "E- SKILLING" DESKILLING?

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ABSTRACT

This paper takes forward the discussion for the development of a Framework for e-Learning. It briefly describes how the discussion has progressed from the suggested development of a Framework and the findings of a study investigating the use of Blended Learning, to the application of PESTE factors from Sociology and the proposal of new PESTE factors for educational software and e-Learning, asking if the current use of Computer-Mediated Communication (CMC) is leading to the deskilling of professions, by the provision of direct, front-line service applications and the implications for e-Learning [5].

Keywords

e-Learning, e-Skilling, e-Tutoring/e-Moderating, Computer-Mediated Communication, PESTE factors, Blended Learning.

1. INTRODUCTION

In March 2005, it was reported that the main reason for the failure of the UKeU was attributable to the lack of research into potential customers' needs and a "supply-driven approach" [1]. This is one of many recent examples of problems with the development and employment of e-Learning. Mason [13] states that:

"There is absolutely no evidence that learners are able or willing to do without teachers, no matter how well designed the materials, how extensive the resources or how 'just in time' the learning. The fundamental role of the teacher or tutor has not changed but the mode of operation has".

This view was further supported by experiential data from current students on Information Systems, Multimedia, and Computer Science programmes within our own university [11] insisting on no more than thirty percent of their courses in total (their management, content and delivery, etc) be "e". A preliminary study in 2005 [9] looked at the skills and knowledge required for both traditional and e-Tutoring in an attempt to discover the reasons behind the apparent lack of success of current e-Learning systems. It attempted to establish whether this lack of success was: an issue of requirements gathering and analysis; a tutoring problem; or simply a communications problem and an issue of Human-Computer Interaction (HCI - more commonly referred to as Interaction Design). These endeavours led to the development of a Framework for e-Learning [9]. The Framework for e-Learning is described, its relationship to Salmon's 5 Stage Model of e-Tutoring, and the evaluation of an in-house system as to its fulfillment of the Framework and its conformity with Blended Learning [7]; [8]. PESTE factors from Sociology were applied to the employment of e-Learning. The discussion then moves to look at the recent trend for on-line/direct front-line services and the use of CMC in deskilling previously professional tasks. Conclusions are drawn as to the efficacy of Blended Learning and e-Learning, and the proposal of new PESTE factors [6]. Finally, asking whether the provision of direct front-line services is deskilling and the implications for e-Learning.

2. A FRAMEWORK FOR E-LEARNING

2.1 Tutoring: Activities and Requirements

In order to identify typical tutoring activities, a representative week in the calendar of several university lecturers was elicited, resulting in a synthesis of common interaction examples that constitute teaching and tutoring. Highly noticeable was the significant amount of time spent dealing with e-mail. The activities and tutoring skills required were identified from this diary synthesis. A third column was added which suggested the new skills required if for e-Tutoring. The inference is that e-Tutoring requires all the same skills as traditional face to face (f2f) tutoring, plus some additional skills.

These additional skills were considered to be firstly technological and secondly, skills which dealt with managing mostly remote and often asynchronous communication. Such skills relate directly to perceived problems with CMC, and are equally inherent in Computer-Supported Cooperative Work (CSCW) and HCI. CSCW is about groups of users and designing systems to support their group work, understanding the effect of technology (products often called groupware) on group work patterns [3]; [16]. Groupware can be classified as synchronous or asynchronous, co-located or remote, supporting computer-mediated communication, and shared applications and artefacts, facilitating meeting and decision support systems. Interaction problems such as the lack of visual and audible cues, gestures, intonation, turn-taking, context, collaboration, group dynamics etc have long been recognized by HCI and CSCW practitioners [12]. A further related area is Information Visualisation. Information Visualisation [20] can be defined as "the use of interactive visual representations of *abstract* data to amplify cognition". Learning is arguably a social activity, and communication is widely accepted as being central to any successful teaching and learning strategy [21]. A system will fail even if it fulfils all its functional requirements, if it does not address the requirements of the user.

2.2 Salmon's 5 stages of e-Tutoring

The mapping of the relationship between the skills identified and those given or suggested by Salmon's [19] five stage model of e-Tutoring, was next explored. Salmon's model for e-Moderating gives more weight to the social aspects of e-Tutoring; adapting to the e-Learning environment and the group dynamics (three of the five stages). The last two stages are those concerned with the actual knowledge construction and development. From direct experience, this emphasis is probably correct and this is the main implication for practice. In the Framework proposed (Figure 1), the human factors associated with stage 1 of Salmon's model appeared to be paramount to the success or failure of a system. Referring here to human factors such as; the current learning situation, communication, cultural and social aspects, all of which are well known to other aforementioned disciplines and have much in common with the user requirements. Learning is achieved by providing appropriate scaffolding, whether for traditional tutoring or e-Tutoring. Instead of motivation there is e-Motivation, socialising becomes e-Socialising. Fundamentally, the nature of human interaction and the lack of visual and social cues etc provided by the technology is likely to be a major reason for Salmon's e-Tutoring stages 1 to 3 being more difficult in non f2f situations.

SALMON STAGES	SKILLS TO BE ACQUIRED	KNOWLEDGE TO BE ACQUIRED	ACTION TO BE TAKEN
STAGE 1: Access & Motivation	There is now an abundance of tools available, which may be W3C compliant (and SENDA compliant to some degree). These tools have much of what is required for all of the five stages, so what must be acquired are the skills and knowledge necessary for their use. It is the non technical aspects which are therefore the focus.	See skills to be acquired column. Tools are easier to adopt (and have often been adopted) for stages four and five, with forums etc available, to cater for stages two and three in particular.	Computer Science, Multimedia, and Information Systems students should be capable of attaining access! Motivation is the main problem which could be assisted by improvements to the course site Welcome? F2f meetings to be arranged prior to e-Tutoring?
STAGE 2: Online socialisation			Use of tool's news and course forums to be adopted for conferencing etc. Regular checking of forums is very important.
STAGE 3: Information exchange			Ditto stage 2 above.
STAGE 4: Knowledge construction			Stage 4 is often fully implemented and operational. Further improvements to the presentation and compliance could be made.
STAGE 5: Development			Achieved in most cases, but could be further improved upon, e.g. the links to past papers and other resources.

Figure 1 A Framework for supporting e-Tutoring Maintenance is deemed to be an issue for all stages of the model. STAGE refers to Salmon's [19] 5 stage Model of e-Tutoring.

2.3 Blended Learning

One possible solution implied by the "Action to be taken" column and often proposed to resolve the inadequacies of e-Learning identified as the human requirements; such as "Motivation" and the lack of "Online Socialisation" described by Salmon's early stages [19], is the application of Blended Learning. There is currently a movement towards Blended Learning, with in-house course management tools invoking a creeping change in teaching practice from traditional tutoring to e-Tutoring. Blended Learning [22] has been defined as:

"An educational formation that integrates elearning techniques including online delivery of materials through web pages, discussion boards and/or email with traditional teaching methods including lectures, in-person discussions, seminars, or tutorials".

In developing a Framework for e-Learning it was apparent that many of the technological requirements necessary to enable e-Learning were provided by an in-house tool, namely; Teachmat [8]. On reflection, it led also to the realization that many aspects of this Framework in relation to Salmon's 5 Stages had been attained for many courses, effectively these courses were using technology led Blended Learning. Teachmat and the CMS intranet are treated as synonymous, although strictly speaking Teachmat is part of the CMS intranet. Teachmat was originally developed primarily for course content management support. It has been extended considerably, and indeed since the framework was suggested, from a mere repository for course materials to a comprehensive on-line intranet system. The result is that the Teachmat environment has changed the learning and teaching style from traditional to Blended. The level of Blended Learning being individual to courses, with some courses employing multimedia course delivery, such as video. The facilities used for courses are presently a matter of choice, however, virtually all coursework is uploaded on-line and there is a growing pressure for on-line assessment. Forums are available to students and staff at course level. The level of electronic communication with students and other staff has exploded as a by-product. Fundamentally, more and more elements of the teaching and learning are now electronic. Face to face (co-located and synchronous) teaching is still the predominant method employed in the institution for local (co-located) students, but much of the related activities are now remote and asynchronous. Lecturers still give lectures, tutorials and workshops in person but via personal computers, stored on data sticks or directly linked to Teachmat. Teachmat is being further exploited for external institutions, where both teaching and supporting activities are being carried out remotely and asynchronously, using video for example. Here learning is moving from Blended to fully "e". The pros of this situation, the deployment of Blended Learning, appear to be mostly managerial: Everything is on Teachmat. Teachmat, whilst having provided for many of the mostly technical requirements of Blended Learning or the Framework for e-Learning support, has yet to completely resolve the human issues: There are still health and safety, pedagogical, as well as social issues regarding e-Tutoring which have yet to be addressed; Everything is on Teachmat!

2.4 PESTE Factors

Wannermacher [23] identifies the following categories for incentives for increasing Faculty acceptance of e-teaching at German universities:

"*a) Financial Incentives*
b) Infrastructural and Technical Incentives
c) Accounting and Reducing Workload
d) Distinctions Incentive
e) Competitive Advantage for Universities
f) Creating a Climate Conductive to E-teaching"

Sociology uses PESTE factors (Political (P), Economic (Ec), Social (S), Technical (T), and Environmental (EN)). Reclassifying Wannermacher's incentives in terms of PESTE factors, it can be seen that for the normal interpretation of Environmental issues, these issues are not pertinent to e-Learning. However, a looser interpretation could classify incentive f) as Environmental (educationally environmental).

a) Financial Incentives (Ec)

b) Infrastructural and Technical Incentives (T)

c) Accounting and Reducing Workload (Ec)

d) Distinctions Incentive (S/Ec)

e) Competitive Advantage for Universities (Ec)

f) Creating a Climate Conductive to E-teaching (P)

The major concern with the incentives identified by Wannermacher is that pedagogical motives are not evident. This significant absence is true of the evaluation of the application of Blended and e-Learning through in-house tools such as Teachmat [7]. The findings of Wannermacher [23] and Graham [8] indicate that e-Learning is management driven, the pros given above are mostly managerial and, as they originate from the higher echelons of the institution are likely to be externally politically driven. Hayden [10] suggests that the current e-Learning trend in the UK is highly political, but again it is the lack of the employment of e-Learning to improve pedagogy as the primary motivation that raises considerable unease.

3. E-SKILLING

A recent development has been the provision of on-line/direct front-line services for domains previously operated by professionals. Although learning ("e" or otherwise) is not the primary objective here, the underlying motivations for e-learning identified (economic and political) appear to be equally prevalent. Two examples of these direct services are NHS Direct [15] and Consumer Direct [4]. In the case of NHS Direct, patients who would have contacted their General Practitioner (GP) practice in the past are now advised to telephone or contact this service on-line for out-of-hours needs in particular. The telephone option for this service, whilst apparently being run by trained nursing staff, has delegated the front-line assessments from GPs especially during "out of hours" surgery times, or when it has not been possible to make an appointment, to less qualified personnel. The on-line version can be accessed at anytime, unsupervised, although it's not easy to know which link is the correct one as there are several resulting from a search. Patients are required to select options for the part of the body affected and their symptoms, to be advised of the action to be taken, e.g. to telephone 999 for an ambulance. It has effectively deskilled the job of the initial consultation, appraisal and diagnosis, to an operator or the patient themselves.

A second example is that of Consumer Direct. Prior to the establishment of Consumer Direct, people would be put through to Trading Standards via a telephone call to their local district council. Telephoning the local district council and requesting Trading Standards now results in being put through to Consumer Direct, where again trained operators, but not Trading Standards professionals, assess the enquiry, give limited advice and decide whether or not it warrants being forwarded to a Trading Standards officer and awarded a reference number. As for NHS Direct, the on-line version (site) for Consumer Direct can be accessed directly for unsupervised searching and selecting of problem categories and advice.

4. DISCUSSION AND CONCLUSIONS

In developing the Framework it had been suggested that the problems of e-Learning were not new and were as for other forms of interaction and their requirements. It was further suggested that e-Learning should heed the lessons learnt from other areas such as HCI and CSCW and that the problems of e-Learning and associated requirements were no longer fundamentally technological but human. It was concluded that it was these problems that needed to be addressed in any proposed framework, if progress was to be made. This might be enabled by greater improvements in communications technology becoming sufficiently sophisticated as to convey subtle cues etc, but subsequent progress may ultimately necessitate a cultural and social shift in the attitudes of tutors and tutees towards teaching and learning per se. It was yet to be seen whether or not the Department for Education and Skills' latest e-Strategy "Harnessing Technology: Transforming learning and children's services" [2] would prove successful in addressing the issues raised.

It was also concluded that the use of Blended Learning has been an indirect consequence of the in-house technologies now employed. Tools like Teachmat are directing teaching and learning practices towards Blended Learning. The development of such in-house tools has caused a technology led proliferation in the employment of Blended Learning. This sea-change was not a conscious decision by staff and students, who are highly unlikely to request e-Learning. This raised questions about the pedagogy behind systems developed. HCI and communications issues remain, as do some technical problems. The major concern is that although many (but not all) of the technical requirements have been catered for by tools like Teachmat (as demonstrated by the list of pros, in the main associated with Salmon's Stages 3-5), many important issues, namely those referred to as "human" have not been addressed (reflected by the list of cons, mostly associated with Salmon's Stages 1 and 2). There has not necessarily been any cultural or social shift in attitudes however. Concluding that the successful embodiment of human factors; pedagogical, social, etc, is still key and requires most effort for fully "e" or Blended Learning. Blended Learning is presently not providing a solution, it has yet to accommodate the attainment of Salmon's motivational or social stages identified by the Framework, the constant focus on the technology is merely aggravating the situation.

It was therefore proposed that, after evaluating the application of e-Learning using PESTE factors from Sociology, e-Learning should adopt its own PESTE factors, where PESTE stands for Pedagogical, Educational, Social, Technical and (Educationally) Environmental. The order of these PESTE factors for "e"

Teaching and Learning is highly significant; Pedagogy should be the main concern. Obviously this overlaps with Education, but Social factors should also be high on the agenda in accordance with the findings that human issues are paramount, as learning is inherently a social activity, most fundamentally founded on the instinct to survive. Equally in relation to the findings, Technology and the Environment should carry less weight. A deliberate, conscious decision was made to exclude Political and Economic factors which are credited as the present drivers for much of the expansion of e-Learning. In practice, economic incentives are likely to prove to be a myth, as serious attempts to realize e-learning are experientially at least as expensive as f2f learning.

The current drivers for e-learning (economic and political) also appear to be the drivers for front-end, direct services for a plethora of domains. In both examples discussed, it is the front-line appraisal which has been removed from the professionals and experts and "deskilled". The initial assessment is either carried out by a lesser skilled operative (if conducted over the telephone) or by the "customer" directly on-line. There are obvious economic advantages in the replacement of skilled professionals by less qualified staff for specific tasks enabled by computer supported advice systems. However, there have been reports of public dissatisfaction in the press, notably in relation to telephoning NHS Direct were the consequences have been serious. The significance of the lack of important subtle cues gained from a f2f medical consultation cannot be underestimated. The unsupervised browsing of these services is equally disconcerting, especially in the case of NHS Direct if the outcome recommended is to telephone 999 for instance! It could also be seen as a Hypochondriacs charter.

The promotion of e-Learning raises similar issues in terms of responsibility, in this instance the responsibility of learners, when most learners are not the ideal "independent learner" aspired to for e-learning. Skilled professionals are usually employed for the initial content design of systems, but with the long-term management designated to non-teaching professionals. The number of experts being required at the front-line thereby being substantially reduced, also reducing costs. It is likely to impact on the assessment of "e" assignments, a move to more recognition rather than recall based on-line tests which are easier to manage and require little expertise to assess once created. Electronic marking having recently been criticized by the Association of Teachers and Lecturers [13]: "Pupils are at risk of receiving the wrong grades in their exams under plans to extend electronic marking", due to fatigue. "Question papers could be 'dumbed down' to make the scripts easier to process and markers could make mistakes if they do not take regular screen breaks" reinforcing the need for attention to be given to health and safety issues in relation to CMC. Electronic marking "was introduced to speed up the process and cut the cost of posting scripts to assessors".

So the question posed is that in the design and development of more "e" systems using CMC, whether the "e" is on-line or via the telephone, is it a result that these on-line direct systems are, rather than enabling, they are deskilling?

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WRITE IT RIGHT: DEVELOPING ACADEMIC WRITING WITHIN THE DISCIPLINE OF COMPUTING USING *FEEDFORWARD* FEEDBACK

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ABSTRACT

This paper reports upon action research to improve feedback on writing for assessment at one new UK University. The need to explicitly develop academic writing within all disciplines is now increasingly acknowledged [16]; but Computing tutors have also identified issues of confidence and motivation relating to first year undergraduates who often privilege practical skills above academic literacy and are reluctant to engage in writing [13]. Academic writing is traditionally assessed summatively, but feedback on completed assignments is often an inadequate response to students' need for support. One possible solution is to reconceptualise the delivery of feedback as *feedforward* guidance, mapped to principles of good practice [21]. This has the potential to scaffold students' ability to improve their writing through *self-assessment*. An evaluation of this intervention is presented. The analysis of results demonstrates a significant impact on: academic performance, student confidence and motivation. Therefore, recommendations are proposed for future feedback practice.

1. KEYWORDS

Feedback, Feedforward, Assessment, Academic Writing, Computing.

2. INTRODUCTION

Current pedagogic theory conceptualises assessment as a dialogic process in which quality feedback is the most powerful single influence on student learning [11] and it is widely known that quality feedback is a fundamental requirement of effective assessment in higher education. In practice, however, feedback has consistently been identified as the least satisfactory aspect of the student experience [20]. Therefore, to improve assessment it is first necessary to improve student feedback and close this problematic gap between theory and practice. Frameworks for good practice in assessment have been developed [21,9] but such principles have often proved difficult to implement because these models position the delivery of quality feedback within a formative rather than summative context, at a time when increasing modularisation and semesterisation and changing staff-student ratios within higher education appear to have limited the possibility of any alternative to end-loading assessment [14]. Receiving feedback on an assignment *after* completion of the relevant unit of study is a common experience for most students [8]. Such assessment does little for student confidence, motivation - or to support their learning [2].

Summative feedback is even less effective in developing the writing for assessment through which students construct their disciplinary knowledge. It is now increasingly recognised that standards of academic literacy are changing across disciplines and Computing is no exception [6]. At the local level, Computing tutors within a new university pursuing a robust widening participation policy have found the summative assessment *of* learning alone is an inadequate response to the need for guidance in such a context [13].

Traditionally, it has been assumed that students will come to know what is expected of them by a process of "implicit socialization"; if this failed then the default alternative was to resort to supplementary 'upskilling' [18]. In the teaching of information literacy the more effective strategy of 'embedding' within the discipline has long been advocated [26]; likewise the theory of writing development now highlights the need to explicitly develop students' academic literacies through "dialogues of participation" [19] in which explicit feedback is provided within the discipline prior to the submission of an assignment.

This is not so much feedback as *feedforward*. If future Computing graduates are to develop the skills that employers want [12] what is now required in the Computing curriculum is formative, assessment *for* learning [1] which scaffolds the skills of "*informing judgment"* necessary for independent learning to graduation and beyond [4]. To sustain such future learning, Computing graduates need to know not only how to retrieve and produce information but also how to *evaluate* it. We argue that such skills can be embedded through improved student feedback on the writing process that progressively develops students' ability to independently self-assess. This paper reports on action research to design, implement and evaluate such an intervention within a first year Computing Studies module.

3. AIMS OF THE PROJECT

The project aimed to develop first year Computing students' competence and confidence in their academic writing skills through improved feedback. To enable good feedback practice, the design and delivery of a *feedforward* cycle of systematic, formative guidance was planned. Within this integrated programme, formative learning activities were embedded which aimed to enhance students' engagement with writing for assessment. In particular, weekly sessions provided the opportunity for dialogue including, a discussion of the writing process and the role of academic writing within the students' own professional development

4. THE INTERVENTION

4.1 The Computing Tutor's Perspective

The intervention was instigated by a subject specialist, the modular leader for *Computing Concepts* (n=20). The module provides a theoretical and practical foundation and is delivered over two semesters throughout the first academic year. Whilst students have consistently proved keen to attend lectures and seminars, engaging in the practical elements of the course, the tutor has observed that first year undergraduates are often reluctant to engage in the extended academic writing required to demonstrate understanding. One assessment involves the creation of a web page and is predominately practical with students frequently being awarded satisfactory grades. However, comparative results for the extended written essay and the final assignment requiring a presentation and reflective writing have been disappointing with assignments from students with high entry grades characterised by description rather than critical analysis and evaluation.

In the experience of the Computing tutor, this apparent lack of engagement with written tasks is not simply due to a lack of effort. This perception is supported by recent research which draws attention to the possibility that Computing students privilege practical skills above academic literacy because of negative attitudes towards academic writing itself and a lack of confidence in their own abilities in particular [13]. Therefore, from the perspective of the subject specialist any intervention to improve assessment needed to address issues of student motivation and confidence.

The design of the intervention to improve academic writing using *feedforward*/feedback was the result of collaboration with the University's *Write Now* Writing Fellow. Initial discussions were informed by recent CETL research demonstrating that student perceptions of writing for assessment as first year undergraduates are significantly influenced by their experience of assessment prior to university [2]. As a result, there was an awareness that any intervention needed to support students in negotiating the transition across sectors between markedly different assessment and feedback practices. It is the leap across this gap which can have a significant impact upon academic performance, motivation and confidence. One key strategy, therefore, was to develop students' understanding of expected standards through *feedforward* learning and teaching activities designed to make explicit the core criteria for assessment in higher education [22, 23].

In schools and colleges, assessment *for* rather than *of* learning has been shown to substantially enhance and improve performance [1]. In higher education, the use of formative assessment strategies has not been without criticism. For example, *feedforward* activities such as the explicit discussion of assignment criteria with students prior to submission can been perceived as 'dumbing down'[10]. Yet the fundamental principle of formative assessment is to:

> "enable students, to judge the quality of what they are producing and be able to regulate what they are doing during the doing of it" [25]

In delivering the intervention, therefore, tutors emphasised that the ultimate goal was to enable students to improve their own writing through increasing self-direction, a skill highly valued by employers [12].

4.2 Design and Implementation

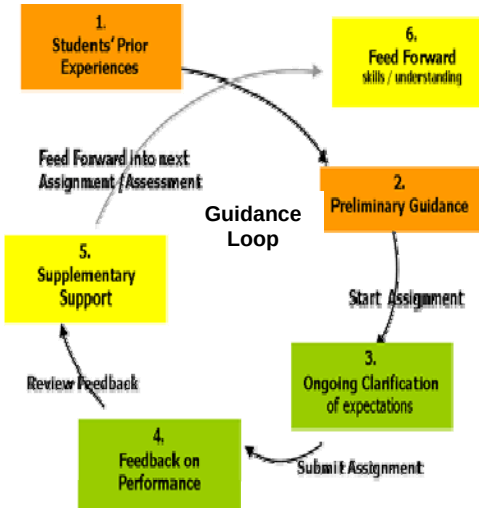
Computing tutors are often aware of the need to develop students' academic writing but feel they lack the

specialist knowledge to achieve this in practice [13]. Significantly, both the theories of academic writing and assessment advocate formative feedback as a driver to enable students to improve their own writing. Therefore, two models of feedback practice [21,15] informed the design of a writing for assessment curriculum, but the implementation of this intervention aimed to address problems associated with both these theoretical perspectives. The principles of good feedback articulated by Nicol and Macfarlane-Dick [21] have been a welcome contribution to the current debate on assessment but the impact of a set of abstract concepts on actual practice has been limited [3]. Hounsell *et al* [15] have recently identified a diagnostic framework from research across the biosciences to support analysis of assessment practice in higher education (Figure 1). However, research has already shown that this guidance loop is not experienced by first year undergraduates within *individual disciplines*, even though such guidance is a distinctive feature of their experience in further education [2]. What is required is an integrated cycle of *feedforward*/feedback that is systematically embedded within the discipline, as within the first semester of *Computing Concepts*, outlined in the table below (Figure 1).

Guidance and Feed forward Loop	Semester 1	Assessment Activity 20-30 minutes at the start of each weekly seminar	Principles [1-7]			Weekly Team Meeting
Pre -Guidance	1 - 6	Audit of Prior Experience Introduction to Core Criteria *Assessment Plus* Discussion using exemplars	1	↑	↑	↑
In-task Guidance	7	Discussion of assignment criteria Peer marking of exemplars	1 2	4	5	7
	8 - 9	Peer/Tutor discussion of students' drafts	3 6	↓	↓	↓
		Submission				
Feedback *for* Feed forward	10	Self Marking (before mark given)	2			
	11 -12	Tutorial Feedback Sessions – discussion of written comments with tutor	3			

1	Clarifies what good performance is (goals, criteria, expected standards)
2	Facilitates self-assessment (reflection) in learning
3	Delivers high quality information to students about their learning
4	Encourages teacher and peer dialogue around learning
5	Encourages positive motivational beliefs and self-esteem
6	Provides opportunities to close the gap between current and desired performance
7	Provides information to teachers that can be used to help shape the teaching

Key: Nicol & Macfarlane-Dick (2006) Seven Principles of Good Feedback Practice



Hounsell *et al* 2008

Figure 1: *Feedforward*/Feedback Curriculum Design

The importance of dialogue is emphasized not only in assessment pedagogy but also in the research literature of Academic Literacies, in which dialogic feedback is held to be the key to scaffolding writing development within a community of practice. The work of Ganobcsik-Williams with the Department of Computer Science at Warwick University, demonstrated the positive impact of discussing the value the writing process [7]. This understanding informed our planning: formative feedback was delivered through 20-30 minute workshops at the start of each weekly seminar to provide opportunities during which the conventions of academic writing could be made transparent, actively discussed and practised. In semester one, students participated in formative assessment activities designed to *feedforward* to the first written assignment, *Social Issues in Computing*. For example, in introductory workshops students and tutors discussed core criteria [22] for essay writing then progressed towards shared understanding of the assignment marking scheme through peer marking of exemplars. In this way tutors modelled their own engagement with academic writing.

This pilot project was funded by the *Write Now* CETL, with sessions delivered by the module tutor and CETL Writing Fellow. Regular team-teaching meetings included the research assistant who gave feedback from participating students. These discussions informed on-going teaching. In the second semester the cycle was repeated in relation to a reflective writing assignment and presentation, but with less teaching input.

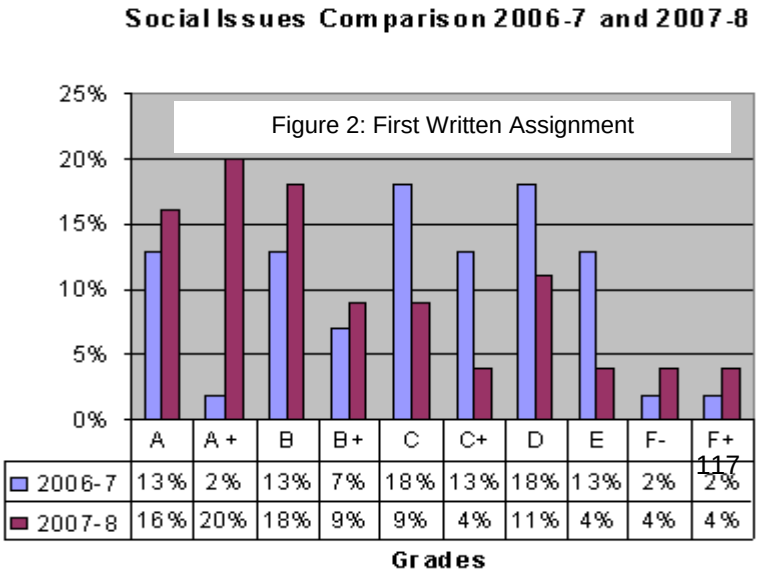


Figure 2: First Written Assignment

5. Analysis of Results

Evidence that the initiative enhanced the student experience of feedback and

assessment was drawn from three areas based upon the aims of the project: academic performance in assessed writing; student confidence and motivation. Results are based upon a mixture of both quantitative and qualitative data collected from: a comparative analysis of academic results and a series of questionnaires, using Likert scales to self report perceptions at significant milestones; together with a thematic analysis [5] of the tutor's own reflective account and the transcripts of a series of student focus groups. This methodology produced a rich set of data relating to the impact of the project upon student learning and the professional development of teaching staff. Analysis of the data is on-going, but a brief discussion of key findings to date is presented below. Overall, the intervention to embed a systematic curriculum of feedforward/feedback guidance within the Computing module clearly succeeded in improving most students' writing for assessment and their confidence and motivation in undertaking their first written assignment.

5.1 Academic Performance

Performance measures indicate a significant improvement between the 2006/7 (control group) and 2007/8 (intervention group) cohorts of Computing students. Following the intervention there was a 27% increase in students achieving a grade above C (or % equivalent) in their first written assignment (Figure 2). These results were sampled and moderated. The control group had a similar entry profile, completed the same assignments and received the same teaching but without the intervention. Concerns have been raised that formative guidance on the meaning of core criteria can generate only a surface understanding of these terms [23]. However, the apparent impact upon deeper, higher order learning indicated by student grades correlates with students' (n=12) final perceptions of the relative importance of core criteria (Figure 3). We propose, therefore, that this suggests progression towards shared meaning.

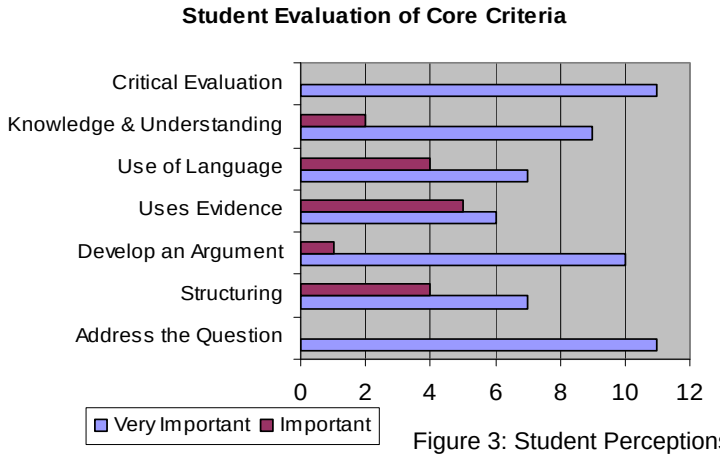


Figure 3: Student Perceptions

5.2 Students' Confidence in Academic Writing

A key strategy to increase students' confidence was to make expected standards explicit. Following initial workshops on core criteria, 61% of students agreed/strongly agreed that they understood these. Comparing the results of questionnaires (n=14; n=20) demonstrated that this confidence was sustained and slightly increased on completion of the assignment. However, significant findings to emerge include the fact that only 21% of students felt confident enough to actually *write* their first academic essay after the initial workshops and in the final evaluation students claiming to be *extremely confident* in academic writing decreased from 5% to 0%. However, there was a 100% increase in students rating themselves *confident/very confident*, with the *extremely unconfident* self-score reduced from 30% to 0% by completion of the first assignment. Thematic analysis of transcripts from two focus groups (n=18 in each) suggests that the on-going *process of guidance*; in particular, the experience of discussing peer marking exemplars and self-marking with reference to criteria, increased student confidence in writing over time or, resulted in a more realistic understanding of standards. There was a high frequency of students linking the increasing ability to evaluate their own writing and increased confidence, of which this comment is typical:

"it was the fact that you got feedback, and [can] see what can be improved"

5.3 Students' Attitude to Academic Writing

The intervention appeared to impact most upon students' attitudes to academic writing, with 83% reporting that their attitude had changed to become more positive as a result of discussions and activities during the weekly sessions. A baseline audit of attitudes revealed that on 7% of students believed academic writing to be useful to them; in contrast, at the end of the course 80% of students reported that they now rated academic writing *important/very important* to their degree and 60% understood the relevance to future employment. Thematic evidence from focus groups demonstrated that the value placed on writing development by tutors in the sessions and a focus on giving guidance on the writing process proved significant. The following responses are characteristic of a marked change in the majority of students' perceptions, which in turn impacted upon motivation:

"..at first I didn't think there was any point to it.. another useless thing.. it's not going to help me later on in life [but] we've talked about it a bit in class, and it does actually make sense now, I'm all for it.." [FG, AP]

"..It's been a lot easier than before, before I didn't like writing essays, I used to end up leaving them to the last minute, I really like doing them now.." [FG, AP]

5. TUTORS' REFLECTION AND RECOMMENDATIONS

The collaboration with the *Write Now* Writing Fellow changed the Computing tutor's perception of how to improve students' engagement with academic writing. Although there was a strong determination within the Computing department to enhance the student experience of writing for assessment, designing a curriculum of formative, *feedforward* guidance overcame the problem of how to deliver sustainable feedback in practice. In particular, the design of a curriculum planning tool which can be adapted to the requirements of various Computing modules has led to wide dissemination of the intervention. As the pilot project was small-scale and the sample limited, the credibility of our results is grounded within their context but we argue that sufficient evidence emerged from the data to support the proposal that academic literacy within the discipline can be improved by embedding assessment *for* learning [1] and we recommend that further cross-institutional research be undertaken to validate our results. To this end, we note that "front loading" [24] feedback so that it is "intrinsic" [17] to situated learning is not without its challenges, for example, a baseline audit revealed only three students had prior experience of the reflective writing required for the final assignment. This finding contradicted the tutor's initial assumption that only one cycle of guidance was needed. Instead, we recommend that a repeated iteration of the *feedforward* cycle is required within the first year of undergraduate study with differentiated teaching input. Finally, auditing students' prior experience of any assessed task is also recommended as a crucial first step in improving assessment and student feedback in higher education.

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HOW TO SUCCEED AT CHEATING WITHOUT REALLY TRYING - FIVE TOP TIPS FOR SUCCESSFUL CHEATING

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ABSTRACT

Academic institutions can sometimes make it easy for students to gain qualifications using dishonest means. This paper is a guide for students that motivates and suggests modern techniques that can be used to cheat. The methods are inspired by the authors' own experiences, especially from researching contract cheating and student plagiarism. They have been selected to be suited to students with a technological background, such as Computing students. The five tips covered include: (i) choosing modules to cheat on; (ii) creating a 'stone soup' assignment from other peoples' cumulative contributions; (iii) outsourcing the work using an auction site; (iv) using online communities to create private cheating networks; and (v) using TurnItIn.com [1] to improve off-the-shelf assignments. No attempt is made to glamorise cheating. It is hoped instead that the paper will provoke open discussion amongst tutors and students alike.

Keywords

Contract cheating, plagiarism, academic integrity, emerging technologies

1. INTRODUCTION

There are different ways for you, as a student, to succeed.

One way is to work very hard, to produce consistently excellent work for all assessments and exams, and to leave with a thorough knowledge of your subject and potentially good career prospects.

The other way is to take every short cut possible, to find ways to cheat the system and to produce the work without having to do it yourself.

This paper is intended for students who are considering whether to attempt to use cheating methods to succeed. The authors are experienced Computing tutors. Our own experiences at detecting students who are contract cheating [2, 3] has provided us with a lot of insight about how students can use emerging technologies to cheat. Briefly, contract cheating is where students outsource the production of original work which can be handed in as if were their own, We present that knowledge with reference to five novel tips to follow to perhaps become a successful cheater. Other students are exploiting similar methods and now you have the same knowledge available that they do!

The five tips do not represent every possible cheating method. Many cheating techniques are kept closely guarded; some of the most successful cheaters may never get caught and so wouldn't willingly reveal their methods. The tips should open avenues to explore. Many tips depend on knowing as much as possible about your tutors and fellow students, past and present, and there are always networking opportunities to take advantage of. Of course, if we know these methods then other tutors do too!

2. WHY CHEAT?

Students that have been caught cheating may use many reasons to justify their actions. Here are several that we have identified:

* Many students are working part-time to enable them to progress through their studies and may be unable to cope balancing the equation of work, life and study.
* The overuse of coursework can mean that 'continual assessment' can seem like 'continual harassment'.

* Some students are unprepared for the relatively unstructured mode of learning that takes place in higher education. Assignments can be set which the students are left to get on with. Even where support mechanisms are in place students may not realise they need help until it is too late.
* At school or a previous college, the culture of 'getting help from others' and 'copying from the Web' may have been endemic. Students may expect this approach to learning to work in higher education.
* A small minority of students may be of the opinion that they have paid a lot for their degree and therefore it doesn't matter how the work is completed.
* To some the benefits of getting an academic qualification, particularly at postgraduate level, include the right to permanent residency or a better job. Thus the need to succeed is imperative.

Studies show that a sizeable proportion of students engage in activities that broadly come under the heading of academic dishonesty. A 2006 survey showed that over 50% of business studies students had cheated in some way [4]; other studies seem to confirm the general trend even if the proportions may vary.

Publicity seeking owners of essay mill services have sparked headlines in the press which include "threefold increase in overseas students buying university essays" [5].

In a scene from a forthcoming novel *Cheat 22* – we have not decided whether or not to set it in the present or the near future – Professor Daneeka is berating a student: "... and what if everyone paid for their assignment to be written for them?". To which the student, Yossarian, replies "Then I would be a damn fool to do otherwise!".

3. FIVE TOP TIPS

3.1 First Tip: Not All Modules are Created Equally

The five tips presented are focused on modern ways to cheat. We have shied away from exams; instead the discussion is focused on written and technical assignments.

	Module 1	**Module 2**
Tutor	Busy tutor, teaches lots of things. Not got time to check details.	The tutor only teaches one or two modules. Lots of time to get to know the whole class.
Number of students	Huge group, over 100.	Small group, 20 students.
Written assignment	Uses questions from a popular textbook, for which model answers are available.	Writes a new and original assignment every year.
Individualised assignment	Everyone does the same assignment.	Each student is given a different set of tasks to do.
Use of a viva-voce	The written work is the only thing marked.	The tutor books an individual appointment with you, where they ask you questions about what you have handed in.
Written examination	The course doesn't have an examination.	The course has a written examination.
Plagiarism software	No anti-plagiarism software is used.	The work is collected in electronically and automatically checked for plagiarism against work copied from other students, the Internet and work previously submitted.
Penalties	The likely penalty for being caught is to have to redo the assignment.	Previous students have been expelled, or required to complete community service.

Table 1 – Comparison of Two Modules

There's nothing to stop you from taking the traditional approach to cheating that you might have used before. Go to the Web, grab a likely looking essay from an essay mill. If it matches what you have to do, and you can get away with handing it in as your own work then that's the problem solved.

Or just hand in the same work as a friend, or a few friends.

But the truth of the matter is, it's easier to cheat in some subjects than others. Consider the two subjects shown in Table 1. Which one would you rather study?

We're think it's fairly certain that you would prefer Module 1.

That's why it's worth spending time to find as much out about each module, and each course as a whole, as possible before you make your module choices. Hopefully you're studying for an academic qualification offering a large degree of optionality. This provides you with the maximum number of opportunities to choose the modules that you can best cheat at.

Wherever possible, choose modules where you can sink into obscurity and minimise your class contact. That way you don't have to worry about learning anything. If you can avoid examinations too, then even better!

3.2 Second Tip: 'Stone Soup' Assignment Production

One successful approach that can be used for a programming or other technical assignment is based around the fable of 'stone soup'. For those unfamiliar with the story, it is shown in Table 2.

"According to the story, some travellers come to a village, carrying nothing more than an empty pot. Upon their arrival, the villagers are unwilling to share any of their food stores with the hungry travellers. The travellers fill the pot with water, drop a large stone in it, and place it over a fire in the village square. One of the villagers becomes curious and asks what they are doing. The travellers answer that they are making 'stone soup', which tastes wonderful, although it still needs a little bit of garnish to improve the flavour, which they are missing. The villager doesn't mind parting with just a little bit to help them out, so it gets added to the soup. Another villager walks by, inquiring about the pot, and the travellers again mention their stone soup which hasn't reached its full potential yet. The villager hands them a little bit of seasoning to help them out. More and more villagers walk by, each adding another ingredient. Finally, a delicious and nourishing pot of soup is enjoyed by all."

Table 2 – The Fable of the 'Stone Soup' [6]

The approach can be recreated by using existing online resources, such as message boards and forums.

First, find a message board that specialises in a subject related to your assignment. It can help if you find a board with lots of traffic and people willing to help.

Find a small part of the assignment that one person might be willing to solve. For instance, this might be a few lines of program code.

Place a request on the discussion forum asking for help. If all goes well you'll get a quick response and a solution.

Now repeat the process with another section of the assignment and watch your 'stone soup' assignment grow.

Just don't make the mistake of asking for changes too soon after one another, or someone may get suspicious.

As you get to the end of the assignment it is quite acceptable to say "I've nearly finished my assignment, I just need help with the last bit". It's true.

The big advantage of this approach is that you can be provided with a complete solution, and all for free!

3.3 Third Tip: Saturday Night Takeaway

Picture the scene. It's Saturday night, and you have an assignment to write, but you have had to do an extra shift on your part-time job.

What if there was a way by which you could quickly and easily find someone to write your assignment for you?

There are three main and easily applicable options for outsourcing your assignment. The first is to use an essay writing site, such as the much publicised UKEssays.com [7]. The second is to use an auction service, such as RentACoder.com [8]. The third is to request tutorial support through a site such as Kasamba.com [9]. All of these result in original work. This solution is known as contract cheating [2, 3].

Although the quality of the work that you may get back from any of these services can be variable, we would suggest that the essay writing service should be considered a last resort. The price charged by an essay writing service is likely to be considerable more than the other options and there is no guarantee of better quality. Further, there is a likelihood of essay sites working as third party subcontractors [2, 3]; that is, collecting money from students, then themselves outsourcing the results to RentACoder.com and pocketing the difference. So, why not just cut out the middle man?

Another advantage of RentACoder.com, as well as some but not all of the other auction sites, is that payment made in advance for work is held in escrow until a suitable quality of deliverables are returned. With essay

writing services you pay your money directly to the company providing the results and so the risk of receiving something unsuitable, with no easy comeback, is much higher.

When auctioning off the rights to complete your work, always bear in mind the phrase that “anyone can be a dog on the Internet”. Choose a coder carefully. There is never a guarantee that the coder will complete the work for you, or will complete it to the standard that you require. Provide as much assistance as you can to the coder, for instance details of the programming style you want and about the module you’re working on. Otherwise, investigations have found that the quality of the work returned can be poor [10].

Be warned that there are a number of ways in which outsourcing can go wrong. Two particular stories have been reported to the authors. First, the UK media, completing an ongoing study, attempted to outsource an assignment. Within 24 hours, an investigator at a UK institution had traced the assignment back to its source, based purely on the originating tutor’s clear love for The Goon Show. Second, another coder, unhappy not being paid, went one step further, directly notifying the student’s tutor of the cheating attempt.

3.4 Fourth Tip: Face-To-Face Collusion, by the Book

Never underestimate the usefulness of other peers. Students who have studied the same modules and materials as you in the past may have in-depth knowledge about the subject and its assessments.

It may be apparent, for instance, that your tutor uses the same assessments year-on-year. Rather than copying a solution from another student in your current class it may be safer to copy from a student in a previous year.

Working together with other students can be easy. Sites such as Facebook.com [11] provide an easy method through which to communicate with others who are studying with you. Over several years they can become a useful repository of information. Networking with previous students, once such a network is established, can be simpler than trying to arrange face-to-face meetings.

One danger of using Facebook.com for this purpose is that tutors will want to know why you haven’t made use of legitimate assistance services first, such as your own institution’s online support forums. The precedent of Chris Evenir [12], found to have set up a Facebook.com support group, shows that tutors find such use unethical, even when it is not intended for cheating purposes. So, tread carefully if taking this route.

3.5 Final Tip: Turn It In… Until it Passes!

Many academic institutions, including those in the UK, now habitually use the TurnItIn.com [1] plagiarism detection software to find copied work. If you are a student in one of these institutions, and take chunks of texts from the Internet, you may be caught and penalised.

The exact algorithm used by TurnItIn.com to decide whether documents are copied is not publicly available, and may change from time to time. Therefore it is impossible to know how to change your text to avoid being detected

There appear to be a number of institutions who give students free access to TurnItIn.com in an attempt to make sure that students do not inadvertently plagiarise. If you are in one of these institutions, or otherwise have access to TurnItIn.com, this can present a golden opportunity to learn to cheat.

The objective is to get hold of an off-the-shelf assignment, such as that provided by an essay mill, or perhaps through the purchase of a ready made dissertation through a service such as eBay.com [13]. Make sure that it accurately matches the assignment that you’re required to hand in, otherwise you might not get a very high mark. You can patchwork together an assignment by taking text from many sources, but why bother? The result is likely to be a bit of a mismatch of all sorts of different writings, and that can tip your tutor off that the work is not your own.

As with most cheating, using TurnItIn.com can take a lot of time. The idea is to make use of the opportunity to submit the work that you purchased to TurnItIn.com and see if it is detected as plagiarised. If it’s off-the-shelf work it almost certainly will be. So edit the work by making a few changes throughout it. You might do this by changing the odd word here and there, or by taking paragraphs and rewriting them. There is no point just changing the order of large sections of the document, as TurnItIn.com will detect this.

Submit the revised version of the document to TurnItIn.com. If you have made enough changes then the report will show a low similarity score. If not you can see the areas that you need to change. Continue making changes to the document and resubmitting it until you are happy. The result will be an original version of a standard copied document, all ready for you to hand in.

4. A DISCLAIMER FOR STUDENTS

Any attempts to cheat are carried out at your own risk.

The penalties for being caught can be severe. They can result in you having to repeat modules, or potentially being dismissed from your course of study. This can continue to affect you in the future; for instance the verdicts can appear on transcripts of your results, or in academic references. In careers where 'honesty is a virtue' this can seriously affect your career prospects.

We encourage you to consider whether you really need to cheat. To cheat successfully takes a lot of effort. In many cases it is both quicker and more rewarding to complete the work yourself. Who knows, you might even learn something!

5. A DISCLAIMER FOR TUTORS

As class sizes rise and scheduled contact hours increase it can be easy to become complacent when teaching. The methods of deception discussed here are achievable by students, particularly for those on Computing courses. Many students now come equipped with technological skills ahead of those of their tutors and some students will exploit this advantage.

It is intended that this paper can be taken as a starting point to open up a discussion at your own academic institution. Take a look at your own teaching and assessment methods and those of your departmental colleagues. Think how many cheating techniques are possible on your modules and if there are policies and practices in place to cope with such techniques.

We end with inspiration from the musical Barnum:

> *"There Is a Sucker Born Ev'ry Minute."*

Please make sure that this applies to the student attempting to cheat, not you.

6. CREDITS

The title of this paper and some references within are shamelessly plagiarised from popular culture.

The cheating techniques are a combination of those from the authors' own experience and some that have been referred to us. It is impossible to remember and list every academic who has told us a story about catching a student cheating, but we gratefully acknowledge their efforts in tacking the cheating problem.

We hope to continue to collect and circulate details of innovative and modern cheating techniques, in order to facilitate understanding around the community. Feel free to share with us any that you find.

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EVALUATING THE USE OF WIKIS IN STUDENT GROUP WORK WITHIN BLACKBOARD

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ABSTRACT

The emergence of Web 2.0 and the popularity of social networking websites is providing a significant impetus for development of new ways of collaborative learning in higher education. In this paper, we describe our experience of using wikis integrated within Blackboard VLE to conduct and assess students' group projects in two undergraduate and one postgraduate modules The project explores the extent to which wikis can prove a valuable group learning and assessment tool. Overall, student groups find wikis both enjoyable to work with and beneficial for facilitating learning.

Keywords

Wiki, group learning, collaborative learning, Blackboard VLE.

1. INTRODUCTION

The paper reviews a pilot project designed to support a collaborative learning environment for students in a university setting. Blackboard is a virtual learning environment that is widely used in many UK universities. The wiki is part of the TEAM LX[18] extension to Blackboard VLE developed by the Learning Objects (LO) Company. The project has three principle aims:

- To provide a technologically innovative approach to group coursework delivery and assessment
- To increase integration and usage of the university's existing Blackboard VLE to deliver and assess module content
- To evaluate the effectiveness and use of wikis as a group work tool in comparison to traditional teaching and assessment methods

The provision and use of the wikis as part of module delivery and assessment of three pilot course modules has served to address the first two aims. The evaluation of the project incorporated in this paper addresses the third aim.

The rationale for the project is that it is likely to deliver a number of benefits for the students concerned. These include - (i) improved student participation in coursework delivery, (ii) improved collaboration among groups of students who are already used to similar modes of communication (e.g. social networks), (iii) enhanced student creative skills through collaborative wiki design and content creation, and (iv) improved team work skills.

After introducing the nature and scope of the project, the paper goes on to summarise the methodology applied in this work. A detailed analysis ensues. The evaluation of project's outcomes is based on an analysis of wiki usage statistics, student questionnaires and focus groups of selected participating students. This assessment includes summary statistics as well as qualitative analysis of some of the underlying reasons for the results obtained. The paper continues with a discussion of the key outcomes and observations of the project, together with an assessment of their implications for the students, the staff involved, and the institution.

[18] Teams LX™ is wiki software designed specifically for education, enabling students and instructors to collaboratively create interactive, multimedia websites. http://www.learningobjects.com/

Clearly this is a small project with limited time and resources available to it. There are thus many questions which the project and this paper have not been able to address. The paper will thus conclude with recommendations for further research which could usefully be carried out in this area.

2. USING WIKIS

The term Web 2.0 was first introduced by O'Reilly Media [9] and was used to describe second generation Internet-based services that enable people to socialize and share information in new ways, for example by using social networking sites, blogs, wikis, tagging, etc. The past two years have seen a substantial rise in the use of the social networking websites, which connect people with common interests by provision of services, such as photo-sharing, email, wikis, blogging, etc. Turban et al [14] defines the wiki as a "website that enables visitors to add, remove, edit and change content without the need for registration". A variety of wiki tools are now available for for a range of purposes and uses [13]. The wiki is a new generation of collaborative tool enabling people to work simultaneously on the same documents in a timely manner. Examples of the use of wikis in corporate environments have also been reported [5,6,11].

Evidence suggests that use of collaborative learning techniques supported by appropriate electronic tools in higher education is growing [1,10,12]. The wiki is a suitable technology for online collaboration that can support effective learning [4,8]. The use of wikis to support students' group projects has been reported by a number of authors [2,3,7]. The reported findings on this use for group-based projects have been encouraging overall. The tool facilitates student participation in group work; it is useful for organising and maintaining group documents; and certain wikis enable the tutor to monitor and assess individual student participation in the group project. Some issues with regard to wiki usability have been reported, but overall the results have been promising.

3. PROJECT DESCRIPTION

A wiki is a tool for collaborative development. As mentioned, its popularity and use among students and staff is increasing. Educational Virtual Learning Environments (VLE) such as Blackboard and Moodle are established platforms available in many UK universities. The use of a number of supplementary course tools, for example SMS text services, blogs and wikis that are integrated with VLEs, is growing.

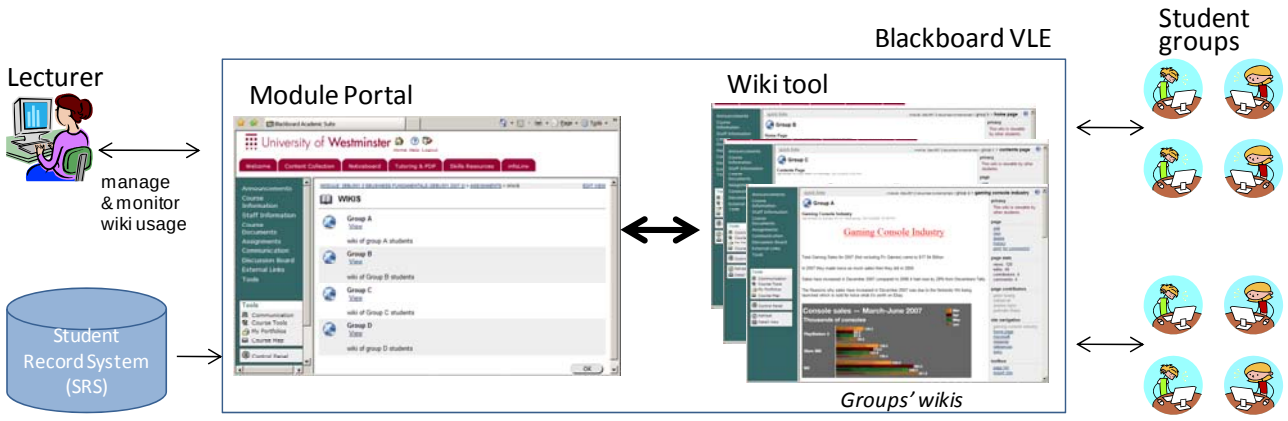

Figure 1. Framework for the use of wikis within Blackboard VLE.

Three modules were selected to be part of the pilot project – two undergraduate (2EBU501 E-Business Fundamentals, 2BUS501 Managing Business Resources) and one postgraduate (2BCO7H4 Managing E-Commerce). The assignments required the formulation of strategies. In one module, the requirement was for an Internet strategy, in another it was for an information management strategy, and the third was for a strategy for a new electronic market. A total of approximately 30 students participated in the project. Students on the three modules were required to make submissions to the module's wiki site as part of the assessment. Using the wiki tool in Blackboard, an environment was set for each module as shown in Figure 1. A wiki was created for each group of students, with editing rights set up for each group, where members were allowed to change the wiki content. The lecturer also enabled all students to have read-only access to other groups' wikis. This was an important element which allowed students to monitor their peer groups' progress.

The assignment required students to produce a joint collaborative web-site style wiki on a particular topic. Students were required to conduct research on the topic and present their findings on the wiki. The wiki's editing rights were similar to those of Word documents, allowing students a degree of creativity with regard to

colours, fonts, pictures, external links, etc. Additionally, a hands-on training session on how to use the wiki was also given.

The lecturer was then able to monitor the usage of wikis over a few weeks in one semester.

4. METHODOLOGY

An attempt has been made to verify the results of this project as far as is feasible. This has been done primarily by triangulation. Thus both quantitative and qualitative analysis have been included, and the qualitative analysis has been used to both corroborate and provide a greater understanding of the quantitative variety.

The sample is small but, given the triangulation described above, the results do seem sound and worthy of note. Thus several sources of data have been used. These include:

- A questionnaire combining a lickert scale (from 1 to 5) and open ended questions which was distributed to students at the end of the semester, once the coursework assignment was completed;
- Wiki usage statistics which were extracted from Blackboard's wiki tool;
- Individual students' written reflective statements;
- A focus group meeting with students which was conducted at the end of the semester.

5. ANALYSIS OF RESULTS

5.1 Survey

Overall, the use of the wiki was considered to be beneficial in a number of ways. The survey results reflect a generally positive reaction on the part of the students. Summary statistics of some of the questions from the survey are provided in Appendix A. The following observations can be made about student response to the use of the wikis:

- Few students had used wikis before. Over 70% of students reported that they have never participated in wiki activity prior to this pilot project.
- Student sentiment about the use of the wiki is clearly positive. When asked if wikis were useful and easy to use, over 75% replied 'Agree/Strongly Agree' and over 60% of students agreed that the use of the wiki helped in their coursework assignment
- Students felt that the wiki facilitates group collaboration, a view supported by over 65% of the students.
- Students spoke almost unanimously of the 'convenience factor' that the wiki generated by enabling students to work in an asynchronous way from different locations, e.g. homes, university, etc.
- Most students seemed to feel that there was, nonetheless, room for improvement, for example a number of students commented on inconsistencies occurring in text and picture formatting, the lack of a spell checker, etc.
- 75% of students reported that they would like to see more use made of wikis on other modules.
- There were one or two students who did not seem to find the experience useful.

Generally, students found that the wiki had been enjoyable to use and had made a valuable contribution to the learning experience.

5.2 Usage

The wiki tool provides the lecturer with up-to-date statistics on the individual student's contribution. It enables staff to drill down to minute details such as which lines were edited by whom and at what times. Figure 2 gives a snapshot of usage statistics on one of the modules and the level of group participation (users' details have been modified to maintain student anonymity).

Participation for Group A			Participation for Group B			Participation for Group C			Participation for Group D		
User	Total Page Saves	Total Lines Modified	User	Total Page Saves	Total Lines Modified	User	Total Page Saves	Total Lines Modified	User	Total Page Saves	Total Lines Modified
1	30% (112/377)	41% (809/1991)	1	83% (360/433)	89% (1532/1714)	1	55% (149/269)	43% (222/511)	1	64% (127/198)	49% (599/1215)
2	22% (82/377)	28% (563/1991)	2	8% (36/433)	7% (116/1714)	2	22% (59/269)	29% (146/511)	2	28% (56/198)	45% (551/1215)
3	31% (116/377)	24% (487/1991)	3	4% (17/433)	2% (35/1714)	3	15% (41/269)	17% (88/511)	3	8% (15/198)	5% (65/1215)
4	18% (67/377)	7% (132/1991)	4	5% (20/433)	2% (31/1714)	4	7% (20/269)	11% (55/511)	4	0% (0/198)	0% (0/1215)

Figure 2. Wiki usage by student groups

The usage statistics seem to suggest that participation in the use of the wikis by group members was distinctly unbalanced. It would appear that some groups were much more active than others and some

members ‘carried’ others. The focus group discussions (outlined below) suggest that this is not always the case. For example, sometimes the group would all contribute to the discussion while only one member recorded what was agreed.

5.3 Reflective Statements

Reflective statements were sought from one of the larger classes. The examples below are typical of the statements made and provide some explanation for the questionnaire results above.

Once again, the comments were generally positive. Most students enjoyed using the wiki and felt it enhanced the learning experience. Some students experienced some technical difficulties with the tool however.

“A Wiki would be a useful tool for group work if the members lived far from each other”. “...The convenience of being able to work from home and not having to physically meet up as a group”.

“..Being able to communicate with your group members, and leaving comments whilst doing your work. So every time someone else logged on they could see the comments and take the work from there. Another one was it [was] easy to access and easy to update anytime you wanted. It was easy to use and you didn’t need to have many skills to use the wiki.”

“One problem my group found is that wiki’s are only capable of being edited at one computer station at a time”. “When editing text on the wiki page I would save what I had edited, but when the page was uploaded online it wouldn’t display what I had edited. It took me many attempts to get it right”.

“My personal experience of using the wiki was excellent”. “I believe that the use of wikis is a great way of setting work in higher education”.

“The use of wikis will help groups to see who is performing well and which individual is not participating and maybe looking for a ‘free ride’ in the assignment”.

“Although I have used sites like wikipedia and other sites which allows information to be simultaneously uploaded and edited, I was surprised to learn how this could be both an exciting and beneficial method of doing coursework and group work in particular”. “In conclusion, I think that the use of wikis within groups benefits both the group members and the tutors alike”.

5.4 Focus Group Comments

The focus group, carried out on the same class at the end of the module, provides further insights into the sentiments of the students.

Again, the general feeling was that students found the use of wikis valuable and interesting. Most students had not used a wiki before and were pleasantly surprised by the benefits they offered. It was really convenient for group members to communicate with each and leave messages through the “comments” facility provided by the wiki. Students felt that while the wiki reduces the need for frequent group meetings, though it does not eliminate the need for face-to-face meetings. Group meetings and personal contacts are still needed especially at the onset of the coursework assignment.

Students also commented that wiki participation statistics do not necessarily reflect the actual contribution that an individual makes to the group work. Nevertheless, it was felt that it can be used to identify free-riders.

From a technical point of view wikis were seen as being easy to use. The main complaint was that the wiki’s feature set could have been a little more comprehensive. In particular, the ability to incorporate a spell checker and multimedia elements into the wiki would have been welcomed.

Finally, most students expressed the view that they would like to see more Web 2.0 type tools integrated into their learning and assessment.

6. CONCLUSIONS

Overall, the project has been an unqualified success. Students found the use of wikis enjoyable, for the most part; and, equally, they felt it made a discernable contribution to the enhancement of their learning. The project has helped to achieve the following key project outcomes:

- Improved collaborative interaction between students in a group setting;
- Increased module content awareness, participation and performance by the students;
- Availability of an additional (web) channel for delivering and presenting joint coursework;
- Improved ability to demonstrate learning outcomes;
- Improved ability of staff to assess individual student contribution to group work;
- Improved student team working skills that are essential in the workplace;

- Improved assessment evaluation and feedback from course staff.

However, the institution needs to ensure that the wiki software works reliably and that the software is kept up-to-date. The relentless pace of change in the computer industry in general, and the Internet in particular, requires that in-house systems are maintained in line with the requirements and expectations of students.

It is customary today to talk of paradigm shifts, disruptive technology, and the need for radically different ways of doing business. But it does appear that we are witnessing a substantial shift in the way in which companies interact with their customers, especially on the Internet. The wiki in many ways epitomises this more collaborative, community driven environment. The more we are able to embrace this kind of technology, understand its strengths and weaknesses, and deploy it in support of our teaching, the better placed we will be to accommodate, indeed benefit from, the changes that accompany such technology.

7. RECOMMENDATIONS

More research on when and where wikis work well in an educational context and when they are not particularly appropriate would clearly be useful. Similarly, some clarity on the kind of assessment which is most suitable would also be of great value.

Industry at large is beginning to wake up to the potential of wikis as a tool for collaboration between employees. Presumably, wikis could prove an effective communication and collaboration vehicle for academic staff too. Further investigation into the circumstances under which this works well would also be helpful.

8. ACKNOWLEDGEMENTS

We wish to thank the Higher Education Academy, Information and Computer Science subject network for supporting this project under the General Development Fund 2007/8.

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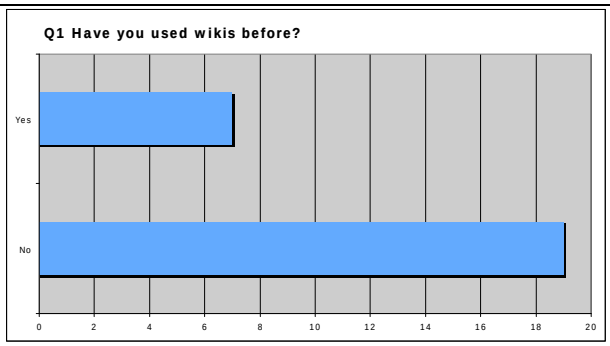
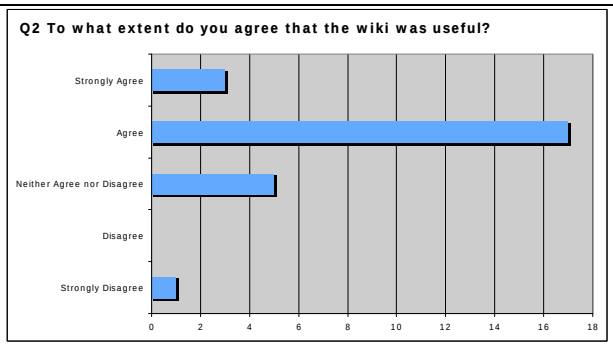
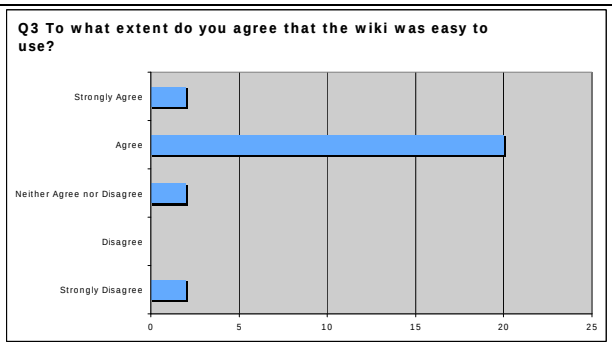
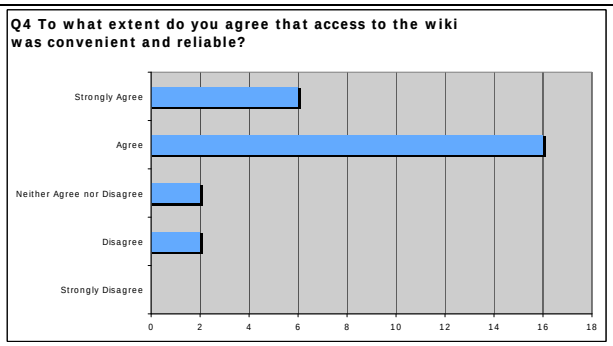
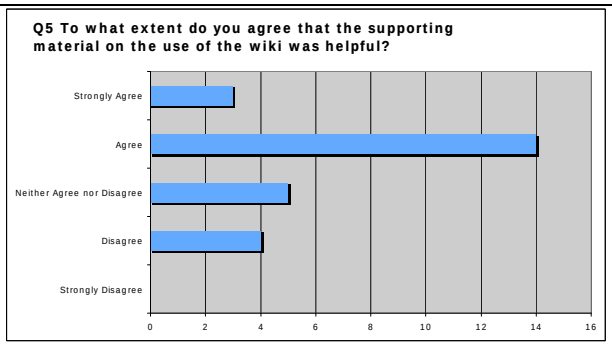
Appendix A. Summary of the students' survey

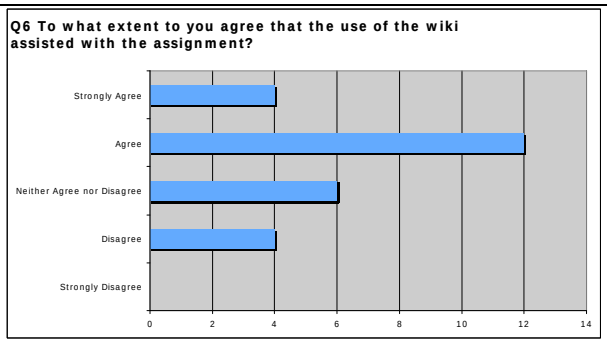


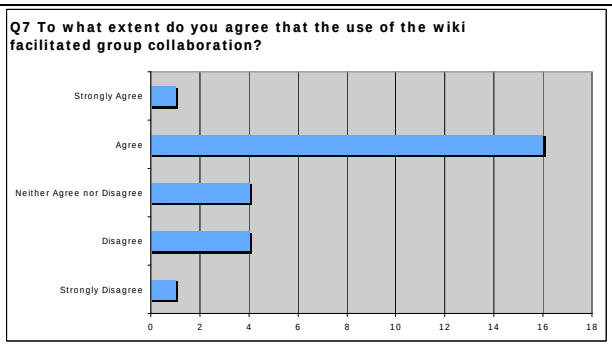


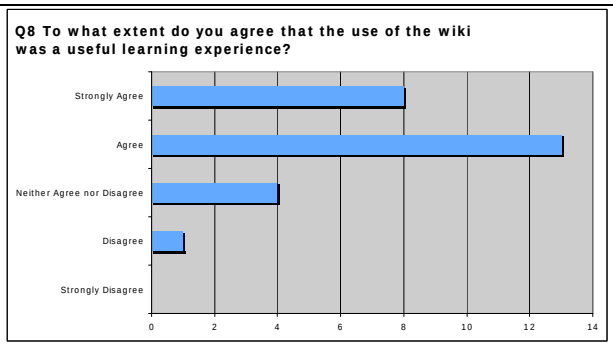


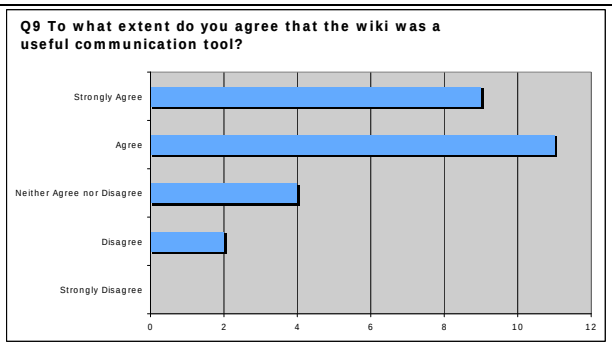


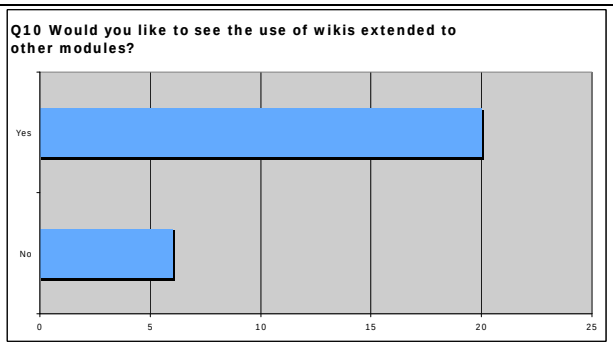












IMPROVING ASSESSMENT IN SOFTWARE ENGINEERING STUDENT TEAM PROJECTS

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ABSTRACT

In this paper we outline methods of peer and self- assessment and formative feedback that have been used in a unique software engineering cross-site team project in undergraduate Computing Science departments at both Newcastle and Durham University as part of the CETL initiative – Active Learning in Computing [1] . We outline the team project involved, illustrate how our approach aligns with the learning outcomes of our modules and meets the overall pedagogical aims of ALiC and describe the assessment methods used. Based on our experiences we then provide guidance for the wider use of these assessment methods for team work in the HE community.

Keywords

Assessment, Feedback, Team working, Software Engineering

1. INTRODUCTION

Active Learning in Computing (ALiC) is a five year collaborative CETL project funded by HEFCE involving 4 consortium partners – Durham University (CETL lead), Newcastle University, Leeds Metropolitan University and the University of Leeds. As part of the project, we run a year-long cross-site team project between Newcastle and Durham students taking our respective Level 2 Software Engineering (SE) modules. The students are formed into companies with each company's 'employees' being made up of Durham and Newcastle students. Each company must collaborate and communicate in order to develop and deliver a large piece of software plus the accompanying documentation at the end of the academic year. The activity which has been running for three academic years to date was designed with the aim of mimicking cross-site development practice that has become commonplace in the software industry [10, 11]. It aims to give students an insight into the real challenges faced by companies competing in a global market and to encourage the development of transferable skills that are a vital accompaniment to their technical repertoire. This paper describes the assessment methods that we have used during the cross-site project to determine team and individual effort fairly, and our approaches that involve students in their own assessment. We illustrate how our assessments align with the learning outcomes of our SE modules and the overall pedagogical aims of CETL ALiC. An overview of each of the formative peer and self-assessment methods used during the project are described with our experiences of using them. Finally we provide some guidance for the wider use of these methods in team work assessment.

2. ALIGNING PEDAGOGICAL AIMS AND ASSESSMENT

The fundamental vision of ALiC is to identify and enable ways in which students can become more active in their learning [2]. Through promoting activities such as team working we aim to develop innovative approaches to learning that enable students to move towards independent learning guided by appropriate support materials. Furthermore, any assessments used will be sensitive to this new style of learning, which are larger in scale and scope and encompass all aspects of the curriculum. This new type of learning will provide a solution to the over-assessment problem experienced within the Computer Science discipline.

The cross-site SE team project between Durham and Newcastle is designed to fulfil the standard learning outcomes of both our SE modules i.e. to introduce issues regarding programming in the large including software development models, project planning and management and to provide practical experience in the skills of the discipline such as requirements analysis, team structure, document preparation and the design and implementation of a large software system; the ability to work as a member of a team and to fulfil appropriate roles within the team etc. Other learning outcomes include improved written communication, practice in problem solving, interpersonal communication, assessment of use of initiative, adaptability and team working skills [3, 4]. Table 1 illustrates the mapping between these learning outcomes and the project deliverables. It also denotes which deliverables are individual submissions (I), local team only deliverables (T) and company deliverables (C).

The necessity for cross-site collaboration in order to complete the project places a strong emphasis on students managing their own teams, communicating with their colleagues at the other university site, allocating roles, distributing tasks and responsibilities, and planning the project together, all which emulate what currently happens in the software industry. This also maps directly to the fundamental vision of AliC by introducing a strong element of independent learning by providing a realistic and challenging project that allows the students to practice and develop the employability skills that employers require.

LEARNING OUTCOMES	**DELIVERABLES**
Communication – with customer Problem solving, requirements analysis	Statement of work document (C)– requirements analysis
Use of initiative, planning, use of software development models, problem solving	Project plan (C), log books (T, I), team reports(T)
Software design, software development models, industry standards and practices for design notation	Project document (C) - design
Programming, testing, software development	Software source code and documentation, user manuals etc. Project Document (C)
Adaptability, leadership, interpersonal communication, cross-site communication and collaboration, work as member of team, fulfil roles, time management, organisation	Personal skills analysis (I), individual reports (I), meeting minutes and observations (T), team reports (T), Team contract (T), log books (T, I), evaluating own and others performance (T) and individual reflective reports (I)
Communication	Team presentation (T), written reports (C, T), talking to customer(C), use of technologies (C, T)
Written communication skills, using industry-standard notation	Project Document (C), team report (T), individual reports (I), coding (C), documentation (C)

Table 1: Mapping of Learning Outcomes and Assessed Deliverables

3. ASSESSMENT METHODS

Assessment of team work could be relatively straight forward if we were simply assessing the tangible deliverables and products of team work, and if our marking criteria were just based on the standards of the discipline and not the personal characteristics of the participant. However, team work assessment invariably involves allocating an individual mark for both *product* and *process* which often proves problematic [5]. It is much harder to assess the processes involved in team work as it is necessary to know the contributions of each team member to determine an individual mark. With either collocated or cross-site work it is vital that

each individual is assessed fairly so that those who significantly contribute are rewarded and those that don't will not benefit from the effort of their more conscientious colleagues. However, accurate individual assessment is difficult in an environment that allows students to contribute at varying levels whilst also trying to ensure that students gain maximum benefit from the team work experience. Assessment of team activities causes considerable concern to students and can for some result in spoiling an activity that they would have otherwise enjoyed. Working across sites and universities makes addressing this issue all the more imperative.

Each university has its own way of *doing things* which include a different structure of the SE modules and how they are assessed e.g. the module at Durham is worth 40 credits whereas at Newcastle it is worth 20 credits. Assessment in this cross-site work therefore presented a challenge. It was necessary to agree on a set of common deliverables and define the assessment and marking criteria which would fulfil both sets of module aims and learning outcomes. It was also necessary to ensure that we acknowledged individual and team effort at each site and that ultimately a team's assessment was not compromised by a poorly performing team in the other University. It was also very important to make the assessment methods clear to the students at both sites to reassure them that a poor collaboration between two teams would not necessarily be detrimental to their overall marks for the module.

3.1 Joint Assessment of Company Deliverables

Initially, at the beginning of the cross-site work it was decided to summatively assess all the shared deliverables from each company and at the end of the module use individual and team reports and log books to help determine individual effort. It was our intention to reinforce the collaboration between sites by making the deliverable very much a company effort, where this deliverable was given one overall mark, regardless of the location and effort. Whilst the deliverables have been jointly marked by staff at Durham and Newcastle, it was however not possible to use such a simple process as students at each site felt that they had contributed much more than others and felt it very unfair if their section was particularly good but another section actually brought the overall mark down. To overcome the problem of determining contribution from each site and each individual, a contribution matrix was introduced (Figure 1).

Sections	Joe	Kirill	Michael	Tom
1.0 Introduction	Newcastle	Newcastle	Newcastle	**Newcastle**
1.1 Purpose	CMR	R		**R**
2.1.1 PC Modules				**CMR**
2.1.2 PDA Modules	Newcastle	Newcastle	Newcastle	**Newc**
3.1.1 PC Modules	CMR	CMR		
3.1.2 PDA Modules	Newcastle	Newcastle	Newcastle	**Newc**
3.2 Inter-process deps.	CMR	R	MR	**CMR**
3.2.1 PC Modules	CMR	R	MR	**CMR**
3.2.2 PDA Modules	Newcastle	Newcastle	Newcastle	**Newcastle**
4.2.3 PC Process Interface			CMR	
4.2.4 PDA Process Interface	**Newcastle**	**Newcastle**	**Newcastle**	**Newcastle**

Key;
C – create
M – modify
R - review

Figure 1: An abridged sample contribution matrix completed by Durham for the design deliverable

3.2 Contribution Matrix

In order to accommodate students' concerns and make our assessment fairer, we specified a simple contribution matrix should be included by each site with every company submission. This matrix provided the opportunity for each team to describe individual members' contributions for every deliverable i.e. who was responsible for creating (C), modifying (M), editing or reviewing (R) documents and code associated with the project. The matrix clearly shows which parts of the deliverable the local team completed and also the parts that were undertaken by their counterparts at the other university. Teams at each site do not have to agree on the contributions in the matrix, but these are compared across site by staff, and students are aware of this. It has proved a good way to monitor the collaboration between the sites and also to note what is happening

locally. The matrices generally helped to reassure students that all efforts were taken into account. During the course of the projects it has been noticed that students tend to view the coding of a system as the most important part of the work and the *soft skills* i.e. documentation, organising meetings, project planning and management etc. are often viewed as less crucial. Completion of these matrices not only has helped to reassure students that effort has been recorded but also makes the students realise the importance of the efforts of all team members, regardless of whether the task is writing code, project management or writing documentation.

3.3 Newcastle: Percentage –Sharing

At Newcastle, a percentage-sharing exercise was undertaken at two intervals during the year. Students were asked to share 100% between their team members based on their efforts during each semester. It was observed that early on, during the first semester, students tended to divide the 100% quite evenly across all team members whereas the second set of percentages allocated during or just after the rather difficult implementation and delivery phase in the second semester is where a noticeable change was reflected in the percentages awarded to team members. This phase was generally more intense and stressful for the students and they needed to collaborate quite closely across sites. At this point they tended to be much more inclined to be realistic and actively discuss and debate locally the distribution of the 100%. Coming to an agreement often proved difficult and students became quite emotive about their contribution and the fairness of the distribution. To help mitigate the possibility of unfairness, staff monitors provided guidance to the students on how to conduct the exercise so all team members felt their views have been heard. In addition, to support the distribution of percentages, the contribution matrices, interim team reports and final reflective reports were used to provide supporting evidence in determining what was happening within a team throughout the project and to ensure that final weightings were based on as accurate a picture as possible.

3.4 Durham: Self and Peer Ranking

Durham students completed four self and peer assessment tasks throughout the life of the project. Each student was asked to place themselves and their team-members on a grid of 15 places (1-5 being for most contribution). In this way they are able to more strongly demonstrate exceptional, or non-contribution. This process made the student evaluate their own performance in comparison to other team members. As in previous work, we found that few students ranked themselves as contributing the least – and that they found it hard to be objective about their individual contribution to the team [6]. In addition to this each Durham team has a project manager (usually two) who are third year students studying a Level 3 Project Management module. These Level 3 students take responsibility for project management of the local team, making recommendations for the co-ordination and allocation of tasks as well as being involved in the setting and tracking of internal deadlines [9]. These project managers, who meet with their team on a weekly basis, are also tasked with completing peer rankings for each of their team members

The contribution matrix, self and peer ranking by students, peer ranking by project managers and staff observations together help to determine an individuals mark for the project. This data builds a picture of a student's contribution over the lifetime of the project. From this, each team member is ranked by staff and a personal adjustment of the team mark is made, resulting in an individual mark for the team project.

3.5 Cross-site Percentage Sharing

In addition to the methods of self and peer assessment discussed above, each company was asked to simply divide 100% between the two sites. We where very interested to see how the students perceived the contribution of their local team in comparison to the other site. . This cross-site percentage sharing was never intended to be used in the assessment of the project. Students were told that they did not need to confer with the other site in coming to their decision but could if they wanted to. Our experiences with this form of peer assessment have shown us that what seems to be a simple task in fact, in some cases, can turn out to be the most problematic. Some of the companies decided they would confer for this distribution and consequently discussions turned out to be quite heated. There was quite a lot of disagreement over which site had contributed the most. Of course, we had some idea that a few collaborations had not been as productive as they might throughout the year and the cross-site percentage sharing process seems to have borne this out, with several companies completely disagreeing over the appropriate division.

3.6 Formative Assessment and Feedback

As part of the learning process each company had to submit a draft version for each of the two major written deliverables and feedback would be provided. This feedback was a combination of the comments from coordinating staff at both sites and came in the form of comments on the draft document and verbal feedback

to each team at their own site. This dual feedback provided a much richer and varied set of comments and suggestions for improvement of the work before final submission. Many teams found this very useful and acted upon the advice. Other forms of formative feedback provided where comments and advice from monitors (Newcastle) and project managers (Durham) during weekly meetings. At Newcastle each team was given an overview of their progress based on their average grade for team and company deliverables throughout the year – this meant teams knew if they needed to make more effort as final marks are not calculated until the very end of the project. At Durham students had to provide verbal weekly progress reports and agree on internal actions lists for the coming week, Students found these regular meetings quite helpful and our intention is to increase the level of these forms of feedback and so strengthen student future performance.

3.7 Calculating a Final Individual Module Mark

An example of how the final marks for the module are now awarded at Newcastle and how we calculate an individual mark is as follows: 15% of the module mark is awarded by a team monitor as an individual mark based on individual deliverables. These are: individual report, individual log book, observations of performance in meetings etc. 25% of the module mark is awarded by the team monitor as a team mark based on team/company deliverables. These include the team contract, website, interim team report team log book and final team report. 20% of the module mark is awarded by the module leaders as an individual mark based on individual assignments including the strengths essay and tick list & team structure essay and interim individual report and 40% of the module mark is awarded by the module leaders as a team mark based on company deliverables i.e. statement of work, project document and implementation (software demo and presentation, code). All company deliverables have common marking schemes across sites and are double-marked. Durham students' team marks are calculated in the same way for company deliverables. The differences in module credits mean that Durham students undertake exams and other individual assessments as part of their SE module. The cross-site team project only constitutes 75% of the coursework mark (60% coursework, 40% exams). Results from the peer assessments are also used to help determine the individual component of team deliverables at both sites.

The assessment methods we have employed help us to gain a more complete picture of local team and cross-site company interactions. We are able to focus on the results of the technical and non-technical aspects of the deliverables and also the development of the students' transferable skills. We believe the assessment methods we use are now fairer in that we have a clearer picture of an individual's contributions via a number of methods, including observation and peer assessment. We are however continually trying to improve our process and our assessment design and in such a way as to make them more transparent to students. This is not an easy task, as cross-site assessment and ensuring fairness can be complex depending on the cohort size, the problem specified and the shared assessments and deliverables.

4. USING THESE ASSESSMENT METHODS

Throughout the course of this project we have gathered feedback from students and staff in a number of ways. We have used focus groups, module questionnaires, skills self-assessment tasks, observations in team meetings and student reflective reports and log books. In order to determine if our assessments and curriculum design are working the way we want them to we have compared the modules quantitative results, student learning outcomes and performance at the end of each year with results from the pre-cross site initiative [12, 13].

The cross-site work puts team assessment more sharply into focus. It also makes it imperative to get it right as the risks involved increase, in comparison to co-located team projects. Whilst the learning experience and skills gained throughout this type of work are invaluable, assessment is the more immediate primary concern of the students. Students need reassurance that the assessment is reliable and fair and therefore it is necessary to use a variety of assessment methods – each capturing different elements of the work.

In using these assessment methods the following guidance is recommended:

- **Agree clear assessment criteria** - As with any assessment, students involved in teamwork must be provided with clearly defined assessment criteria and well-developed marking schemes that show how achievements are to be evidenced and judged. In cross-site work this information must be held in a central location accessible to all. Each company therefore had its own shared protected area within a Wiki and within this shared area each site also had its own protected area.

- **Teach students about peer and self assessment** - Peer and self-assessment provides a lot of benefit to students in that it lets them see how much effort their team has put into joint work and also evaluate their own skills and learning achievements throughout a project. It also helps students to take responsibility for their own learning and to realise the importance of teamworking in their professional skills development. However, students are not experts or have little evaluation experience and therefore peer and self assessment is something they need guidance with. Students can find it difficult to judge their own contribution and often overestimate or underestimate their own performance. Providing this guidance is important especially with the Durham peer and self assessment with rankings being clearly defined. Some students scale widely using the full 1-15 whilst others rank only in the first half of the scale thereby making it difficult to determine the level of overall contribution. Students may also feel uneasy about having the responsibility of assessing other students' work. A session at the start of the year that outlines the purpose of self and peer assessment and allows students to practice this skill would be very beneficial. Also, our use of a simple contribution matrix for every deliverable can help students to recognise more clearly the efforts of their peers and the contribution of all team members throughout the project and may serve as a way of helping students make better judgements.

- **Continue to actively allay student anxiety -** Whilst company percentage sharing did not directly contribute in determining team or individual marks in the project it was an extremely interesting short exercise which highlighted student perception of their site involvement in the project. Herbsleb et al., have undertaken a number of surveys regarding global software development and report "a strong relationship between delay in cross-site work and the degree to which remote colleagues are perceived to help out when workloads are heavy" [7]. A perception of how much each team contributes and supports their counterparts varies considerably with generally a mis-match between how each site sees the percentage split. From a student perspective, they often simply believe that their own site does all the work and the distribution of work is not equal. Our use of contribution matrices and cross-site contribution sharing has shown us that students need regular staff reassurance about assessment throughout the project and that all their efforts are recognised and that their marks will not be compromised by the other site.

- **Formative assessment needs to be timely and meaningful -** Providing formative feedback of draft documents was helpful to the teams in order for them to improve their performance and consequently the mark awarded for the work. Students appreciated the face-to-face feedback afforded to each team however from a staff point of view this was relatively time-consuming. However, involving the students in this feedback process was an invaluable learning experience that motivated them to take greater responsibility for their work especially when they can clearly see where improvements could be made. We chose to give formative feedback on the larger deliverables throughout the year not only to ensure that students could learn from their mistakes and make adjustments to improve their marks, but also to reassure them of their successes.

5. CONCLUSIONS AND FURTHER WORK

The use of various assessment methods such as the contribution matrix, self and peer assessment via ranking or assigning percentages we believe, help to ensure greater fairness and enable intangible tasks such as communication, organisation, team working etc. to be given value. Involving students in assessment enhances their motivation and enthusiasm by encouraging active participation in the learning process, making assessment a shared, collaborative activity. The contribution matrix will be developed further to deal more explicitly with activities that demonstrate the non-technical, transferable skills components of the project.

It was difficult to find a balance between reassuring students that the collaboration would not impact adversely on their overall attainment without reducing the need for strong collaboration between teams – which is essentially a major part of their learning process. It is still quite difficult for staff to determine an individual's mark even with the wealth of supporting evidence obtained from the various assessment techniques and we are still working on improving this.

Cross-site student software development work such as this goes some way to emulate real world working methods within the software industry and should be continued. There are a number of issues which need further consideration such as the scalability of this type of work and in particular research results which show that "distributed work items appear to take about two and one-half times as long to complete as similar items where all the work is collocated" [8], which can impact on future projects and their assessment.. However this is the subject of another paper.

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COULD PLES BE THE FUTURE – FROM INSTITUTIONAL TO STUDENT CONTROL?

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ABSTRACT

This paper explores the current use of VLEs within a FE College in order to determine how staff and students are engaging with them as part of teaching and learning strategies.

The recent development of personal learning environments (PLEs) is discussed with regard to how these fit within the rapid growth in Web 2.0 technologies. The paper indicates the need for further investigation into alternative solutions to the problem of student engagement and suggests a more student-centred approach involving the creation of appropriate resources to allow students to adapt their learning requirements in a digital media that includes ePortfolios

The paper concludes that efforts to improve VLE use have not been successful and since we are experiencing a shift towards the more non-compliant student we need to address the change in a positive way.

KEYWORDS

VLE, PLE, Web 2.0, social networking, collaboration, teaching and learning.

1. INTRODUCTION

Educational institutes have, for some time, used virtual learning environments (VLEs) as a means of engaging students with learning content. A Virtual Learning Environment can be defined as a software system that supports learning and teaching within the educational setting.

These VLEs traditionally work across the Internet and provide users with a collection of tools for assessment, communication, content sharing, return of students' work, and the administration of student groups. A range of VLE software is available and educational establishments have a variety of suppliers.

In recent years there has been a significant change in the use of the Internet. Social networking sites have grown tremendously creating a web that is changing in look and feel. The interactive web has resulted in the

term Web 2.0 which encompasses a variety of meanings but with an emphasis on user generated content, content sharing and collaboration.

This change in emphasis raises the question of how educational establishments manage their resources for teaching and learning. If the web is becoming a data sharing and collaborative place, then where does the current style of VLE fit in?

An increasing number of suppliers are offering hosting facilities with many free. Individuals can create their own virtual environments in the form of Personal Learning Environments (PLEs) which can be generated in a format determined by the user.

If this functionality is available, then what should educational institutes do in order to engage with such facilities? This paper explores the current trends in Web 2.0 technology and the increasing use of PLEs as a learning tool for students. Should we be creating an environment for students to store, to share and collaborate their learning resources, and ask the question whether VLEs have outgrown their usefulness?

2.0 THE INTERACTIVE WEB AND STUDENTS (WEB 2.0)

Mark van Hamerlen [10] makes an observation that the introduction of Web 2.0 technologies is helping change some characteristics of current and future student cohorts. It could be argued that these changes may necessitate profound changes in learning and teaching methods [1].

Mark van Hamerlen [11] cited the work of Marc Prensky [9] and describes his definition of 'digital natives' as "a generation that has grown up with digital technology, operating at "twitch speed", and performing multiple activities simultaneously". Van Hamerlen also quotes from part two of the same article that Prensky claims that changes in activity during development may ("almost certainly") have resulted in different neural wiring via processes of neuroplasticity. Prensky claims that digital natives have acquired different ways of thinking, thanks to different cultural practices. Prensky proposes that while digital natives have shorter attention spans, and less ability to reflect on topics, they instead have greater visual skills, the ability to concentrate on different media simultaneously, and the ability to monitor changes and make inductive discoveries.

There is some debate over Prensky's claims but what is evident is that current students in FE/HE are entering study with a different background of skills. This can be summarized by the observations made in Oblinger and Oblinger work [6]. They define the following characteristics of the new net generation students as:

- digitally literate,
- highly Internet familiar, connected via networked media,
- used to immediate responses,
- prefer experiential learning,
- highly social,
- prefer to work in teams,
- craving interactivity in image rich environments, and
- having a preference "for structure rather than ambiguity".

Oblinger and Oblinger offer the premise of a different kind of student, one who is non-traditional and working at the same time as studying. While their description is US-oriented, this profile is becoming more evident in our UK HE establishments.

If these new student skills and study preferences are significant, should we not explore different teaching and learning methods? Should we be exploring new ways of allowing students to use these incoming skill sets? Will the changing profile of students change the way we deliver programmes and facilitate learning?

Mark van Hamerlen [11] proposes some anecdotal evidence that, there are different perspectives relating to student engagement (and therefore grades and retention). He indicates:

- There is a recent case of a university teacher switching his instruction to a social medium (FaceBook or MySpace) because the teacher's students would not engage with the traditional VLE. Web 2.0 enabled approaches may therefore help engage with students.

- On the other hand, recent student interviews in a humanities school in a UK University revealed that students were not concerned how they are taught (e.g. through lectures, seminars, or through a

blended learning approach) so long as the instruction was good. This then raises the question of "what is good practice in learning and teaching in different modalities?" So recent in fact that the academic commissioned to interview students has not even presented these results to the school concerned, precluding dissemination of the name of the particular school and university.

2. THE FUTURE OF LEARNING ENVIRONMENTS.

3.1 A changing population

Just when VLEs appear to be acceptable and stable, Web 2.0 appears and the whole concept of resource access and interactivity has been turned upside down. The Web 2.0 concept that is growing at a tremendous rate, is highlighting the limitations of current VLE technology. Web 2.0 has not been a revolution, but more a necessary evolution. Technically there is not much new about Web 2.0, but it demonstrates a change in how technology is perceived and used. Innovative combinations and uses of technology seem to occur all the time under the Web 2.0 banner.

O'Neill, G and McMahon, T [8] made comment that

> "The changing demographics of the student population and the more consumer/client-centered culture in today's society have provided a climate where the use of student-centered learning is thriving"

Downes [5] in one of his famous blogs similarly commented that "learning is characterized not only by greater autonomy for the learner, but also a greater emphasis on active learning, with creation, communication and participation playing key roles, and on changing roles for the teacher, indeed, even a collapse of the distinction between teacher and student altogether."

The following section is intended to offer an alternative teaching and learning approach that is being explored within an FE/HE college where traditionally VLE and ICT have played a major role in course delivery but with limited success. The concept of Personal Learning Environments is therefore discussed as a learning tool for the future.

3.2 Personal learning environments

Personal Learning Environments (PLEs) can be described as systems that help learners take control of and manage their own learning. This includes providing support for learners to

- set their own learning goals
- manage their learning; both content and process
- communicate with others in the process of learning

A PLE could contain one or more subsystems: It may be a desktop application, or a combination of one or more web-based services [10]

Important concepts in PLEs include the integration of both formal and informal learning into a single experience, the use of social networks across institutional boundaries, and the use of networking protocols (Peer-to-Peer, web services etc.) to integrate a range of resources and systems within a personally-managed space.

According to Donald Clark [3], tens of millions of people have PLEs. Hardly any of them see it that way – for example:

MyYahoo	*50 million*
MyMSN	*12 million*
Google personalised homepage	*10 million*
Netvibes	*10 million*
Etc	

The concept of the 'personalised homepage' with calendar, alerts, links, feeds, news, to do lists, weather, stock prices, gadgets and knowledge sources is fast becoming commonplace. The point Clark makes is that the learning is part of the doing – "it's next to your calendar and things to do list. It's part of your everyday life".

Clark also proposes that such PLEs conform to needs as a person and learner, The individual does not have to conform to the system, it conforms to the individual. These tools give a sense of freedom and control. VLEs or LMSs or other top-down content management systems do not offer this. Clark feels that an LMS/VLE is teacher-centric about push and top-down control and dissemination. Clark claims that content is no longer institutional – it's increasingly abundant and free.

Clark advances the suggestion that we are now witnessing the death of the compliant learner, and that learner control and freedom are essential. The contributing student is the future and PLEs along with Web 2.0 offer the mechanism.

4. CASE STUDY (PILOT)

4.1 Method

This pilot study forms part of an ongoing investigation into the use of Web 2.0 technology within the teaching and learning environment. The investigation will form part of a strategy to develop new ways of delivering programmes across the campus.

Participants

This study involved some 40 students on two separate courses. One a Media programme, and the other a Foundation Degree. The control group consisted of 18 IT Practitioner students. Students and staff had access to both the VLE and a range of Web 2.0 tools.

4.1.2 Procedure

Over the last two years, a range of investigations have been carried out to determine the extent that ICT and VLEs were used within teaching and learning [4]. This study was a review of how staff were embracing the use of Web 2.0 tools and how the use of such technologies could be further developed.

Having determined a broad understanding of the use of ICT within the institution, it was necessary to explore how tutors could enhance their practice using some of the latest tools available in the form of Web 2.0 technology. Two programmes were selected to investigate. Tutors on these programmes were enthusiastic about using new approaches and it was felt that a comparison to other areas not engaging with such techniques would provide some insight into the way forward.

The two groups selected consisted of a media class of 21 school children aged 14-16 studying a range of media applications (animation, web design and movie making). The other group consisted of 15 Foundation degree students studying Chemical Technology. Both groups were given support in setting up VLE (Blackboard) material and Web 2.0 tools as appropriate. The control group for the study consisted of 18 students on a first year IT Practitioner's programme. Feedback from students and staff was collated during the study and at the end.

Analysis of VLE access activities would provide data on how students related to their learning environment and coupled with relevant feedback on their learning experience would provide some indication of how students were interacting with the technology available.

4.2 Results

Previous studies on the use of ICT in teaching and learning found that when asked what VLE presence their courses had, 75% of staff indicated they had resources uploaded on the VLE, 20% did not but would like to upload material. In contrast, 5% indicating they did not want to use VLE technology at all. VLE usage statistics showed that there had been only a slight increase in both staff and student use since September 2006.

Earlier studies have concentrated on how the college could improve VLE involvement. 55% of staff surveyed felt they did not have time to develop resources whereas 40% would like better access to ICT equipment. Only 5% of staff wanted ICT staff development time [4]. Attempts to improve VLE use and engage students consistently seem to fail and it could be argued that an alternative approach was necessary.

Analysis of the two group's usage of VLE facilities compared to a control group, provided some interesting observations. The following tables show a summary of access activities by group.

Foundation degree students	% of hits
Announcements	44
Personal Information	1
My grades/tasks	1
e-mail	2
Collaboration	3
Content	0
Communication area	12
Dropbox	1
Tools	5
Discussion Board	16
Messages	12
Other	3

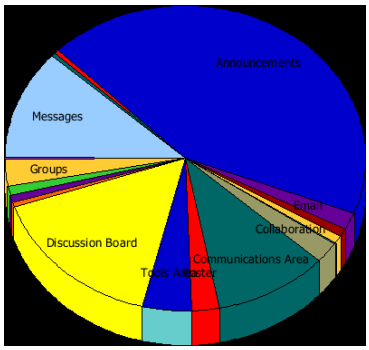

Table 1 Breakdown of VLE access activities for Foundation Degree students (Sept 07 – May 08)

Media Students	% of hits
Announcements	15
Personal Information	0
My grades/tasks	0
e-mail	2
Collaboration	1
Content	0
Communication area	14
Dropbox	8
Tools	4
Discussion Board	15
Messages	37
Other	4

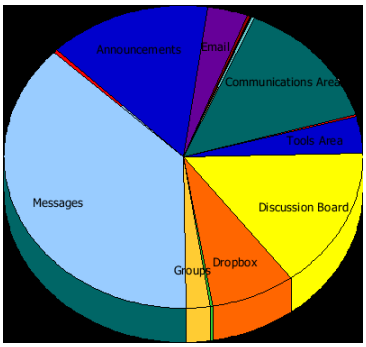

Table 2 Breakdown of VLE access activities for Media students (Sept 07 – May 08)

IT Practitioner Students	% of hits
Announcements	41
Personal Information	0
My grades/tasks/Gradebook	33
e-mail	1
Collaboration	1
Content	0
Communication area	2
Dropbox	9
Tools	8
Discussion Board	1
Messages	4
Other	0

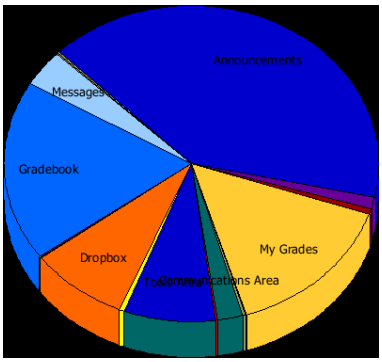

Table 3 Breakdown of VLE access activities for IT Practitioner students (Sept 07 – May 08

What appears to be indicated by the data collected over this period is that students are predominantly using the college VLE for social and learning networking. Even in the case of the control group, most student activity fell under the networking banner. Hardly any content access was recorded. This implies that our use of VLEs should be questioned.

Feedback from students indicated that course material was only accessed on Blackboard when it related to either coursework or was useful for revision purposes. Most were happy with face-to-face content delivery and indicated that the latter provided sufficient background knowledge for progression on the course. Collaboration between students again related to coursework and communication with tutors on content and style issues.

All groups used electronic transfer of documents (dropbox), especially within the ICT based courses where tutors had implemented electronic assessment techniques. The impact of electronic assessment was evident in the case of the IT Practitioner group who accessed their gradebook frequently (33% of hits). All students however, accessed the announcement section regularly, since this was the major means of tutor communication to various groups.

The use of wikis, podcasts and video material only seemed to provide added interest for students and did not offer any evidence of improved learning. What it did offer staff was a new way of communicating to their group and provided a fresh look to their course. Web 2.0 technologies have rapidly become a part of many students' lives and this could be a reason why the networking aspects of VLEs were predominantly used.

5. CONCLUSION

The limited appeal of current VLE facilities and a poor staff and student engagement has resulted in a series of investigations to seek alternative solutions. Attempts to improve VLE and ICT use in teaching and learning have not been successful. VLEs are consistently used as lecture material repositories with little or no student interaction unless resources are assessment based. Institutes are seeing a shifting student population who are very much non-compliant and this seems to indicate the need for a new and more dynamic approach to learning environments.

An investigation into the access activities of the college VLE seems to indicate that students use facilities mainly for social or learning networking reasons. Collaboration and communication activities form the major basis of VLE use. Since the VLE is mainly controlled by the institution for the dissemination of course resources, it was surprising to see that this aspect of VLE use was very limited.

Two courses were given access to Web 2.0 technologies in the form of wikis, podcasts and video material. However no great improvement in learning was determined, but students did express that these tools provided and added interest to the course. Providing students with facilities to organize their own personal learning environments and access to tools for such an approach would help create a more integrated and dynamic environment that improves the integration of learning within their daily lives.

A further investigation into the development of personal learning environments is proposed to follow this pilot study in order to determine what form the learning environment should take. It is suggested that this approach would result in the creation of an adaptive personal environment integrated with assessment in the form of ePortfolio development. The use of third party solutions or the integration of add-ins to the college VLE would need to be investigated. The question of security and support however is an issue that will be considered, but a shift towards student centred control from institutional control is rapidly becoming a viable option.

There are many options but what is reasonably consistent is that an ideal set of tools would contain shared file storage, organiser, search and bookmark tool, messaging or chat facilities and a media centre for audio, video and digital pictures. Access to web space and the means to create an ePortfolio are other desirable tools or facilities.

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WIDENING PARTICIPATION THROUGH ADAPTABLE PERSONAL LEARNING ENVIRONMENTS

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ABSTRACT

This paper proposes a model for the development of a framework for an open source Adaptable Personal Learning Environment (APLE). We define an APLE as one that is adaptable to the learner's needs and preferences, to the environment in which they are working and encompasses personal systems and tools. The framework is focused around the creation of novel interfaces for personal learning taking as the starting point an existing Virtual Learning Environment (VLE) known as the Portland VLE. Central to the project is engagement with and development of a community of practice comprising tutors, developers, students and administrators. Through this engagement we aim to develop a set of anonymous personal profiles from which sample interfaces and learning objects will be produced. In addition an exploration of appropriate standards is required to establish a framework that enables interoperability between learning environment, devices and learning objects.

Keywords

Adaptable, personal, learning, environments, accessibility, inclusion

1. INTRODUCTION

JISC [7] describe a Personal Learning Environment as one that replaces some or all of the tools of a standard Virtual Learning Environment (VLE) with tools that are personal to the learner and integrated with the student's own personal systems and tools. The interface and tools are not designated by the institutional VLE; instead they are the personal choice of the learner. We propose to extend that description by adding the concept of adaptability as defined by the IMS *AccessForAll* [6] group. An Adaptable Personal Learning Environment would facilitate participation by all students including those with disabilities for whom access may currently be difficult or impossible. The framework is focused around the creation of novel interfaces for personal learning, taking as the starting point an existing Virtual Learning Environment (VLE) known as the Portland VLE. It was developed as part of a recently completed research project on a symbols-based accessible VLE for the Portland partnership, a large cross institutional European funded initiative. The areas under scrutiny are symbols based interfaces, social software and inclusion and draws on related work with the IMS *AccessForAll* [6] anonymous Profiles of Needs and Preferences (PNPs). Central to the proposed Adaptable Personal Learning Environment (APLE) is the need to establish and test the concept of personal profiles.

Three major areas of research for us are the development of an adaptive, symbols based VLE for students with severe disabilities, self adapting interfaces for mobile devices, and a Transformation, Adaptation and Substitution Service (TASS) for the definition of adaptable learning objects. Linking all of these is the concept of anonymous personal profiling. This enables adaptation of the mobile interface, the delivery of learning objects and personalisation of the VLE to meet the needs and preferences of the individual. In addition an exploration of appropriate standards is required to establish a framework that enables interoperability between learning environment, devices and learning objects [12].

2. THE PORTLAND PERSONALISED VIRTUAL LEARNING ENVIRONMENT (PVLE)

The Portland VLE [4] took a specific and pragmatic approach to the development of an adaptable learning environment. To some extent, therefore, the Portland VLE might be thought of as a Personalised Virtual Learning Environment (PVLE). It relies on the tutor or administrator making the required adjustments to the VLE by selecting elements of interaction according to the learner profile that is derived from baseline observations and formal assessment of student needs.

This VLE is designed so that it can be tailored to meet the individual needs and preferences of the target user group. The interface is personalised to allow learners to have the screen display and layout of their choice, and choice of symbol set (PCS, Rebus or Makaton). This means the environment meets the needs of those learners with low literacy levels through symbol-supported text and speech output. Interaction is tailored to meet students' requirements through compatibility between the VLE and their preferred input device (e.g. mouse, switch, scanning).The Portland VLE includes the standard features found in most mainstream VLEs, (e.g. a secure login system, communication tools, timetable and access to tailored learning resources).

Portland's unique functionality and features has resulted in an accessible and adaptable learning environment that meets the needs of learners with severe learning difficulties and physical disabilities. The design encourages a greater level of independence for the learner by ensuring that the VLE and the learning objects are accessible with the appropriate input device, language tools and layout required by each individual user (Figure One).

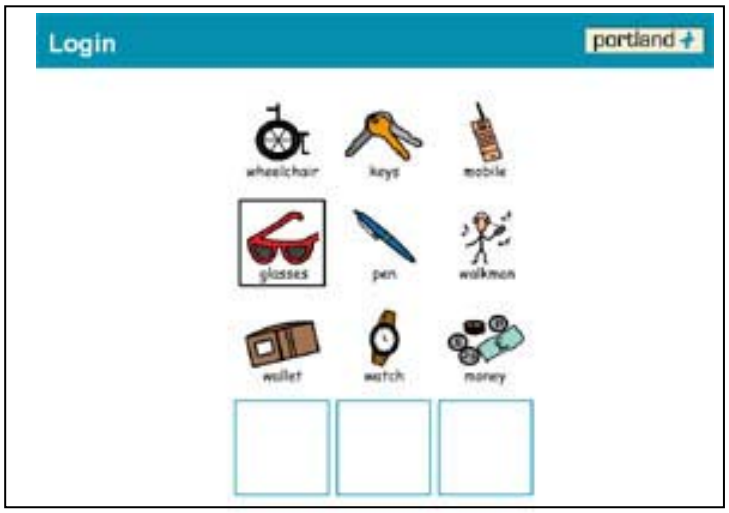

Figure One: The Portland VLE Symbolised Log-in Screen

The JISC concept of a Personal Learning Environment (PLE) goes one step further in that every aspect, including the functions of the environment such as e-mail, discussion and calendar are actively selected by the individual. A PLE can be developed from a PVLE if a common set of standards can be identified for component interoperability and the individual is allowed to build up their personal set of functions from available components [11]; [3].

The beta application developed demonstrated that a PVLE could be created that is adaptable to the needs of a particular group of learners with complex physical and cognitive disabilities and is in use by the students and their colleagues who were involved in its development. Transforming the PVLE to an open source tool, adopting the JISC concept of a PLE and incorporating aspects of adaptability would result in the creation of an APLE that could be used by many other learner groups with particular needs and preferences.

2.1 A Transformation Augmentation and Substitution Service for Adaptable Learning Objects and Learning Patterns

In order to achieve an accessible relationship between the resource and the user, descriptions of user needs and preferences are checked against descriptions of resource components until they match. This process involves a description of a user's control, display and content needs and preferences being matched with a description of the components of the learning object [9]. The delivery of the appropriate component will form an accessible relationship between the user and the learning object. According to the *AccessForAll* metadata overview, accessible systems should be able to adjust the user interface of the learning environment, locate needed resources and alter resource properties to match the needs and preferences of the user. This may involve the substitution, augmentation or transformation of components of the resource such as changes in

sensory modality. For our purposes we have developed a transformation, augmentation and substitution service (TASS) which is geared to a limited subset of e-learning applications and contexts. It represents a special instance of an *AccessForAll* service.

Our work to date has focused on applying the TASS to learning objects. To make rich online content match individual needs and preferences, this approach requires a basic resource to be created from existing or newly authored components, and the appropriate adaptations (transformations, augmentations and substitutions) need to be identified. Examples of these adaptations are as follows.

Transformation
Transformation may occur where text is rendered visually, as characters, or a sign language, or aurally, perhaps by a screen reader, or transformed into a tactile form as Braille or simply changed in colour, size and other display features.

Augmentation
Augmentation involves the optional addition of a feature to a primary resource, for instance a textual caption could be added to a video when required by a user with a hearing impairment or in a noisy environment.

Substitution
Substitution might occur when a user requires a vision-free access to the resource, for instance if the user was accessing the learning object on a PDA on a field trip and to be accessible it is necessary to replace the visual element of the learning objects with components that match the user's preferences of vision-free access. Alternatively, an interactive exercise requiring a mouse for operation could be substituted by one that can be controlled using a keyboard or keyboard emulator for a user with a mobility impairment.

As an example a replacement occurs when a user accessing a learning object requires vision-free access to a resource, and therefore needs alternatives to the visual content contained in the primary resource of the learning object. The profile of this user may actually be the same as the profile of a sighted user accessing the learning object on a PDA while driving: the user needs to access the learning object using non-visual techniques. For this relationship to be accessible it is necessary to replace the visual element of the learning objects with components that match the user's preferences of vision-free access. It is also often the case that the original content of the resource has to be supplemented, as for example with their availability of a dictionary or captions, for an aural component.

2.2 Application Profiles

In this context we accept the extension of the definition of accessibility beyond disability, and define the relationship between a user and a resource as accessible when the characteristics of the resource as delivered match the user's needs and preferences [8]. The definition of accessibility implied here is that the relationship between the user and the resource is one that enables the user to make sensory and cognitive contact with the content of the resource [6] op.cit. According to the *AccessForAll* statement the term disability has been re-defined as a mismatch between the needs of the learner and the education offered and it is therefore not a personal trait but an artefact of the relationship between the learner and the learning environment or education delivery [1]. Accessibility, therefore, is the ability of the learning environment to adjust to the needs of all learners and is determined by the flexibility of the environment (with respect to presentation, control methods and access modality) and the availability of adequate *alternative-but-equivalent* content [5]. The needs and preferences of a user may arise from the context or environment the user is in, the tools available (e.g., mobile devices, assistive technologies etc.), their background, or a disability. According to the *AccessForAll* vocabulary, descriptions of needs and preferences are separated into display, control and content characteristics. Declared needs and preferences may change according to context. [8]; [10].

2.3 From adaptable resources to an APLE

One way of achieving an APLE is to extend the concept of a transformation, augmentation and substitution service to deal with the features of the learning environment as well as the content, and then to embed the TASS into the PVLE (Figure 3). This suggestion is based on the principle that learning content can be generated from adaptable aggregations of learning objects and media components using proven learning patterns. Using a variant of IMS AccessForAll [6], the TASS works on available metadata and user profiles to

generate alternative, equivalent learning experiences relating to a user's declared needs, preferences and learning styles [12].

This might provide a more pragmatic, adaptable and ultimately accessible learning environment than the current JISC PLE concept can achieve by itself. Although the JISC PLE proposals consider the concepts of personal choice, no specific account has been taken of the work on adaptability by the IMS *AccessForAll* group. The JISC PLE proposals are based on a well recognised and understood need to make learning environments more usable for individuals or better suited to their learning and research needs. It is a small step to extend this to be more accessible by adapting both content and functions to the needs and preferences of our users.

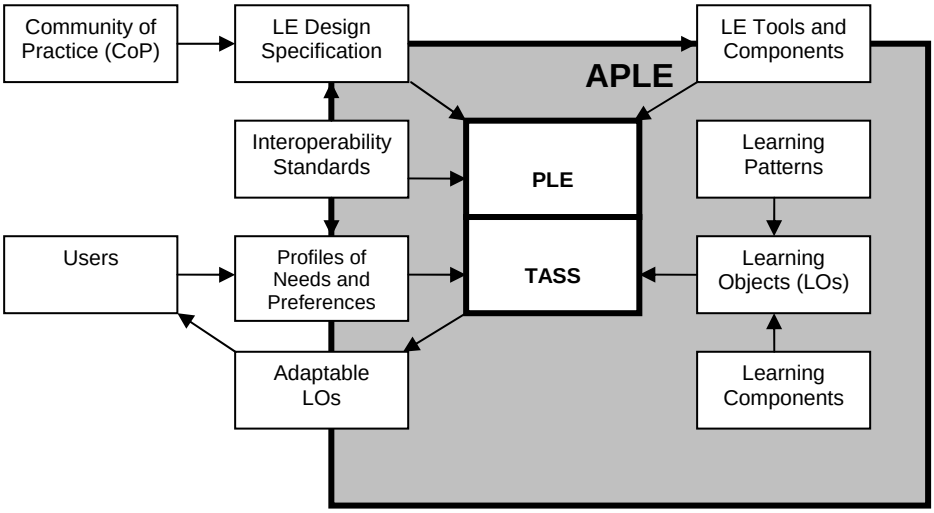

Figure Two: An Adaptable Personal Learning Environment

3. FURTHER WORK

Further research is needed on user interface and component aspects of adaptability before a fully adaptable open source PLE becomes a reality. For example one principle of a full IMS AccessForAll service is that the alternative content or services can be provided from a number of potential sources. If a function or learning object can be identified that is better suited to the individual, in theory it can be accommodated. In practice this accommodation is fraught with problems associated with incompatibility and lack of interoperability. We have identified three specific areas of research that will turn the potential for APLE into a real prospect. Through close involvement with an already partially established community of practice, we propose to explore the potential for adaptability of learning objects, interfaces and environments.

1. The current Portland VLE is being evaluated and re-engineered, through engagement with an existing CoP comprised of stakeholders in further and higher education. This will establish the requirements for typical groups of users to develop a framework for an Open Source Adaptable Personal Learning Environment. This ongoing work includes:
    - Evaluation of the existing adaptable VLE in terms of alternative user requirements;
    - Gathering sample profiles of typical users from a range of user groups e.g. learning disabled; hearing impaired, vision impaired, learners with English as a foreign language;
    - Concept designs based on user requirements;
    - A technical requirements specification for an open source APLE;
    - A prototype of an open source APLE component model.

2. A personal profiling model also drawn from our CoP user groups will be mapped against the TASS to produce a set of sample learning objects adaptable to users' accessibility requirements, personal preferences, device or environmental needs. This is being achieved by:
    - Analysing existing sample profiles;
    - Mapping the profiles against Dublin Core and IMS PNPs;
    - The development of structured templates;
    - Mapping of structured profiles against TASS for adaptability requirements;
    - Creation of sample LOs based on template information and TASS.

3. The third area of research is to establish the existing standards pertaining to each component of a PLE for interoperability, and to identify gaps and inconsistencies. We propose a case study that will include:
    - Identification of specific standards for PLE, mobile devices and LOs;
    - A critical evaluation of the standards in practice;
    - Identification of requirements and standards for interoperability;
    - Analysis of problems, gaps and inconsistencies in interoperability;
    - Recommendation on standards for APLEs.

4. CONCLUSION

This project aims to develop a community approach to the definition and delivery of an Adaptable Personal Learning Environment. The component elements of content, context, user needs and preferences are all considered equally important with respect to the learning environment. However central to all of this work is the learner and the resulting enhancement of the learner experience. We may not be able to guarantee an improved experience in all cases but we believe we are providing for a more inclusive definition of a PLE. Finally the project will produce a personal profiling model and a framework for an open source Adaptable Personal Learning Environment - that is an adaptable model able to grow and change according to the needs of the user. Through our collaborative approach with users involved throughout, we are confident of outcomes that offer maximum potential for wider adoption not only by disabled learner groups but within the mainstream community.

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PRODUCING SUB-TITLED LECTURE RECORDINGS FOR THE DEAF USING LOW-COST TECHNOLOGY

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ABSTRACT

This paper describes traditional methods of production of videos of lecture presentations with subtitles for the deaf and argues that these are suitable only for a limited number of presentations due to the high cost of capture and post-production. The concept of making every presentation of every class available is discussed, and a method of utilising low-cost technologies and applications to allow this to be achieved is presented. Experiences of pilot schemes utilising a variety of devices and a mix of commercial, freeware and self-written production methods will be presented, with comment on the usability of each approach at both capture and production stages.

Keywords

Lecture capture, Subtitling, Deafness, Assistive technology , Student-centred learning

1. INTRODUCTION

There has been a long-running debate on the role of the basic presentation or lecture in modern education. Gibbs[1] states that "the dominance of lecturing in higher education has little rational justification". There were strong arguments to dispose of "expository teaching" in favour of Schulman and Keisal's "discovery learning" in the 1960s [2], from which grew a push to student-centred learning heavily dependent on "Educational technology" such as promoted by Rowntree [3]. However it is clear that lectures and presentations from a "knowledgeable" person are still highly popular with both providers and consumers of education – whatever the reasons. What is clear however is that the concept of being there in person is not viewed as an attractive proposition to many deaf students due to the difficulty they have in following a complex subject by the traditional methods. The authors have been working on a method of providing a "live" subtitling mechanism which can be used by any presenter without specialised equipment [4], and a short review of this is included below. However, there are pressures for more flexible, student centred teaching methods, and furthermore attendances at all kinds of timetabled events in educational establishments are a particular concern – even those students who are committed to the course do not feel it is important to attend at the levels of a generation before.

This has led to the rapid growth of "pre-recorded" media content. There have been a number of courses where the "video lecture" has been a core element of the teaching methodology, notably the materials produced by the Open University in the UK. In the professional world, many companies have produced material for educational purposes or for corporate information (e.g. Cisco and SUN [5] [6]), or to make the keynote speeches by august persons available to the masses, such as the talks by industry leaders to institutions such as the IEE [7].

Commercial equivalents to the specialist publishing houses have also sprung up to cater for niche presentations in engineering, legal or medical fields such as Boxmind [8]. Thus there is a demand for every presentation which a student may have not attended to be available for their "offline" perusal, and an unwillingness of the consumer to accept that the institution should not make it possible for the staff to achieve this. The authors realised that if a way were found to extend the capture and display of the presenters words to include the whole presentation, then this would be a significant resource for deaf students (as well as anyone else who was unable to attend the original).

Summary of the subtitling application “Talkshow”

In general the staff who are involved with teaching the hearing impaired students utilise a range of methods to improve communications with the student. These range from the provision of additional prepared material (eg annotated slides from Powerpoint), sitting with the student around a computer and using it as a means of transferring text information which can also be printed out later, to simply passing a notepad between the lecturer and the student.

It was felt by the authors that there could be alternative ways that this could be done. One area that was of particular interest was that of speech recognition. The technology had been evolving for years and was now supposed to be at a stage where it was possible for suitably trained software to achieve a good standard of recognition of continuous speech on mid to high end desktop computer systems. This allowed an application which could add “live” subtitles to a lecturer’s presentation without the need of a specialized “captioner”. (For those who can afford the institution-level tie-up with IBM and the Liberated Learning Consortium[9], their “ViaScribe” product is highly recommended, but in the personal experience of the author this is not available to individuals.)

The application created by the authors, “Talkshow”, was not developed as a full product, but as a test bed for a variety of different possible solutions all of which utilised some of the features of voice recognition. Many different ideas were tried and many different prototypes created before the rough final version for Talkshow that is currently available was developed. There were many possible contenders for the recognition software but for continuous speech support, the software that was used as voice-recognition was IBM's “Via Voice”. At the time of developing the system this was generally considered to be the most effective of the voice recognition software packages. It did indeed proved to be a powerful package but still had limitations and certainly was not capable without significant training of providing accurate translation of the speaker's voice. In addition the software package was found to be quite a "bad neighbour" in that it was very resource intensive and tend to slow down the operation of other applications. Since then the authors have also been experimenting with the “free” Microsoft Speech API, and have found it to be very similar in operation – i.e. it still needs careful speech to recognize accurately.

There are two basic elements to Talkshow. The first uses a small window at the base of the screen to contain text that was generated as the lecturer spoke, named “Adlib”. This was the area that utilised the voice-recognition software and clearly provided the greatest challenges. At the end of a session the work could then be saved (and also used to improve the accuracy of the speech model by feeding it back into the recognizer offline). The second part of the Talkshow application, “Autocue” could take previously existing text, such as that produced by “Adlib”, and scroll it across the screen to provide subtitles or subtext to the powerpoint slides. As such this did not to use any voice-recognition technology but provided a way of presenting the additional supporting information in a pre-prepared, edited and corrected fashion. The timings for the presentation of the text could be set automatically (e.g. one line every 5 seconds), or could be driven by a “cue” device based on a table of times attached to the text file.

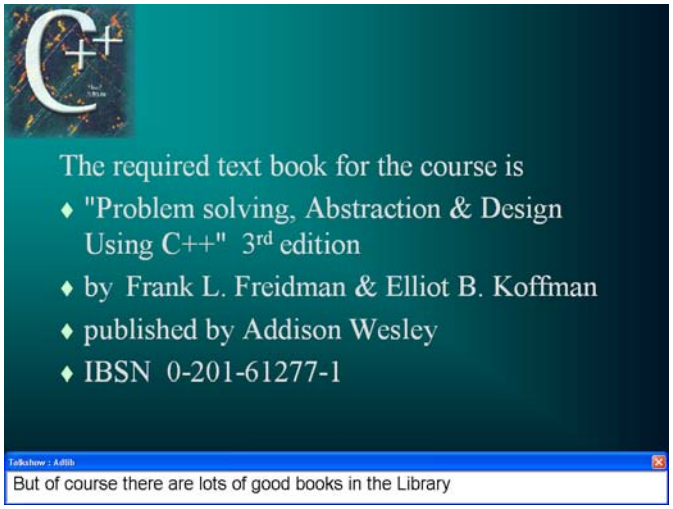

Figure 1. A typical screenshot of “TalkShow” in use.

It is worth noting that the accuracy of the speech recognition is very dependent on the training of the speech model. In a system used by several people (as is the case with Talkshow), great care has to be taken to ensure that the correct voice model is used. If it is not, or even worse, if the wrong voice model is trained by a person, thus corrupting it, the quality of the translation deteriorates markedly.

2. THE LECTURE CAPTURE APPLICATION "LECTURESHOW"

The authors have been involved with "off-site" or "work-based" learning for many years [10]. As part of that course it was necessary that lectures were to be available in multiple locations at multiple times – clearly not practicable for an individual. Due to security issues, many of the locations of the students were not compatible with "broadcast" lecture techniques such as the ISDN-based teleconferencing equipment then in use. The solution was therefore to record the lectures to videotape. Of course this is not a new concept – in places with even greater geographical challenges recorded lectures are common, and a very good discussion of the use of such technology can be found by Rob Phillips [11].

In order to do this, the Audio-Visual support services of the University were involved. These were professionals and the lecturers were surprised by the sheer scale of the process involved in producing "studio quality" video. To begin with the venue had to be suitable both in "sight-lines" and for audio – and considering these were purpose built lecture theatres it was a revelation how badly many of them were considered "unsuitable". Then there were the personnel – two camera operators, a sound person, and a "gofer" who set up the lighting rig and timed the events of the presentation. Then the actual recording was required to be redone several times, so that there would be no need for "retakes" at al later date. Thus a one-hour lecture took a full day to capture. After capture the AV post-production team used a professional editing suite to produce a "clean" version of the lecturer's performance from the several takes. They then used a "split-screen" hardware video facility to add the presentation materials (consisting of powerpoint slides, screenshots of applications, and stills of objects) to the presentation. This apparently took two days of the editor's time. The resulting video was then duplicated and distributed. This effort was funded by the external income generated, however as can be imagined it was very costly (the only person who did not have to be paid was the lecturer!) and was clearly a "big deal" and thus is appropriate only in the most special cases. This is therefore not a suggested method for producing lecture recordings on a wide scale.

Recently however the quality and useability of camcorders has advanced in a quite staggering fashion, and with the limited quality (pixel count) required for PC based display these are easily good enough for the purpose. For example the camera currently used is a hard-disc camera with more than 2 hours of battery life and can hold over 100 hours at top quality – over 4 times the quality required for a computer screen. The screen on the camera can revolve so that as one lectures it is easy to check that one is in the field of view. This particular camera also has a remote control which would allow zooming in to a particular point on the whiteboard, then back out for a full view. The quality of the image capture is good enough so that normal lighting is fully adequate, so no need for the studio lights the AV techs had to drag around. To get the recording into the computer, the camera simply attaches to a standard USB port and looks just like a disc, and the transfer speed is as fast as a flash drive. With such devices being easy to use and very robust, even the smallest department can choose to share one and so it is possible for every lecture of every course to be filmed and stored. The next problem then is the cost of post-production.

For entire presentations a common look has evolved – that is a stand-alone window with a small frame "upper-left" with the video of the presenter, a larger frame "upper right" with the presentation, and often smaller frames with stills or text/subtitles towards the bottom. Fig 2b. shows a typical screenshot.

If the presentation is a set of Powerpoint slides, then during the live lecture, a feature called "rehearse timings" is selected rather than the usual "show", which then captures the relative times of the transitions as the slides are advanced. These are stored in the presentation file, and can be seen in the edit view. In order to add the subtitles the presentation must be saved as a video file. Thus there must be a method of including the PPT file in the final video file, with the video of the presenter and the generated subtitles. The simplest method of doing this is to use a "screen capture" mechanism. There are a number of software-only screen capture applications, such as CamStudio [12]. Using this as a basis, an application was written (LectureShow) to record all three elements at once, using a standard PC without using specialist capture equipment. This application asks for the "lecturer" file (as a video), and the "presentation" file (as either a PPT file or as a video) as shown in Fig 2a, and the "autocue" file produced by the "TalkShow" application as described above It then starts the CamStudio capture application and runs the three frames simultaneously. The "operator" then only has to watch for the end of the session and hit "exit" for the output file to be produced, ready for storage, as seen in Fig 2b.

(Note Powerpoint also has a nice little feature that allows you to record the audio directly, with the output being either one long audio segment or a set of one per slide, and so a very basic auto-presentation can be produced. However this does need a powerful laptop and obviously misses the visual cues of the presenter.)

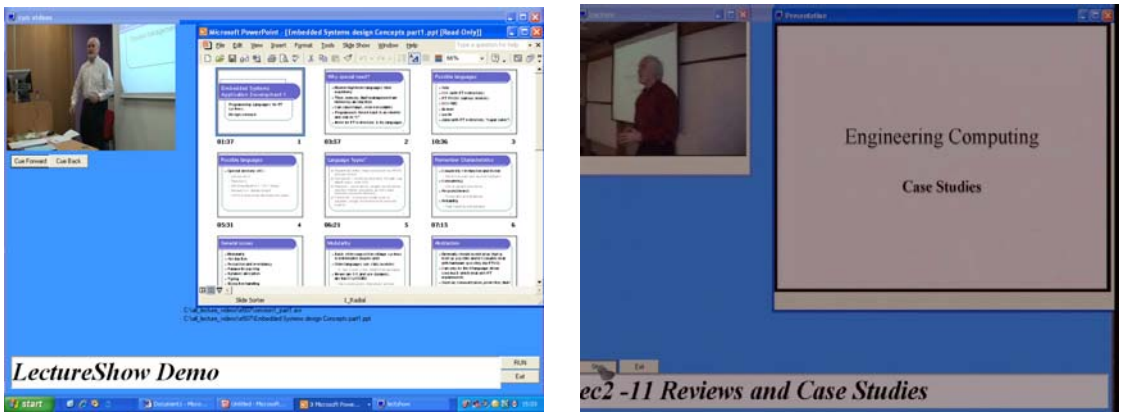

Figure 2a, 2b Screenshots of LectureShow and its output.

Once these two applications existed, the obvious action was to include the subtitled text into the video of the lecture. This produced the output shown in the screenshot of Fig 3.

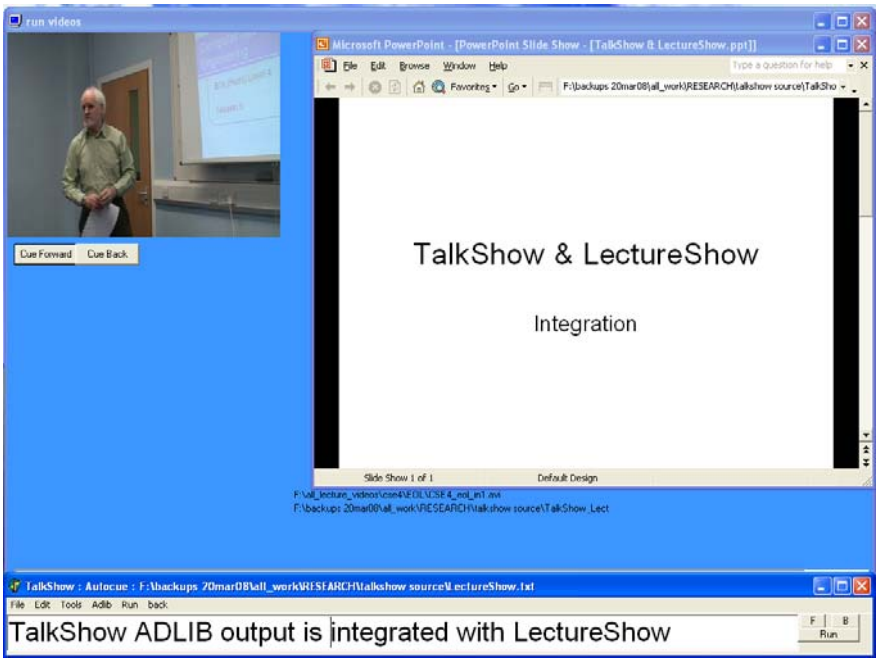

Figure Screenshot of Integrated LectureShow with TalkShow

3. CONCLUSIONS

The author has now archived a full year of lecture presentations using the various mechanisms described above. This averages 6 hours per week in front of a class, and so the overhead of producing the material had to be low, and given almost no external funding, had to use minimal resources.

This work is still very much in the trial phase, and so rigorous experimental data is not yet available – however the high student access to the produced material warrants the presentation of the approach at this early stage. A sample of 4 key lectures with deaf students in the audience were presented using TalkShow and also captured, and the post-production performed using the media from both. The time cues for the TalkShow Autocue presentation were edited by hand to ensure they matched the powerpoint presentation – this mechanism is intended to be automated in the next version of the integrated product. It can be clearly stated that the use of the disc-based camcorder and Powerpoint “rehearse” mode made capture trivially easy, while the screen capture application CamStudio along with the self-written display application LectureShow allowed a total of only 10 minutes to be spent in post-production, compared with the 2 days of the AV technician.

Was it worth even that amount of effort? The 40 students in the presentation were asked to record their reactions using simple questionnaires, with a -5 to +5 scaling. Typical questions were:

- Did the recording impact negatively or positively on the performance of the presentation
- Did the subtitles at the bottom affect your reception of the presentation
- Was the quality of the stored lecture sufficient
- Did you use the recording, and was the existence of the recording helpful
- Do you wish this pilot to be extended to other modules

The evidence was overwhelmingly positive. No-one gave a negative score to either the use of the recording equipment or the subtitling – in fact most were substantially positive. Not a single person could be found who had not watched some of the recordings. None of them had any comment about the quality not being "studio" standard. Interestingly there were a few comments that they lecturer was actually clearer since they were attempting to ensure a good recording with fewer "umms, ahhs and mistakes".

Of special note were a few individuals who stated that they found the recordings indispensable:

- The deaf student praised both elements, but particularly liked the "offline" resource.
- a student with long-term illness who kept up with the module from hospital.
- a foreign student with poor language skills who stated that the text allowed him to understand parts of the talk he was otherwise struggling with.
- Another lecturer who was using TalkShow were persuaded to assist with the pilot. He reported that he had little difficulty in recording the material, and was satisfied with the files returned to them after post-processing, and stated he did use them in his teaching.

Given the success of the pilot it seems worthwhile to promote the provision of this media, i.e. to increase the use of these applications. The authors have gained the backing of their School to provide a low-level technical support person to do the minimal amount of post-processing, and to make available more camcorders and microphones for staff. The ethical committee have also cleared the way for formal and rigorous evaluation methods to be implemented (due to the inclusion of actual students in the process).

Trial versions of the applications have already been "loaned" to staff at other institutions, but the feedback made it clear that a more "robust" application is required for untrained use. The authors are examining ways of funding the production of a more "user-friendly" version which will make it even easier to use, including embedding more synchronisation cues into the applications to further automate the post-processing.

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SITUATED LEARNING IN A MULTI-USER VIRTUAL ENVIRONMENT

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ABSTRACT

Multi User Virtual Environments (MUVEs) open up new and innovative opportunities for teaching and learning. The research reported here analyzes the findings of a small case study into the challenges and benefits of using a MUVE, in this case Second Life, for Situated Learning in a blended learning context.

This paper records the technical challenges, the student experience of studying and completing assignments, and an evaluation by the teaching team of implementing Situated Learning in Second Life. Conclusions are drawn for future developments within the Computing curriculum.

Keywords

Virtual Learning Environments, Gaming, Computing, MUVEs

1. INTRODUCTION

Today's 'digital natives' [1] have different thinking patterns and ways of processing information than their digital immigrant [2] predecessors. MUVEs (Multi User Virtual Environments) provide new and innovative opportunities for teachers to design new ways of meeting the needs of 'digital student' learning styles [3], [4], [5]. They offer a rich, multimedia environment where interaction and collaboration between learners can take place [6]. Our findings show that many of our students spend a significant number of hours online engaging in social networking and gaming type environments in addition to study. The rationale for the approach used was to build upon those skills and interests gained by students outside their normal academic environment.

This case study examines a third year Graphics and Modelling Development module within the context of Liverpool Hope University's Moodle environment. The module combined online resources, online activities, online support and online assessments with face to face teaching and MUVE based activities. The exploration of Situated Learning in Second Life, an Internet-based virtual world developed by Linden Research labs, formed a small part of this larger blended learning initiative. The philosophy was to work with students who are both technically competent and experienced in working in 3D environments so that the cognitive demands of learning in a MUVE are minimized. The paper is organised as follows, the aims and methodology for the project, the findings along with reflections from the staff and students and finally conclusions are drawn.

2. AIMS OBJECTIVES AND METHODOLOGY

The project formed an initial small scale inquiry into the potential and problems of using a MUVE as a vehicle Situated Learning to inform possible future larger implementations. The objectives of the project were to:

1. Record the technical challenges involved in using MUVEs in HE;
2. Provide an analysis of the student experience of studying in MUVEs;
3. Evaluate the design, implementation and results of the Situated Learning assignments within Second Life.

The number of students involved was small (15) so multiple perspectives and data sources were used to provide triangulation for improved validity. Data were gathered from three sources:

1. Student opinions via a number of electronic methods facilitated by Moodle, the VLE currently used at Hope: forums, questionnaires and reflective journals;
2. Focus groups, with structured questions, were run to encourage and capture increased depth and discussion of opinions;
3. Staff opinions with a peer-validation group created to regularly critically review the research progress. This validation group was crucial in ensuring that claims made for the project outcomes are supported by evidence. To this end the additional critical friends were independent of the project yet were involved generally in the subject area of Computing in order that they understood the context of the project.

3. TECHNICAL CHALLENGES

The use of Second Life on the University network was initially opposed by the administrators as it was perceived to compromise the security of the network. To allow access to Second Life from within the network several ports in the firewall had to be opened. The standard firewall filter configuration is - BLOCK ALL TRAFFIC i.e. do not allow any network packets to pass from the internal network interface to the external network interface and vice-versa. In order to allow access to the Second Life client exceptions to this rule had to be created. To minimize the security risk to the network under these circumstances "statefull exceptions" were required. One data port had to be opened, to allow a route for the firewall to be bypassed. By making it "statefull" the port was only opened when a legitimate connection was attempted, allowing traffic back in which was responding to the originating system and when the originating system closes the connection, the port is closed.

The registration and account creation process for Second Life involves responding to a series of emails. Our spam filter delayed emails originating from Second Life which caused significant delays in the first teaching session. Ideally we would have used a common Second Life surname to identify our students to each other more easily and foster a stronger sense of community. However, the small size of the pilot group and the significant financial cost to the institution of such a move was prohibitive for the purposes of this study. An additional problem was students losing/forgetting usernames and passwords which we would endeavor to set up a system to control and manage in future.

The Second Life has its own software (or client) which is regularly updated. Whilst it was not especially problematic to maintain the latest client version on the limited number of machines we used for teaching in this instance, we anticipate that maintaining client versions across the institution would require close management.

4. THE STUDENT EXPERIENCE

The students were asked to complete the following of Situated Learning [7] tasks in Second Life, then to discuss and reflect upon those activities in Moodle:

- Register and choose/alter their avatar
- Move around and experience Second Life
- Interview other avatars (not in their group)
- Build an object (a chair) and add interactivity to the object

4.1 The Quantitative Student Experience

An initial survey was carried out to determine the previous experience of course members. There was a total of 17 (this included 2 observers) responses to this initial survey. Respondents were predominantly male (94%), and in the 19-24 age-range (65%). From this survey, some interesting facts emerged:

- Just over half of the students spend at least 5 hours online per day
- 59% of the students reported that at least half of this was on non-work-related activity.

In terms of what this activity might comprise 58% of the students reported using Social Networking sites such as Facebook (24%), MySpace (24%) and Bebo (10%), along with a huge variety of other forms of social software.

Almost all (91%) (Figure 1) of the respondents use some form of social software, with instant messaging and forums being the most popular. Fewer students (36%) use Massively Multiplayer Online games (MMOs) such as World of Warcraft (WOW) or Lord of The Rings (LOTR) online regularly.

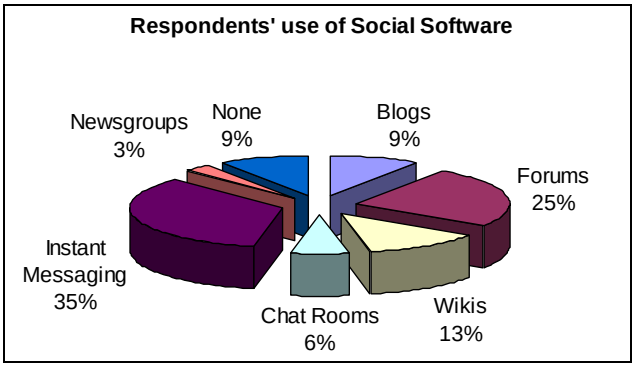

Figure 5: Respondents' use of social software

Only 29% of respondents had previous experience of Second Life. In almost all cases students had investigated the environment, and found it not to their liking. Typical of their responses to it were: "*I only used it for an hour and got very bored*", "*I was very disappointed, since SL is far from a game*".

At the end of the students' involvement with Second Life in the module, a further survey was carried out. During this survey, students were asked to reflect on their experiences, firstly on the level of difficulty of particular tasks, and secondly on their overall impressions of Second Life.

The majority of students found the technical tasks straightforward. Only 13% students reported that the chair task was difficult and 33% of the students reporting difficulties with the scripting task. However, students did not generally warm to either of these tasks. Several students commented on the simplicity and the non-transferability of the scripting tools, compared with other methods previously encountered. In contrast, the interview task was seen as difficult by just over half the respondents. Reasons for this were varied, but 47% of the open-response items talked about the difficulty of persuading other inhabitants to answer questions.

The overwhelming majority of students (80%) stated that Second Life should not be included in the module for next year. However, this should be seen in the light of comments made in open-response items. The majority of these responses suggested that it might be included, but possibly with a lower profile role. Only 4 students were definite in their opinion that it should not be included, suggesting that the time could be better spent further investigating more technical skills, such as lighting, animation and texturing.

From these responses, it can be seen that the Second Life experiences of students during the module mirrors almost precisely the responses given in the initial survey. Second Life is not an environment where they would choose to spend time. For those who enjoy social software, the reported difficulties of engaging with others seem off-putting; for those who enjoy gaming, the lack of any 'game scenario' makes it unappealing. However, Second Life did generate a huge amount of discussion within the module, and the responses to the questionnaire items reveal that students have engaged fully with the environment, and are able to talk knowledgeably about its features, and its shortcomings.

4.2 The Qualitative Student Experience

As the questionnaire data had shown a negative response by the majority of the students to Second Life, the focus groups were aimed at moving away from personal opinions towards more constructive discussions about possible future use of MUVEs within the subject area. For example "*Should Second Life be included on a graphics and modeling course*" and *"…has it the potential for being used as a virtual learning environment*". It was felt that no great skill was needed to interact with the environment, items could be created and used immediately and as such was "*too easy*" for third year students with extensive modelling experience. The group did feel that the immediateness of the experience "*good to build and use immediately*" would be appropriate for a first year scripting module. One concern raised consistently was that the students perceived the environment as distracting for learners, *"People would wander off and leave class" and "Would people concentrate or would they all drive round in their cars of have sword fights or something?",*

Figure 2: The students and staff in First and Second Life

The students were asked to discuss the teaching sessions. The introduction to Second Life was well received *"A good ice breaker, you can laugh together"* and "*The first session was good when we had the T shirts on*". They consistently reported that they enjoyed the blended learning sessions delivered in the computing labs with comments like *"More fun in class, more people to interact with" and "You can see what other people do and learn from them"*

Finally the students' opinions of the benefits of learning in Second Life were discussed. They were concerned that the commercial nature dominated the environment *"Its all about selling things*" and "*Everything costs*". They did feel that it had potential for collaborative projects.

5. STAFF REFLECTIONS

5.1 Computing Staff

Staff noted that students who used social networks such as Face Book were more accepting of the Second Life environment, those that did not use social sites felt very strongly against the use of the environment.

"I do not use social sites like face book and all of a sudden I have to deal with these people, I had to make a 'me' and I did not like it."

The lack of social interaction in Second Life was a significant issue, when activities were scheduled in class students interacted in real life and in Second Life, learning in both environments concurrently. Difficulty arose when students were in Second Life outside of class and on one else in the environment wanted to interact with them. Any future use of Second Life should include agreed meeting times within the environment when the students are not in class.

We were surprised by the reaction of the students to Second Life, as one student reflected "*we have not learned within Second Life we have learnt about it*". The discussions, both negative and positive, about the nature of Virtual Reality Environments formed an important, but unexpected, part of the module. We were very impressed by both the level and quality of debate that occurred within the forums as a result of introducing the students to this type of environment. The degree of involvement by some of the students to the forums and reflective journals far exceeded the requirements for assessment and was on a level which we would not normally expect from computing students, who would typically invest many more hours to the technical aspects of a course than to any written element. [8]

Second Life does have potential as a learning environment but activities must be distinct and structured and expectations cleared established.

5.2 E-Learning Developer

A JISC Student Expectations Study [9] notes that the least popular technological pursuit amongst the digital native [1] generation was taking part in online communities; digital natives found the concept of such activities both amusing and 'sad'. The authors of the study conclude that, for the digital native, technological adoption appears to depend on a technology being perceived as having a specific benefit or purpose which will be of direct personal benefit to the user. Second Life was perceived as having no specific benefit or purpose; it was seen as technology 'for its own sake' and therefore more likely to be of interest to an older, digital immigrant, [1], generation.

Feedback indicates that our group of students would largely concur with those interviewed in the JISC study [9]. Furthermore, our students highlighted an issue which was also touched upon in the JISC study [9], namely a sense of 'technological hierarchy'. Participants in the JISC study [9] discussed their online social networking activities in terms of 'graduating' from the 'lightweight' MySpace to the more 'serious' Facebook or

Bebo. Similarly, many of our students felt that Second Life was 'lightweight' or not technologically 'hardcore' enough to merit inclusion on a third year module, but would be useful as a first year introduction to the principles of 3D graphics, modelling and scripting. There is a clear sense, in both instances, of students wishing to engage in increasingly sophisticated and complex technologies, to more fully actualise their digital self-concept. For this group of students, the switch from working in a 3DS Max environment in previous academic years to working with Second Life's simple in-world tools was perceived as a regressive step rather than a scaffolded task in the zone of proximal development [10]. Paradoxically, an experience which the students, in many cases, framed as a negative experience could be argued to have had a positive experiential impact on the group's sense of community overall; student engagement with the module was good and the level of debate which took place within the forums concerning Second Life and other related topics was surprisingly sophisticated.

6. CONCLUSION

Vygotsky defines the zone of proximal development as those functions which have not yet matured but which are in the process of maturation, and stresses that the maturation process is enhanced when instruction involves interaction with peers and a focus of learning that is just ahead of the current developmental level of the learner. [10] Interactivity and networking were built into most of the Second Life tasks in the module but a degree of independent learning was also required for some of the activities. Significantly, the activities which were not collaborative were the activities which were received with least enthusiasm and which were reported by students as the most difficult and frustrating – which would seem to support the notion of social interaction being key to the development of learner understanding [7] [10]. Paradoxically, perhaps, students reported that the most irksome task they were set was the one requiring most social interaction; the interview task. Students enjoyed collaborative learning with their peers in class, online and in-world but were extremely reticent about engaging with Second Life residents who were not already known to them. This reticence may have been part of a larger discomfort with the MUVE setting; wherein the absence of preset goals and objectives together with the social nature of the environment proved confusing and frustrating to students more familiar with a traditional gaming frameset, leading them to find MUVE social platforms such as Second Life 'pointless'.

The engagement with Second Life was a learning curve for teaching staff and for students. There are pedagogical issues to teaching in MUVEs which the team would address differently as a result of teaching on this module. In designing future MUVE learning and teaching we would remember the following guidelines:

- To theoretically contextualise the use of Second Life before ever entering into the Second Life environment – this foundation would help digital native [1] students to understand the significance of the technology in a wider context. When the technology itself holds no automatic appeal for the student, this process is important in establishing a positive motivation for engaging with the technology.
- To introduce students to Second Life in a series of highly structured, synchronous activities to ease the transition from a gaming frameset to a more social frameset.
- To encourage collaborative work wherever possible thereafter, to ease the sense of student isolation in Second Life
- To make provision for in world student learning support
- To recognise that MUVEs are 4D environments. Time spent in-world is necessary and important in acclimatising to a new learning and teaching environment. It is difficult to engage meaningfully with MUVEs unless there is a commitment to spend time there both as part of a group and on an individual basis

On reflection the teaching team would expand the situated learning tasks approach to a more problem based learning approach to future MUVE learning design, which together with more carefully scaffolded and challenging tasks would be expected to create a greater sense of a community of practice [11] amongst learners.

7. ACKNOWLEDGEMENTS

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MANAGING KNOWLEDGE ABOUT KNOWLEDGE MANAGEMENT: 'PRACTISING WHAT WE TEACH'

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ABSTRACT

There is a view that knowledge management (KM) is primarily a business concept that can bring increased profitability for commercial organisations. However, the management of processes such as knowledge creation, capture, sharing and use are not exclusive to business; good KM practices can bring benefits to all organisations. Given higher education's (HE) priority of developing knowledge assets, a culture that prioritises KM can be used to underpin a university's organisational processes including, not least, its teaching activities. This paper illustrates how attention to a particular part of the KM cycle, the knowledge creation (KC) process, can inform the delivery of a KM module; in turn, it shows how the author attempts to practice what she teaches. Evaluation of the module from various perspectives has provided very positive feedback. Lessons for the design and delivery of other modules (KM-based or otherwise) can be drawn from this paper.

Keywords

Knowledge management; knowledge creation; module delivery; evaluation.

1. INTRODUCTION

Higher Education's (HE) strategic and operational priorities with respect to the furthering of knowledge align with the iterative knowledge management (KM) cycle of creating, capturing, sharing and using knowledge. This paper draws attention to the benefits of adopting a KM-centered approach at an operational level by sharing the experience of delivering a KM-based module. The delivery of the module demonstrates principles offered by Nonaka et al's [1] Socialization-Externalization-Combination-Internalization (SECI) process of knowledge creation (KC). It is suggested that, even if a module is not KM-based, following basic principles that support KC, will lead to an improved learning experience for students and lecturer alike.

The paper begins by introducing the aims and objectives of the module under analysis. Being neither imperialistic nor isolationist in the choice of her model of learning, Davis' [3] model is used to frame the author's approach to teaching; the model is described and its components are used to set the context of the module delivery. It is in the following section where the cycle of KM and, in particular, the KC process, comes to the fore. Once Nonaka et al's [1] KC process of SECI is introduced, each of its four modes is followed and related to an example scenario from a recent delivery of the chosen module. In the penultimate section, the results of an evaluation of the module are presented. A short summary brings the paper to a close.

2. 'MANAGING PROJECTS: MANAGING KNOWLEDGE' MODULE

The module discussed herein is delivered to both undergraduate and postgraduate students; assessment is different for each level. A typical cohort size is around 25 students. The module aims to enable students to develop an understanding of the complexity of projects and to appreciate the opportunities for KM within the project context, with a view to practising more effective project management (PM) and KM.

The content of the module can be broken down into three areas. Firstly, a range of overarching approaches to PM is introduced to provide a chronological review of the changing trends in that field. Secondly, a review of the emergence of KM is used as a vehicle to introduce KM models and to highlight potential processes in PM that could benefit from a KM influence. The final area is based on five processes that are inherent to PM – team formation, decision-making, communication, participation and problem solving – are examined with respect to its potential to manage knowledge. A range of models and theories (based on critical systems thinking (eg Flood and Jackson [2]) where appropriate) are applied to support and enhance discussion of each of the processes. The interplay between theory and practice is emphasised.

3. MODEL OF TEACHING

A traditional model of pedagogy from Davis [3] underpinned this module. Although KM and learning are closely intertwined, the concept of KM has not, as yet, achieved a high profile in pedagogical circles. However, Davis' model enabled the complementary use of a KM model as will be shown in Section 4. Davis' model of teaching [3] was chosen as a framework through which to both articulate and reflect on the author's practice[4]. It defines teaching as the interaction of a student and a teacher over a subject. Within this model, there are four components – subject, student, teacher and setting – of which all should be considered to promote effective learning. Further, the relationships between the four components are dynamic. An iterative process of reflection, whereby the components and their relationships are regularly examined and adjusted, ensures continual improvement of the learning experience.

The four components can be adjusted to varying degrees. For Managing Projects: Managing Knowledge, the 'subject' is defined by the module descriptor and forms the core content of the scheduled contact time between lecturer and students. This is the written agreement between the parties and is fixed. Working across the spectrum of 'fixed' to 'flexible', the 'setting' appears next. Since the same room booking is made for the duration of the delivery of the module, the location remains the same. However, the arrangement of the fixtures and fittings can be modified to give the possibility of a range of settings, albeit limited, to be adopted. The students and the lecturer ie the 'student' and 'teacher' are anticipated to be the most flexible components, and this is the aspect on which the success of the delivery of this module depends.

4. KNOWLEDGE MANAGEMENT

This section begins by raising awareness of the complexity of knowledge. Then a basic KM cycle is introduced before emphasis is given to the KC process. Next, the SECI process of KC is introduced and then used to aid the analysis of the delivery process of this module. For each example of a knowledge conversion process, the changing role of Davis' 'teacher' is highlighted – thus the analysis forms a bridge between KM, via KC, and the teaching process.

The complex nature of knowledge is apparent from the definition given by Davenport and Prusak [6, p5] - "Knowledge is a fluid mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information." More complexity is added by distinguishing between explicit ('know that') and tacit knowledge ('know how') [7]. So, it is not surprising that managing such a concept is quite a challenge and remaining mindful of Wheatley's [8, pp6-7] lessons would be wise. Her six lessons are that: knowledge is created by human beings; human needs and motivation lead us naturally to create knowledge; everybody is a knowledge worker, people choose to share their knowledge; KM is not about technology; knowledge is born in chaotic processes that take time.

The KM cycle can be thought of as comprising of four processes – knowledge creation, capture, sharing and use[19]. When working with groups of students, it is possible that all of these four processes are happening simultaneously; similarly, each student may not move through the processes in the same order. Henceforth, the focus is on one of the processes – that of knowledge creation. It is shown how the delivery of the Managing Projects, Managing Knowledge module conscientiously supported KC and how, in turn, it also supported other processes of the KM cycle.

4.1 Knowledge Creation

Nonaka et al's [1] KC model is based on a more empathetic view of knowledge than Davenport and Prusak's [5] since it relates to 'justified belief'; it aligns better with the priority of developing critical thinking skills in students. They stress that knowledge has particular characteristics such being dynamic, context-specific and humanistic, and recognise the complementarity between tacit and explicit knowledge. On the one hand, tacit knowledge is rooted in "actions, procedures, routines, commitment, idea, values and emotions" [4] and

[19] More sophisticated cycles may include processes such as knowledge organisation, architecture and codification [eg 8].

subsequently is difficult to communicate while, on the other hand, explicit knowledge "can be shared in the form of data, scientific formulae, specifications, manuals and suchlike" [1, p43]. Nonaka et al's KC model comprises of three elements - the SECI process, a context for KC and knowledge assets. The SECI process is highlighted here although, as will become apparent, the other two elements are intuitively taken account of (via the prevailing culture and via the tools that are used and the roles that the lecturer adopts) as KC is nurtured.

According to Nonaka et al's [1, pp44-45], KC is concerned with four interactions between tacit and explicit knowledge. These interactions are called "knowledge conversions" with the modes being identified as 'socialization', 'externalization', 'combination' and 'internalization'. Each mode is now used to structure the analysis of the delivery of the module. Similar to an earlier comment, all the four modes of conversion might take place during student contact time at different times for different students; additionally, the interconnections of the modes are not disputed. However, for clarity, they are ordered as per the process's acronym and treated as discrete activities.

4.1.1 Socialization

Socialization is the process by which tacit knowledge is converted into explicit knowledge by students and lecturer sharing experiences. The increasing diversity of the student intake with regard to influencing factors such as age, experience, goals and national culture means that students may not naturally partake of this process. Preparation for socialization is key to its success; conceptual and physical barriers to holding conversations and sharing experiences may need to be overcome. When delivering a module, there are restrictive time limits in which to develop an atmosphere in which individuals will feel comfortable about sharing their tacit knowledge. Quickly developing trust between the various parties (between student and student, and between student and lecturer) and working towards an appropriate level of participation from students are priorities for the lecturer and, thus, moves their role into that of a facilitator and change agent rather than the more usual role of a subject expert.

Great efforts are made in the first session to break down as many of Riege's [10] three-dozen barriers to knowledge sharing as possible. Tackled transparently, the aim is to help the cohort of individual students to become a team. As a minimum, at the end of the first session every student knows each other's name and at least three facts about each other. This sets the foundations for communicating with each other between classes and for developing their bonds more deeply. In subsequent weeks, efforts continue to be targeted towards improving group dynamics and increasing the level of trust in the group. Small group activities are regularly scheduled and the method for group selection means that students work with different people each week. Students are often invited to comment on 'how' their group worked together; for example, they might reflect on the way they positioned the furniture, the extent to which everyone was empowered to make a contribution and how they would improve their performance next time. As the weeks go by, emphasis on group formation and breaking down of barriers to knowledge sharing via socialization is reduced; students become attuned to taking responsibility for that themselves and the lecturer's role changes once again.

4.1.2 Externalization

Externalization is the process by which tacit knowledge is expressed as explicit knowledge and is a process that assists the capturing of knowledge. Given the differing levels of experience of students, a valuable first source of tacit knowledge is the students themselves. After the introduction of a family of KM or PM concepts and with a genuine invitation for a more open discussion, students will often articulate their own experience of the concepts and willingly answer questions. The content of the discussion may move into a more tangible form by, perhaps, being integrated into students' note-taking, forming a case study in their assignment or being re-examined in the discussion thread of the students' virtual learning environment (VLE) at a later date.

Although it is acknowledged that tacit knowledge can be derived from experience, delivery of an academic module often does not lend itself to students actually partaking of the subject. An ideal scenario for this module would be to secure employment for students on a project in order for them to observe, feel and sense the expertise that was in abundance. They could then articulate their own new tacit knowledge. For practical reasons therefore, lecturers become story-tellers as they share their experiences and/or invite relevant external speakers to do the same. While telling stories can be very important activities in the socialization process, for externalization it is important that mediums such as handouts, associated academic papers, slides and url addresses are circulated to prompt students to record the tacit knowledge that they have encountered.

In remaining conscious of the need to support externalisation, it can be seen that the lecturer's role becomes one of a source of tacit knowledge as well as an enabler for the students to access other people's tacit knowledge. Indeed, the students have similar roles to play. The lecturers have also become a supplier of documentation that will both be a source of explicit knowledge and trigger students to capture additional tacit

knowledge in a form that is desired by them and accessible for future reference. If more advanced technology is chosen to support externalisation, then the lecturer may also act as a moderator for discussions in the VLE.

4.1.3 Combination

The combination process is where explicit knowledge is converted into more complex and sophisticated explicit knowledge. While this is a necessity for a piece of group assessed work of the module, it is a process that is taken account of during the module's delivery. Individual students will tend to undertake this knowledge conversion independently by seeking out the directed readings beyond the scheduled class time but combination during contact time is also achieved. For example, the lecturer will often instigate the feeding back of results of small group activities to the whole group to enable combination to occur. Thus, students can build on their thinking with the thoughts of others. In a setting where there are high levels of trust and participation from all attendees is expected, such as in the delivery of this module, there is enthusiasm to do this. In a more competitive environment the lecturer would probably have to practise stronger facilitation skills.

4.1.4 Internalization

Internalization is where explicit knowledge is embodied into tacit knowledge by individuals. Awad and Ghaziri's [9, p92], definition of knowledge update as "creating new knowledge based on ongoing experiences in a particular problem area and then using the new knowledge in combination with the initial knowledge to come up with updated knowledge for knowledge sharing" reminds us that each student will come to the scheduled classes with a different starting point and that any explicit knowledge communicated during the sessions will trigger different responses and results. Respecting and working with this aspect can be visualised and supported by Bloom's [11] taxonomy. In this module, the lecturer aims to engage students at all cognitive levels and openly takes them up the hierarchy from description to reflection; an invitation to make this progression is designed within each session and within the module as a whole. For instance, the content of a video or of a group exercise will form the basis of key underpinning theory and form common ground from which students can offer alternative applications and build a critique. Kolb's [12] learning cycle is a useful model to follow in tandem with Bloom's. This enables students' past experiences to be drawn into discussion along with new experiences tried in class via designed exercises, coupled with the lecturer's overt linking to theories shared in academic papers that she distributes and stirs students to critically analyse.

5. EVALUATION

Around 55 students have studied the module in two deliveries, resulting in four evaluation exercises. While the evaluation exercises were based on generic questionnaires administered by the host university rather than questionnaires designed specifically for this module, when taken in context the responses have been insightful and have informed the future development of Managing Projects: Managing Knowledge. In addition, the module was selected for the focus of a Peer Observation Teaching (POT) exercise in which a prospective lecturer reflected on the delivery of a session.

5.1 Student Feedback

Quantitative and qualitative student feedback is now summarised.

5.1.1 Quantitative

The generic evaluation questionnaire that is circulated after the delivery of every module collects student responses on a range of aspects of the module. Of particular interest was the quantitative data resulting from five questions that sought the opinions of students with regards the lecturer's approach. On a 5-point scale (where 1 represents a strong disagreement with a positive statement about the lecturer's approach and 5 represents a strong agreement) the students rated the approach, on average, over 4.5 with one cohort giving a resounding average of 5! Considering the lack of maturity of the module these results were more than satisfying. Other quantitative data that reflect well on the module are the high pass rates and the pleasing overall average mark. Worthy of particular note in a time of strategic learning and a growing tendency for students to rely on technology as a substitute for attendance at classes, students' attendance has been sustained at a rate higher than is generally expected. In this instance, students' attendance mirrored their level of participation, which was also encouraging.

5.1.2 Qualitative

Additional comments that have been extracted from a range of students' feedback sheets include:

- *"A very challenging but manageable module, broken up with relevant practical tasks each week."*

- *"Excellent provision of resources and directed reading. I very much enjoyed the use of multimedia in the lectures to support the learning objectives."*
- *"She made lectures interesting by ensuring students participated actively in class. This certainly helped the theory and practical application of the theory to sink in. I have thoroughly enjoyed the module and will definitely apply what I have learned in the world of work!"*

5.2 Comments from a POT Session

The following comments are extracted from the notes made in the POT report form. They serve to reinforce that the delivery of the module embraced a genuine pursuit of reflective practice and a commitment to KM principles.

- "*The tutor observes each group (same time for each one) observing the discussion, making comments, stimulating the thinking and reasoning about the topic and also giving incentives/provoking the application of the topic to practical situations and real life".*
- *The communication is integrated. It is not only her voice or the words said. Dialogue! She talks to students, exchanges and shares! Open space, give chances. Different attitude ……"*

In response to the question "What have you learnt that will be useful in your future teaching?" the observer wrote:

- *Prepare group discussions/activities.*
- *Link theory to practice, to real life and, mainly, to the students' world.*
- *Stimulate and provoke thinking.*
- *Link the discussions heard by the groups.*
- *Different activities / keep momentum (physically and cognitively.)*
- *Guide group discussion without influencing.*
- *Listen and consider opinions*

6. SUMMARY

A KC process has been used as a 'lens' to examine aspects of the delivery of a particular KM-based module, and an example of each of the processes has been shared. Particular focus was given to the role of the lecturer. Further analysis might use different processes of the KM cycle as lenses through which to view the module's delivery; further studies may include the analysis of the types of assessment used by the module.

An evaluation of the module indicates a very positive reaction from students and an observer. While it would be naïve to suggest that attention to the modes of the KC process was the only influencing factor on the quality of delivery of the module, their potential impact cannot be ignored.

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TEACHING KNOWLEDGE MANAGEMENT: INVESTIGATING SCENARIOS AND APPLYING TECHNOLOGIES

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ABSTRACT

This paper introduces the aims of a single optional module in Knowledge Management which is part of an MSc Information Systems programme. The content of the module is enhanced by material generated from collaboration in applied research projects and by enquiry in related modules. The paper argues in favour of participatory learning as a means of engaging students with issues in the field, and of developing stimulating case-study materials. The combination of student involvement in real-world environments and the application of emerging technologies provides opportunities to extend applied research and learning initiatives.

Keywords

Knowledge Management, Information Management Systems, Participatory Learning

1. INTRODUCTION

Knowledge Management (KM) was introduced as a new module to an MSc Information Systems programme some three years ago. This paper outlines the way in which the module addresses the role of Information and Communications Technology (ICT) within the wider business perspectives whereby KM seeks to exploit individual and group knowledge to enhance organisational effectiveness. The aims are evaluated within the broader context of attempts to foster external links that offer opportunities for participatory learning. Where appropriate, students engage in real-world projects, which enhance their understanding and insight. The resulting software and reports serve as case study material, which can stimulate further applied research and the development of new teaching resources. This paper also identifies complementary undergraduate and postgraduate modules that deal with areas of relevance to KM. Outputs from these modules can also contribute valuable learning materials. More generally, the aspiration to collaborate, both externally and within the curriculum, helps to further departmental knowledge and expertise. Increased reliance on advanced technologies is likely to lead to new learning opportunities as organisations continue to attempt to manage knowledge effectively.

2. INTRODUCING KNOWLEDGE MANAGEMENT AS A POSTGRADUATE MODULE

Knowledge Management is an optional MSc Information Systems programme module and it is available every other year. The programme is studied part-time and most students are employed in ICT-related fields. This enables them to focus on the practical application of the concepts explored. The module aims to present key issues in the field; this addresses the broad perspective of what knowledge is and how it is manifested in human activity, particularly within organisations. Within this general context the specific role of ICT systems is evaluated. This section presents an overview of the key elements underpinning the module. From this core, the wider questions of external collaboration and links to other parts of the curriculum will be discussed.

2.1 Issues in Knowledge Management

Prusak [31] provides an insightful account of the social and economic trends that have led to the emergence of KM and the knowledge-centric view of modern organisations. He asserts that KM is concerned with the classification and utilisation of knowledge, developing consistent knowledge processes, process owners and governance structures, and exploiting individual and group knowledge within the organisation. If successful, knowledge management can become an integral element in the effectiveness of the organisation.

A central tenet of KM enquiry concerns the distinction between tacit and explicit knowledge. Nonaka and Takeuchi [26] identify this distinction as one between subjective and experience-based knowledge. These manifest themselves as context-specific beliefs, intuition and technical craft and know-how on the one hand,

and as context-free objective knowledge that can be expressed in words or formulas on the other. This distinction and its impact upon the effectiveness of ICT influences approaches to KM. Hislop [13] argues that the limitations of ICT systems have been acknowledged within the KM community where the view that explicit knowledge is codifiable and transmittable has been challenged.

Another important precept within KM is the question of sharing and expanding knowledge. There is a tension between the view that knowledge is a resource that can be owned by individuals, teams and organisations, maintained by Alavi and Leidner [2], and the view that knowledge is situated in practice [17]. Research by Newel, Bresnen et al [25] investigates the difficulty of communicating knowledge acquired during project-based assignments between successive projects. Their findings are consistent with those of Lindval, Rus et al [18] in suggesting that social networks are useful for disseminating details of what has been learned in the completion of practical tasks. As Brown and Duguid [3] maintain, these views highlight the limitations of ICT in capturing and transferring knowledge. However, Newel, Bresnen et al [25] suggest that the development of virtual communities may lead to further integration of physical and computational environments.

A principal concern of KM is the ways in which individuals and communities of practice [16] communicate effectively and thereby support the sharing and expansion of knowledge. Such knowledge processes are closely linked to the organisational context in which they are situated and KM initiatives need to address the wider political tensions that inevitably affect the management of organisations' affairs, as McKinlay [19] points out. Acquiring and sharing knowledge successfully within organisations can prove difficult.

2.2 Developing Knowledge Management Systems

Despite the acknowledged limitations of ICT systems in meeting the full range of requirements that KM seeks to address, significant resources have been invested in the development of electronic tools to support organisational exploitation of KM procedures. Commercial organisations seek to derive maximum competitive advantage from their intellectual assets. Tools exist to represent and model domain knowledge. Abdullah, Benest et al [1] evaluate key modelling techniques that can be used to identify and represent organisational knowledge and contribute to the development of KM systems.

Knowledge modelling tools include CommonKADS, which incorporates methods for detailed analysis of knowledge-intensive processes; Protegé, a frame-based ontology editing tool with knowledge acquisition tools for domain modelling, [27]; and the Unified Modelling Language (UML). UML is widely used to develop software blueprints to model software-intensive systems [29]. Chen-Burger [5] argues in favour of multi-perspective modelling in which different techniques are adopted to model particular knowledge domains. This can help accommodate complex organisational data for which individual methods are unlikely to be sufficient. The Zachman framework [36] also models enterprises across multiple dimensions.

Lindvall, Rus et al [18] evaluate a comprehensive range of electronic KM tools. They maintain that knowledge can be organised, classified and stored in repositories where indexed explicit knowledge can be browsed and retrieved. Knowledge repositories comprising documents, e-mails and databases for example can be supported by document and content management systems, such as Microsoft SharePoint [23]. The authors report on the deployment of intelligent technologies to identify and categorise knowledge in on-line sources and to aid in decision-making. Data and knowledge discovery aims to generate new knowledge from existing data, information and knowledge bases. Data mining tools are deployed to identify patterns and relationships between data items to construct new connections in the underlying data. These connections can signify new knowledge [24].

The module cannot deal in detail with such a broad range of approaches. However, as illustrated in the remainder of this paper, there are examples of work done by students in this and other modules that does demonstrate how particular approaches have been used to address KM-related issues and to generate effective solutions.

2.3 Module Aims

The MSc taught module in Knowledge Management aims to provide students with clear insights into the issues facing proponents of KM, as outlined in Section 2.1, and to engage them with the concerns facing organisation in developing and deploying appropriate tools and technologies to support KM initiatives, as introduced in Section 2.2. The module assessment requires students to either critically evaluate an operational KM system or to employ appropriate techniques to formulate a design for a proposed KM system. A critical element of this kind of applied work is the identification of suitable environments that can potentially benefit from the utilisation of KM strategies and complementary electronic resources. This paper relates a number of recent initiatives designed to involve students in projects that address real-world issues. This engagement enhances the curriculum by enriching our collective knowledge and understanding of KM-focused technology. It is also clear that there are links with other modules that tap into related fields. There is

scope to strengthen these connections and to foster more external initiatives. In this way the emerging base of case-study material and electronic resources can be extended. This will enable students to interrogate and utilise this repository and effectively engage in KM as they learn it. By successfully widening the reach of KM-focused enquiry it is anticipated that new applied research and learning opportunities will arise.

2.4 Module Delivery

The module is currently delivered over ten two-hour sessions. The material is based around the work of Hislop [13]. This provides a clear framework that puts KM into a broad organisational context. There are advantages in presenting the wider picture that introduces the role of knowledge in human activity and relates it to individual and collective enterprise and investigates the impact of knowledge processes in a range of organisational contexts. Factors such as organisational culture, power and conflict, learning strategies, and innovation influence the effectiveness of KM initiatives. It is useful to address the design and implementation of ICT systems to support KM in view of these perspectives. Within this framework sessions also focus on the overall role of ICT in supporting KM as well as a more specific investigation of how methods of knowledge representation [34], [32] might inform the development of KM tools.

Key material is available in weekly on-line presentations. These are complemented by links to relevant academic papers, web sites and case study presentation material where appropriate. Each session includes an activity sheet containing a series of tasks and questions relating to the materials presented. Students engage in the activities individually or collectively during the classroom sessions and feed their observations back to the rest of the group. As well as demonstrating an understanding of the concepts presented, the students are encouraged to apply the principles to their own experience to help sharpen their insight into how KM might work in practice.

2.4.1 Integrating Case Studies

The next two sections of this paper present details of specific projects in which students have been involved which use technologies that can feature as part of organisational KM initiatives. Details of some of these examples have been organised as presentations available as on-line case studies. They complement the material presented and activities undertaken during the classroom sessions. Not only do they provide a basis for discussion and critical evaluation but they also offer current students potentially stimulating ideas for investigation.

The potential exists to make this a more interactive resource: student projects could be accompanied by brief audio or video clips summarising approaches, achievements and limitations. An enriched repository such as this could serve as an evolving knowledge base which could be linked to other modules.

3. COLLABORATIVE INITIATIVES

Recent interdisciplinary collaboration has involved the support of applied research in public health. This continues to provide opportunities for students to engage in small-scale software development projects that support the research unit. Some of this work has provided exposure to projects and tools that warrant analysis from a KM perspective.

3.1 Public Health Research

Computing staff collaborated with researchers within the Centre for Public Health Research (CPHR) within the university to provide support for the monitoring of regional services available for vulnerable children. The Cheshire Children's Fund (CCF) project focused on promoting the development of local preventative strategies to counter the risk of disadvantage by child poverty and social exclusion. This work was undertaken within the context of a move towards greater use of electronic resources in the management of children's social services, as proposed in the Government paper on Information Sharing and Assessment [9]. The initiative aimed to enable practitioners to gather and record information about a child systematically so that any concerns could be identified and addressed and shared with other practitioners if necessary to determine what action should be taken and by whom.

A number of regional service providers collected data on the children under their jurisdiction. A web-based environment facilitating access to a server, and the secure upload of project data, was constructed using Microsoft SharePoint Services [23]. Data were uploaded on spreadsheets then extracted and incorporated into a database within the Centre for monitoring. SharePoint supports team collaboration and enables users to work together on documents, tasks, contacts, events, and other information. These resources offered the potential for service providers within CCF to communicate with CPHR but also to share knowledge and experience with each other.

The CCF project provides a useful case study; it provokes questions about the extent to which monitoring data provide explicit knowledge about the scope and effectiveness of child support services. Wider issues about the role of ICT systems in facilitating the sharing of information are raised: it is interesting to consider whether the proposed integration of systems supports the collection and dissemination of professionals' knowledge. No attempts were made to analyse the use of discussion boards or other SharePoint resources within the project but it provided a useful environment in which to begin to utilise the software.

This joint initiative also provided a stimulating environment for student work placements in which bespoke software solutions were developed for the project [14]. It is feasible that similar KM-focused activities could be associated with other partnership-led projects.

3.2 An Agricultural Collective

A current undergraduate student has adopted SharePoint in his dissertation project which aims to introduce ICT resources into a well established agricultural collective, Deeside Dairy Farmers. A significant amount of his time has been spent in establishing a suitable technical environment to support the software but his initial implementation provides live feeds to relevant on-line materials; it supports discussion boards, calendars, document sharing and on-line completion of administrative forms.

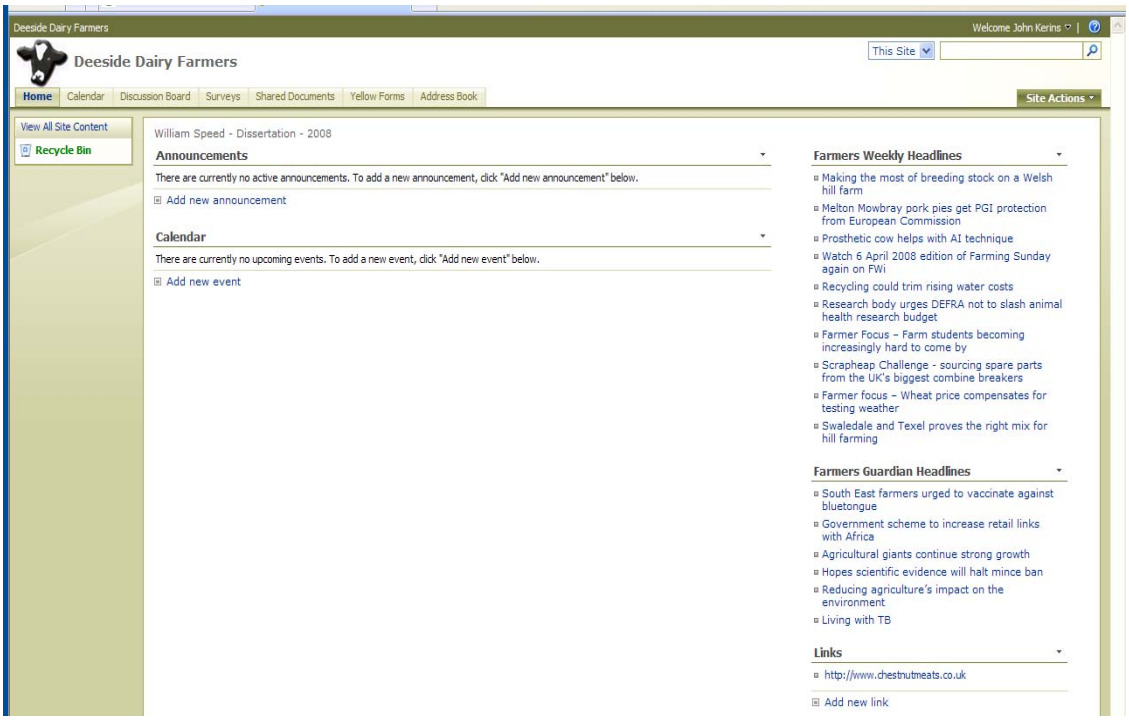

Figure 1 SharePoint Environment for Deeside Dairy Farmers Project

The construction of the SharePoint site in an applied domain is an addition to the potentially useful range of case studies that can be used to stimulate further student interest in similar projects.

3.3 Knowledge Management in Schools

A recent postgraduate dissertation entailed the development of a prototype web-based system to support teaching and learning within the modern languages department of a comprehensive secondary school. The selected development platform was Microsoft's Visual Studio development environment [21], which utilises the .NET framework [20]; this is a common environment for building, deploying, and running Web Services and Web Applications. The system was designed in consultation with the teachers so that they, as users, would be able to co-ordinate information about pupils, groups and resources within the context of the National Curriculum. The researcher had completed the KM module and he drew on the Nonaka and Takeuchi Socialisation, Externalisation, Combination, Internalisation model [26] to map key knowledge processes identified during the consultations. This exercise informed the system's design. The prototype was developed with the explicit aim of investigating the role of knowledge processes within a school environment and creating an infrastructure to support knowledge-intensive professional activities. A more detailed account of this work is available in [15].

Although this research was directly concerned with individual and collective knowledge within the domain of a school subject department, the principal activity was the design and implementation of an effective software solution that met users' requirements. From a KM perspective, many questions are posed about the extent to which such ICT systems support knowledge processes. While the system incorporated a discussion board, various commentators have identified the need to manage this resource in an educational setting [7], [28] and [30].

Key stages of the project are captured in an on-line presentation which shows how the Nonaka and Takeuchi model of knowledge transfer [26] was used to identify knowledge processes and to help formulate system requirements. Details of how potential users were engaged in the iterative development of the prototype provides valuable insight into the design and implementation process and offers scope to assess the extent to which the prototype reflects and supports organisational knowledge processes.

3.4 Systems' Evaluation

Detailed, formal evaluation of the systems that have been developed from the point of view of their effectiveness as KM resources has not been undertaken. This is an area that can be explored as case studies increase and departmental expertise advances.

4. COMPLEMENTARY MODULES

This section discusses activities in other areas of the curriculum that broaden the scope of KM enquiry. Although there is a single, postgraduate module in KM, investigation in other modules is relevant to those students seeking to analyse the range of software tools and techniques that influence the field.

4.1 Information Management Systems

A parallel postgraduate module in Information Management Systems (IMS) focuses on evolution of IMS from transaction processing database architectures to data warehouses [24] and the management of semi-structured data. The module also addresses the application of Business Intelligence software [22]. This area of enquiry provides practical insight into the configuration of ICT systems offering high-volume data warehousing facilities that can contribute to organisational KM strategies. The following model illustrates an organisational architecture facilitating data warehousing and data mining resources, which supports KM activities:

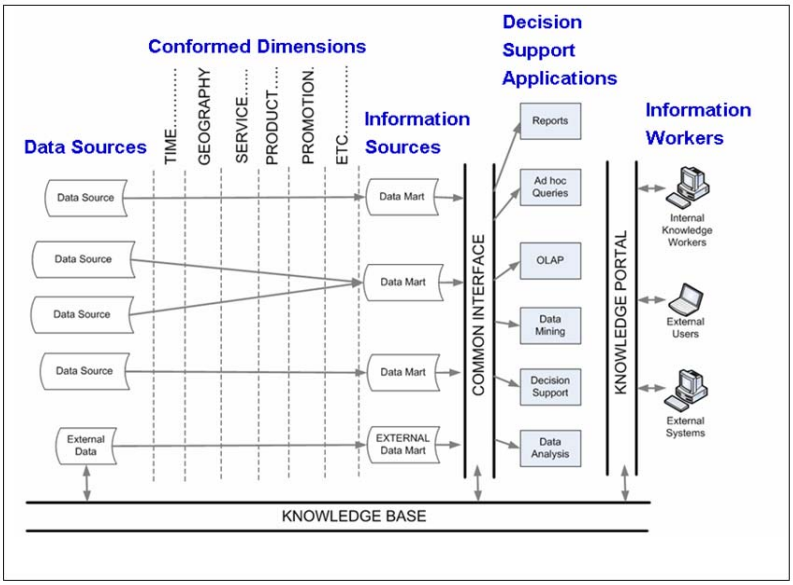

Figure 2 A Knowledge Management Architecture

Again, valuable work has been undertaken by part-time students in exploring the application of advanced database tools in their individual work domains. Two particularly interesting applications were submitted for module assessment. One dealt with the allocation of large-scale research facilities by the Science and Technology Facilities Council (STFC) [35]. The application concerned the potential development of a data warehouse to collect and store details of experimenters, their sponsors and funding details across two STFC

sites in Oxford and Cheshire. This central repository would support data mining and ad hoc queries about use of the facilities. Access to this detail would provide valuable decision-support in seeking to optimise the allocation of research resources.

A second application investigated opportunities for developing a data mart for decision-support in Practice-Based Commissioning within the National Health Service [12]. By identifying suitable conformed dimensions as the basis of the data mart derived from factors such as patient, location, condition, health service provider, time and cost, a repository of data from a range of primary care and hospital systems could be constructed. The report acknowledged the specialist skills required to build and maintain data warehouse systems offering On-line Analytical Processing, data mining and advanced statistical capabilities.

These reports provide valuable insights into the application of advanced Information Management Systems, which can be used to stimulate debate about the role of ICT within the wider aims of KM.

4.2 Systems Analysis and Design

Recent work in a final year undergraduate module in Systems analysis and Design has investigated the application of standard modelling techniques in Data Flow Diagrams, Entity Relationship Diagrams and the Unified Modelling Language [8]. Again, there has been liaison with an external agency to develop a scenario based on the potential design of a prison system which has been used as the basis of module assessment aimed at modelling parts of the system.

Detailed models of the system produced by some of the students serve as useful exemplars of how system properties can be captured diagrammatically. By analysing the scenario and the sample solutions students can see how detailed and accurate models can be generated. The scenario also offers a rich environment in which to evaluate the opportunities for KM initiatives. The use of appropriate modelling techniques is an important dimension in KM investigation.

4.3 Intelligent Technologies

A current final year undergraduate module, Intelligent Technologies, investigates the integration of Artificial Intelligence (AI) techniques into modern software systems and explores the application of technologies such as expert systems [11], machine learning [6], [32], data mining [4] and intelligent agents [10]. Enquiry in these areas underpins the development of systems that contribute to the ICT infrastructure that helps facilitate KM initiatives. Discussion by Smith and Farquhar [33] highlights ways in which AI technology can be applied in KM systems.

5. REFLECTIONS

Ideas concerning participatory learning expressed in this paper reflect a wider aim to link the curriculum with external real-world contexts where possible. The general view is that this can provide stimulating challenges, vital case studies, and opportunities to update departmental expertise. Establishing suitable initiatives takes time and this paper reflects progress at a relatively early stage in the process.

5.1 Student Feedback

The KM module is still comparatively new and at the time of writing it is still being taught to the current cohort so reflective evaluations are not yet available. However, feedback from the previous delivery of the module was positive. One observation identified the value of basing the work around a core textbook: “I feel without this framework to work within it would have been much more difficult to comprehend and grasp the topic.” Relating the abstract notions of KM to realistic, comprehensible scenarios is also seen as challenging: “I found it to be particularly important to reinforce the theoretical concepts with practical explanations either personally or through journal articles to put the theory in context.”

The module assessment required students to critically evaluate an existing KM system or to design a system for a suitable domain. Work was to be presented with reference to current thinking in the literature. The assessments revealed some very interesting investigations into the current state of existing KM initiatives within organisations, such as a marketing department for example, as well as attempts to assess the scope for introducing ICT resources from a KM perspective into much smaller enterprises such as a nursery for example. The reports demonstrated that the students had engaged with issues surrounding the nature of knowledge and the implications of using ICT resources to support organisational activity.

Members of the current cohort are now planning their assessments and they have the benefit of being able to refer to the case study material for examples of successful investigation.

5.2 Staff Perspectives

Providing the students with a contextual framework within which to study KM is beneficial and student comments seem to endorse this. Students with a broad understanding of systems modelling and development including insight into specialist areas such as Business Intelligence are likely to have a keen awareness of the potential and the limitations of the extent to which ICT can support KM. Because KM impacts upon business functions, it demands a wider understanding of how and why software should be developed and deployed. These questions are also at the heart of developments in other areas such as Systems Analysis and Design. Advances in pervasive and contextually intelligent software will continue to affect developments in KM and associated areas of the computing curriculum.

The previous cohort's progress was generally good; assessments displayed a range of stimulating investigations and one student was motivated to complete an excellent dissertation in the field. The results of that work and relevant material from other sources have now been made available as a resource for the current cohort, as this paper has described. It is believed that this will provide stimulus and guidance to help grasp the theory and practice of KM but it is too early to assess this yet.

A further aim is to establish relevant links with external agencies enabling students to work on live KM projects. This may be at individual researcher level but it will serve to bring more learning material to the module.

Another potentially valuable enterprise would be to develop a suitable environment to store case study material. This could act as a test bed for active KM in an educational context. Such an environment could support a number of modules and exploit the connections between them that this paper has identified. In principle, students could be actively engaged in the evolution and maintenance of such a system. Progress in these areas raises interesting questions about the possibilities of expanding the role of KM within the postgraduate teaching portfolio.

6. CONCLUSIONS

This paper has discussed the teaching of a single postgraduate module in KM from the perspective of wider links with external organisations and stimulus from other taught modules on relevant programmes. These additional influences have begun to deliver useful scenarios and opportunities to apply new technologies that provide a rich context for KM enquiry. There is scope to consolidate these links, to expand student engagement in participatory learning and to strengthen the collective expertise in current KM thinking and practise. Potentially, these activities will lead to further applied research and program development opportunities

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DIVERSIFYING ASSESSMENT THROUGH MULTIMEDIA CREATION IN A NON-TECHNICAL MODULE: PRELIMINARY CONSIDERATIONS FOR THE MAIK PROJECT

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ABSTRACT

Creation of multimedia could be a valuable diversification of assessment methods within non-technical modules. The apparent popularity of sites based on user generated video content such as YouTube and also of podcasting suggest that relevant skills and interest are becoming more mainstream. Translating book learnt knowledge into visual forms involves a specific type of intellectual challenge. It seems possible that generating short multimedia presentations will increasingly come to be part of organisational communication, making it an increasingly authentic form of assessment. It could simply be a fun and creative variant of the group presentation. However, there is an entrenched cultural view of the visual as superficial. The "technical skills" involved may give unfair advantage to some students. Any change process is likely to meet resistance and raise novel and unexpected obstacles to its perception as a fair form of assessment. The paper explores the issues and outlines the planned investigation of them in the MAIK project. It discusses in detail justifications for the design of the assessment task in this context.

Keywords

Assessment, multimedia, Knowledge Management

1. INTRODUCTION

This paper explores the issues with making multimedia (MM) object creation a fair part of assessment for non-technical modules. It is based on early findings of an action research project, MAIK (Multimedia Assessment In Knowledge management), funded by HEA-ICS, at the Department of Information Studies, University of Sheffield, to introduce multimedia creation as part of assessment on a second level module on Information and Knowledge Management. The paper summarizes the case for MM assessment and reflects on some insights and decisions from the planning stages of the project.

2. MULTIMEDIA ASSESSMENT

> "Assessment is at the heart of the undergraduate experience. Assessment defines what students regard as important, how they spend their time, and how they come to see themselves as students and then as graduates." [1, p.12]

This quotation encapsulates the centrality of assessment in HE, for students and, indirectly, for lecturers and the institution as a whole. Yet Boud sees it as an area where historically HE has done badly [2]. It can be a "nightmare" for students [3,4]. Several major forces seem to be operating on assessment. On the one hand, is the pressure of massification [5]. On the other hand, there is growing disillusion with exams as artificial and unfair forms of assessment [6, p.303]. Recognition of the need to measure professional competencies, such as group working skills, which cannot be measured by exams, reflects the growing accountability of HE to professional bodies and employers. Yet there is a danger of simply turning HE into a factory for willing employees.

In this context, there are a number of arguments in favour of introducing multimedia creation for assessment. One is simply that diversifying assessment potentially makes it fairer, by rewarding forms of ability not fully assessed by the usual essay and exam. Ivers and Barron make a strong case for the value of assessment through the creation of multimedia [7, pp.3, 12-15]. It is good for assessing collaborative skills, they argue. It represents a new and interesting project management challenge. It tests ability to choose and make effective use of communication mediums. It poses problem solving and skills in information use. It could also be seen as a valid method of assessing creativity. In the Sheffield context, these outcomes tie quite closely to existing degree programme learning outcomes. For students on a IM programme, it produces a valuable counter-balance to technically orientated approaches to multimedia. Specific issues around IPR are highly relevant content.

A second argument is around the appearance on the web of a much wider range of user generated multimedia content. YouTube is probably the most prominent example, but there have also emerged a range of MM creation and sharing sites such as slide.com (http://www.slide.com), as well as applications within Facebook. Podcasting and videocasting are seeing increasing take up [8]. Arguably, young people, especially students are at the forefront of this wave of user content creation. Much of the material being shared on such sites is of relatively low technical quality, yet it is now seen as acceptable for public sharing. This suggests there might have been a shift in standards of what is acceptable, further permitting everyday multimedia creation, where the focus is on the idea not technical quality. According to Pew Internet Survey in 2007 34% of American males between 18 and 29 actually preferred amateur over professional content [9]. Given the trend for technologies tried on the Web to be quickly adopted in the corporate world, there is reason to think that student equipped with multimedia creation skills may have an advantage in seeking employment. For the world of practice it may test more authentically useful skills than are evaluated by the ability to write an essay or report.

Thirdly, there is an argument about the validity of assessment. If one tests book knowledge of a topic with an essay, there is a suspicion that even the best students are merely rewriting abstract ideas in their own words, reproducing them at an abstract level, without really understanding them deeply or concretely. Assessment methods which require the student to rethink the concepts in concrete ways and in a different form could increase the validity of the assessment and tend to produce an assessment geared to “engender appropriate, engaged and productive learning activity” [5]. Thus challenging students to rethink a model of knowledge sharing as an imaginary role play, seems to be a better test of their ability to creatively, deeply understand the concepts they are dealing with, than an essay. Specifically in the MAIK context, as it is related to a module on knowledge management, these processes themselves could be seen as relevant to the subject. Through reflecting on the translation process between book knowledge and multimedia, students could more fully understand ideas about different types of knowledge management: the theoretical and practical, the kinaesthetic, the experiential and knowledge sharing and transformation processes. Given that such processes in corporate contexts are the focus of the module, then asking students to use a KM model to reflect on the process of producing the MM itself adds a useful reflective loop into the activity. Furthermore, it could be argued in the Knowledge Management (KM) context that if workplace knowledge is diverse a Knowledge Manager needs to communicate in diverse ways that speak to knowledge at those different levels. Representing knowledge in MM form as well as abstract essay type writing is an opportunity to think about this.

A final subsidiary argument for the idea of students creating multimedia was that such content would be reusable for future teaching. It would perhaps articulate ideas in forms more immediately understandable to students. Students like MM used in teaching, by getting them to create the content, they are empowered. It also potentially produces rich material for future class room debate.

There are also some reasons to think such novel assessment might not be fair. At the most general level cultural critics of MM would see it as reducing learning to a spectacle, which tends to naturalise knowledge and reduce criticality. As Gabriel has recently argued in relation to teachers’ use of Powerpoint evaluating and responding to visual presentations fits the new range of attitudes and skills current in our society, “which emphasize multi-tasking, discontinuity, visual alertness and semiotic sensitivity as against patient and deep thinking, long periods of concentration and deference to the authority of the text” [10, p.268]. We may feel that the latter styles of thinking are precisely what we wish to foster in HE. Yet such social change has its positive side, as Gabriel argues:

> As consumers in a society of spectacle, we are frequently seduced by image. But we also learn to mistrust image, to question and probe it. We develop skills to read and decode, question and ignore, frame and unframed, combine, dismiss and ignore images [10, p.269].

The question then becomes how to align these critical practices with those of academia. Arguably, when we are critical about the visual, it is often as a sceptical consumer wary, of being sold something we do not need. How does this relate to academic scepticism? Certainly it could be argued that some ideas are simply better presented visually (ibid.: 265). Further, putting onto the students the role of creating the multimedia, rather than being just an audience is likely to sidestep some of these issues.

"Changing assessment procedures is often more difficult than the process of assessment itself" warns Brown [3, p.222]. Brown's focus is the resistance to change coming from colleagues, but innovation in assessment can be experienced negatively by students [11]. This can be because of the extra demands made by unfamiliar forms of work. Students are likely to be resistant to change especially if the requirements are not as clear as those understood from writing essays over a number of years. Students may suspect that the change has been made to cut costs or save lecturer time. Students may resist the need to be more independent and responsible implied by many forms of novel assessment. McDowell and Sambell identify central concerns that may be critical to success in innovation in assessment: such as carefully managing students workload, providing clear guidelines and paying attention to organisational procedures which may work less well with novel assessment types or rapid turn around of formative feedback [11, p.80]. Assessment methods on the degree programme at Sheffield are already quite varied, further diversifying it could potentially undermine the coherence of assessment [12] making it difficult to understand what is being required. But we certainly need to understand what students actually do and think directly, for they may behave differently from how we imagine [2, p.39]

Equally some forms of resistance to change might reflect attitudes which are in themselves also obstacles to learning and so one of the benefits of the MM creation is to challenge them. Students who are operating strategically will be hostile to a change if it alters the rules of the game. It is likely to be more difficult to "fake good" [5, p.25] in a novel assessment form. Meeting these fears head on could be beneficial if it leads students to engage with learning rather than trying to play a system (which may or may not exist), particularly if the process allows an open dialogue in which hidden assumptions and rules behind assessment criteria are articulated and evaluated [13]. We often talk of "being critical" without fully unpacking what this criteria really means or teaching how to do it directly. Assessment change and discussion of potential rubrics could help this by initiating a process in which we articulate such hidden aspects of the curriculum. Again, its easy to claim that assessment by MM is a challenge to be "creative", but unpacking what creativity is, is itself very complex [14]. Is multimedia creative just because anything to do with the media is creative? Is it creative simply because it involves the assembly of disparate elements (sound, image) - if so how does this relate to academic synthesis? If creativity is about novelty, for whom is the novelty: the individual, the discipline, the world? If what is being assessed cannot be clearly defined and then supported/taught, the danger is that primarily aesthetic or simply arbitrary preferences are smuggled into the assessment process. The involvement of students in the development of assessment criteria and in peer or self assessment would increase their understanding of existing criteria and help them develop skills of self reflection and self evaluation that are in themselves desirable learning outcomes.

3. THE MAIK PROJECT

The MAIK project at Department of Information Studies, University of Sheffield explores the issues that are discussed above. Funded by HEA-ICS, the project will build the new assessment into an existing module for level two students on Information and Knowledge Management. The research question for the project could be stated thus:

How can we introduce and support assessment by MM production in a non-technical module, in such a way as it will be felt to be fair by stakeholders?

The primary stakeholders we were concerned with, in fact, were students and staff. Of course the concept of "fairness" is itself ambiguous, and exploring different perceptions of this and articulating the issues were a central aspect of the project. From McDowell's work cited above, a central concern was the change management process. We saw the project revolving around opening up a dialogue with students around the notion of what is fair assessment, and therefore it seemed appropriate to adopt an action research model, in which iterative stages of intervention are observed and reflected upon. The following data collection process is planned:

December & January: Cycle 1. Literature review of use of multimedia in assessment. The development of models and templates.

February to Easter: Cycle 2. Delivery of models in class.

April to mid May: Cycle 3. Students develop their own multimedia.

Second half of May: Cycle 4. Use of student material in classroom discussion.

June: Cycle 5. Summative feedback by students and staff.

July: Report writing

In summary, the following sources of data will be collected: an initial skills and attitude audit; material from workshops about developing; staff reflections arising from teaching and development process, student work and reflections, adapted student module evaluation forms and an end of module focus group. We will also use a peer teaching observation scheme to include colleagues in the processes of analysis and reflection.

At the time of writing (April 2008) the module has not been fully delivered, therefore the second half of the paper focuses on decisions made prior to the delivery of the module, in particular the specifying of the assessment tasks.

4. THE ASSESSMENT TASKS

One critical question was how to scope the assessment task such that it should be clear that an intellectual response, not simply visual rhetoric was being required. We decided that this was effectively conveyed by setting up the assessment clearly in academic language. Thus the group assignment asked them to create:

> One multimedia object presentation (for example, an YouTube style video presentation OR a photostory OR a Powerpoint animation) with the duration of 3 minutes on the theme: "According to many KM authors, managing the issues involved in the conversion of tacit knowledge into explicit knowledge lies at the core of Knowledge Management practices (Schultze and Stabell, 2004:551). Discuss this claim." (30%).

The explicit construction of the question in familiar academic rhetoric helped to clarify that the focus was on intellectual content, rather than technical difficulty. The message was reinforced by reference to an existing standard marking rubric. The assessment guidelines stated:

> This project is set as an open activity and ultimately, it is up to you to decide how you would want to organise, develop and present your argument, as we welcome different perspectives and viewpoints. You can accept or refute the statement above.

Given that the focus was intellectual not technical, we decided that there needed to be a balance between assessment of the plans and initial ideas with the final product. So students were assessed on four elements:

1. Group MM (30%)
2. Group Plans and storyboards (10%)
3. Individual reflection (10%)

> A reflection on the process of developing the argument presented in the multimedia object, from a knowledge sharing perspective; you can use any of the knowledge sharing models covered in the module or another framework (for example, Kolb's learning cycle) (300 words)

4. Individual discussion (20%)

> A discussion of the argument you have presented in the multimedia project against both the literature and the case studies. (800 words)

This made the assessment quite complex, but the structure clear. There was a careful balance between the created object as realised, original ideas in the plan, individual reflection and a more academic discourse in justification/ debate with the MM as a statement. In the context, the balance of individual and group work, of knowledge arising from reflection and book knowledge, mirrors itself on the complexity of knowledge, that is inevitably salient in a KM module, and central to the very nature of the topic. Asking the students to frame their reflection within an existing model adds a layer of learning. Assessing the group plans introduced an area where there could be formative assessment. The reflective piece could be written in the period between the date of presentation of the multimedia which was week 10 and the final hand in date, week 12, so allowing a genuine period for the student to digest the experience and respond to anything that arose at the point at which the MM were presented.

We decided not to involve students directly in the actual marking process, but we do plan to iteratively consult them about what they thought fair criteria should be. So in a workshop in week 1 we got them to work as groups to produce a poster in which they identified what they thought fair criteria would be. We return to this in week 6, asking them to adapt an existing standard presentation assessment rubric, deleting what they think is irrelevant and adding what they thought was relevant. The thinking behind this was that the key aspect of acceptance of the assessment as fair should be clarity and fairness.

We offered support students to follow three possible technical paths:

1. A video
2. MS photostory – a free download from Microsoft Photostory allows users to produce a movie from photos with sound files.
3. MS powerpoint animated model

Video is quite difficult to handle, because it generates very large files and is difficult to edit, we thought the controlled creation process of MS photostory might be easier for novices to handle. Powerpoint offered the opportunity to produce a non-linear MM, if the topic invited it. As a familiar tool, students might feel happier with Powerpoint, though we were asking them to do more than simply produce the standard presentation.

Examples of the type of product were offered in the assessment guidelines:

- a role play of an example of this conversion or a refutation that it can occur;

- a photostory which shows key KM processes;

- an animated KM model or contrasting models (for example, Nonaka and Takeushi and Brown and Duguid) and implications for management;

- an attempt to explore different views of what tacit and explicit knowledge are and therefore what the notion of conversion would involve and implications for management;

- a discussion of tacit and explicit knowledge against some other model of different types of knowledge and implications for management.

A key part of the support process was to produce three examples, one for each technical option. These were reused through the course, and original files made available to students to examine. We designed three models for students to emulate or improve on: A Powerpoint animation illustrated the well known SECI model of Nonaka and Takeuchi. A photostory explored the role of physical space has in knowledge sharing. A video based on interviews with colleagues in the department explored different technology preferences to support informal knowledge sharing.

Intellectual Property Rights (IPR) issues were a central concern. On the one hand, we would consider a layer of discussion about IPR as highly relevant to the discipline, so an appropriate focus for learning in itself. Reuse of material created by the students would be vastly easier if students were restricted to the use of copyright free material (e.g. student authored, with appropriate releases for photographs including human subjects or use of content under creative commons attribution licences). On the other hand, the time consuming character of authoring all content, such as music or certain images, might radically restrict the creativity of the project. We considered that for educational uses and a one time showing, we could allow students simply to use material that came to hand. This would significantly reduce the possibilities of reuse of material, however that was obviously secondary to their using the tools to learn. A compromise position would be to give some added marks for projects that had avoided use of copyrighted material. We certainly encouraged students to use copyright free material and made available a release form if they wanted to film or photograph human subjects. We did offer a session on copyright free material that was available from sites such as Flickr (http://www.flickr.com/creativecommons/) and Freesound (freesound.iua.upf.edu/). Students had to give full sources for any material they used.

The lead in creating the MM was taken by the two non-technical staff on the project (Cox and Vasconcelos), putting the tutors in the role that the students were to take. It is too early to finalise the reflective strand of the project, but some initial comments can be made. The process allowed us to directly experience some of the processes involved in content creation. Certainly it drove home the importance of sound and the pacing of presentation as key elements. There were often unexpected synergies where images and sounds reinforced each other or where qualities of found images or sound added an unexpected useful layer of meaning to the MM. There is certainly a danger in interpreting “technical challenges” simply in IT terms. In fact, the skills of sequencing, pacing a linear visual presentation may be far more critical than simple knowledge of using MS moviemaker or sound file formats. These are themselves technical skills, of course, but of MM not IT, and

could be taught. Also immediately relevant, this creation process by the staff surfaced differences of interpretation, visual preference and evaluation criteria which point to the complexities around the evaluation of visual material.

5. CONCLUSION

At the time of writing we have planned, not yet completed delivery of the module. The students creation of the multimedia and its evaluation will be supported through:
Week 1 a workshop in which they are introduced to the whole module assessment and reflect on criteria and what they think their support needs are
(After spending weeks 2-5 on other work) Week 6 a workshop at which they brainstorm ideas and review some marking rubrics
Week 7 a session introducing the use of the three software packages in the project
Week 8 storyboarding and planning activities
Week 9 a session assembling multimedia
We have adopted an adapted version of Ivers and Baron's model Decide-Design-Develop-Evaluate as a framework for development [7].
As part of the project process a survey of students' pre-existing knowledge and attitudes will be collected. Materials students produce as part of the workshops will start to open up hidden assumptions and allow students to influence the assessment criteria. Most importantly, looking at what students produce, their assessed reflections as well as student evaluation questionnaires and insights from colleagues observing the process as part of our institutional peer assessment schemes should give us a deeper insight into the issues. Although McDowell and Sambell rightly identify the change process itself as a key obstacle to innovation in assessment, if the issue is addressed directly, it can also be an enabler [11]. We are convinced that the dialogue about assessment criteria will lead to a greater insight by students into the whole assessment process in general. MM creation as such does seem to offer some attractive new qualities to include in assessment, particularly, as here, where reflection on knowledge construction processes is key. At the same time we would not wish to underestimate the amount of staff time and effort involved in learning to use MM tools and rethinking existing material and teaching practice to effect the change. Also there are some important conceptual issues to address: How does being critical about or creative with images and sound align with academic notions of criticality and creativity? What non IT technical skills are involved in MM creation?

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DEVELOPING REUSABLE OBJECTS FOR COMPUTER FORENSICS*

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ABSTRACT

This paper reviews the development of a set of learning resources aiming to be diverse and transferable in order to facilitate the tuition of Computer Forensics, an emerging, and currently popular amongst students, subject area. As this field is new, a number of emerging approaches have been so far adopted in the tuition of the specific skills, but none has been established yet. Over the past few years those approaches and their challenges have been debated amongst related academic cycles, particularly at HEA's relevant workshop. We discuss the challenges of developing learning resources for computer forensics and a method for the development of such reusable artefacts. We aimed at the development of learning materials tackling part of those issues in a manner that could be replicated across interested institutions that deliver courses in computer forensics, either in the sense of re-using the actual resources, or by following the method presented.

Keywords
Reusable learning objects, teaching computer forensics.

1. INTRODUCTION

Supporting innovative learning based on e-materials in the area of computer forensics is a key driver for the development of this subject field. According to recent UCAS statistics of applications to the involved institutions, it is emerging as an interdisciplinary and both genders accessible field. This trend can be further supported through the engagement of interested students with realistic and exciting learning materials.

A number of issues, such as the ethical consideration of the materials that the students can be exposed to, the challenging workload to develop those learning aids, the fact that BSc programmes in Computer Forensics are still in their infancy and have not yet produced any graduates etc., all contribute to the need for the development of more established, practical learning environments, implemented in a transferable manner so that they can be deployed across a number of institutions.

The development of a case-based environment can provide an appealing platform that may facilitate student engagement and deliver learning objectives in a practically orientated manner. The tuition of practical skills via an interactive, cohesive and meaningful environment creates the potential for a higher degree of student engagement in an environment that the instructor can set learning objectives against requirements that stem from the professional field itself. This is not particularly feasible when a number of unrelated topical tutorial sessions are used.

This paper reviews the development of a set of transferable learning resources aiming to facilitate the tuition of Computer Forensics. The deliverables of the project described in this paper constitute a cohesive electronic learning environment that students can use both in class and at home. In this respect the final outcome provides the means for greater integration of e-learning materials in tutorial and practical sessions, which may also facilitate further skills building, such as class debates on the cases under investigation or set-up of mock courtrooms to support the development of evidence communication skills etc.

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The paper is then organised as follows; section two provides a brief background on reusable learning objects (RLO), section three introduces the method developed, section four discusses arising issues and section five concludes the paper with a brief overview of initial student reception and feedback and plans for future work.

2. General RLO Background and the Teaching of Computer Forensics

Boyle defined a learning object to be the minimum, meaningful pedagogical unit required to achieve a learning goal or objective [1]. Under this perspective a learning object is a cohesive and decoupled micro-context for learning, designed to enable the achievement of one clear learning goal. Cohesion refers to different learning units satisfying distinct, singular if possible, learning outcomes, whilst decoupling refers to the desired property of each object to reference as few other objects as possible.

RLOs are capable of facilitating learning, as they provide a realistic e-environment that can engage students through interesting assignments. The transferability of the environment can facilitate the instruction of computer forensics across higher education institutions, as interested organisations can adopt this style of practical tuition through case studies and also create their own resources in accordance with the examples and guidance set is the original set of learning aids.

To consider the nature of forensic RLOs student feedback was initially sought. Through that initial discussion, the expectation that practical work should bear a degree of resemblance to reality and the challenges faced by field practitioners was confirmed. The students also expressed the desire for greater cohesion between their practical sessions, indicating the need for the materials to be presented in a structured syllabus, as indicated by Boyle [1].
To implement this we linked the educational objectives of those practical sessions to the skills required through the course of a real investigation, as presented by Wilding [2], through planning a series of independent, but conceptually related, questions/tutorial tasks, intended to develop/reinforce the students' skills in digital investigation tasks, namely

a. Log parsing
b. Constructing timelines
c. Relational analysis of events
d. Contextual reasoning
e. Lateral analysis
f. Comparative analysis
g. Behavioural profiling of user/perpetrator
h. Statistical analysis
i. Intuition

Interestingly, in organising a transferable environment like this, we departed from the original conception of an RLO as given by Boyle above; unlike programming objects that could be conveniently confined within a web container, a forensic RLO includes non-web elements and complementary artefacts, such as associated tools required to develop the skills (a.) – (i.) above. Our perception of what constitutes a forensic RLO is provided below in section 3.4, through a description of the project's model outcomes. Nonetheless, the principles of cohesion and decoupling are still implemented, producing learning objects that are different in nature, similar however in principle with the objects defined in [1].

3. Computer Forensics RLO Development Methodology

3.1 Implementation of Case Studies

The driver behind this whole project is to provide the students with a realistic environment in which to perform their tutorial tasks. Student feedback suggests that the more realistic the tasks that the students are required to work on are, the better the student experience gets. In creating realistic case studies however, academics are faced with a number of difficulties including dedicated resources to emulate a target system for examination, preparation of a scenario, time required for its implementation, acquisition of evidence etc. Another issue relates to the availability of forensic applications and appropriate tools.

Our idea to overcome such issues utilises the principle of virtualisation in that the instructor can use virtual machines to implement specific scenarios (e.g. alleged music copyright infringements, downloading and use of hacking tools etc.) and then produce forensically their hard disc images, in order for the students to examine related digital evidence. In this way, when creating the cases there are no requirements for

specialised resources, apart from typical software and hardware facilities. All required resources including target computers as well as forensic examination tools, could be implemented within virtual machines. The

forensic analyst's workstation may include both freeware/open source and commercial (transferable demonstration licences) specialised forensic application software, if available.

Obviously there is no point in hiding from the students the fact that those hard drive images were acquired from virtual machines, because the installed programmes include applications such as the VMware tools, as well as networking settings and adapters that are created by VMware – most students would be able to recognise that. However knowledge of this fact does not affect in any way the learning experience. That is also supported by the student feedback received during the trial use of these RLOs.

3.2 Acquisition of Virtual Hard Drives

Acquired hard disc drive images of the previous cases can subsequently be provided to the students as digital evidence, upon which to perform their analysis. The images should be acquired from their corresponding virtual systems which can be updated and further obtained at will, producing further cases and evidence. For the acquisition, any live boot Linux distribution can be used. The instructor can insert the live CD in the host machine and boot the target virtual machine through a virtualisation platform such as VMware.

When running the live CD instead of the normal virtual operating system, an acquisition is possible using the *dd* command and redirecting the bit stream image copy of the main (virtual) hard drive to an externally connected USB device of enough capacity. To perform the acquisition, invoke a terminal and enter an acquisition command that grubs the main drive and redirects it to the external USB storage.

3.3 Use of a Coursebook Web Template and Integration of Resources into a MLE

The entire sample set of test objects prepared as deliverable for this project is accessible via a web coursebook. This is a simple HTML structure that allows students to get redirected to the key resources required for the effective completion of their tutorial work.

As effectively those are common web pages, it is easy to integrate into any MLE (e.g. Blackboard) those resources in a transparent way. Depending on the MLE setup, one could either set the coursebook as the main page of the module or, if that is not allowed, it may be linked as an additional resource under a native page dedicated to tutorial sessions.

3.4 Model Outcomes and their Intended Use

Two real cases where the author acted in the capacity of an expert witness were selected to provide loose models for the base of the model learning environment, representing two hypothetical digital crime scenes. Each case was implemented as an example RLO, to support practical tutorial work. Each RLO (effectively a self contained folder of materials) includes:

a. A virtual image (in VMware format) of the acquired computers, to facilitate amendments and re-initiation of forensic images of a ‘suspect’ computer.
b. A forensic (bit copy) disk image of (a.) above.
c. Documentation detailing each case and providing instructions to a supposed computer forensic expert (the student).
d. An example tutorial sheet, outlining the learning objectives and the work required, containing (c.) above as an appendix.
e. An example tutorial guidance sheet for the instructor using the RLO as part of their tutorial.
f. Two (or more) generic virtual images (VMware format) of the investigator’s workstation, containing a state of the art selection of investigation tools.

Each package can be used to derive de-coupled ‘evidence’/artefacts that can be used independently (e.g. Internet browsing history, e-mails etc.), whilst however, maintaining a strong conceptual relationship as being part of the same ‘story’, with maximum cohesion. This story can unfold in the eyes of students taking them through a number of independent tasks and tutorials, aiming at developing the skills discussed in section two. The students could be asked, for example, to extract and analyse the Internet history, construct a timeline of activities with regards to a particular software application, identify users logged into a system etc.

4. Arising Issues from Experiences of Initial Use

4.1 Software Distribution and Licences of Use

4.1.1 RLO redistribution and copyright issues

All software tools and applications used and re-distributed as project outcomes, besides the versions of the Microsoft operating systems and tools included, were free from usage restrictions due to copyrights. To run in particular the Microsoft-based virtual machines or import the acquired images off the virtual hard drives into

tools such as Live View[20], one would need to re-activate or update the Serial Numbers of the software before distributing the configuration files to the students.

4.1.2 Provision of materials and potential risks

Many anti-viruses may detect several tools included as 'malicious' or 'hacking' related (much to the author's disapproval). Depending on the configuration of the anti-virus settings, those files may be deleted automatically, so the instructor should take care during loading/unloading of the materials. Besides the security tools included, peer-to-peer software installed on case study virtual machines may also be detected during scans as a 'virus'. Other virtual machines may also be purposefully left not updated to the latest versions of security updates, as in this way security scanning tools (e.g. nessus or metasploit) can detect and report exposures and vulnerabilities and provide students with a real-like result of such testing. The instructor would need to take precaution if for any reason the need arises to connect such virtual machines directly to the Internet.

4.1.3 Consideration for the Computer Misuse Act

As the produced packages contain security testing and forensic investigation tools, their circulation could perceivably fall under the recently amended Computer Misuse Act that penalises distribution of hacking tools with intent to be used in computer misuse [3]. Students should always be reminded that the tools included in the RLO packages are distributed for educational purposes only, and particularly to contribute to the solution of the workshops/tutorial provided with the RLO package or developed through the home institution. All materials should be provided for educational purposes only and are not to be used with intention to conduct professional or any other type of activity.

4.1.4 Installed software restrictions

Included in the package is the full functioning demonstration version of AccessData's Ultimate Tool Kit (UTK), which is free to download directly from AccessData's own website[21]. This demo can be used to perform forensic analysis and familiarise the students with a major forensic application, however it has an embedded limit of being able to load up to 5,000 file items. Full disc images exceed by far that restriction and hence only analysis of smaller file systems (e.g. USB devices) is recommended via this. Of course this will not be an issue if the home institution possesses licenses of AccessData, or other forensic application, such as EnCase. For full scale analysis with a free integrated forensic toolkit the students may use recent versions of the open source platform sleuthkit and its partnering autopsy forensic browser[22]. A concise guide for this process is presented in [4].

4.2 Size of Materials and Methods of Distribution

The size of artefacts produced as proposed here, including at least one investigation virtual machine, a virtual machine being the subject of investigation, a number of acquired images of virtual drives and any other associated materials (slides, readings, tutorial handouts etc.) is by nature considerably large. Typically it could be as small as several GB, hence its redistribution may be challenging, certainly when students are required to take work off laboratories.

The project output included an example of our own coursework with actual size of 850 MB. This was distributed via DVD to all students of the postgraduate module of Computer Forensics. Most students were expected to conduct the required investigative work at Glamorgan's[23] Computer Forensics Teaching Laboratory, fully equipped with academic versions of forensic software and appropriate hardware.

Therefore, in using the RLOs within the context of a teaching lab and possibly assisted by a MLE as discussed, it should be easy to arrange for students to either download the files into their own workstation, or depending on the teaching laboratory's configuration, to store the files into a server, where they can be accessed via the investigation environments.

However, there was an issue with regards to part-time students who where unable to have regular access to the facility due to their work commitments. For such students the DVD included the investigation environments in a compressed form, to allow them to have access to the capabilities provided by AccessData's FTK imager and by the sleuthkit/autopsy toolkit.

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[20] http://liveview.sourceforge.net/

[21] http://www.accessdata.com/common/pagedetail.aspx?PageCode=downloads

[22] Available from http://www.sleuthkit.org/

[23] The author was faculty of the University of Glamorgan at the time of the project evaluation.

4.3 Appropriateness of Content

4.3.1 Production of offending materials inadvertently

Another interesting and challenging issue was experienced during the period of setting up specific examples of use. As it was deemed necessary for the scenarios to contain realistic use of the Internet and of email access several visits to popular websites were made over a period of time. For example, simple visits to popular websites, e.g. www.youtube.com, may produce thumbnails representing user defined content that depicts females in bathing suits or underwear. Whilst for some cultures such an image would not pose ethical or otherwise issues of concern, others may perceive the image as controversial, or even offensive.

Unfortunately for the instructor, as such content may be randomly generated upon each individual visit, there is the possibility it will eventually end up in the virtual machine. Even if one was to preview the site's contents on the host machine prior redirecting the virtual machine to this site, random retrieval of thumbnails may result in this. Another possibility is for a site to contain any form of explicit language, even when images of any kind are not included, e.g. a blog or postings on bulletin boards.

This situation may be true with a number of sites that may be visited to create a more realistic feeling of web browsing (e.g. lyrics downloads, CD/DVD covers, adverts that are displayed through pop-up windows when running installed tools such as KaZaa or ICQ etc.). The instructor should at least consider the possibility of such content offending particular groups of students and we would advise always performing a sanity check prior circulation of materials. Depending on the level (e.g. postgraduate), some would argue that making an indication of the nature of the potential content that an investigator may come across during their professional life, may even have a pedagogic function and hence that such controlled exposure could be of value.

4.3.2 Copyright-free resources

Another issue with creating real life scenarios, e.g. in cases of copyright infringements via downloads of media (MP3 files or similar), is that obviously it is unacceptable to use peer to peer applications or other utilities to download copyright protected material. In order however to achieve the creation of such cases, there are a number of free resources that an instructor can use, including music sites circulating independent/new artists etc. The author has regularly used promotional sites, e.g. www.purevolume.com, which contain a number of music files available for free use and downloading, without copyright restrictions.

When employing this approach, depending on the learning objectives set, a tutorial could be then set either making the assumption with students that any download should be perceived as breach of copyright/company policy, or to leave the students to identify themselves that there is not an issue of copyright breach there.

4.3.3 Clean Virtual Drive Acquisition

Another issue that needs to be taken into account is that any acquisition of a virtual drive based on the dd command, as described here, retains part of the host drive as free and unallocated space. If the actual virtual drive's utilisation is lower than its specified capacity, the acquisition will result in a part of the hosting drive being copied as well. The precaution here would be to transfer the virtual configuration and disk files to a forensically cleansed (wiped) media first and the cloning of assumed evidence to take place there.

5. Conclusions and Further Work

There are many challenges to be faced by the computing community with respect to the tuition of computer forensics, a key one of which is providing relevant and realistic practical experience to the students. This paper reflected on a project that attempted to facilitate the tuition of computer forensics and tackle the challenges of the delivery of this vocational course, through the design of a learning model and its implementation in a learning environment that reflects on student and tutor needs. The concept of cohesive and de-coupled RLOs was explored and tailored to the needs of the subject field and sample model outputs were put into practical use.

A full trial of the cases throughout a whole term within the author's relevant 3rd year module was eventually not feasible, due to the scheduling of the module's tutorials. Instead, selected student opinions were sought on the nature of the developed cases and a full trial of the materials in tutorials was eventually conducted within the context of the week-long block teaching of a postgraduate module on computer forensics. Student feedback was recorded via the use of questionnaires over the University's Managed Learning Environment and it was overall positive and encouraging. However as there needs to be a substantial amount of use before reuse [5], the author will continue to develop further the RLOs and endeavour to seek trial of the materials by other institutions in an attempt to mature further the method and model outcomes presented in this paper.

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NEVER FINISH A LECTURE WITHOUT A QUICK TEST – AN APPROACH TO REFLECTIVE TEACHING AND LEARNING

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ABSTRACT

In the past few years, we have designed a set of multiple-choice questions for our computer science concepts module (undergraduate, level one). Selected questions are used at the end of every lecture as an in-class test. Although this weekly in-class test is not an assessed test, it has played an important role in helping students to check whether they have understood the lecture, and has helped the teacher to identify how well the content has been received. In this paper, we report how this in-class test method is implemented, and we summarize its advantages. We also present the results of a small scale empirical study on the relation between in-class tests and online tests. We conclude that combining lecturing and in-class tests together is an effective teaching and learning method.

Keywords

In-class test, online test, reflective teaching and learning

1. INTRODUCTION

Three distinctive views of understanding teaching were discussed in Ramsden's book [1].

- In the first view, the teacher sees the job as the unproblematic transmission of information. Students are passive recipients of teaching. Therefore, to improve teaching, the main focuses are on polishing the teacher's performance and communication skills.
- In the second view, the teacher sees the job as supervising the students' activity. The focus has now shifted from what the teacher does to what the student does. The main concern is how to motivate students to be actively engaged.
- In the third view, teaching is seen as a cooperative process. Teachers and students work together to make learning possible. The teacher needs to identify student misunderstandings and put them right promptly. The focus is not only to deliver knowledge and organize activities but also to frequently receive feedback from students, therefore adapting teaching methods accordingly.

It is believed that within higher education the third view is the most appropriate and effective model. That is, the teacher is not just a messenger or organizer; the teacher should be a reflective practitioner. The students should participate in some learning activities rather than just being listeners. Most importantly, both the teachers and the students should constantly monitor the learning progress. These were the motivation for this project.

A first year undergraduate module on computer science theory was taught in a traditional way, that is, a large class lecture followed by small group tutorials. There was a clean cut between the lectures and the tutorials; the former was non-interactive and the latter was interactive. At the time before the project we felt that, although we provided learning activities during the tutorials, it was desirable to add a small learning activity in lectures, especially because lectures and tutorials could not be timetabled consecutively, due to practical constraints on resources. In order to help students instantly grasp the contents, we decided to give students a multiple choice test at the end of the lectures.

There is much literature on how and why using in-class tests can improve learning objectives. For example, Bassey [2] suggested that immediately working on a taught subject makes a learner remember the subject better. This is exactly an area that we were trying to explore. Another issue is to identify whether our in-class test can effectively monitor the learning and teaching progress.

This paper presents our findings from experimenting with this new way of teaching. The rest of paper is organized as the following: Section 2 reports how the in-class test was implemented; Section 3 summarizes the advantages of using the in-class test from both students' and teachers' points of view; Section 4 presents the results of a small-scale empirical study on the relation between in-class tests and online tests; finally, some statistics and reflections conclude the paper.

2. THE IMPLEMENTATION OF IN-CLASS TESTS

2.1 Setting the questions

There are five multiple-choice questions per lecture. The reason for using multiple-choice questions is mainly to save time spent on testing and marking.

All questions are related to the content of the delivered lecture. The level of the questions varies. The following is an example of an easy question which is used at the end of the lecture on 'inductive definition'.

The following is an inductive definition of a set S.

Basis: 1 is in set S

*Induction: if **x** is in set S so is 2**x** (i.e. 2 times **x**)*

Closure: only numbers generated from the above two steps are in set S

Can you tell what the set S is?

a) S is a set of positive integers, i.e. {1,2,3,4,5,6,...}

b) S is a set of positive even numbers, i.e. {2,4,6,8,10,12,...}

c) S is a set of numbers which are powers of 2, i.e. {1,2,4,8,16,32,...}

d) S is a set of squared numbers, i.e. {1,4,9,16,25,36,...}

A question like this is well attempted by most students. This is because that we had just gone through an example on how to define natural numbers inductively; students could simply apply the example to answer this question.

The next question is a harder one used after introducing the concept of recursion. Many students can get the first question correct but not the second one. Many of them think the answers to these two questions are both (b). The common mistakes like this can then be corrected in tutorials or in the next lecture.

Consider the following Java program

```
static public void print(int n) {
    if(n == 0) System.out.println(n);
    if(n > 0) {
        System.out.println(" "+n);
        print(n-1);
    }
    else {
        print(n+1);
        System.out.println(" "+n);
    }
}
```

Q1. What do we get on the screen when we call print(5)?

a) 0 1 2 3 4 5
b) 5 4 3 2 1 0
c) 0
d) 5

Q2. What do we get on the screen when we call print(-5)?

a) 0 -1 -2 -3 -4 -5
b) -5 -4 -3 -2 -1 0
c) 0
d) -5

2.2 Running the test and marking

When considering how to operate the test, we had two choices. One method is to display questions on the screen and let students write down their answers. Then the marking can be done immediately by giving out the correct answers on the screen. Students can either self-mark or peer-mark their work. Another method is more formal than the first one: students work on a pre-printed test sheet and return the sheet to the lecturer for marking. Although the first method saves the marking time and saves paper, the second method was eventually chosen. It was felt that with the first method the teacher cannot receive adequate feedback as the test result is not returned. So far, we have not found that the marking presents any problems in terms of administration and time. With a class size of 40-50 students, it normally takes less than 30 minutes to mark the test and enter the results into a computer.

For administrative reasons, we did not make the tests part of the formal assessment. Therefore, the end-class test normally has a relaxed atmosphere; students are allowed to discuss with each other. In order to encourage students to do their best, we praise students who achieved a mark over 70%: we list them as '5-star students' on a lecture attendance table which is updated weekly and published on the module website. Note that we never name the students on the website; only the student ID is listed. We also produce a '4-star' list, which praises students who achieve over 70% attendance at lectures.

3. ADVANTAGES OF HAVING IN-CLASS TESTS

3.1 Advantages of having in-class test – for teachers

- **It gives the teacher instant feedback on the lecture delivery**

To the teacher, the results of each test are valuable information. In the past, we could only find out how well a student is getting on with the module when the first coursework is submitted; this normally does not happen until the end of the first semester. Now we can quickly get a clear picture of how well a student has understood the lecture. For example, if the majority of students achieved 3 out of 5 or above, we can be confident that the lecture was delivered successfully. Otherwise, we have to identify the problems and redeliver some of the content in different method if necessary.

Apart from the overall mark, it is also possible to gain feedback by looking at individual answers to specific questions. We can then instantly identify which areas are easier or harder, what common misunderstandings students may have in the subject area, or what difficulties students may have faced. That information can quickly be fed back to our subsequent teaching practices. An improved way of teaching the same subject can be reconsidered; student misunderstandings (if any) can be corrected in the next lecture.

- **It makes lectures well planned with clear objectives**

This is an extra bonus from writing test questions for each lecture. We have to take care to make the questions match the content of the lecture. Therefore, during the process of writing the questions, we also go through the process of reviewing the existing teaching material and planning each lecture in a more thoughtful way. We first decide the intention and the learning outcomes of the lecture, and then assign five test questions to cover them. This process makes teaching better planned and, overall, more structured.

- **It records lecture attendance**

Unlike in primary and secondary education, class attendance is not monitored in higher education. However, the attendance at a module, especially for first year students, is a useful piece of information to help us to identify the problems and check how well students are engaged with the learning. Our end-class test incidentally helps us to collect the lecture attendance. Therefore we have been able to spot at-risk students at an early stage.

3.2 Advantages of having in-class test – for students

- **Students can self-monitor their progress**

In the past, some students could not tell whether they have grasped the material until they started doing their coursework. Now students can find out whether they have fully grasped the content through the test. The following method is what students may use to analyse their test results. For overall marks, 4 or 5 out of 5 indicates that students had learnt well. A mark of 3 out of 5 shows that students had at least grasped the basic ideas but need to do more work (through tutorials). Marks lower than 3 are a cause for concern.

- **Students are encouraged to digest topics instantly**

For students, the in-class test is an extra activity apart from listening. The test is far more beneficial for student's learning than monitoring. Students may gain a deeper understanding of the subject by working

through the problems in the test. As mentioned before, our initial motivation is to add an extra learning activity to help students grasp the taught materials effectively. From student's feedback, we are convinced that it really works. For example, this comment from one student shows how the tests have affected the student's learning.

> *"It is easy when being given a lecture to listen, but not really take in the information given.*
>
> *By doing short practical questions at the end I am able to consolidate the topics learned."*

- **The in-class test makes students listen better**

The in-class test is not assessed work. Therefore, students inevitably will not feel pressure to perform well. However from what we heard, they take their test results quite seriously. This might be partly because we use the module website to praise students who achieved a mark over 70%.

> "*The in-class tests make me listen to the lecture better*".

This is an encouraging comment from many students. We initially only aimed to introduce class activities to make students work and monitor the learning progress. As a surprising outcome, it improved students' concentration during the lecture. It seems that the end of class test makes students more motivated and focused when listening.

- **It helps students become familiar with the final exam questions**

We have made the in-class test share the same format as the final exam. Therefore, students are constantly practising 'the exam' throughout the learning process. It has been mentioned by Ashcroft and Foreman-Peck [3] that one advantage of formative assessment is that it can be used to help the student practise and prepare for the final judgment on achievement. This is exactly what we have experienced.

4. A SURVEY ON IN-CLASS AND ONLINE TEST

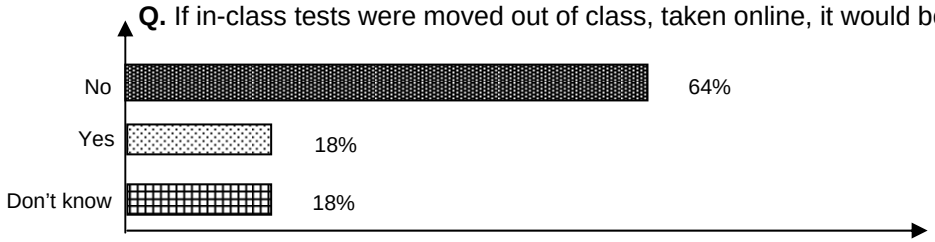
We also developed an online version of the in-class test.

At the moment, the online version of each test is available after the lecture. This allows students to check answers. It is also useful for revision.

Having made the tests into an online version, the next question is this: should an in-class test be replaced by an online test? That is, instead of asking students to complete the test on paper at the end of lectures, we ask students to take the test later on, in their own time, using the Internet. It was not clear to us whether our weekly test could be done effectively online. We therefore conducted a case study on this issue.

We surveyed 50 students. First of all, they all agreed with the following statement; *'the in-class test helped me to learn the module*'.

We then asked whether they agreed with this: 'if in-class tests were moved out of class, taken online, it would be more effective.' The result is not very decisive.



As shown in the above bar chart, 64% of students answered 'no'; only 18% of students think the online test would be better than the in-class test; the remaining 18% of students chose to tick 'I don't know'.

Students gave some reasons why online tests would not be as effective as in-class tests:

- *I would forget to do them if the test is not in class*
- *I would forget to do them and not be enthusiastic when doing them online (many similar answers like this one and the one above)*
- *I can't see many people finding time to do them if online*
- *The subject is still fresh in my head if I do it in class*
- *A test at the end of lesson helps reinforce what has been taught*

- *We like to take in-class test because we can discuss the problems together and ask questions to the lecturer.*
- *The internet is not always accessible*
- *In-class tests help to monitor a lecture's attendance*

For students who believed online tests would be more effective, they gave the following reasons:

- *We can do it in our own time*
- *Tests often overrun the hour lecturing session*
- *Tests use up lecture time*

The students' views on in-class tests versus online tests suggest that in-class tests should not be replaced by online tests. Although some lecturing time is used by the test, as long as it reinforces what the students have learnt, it is definitely worth it. The conclusion is that we should have both in-class tests and online tests running in parallel.

5. SOME STATISTICS AND REFLECTIONS

How does the in-class test approach affect students' learning outcomes?

We have already seen that the feedback from students is very positive. Most students strongly feel that having an end of class test helps them to learn the subject.

Do the statistics support the above claim? In order to answer this question, we looked at statistics on the module which are available to us. We noticed an increase in the first-time pass rate[24] in the year when the in-class test was introduced. It changed from 73% to 78% which is a quite significant increase. We also looked at the percentage of first-class students (i.e. mark above 70%), which is 20%. This figure shows that a larger number of students meet the learning outcomes at the high end.

Are there any disadvantages and problems when using the in-class test?

As mentioned before, the marking effort is not a problem as it only takes less than 30 minutes. However if the total number of students increases, it will become a noticeable overhead. Other alternative methods such as using machines for automatic marking should be considered.

Another problem is that sometimes the lecturer forgets to leave enough time for the test, so that the test overruns the one-hour lecture session (see the student's comment above). Fortunately we have the online version of the test; if this happens, we may ask students to do the test online.

6. CONCLUSIONS

We have applied a teaching method which ties lecturing and formative tests together. We found that the approach is effective. Both teacher and students can be more reflective when having in-class tests at the end of a lecture. Students' performance has been improved. Most importantly, feedback from students shows that they learn better with this approach.

From the development aspect, we have produced a set of online tests on computer science concepts. From the case study aspect, we have investigated students' view on in-class and online tests. We hope that the teaching materials developed in this work and the research conducted will bring a shared interest in the ICS community.

Never finish a lecture without a quick test. We hope that it will lead to new experience and reflective practice for all teachers.

7. ACKNOWLEDGMENT

We would like to thank HE Academy ICS for funding this project. We would also thank our school for their financial support to the project. Finally we thank all referees for their constructive comments on the paper.

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VIDEO-BASED LEARNING OBJECTS FOR TEACHING HUMAN-COMPUTER INTERACTION AT DIFFERENT LEVELS

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ABSTRACT

This paper reports on an HEA-ICS Development Fund project which explored the development of video-based learning objects to teach human-computer interaction (HCI) across degree levels. Four video-based learning objects were created to illustrate four key HCI themes: Know the User; Paper Prototyping; Evaluation; and Accessibility. These were evaluated by students from undergraduate levels 1 and 3 and from postgraduate level M to assess their effectiveness and appropriateness to each level. Students were offered options of viewing on the web or downloading (to computer or to mobile) via subscription. The results showed that the students across levels found the learning objects useful and that the majority preferred web streaming as a mode of access.

Keywords

Reusable learning objects, video, podcasts, web streaming, human-computer interaction.

1. INTRODUCTION

This paper reports on an HEA ICS Development Fund project exploring the development of video-based learning objects to teach human-computer interaction across all degree levels. Our aim was to develop a suite of reusable video-based learning objects to illustrate key techniques in user-centred design which students across all levels find difficult to grasp from description alone. We were looking to assess whether or not we could create materials that were acceptable and useful to all levels from Level 1 to Level M and to identify any student preferences with regard to different delivery mechanisms.

2. BACKGROUND

In common with many institutions, Leeds Metropolitan University is examining the potential of using reusable learning objects (RLOs) to support curriculum delivery and is developing infrastructure to underpin this (for example, see JISC-funded repository projects Institutional Repository [1], Streamline [2] and Persona [3]). The potential benefits of RLOs to enable sharing, avoid redundancy and encourage the development of high quality shared resources are well documented (e.g. [4, 5]). In this project we sought to examine whether it would be possible to develop resources that would be usable by different cohorts at different levels of study. If successful this would allow resource sharing across subject groups as well as within module teams. We selected the subject of human-computer interaction as this is now a standard component of most computing and related degree courses and it is covered in modules at Levels 1, 3 and M at Leeds Metropolitan University. Although the depth and approach to teaching differs from level to level, all three require students to cover common themes, such as user-centred design, evaluation, and accessibility. HCI was therefore selected as a topic where level-independent learning objects might be both feasible and beneficial.

Our next consideration was what form these learning objects should take. Definitions of learning objects vary,

ranging from any learning resource to a clearly defined self-contained chunk containing "presentation, activity, assessment & links" [6]. Recognizing that assessment was unlikely to be level independent, we took a middle ground and sought to develop resources that provided an active presentation of a topic and provide secondary suggestions of activities for their use in different contexts. In the HCI area there are several user-centred design techniques that can be difficult to demonstrate in a class environment but which students find hard to practise correctly otherwise. Presenting these using an engaging visual approach therefore had the potential to support the teaching of these design topics. Podcasting is an area of current interest in many quarters ([7, 8]) and Leeds Metropolitan University has been working in collaboration with Apple to develop video and audio podcast capacity within the institution [9]. We therefore decided to focus on developing video podcasts to illustrate key processes, together with additional resources to enable staff teaching at each level to make appropriate use of these materials.

Our purpose of supporting the learning of practical topics was consistent with previous recommendations for the use of podcasting [10] so we considered our other requirements: we were also looking at relatively stable topics where we could produce persistent resources suitable for reuse and where the content demanded visual representation. According to the Impala model of podcast development [11] this suggested that we should consider slightly longer podcasts (10 minutes+) with multiple voices and an informal style. We took this as a starting point for planning our resources.

One advantage of podcast resources is the benefit of mobility for the student. This was a secondary consideration for us but the project gave us the opportunity to determine how much students valued mobility in their consideration of learning resources. We therefore decided to deliver the podcasts to students using different mechanisms, including podcast subscription and web streaming, to assess their preferences.

3. DEVELOPING THE LEARNING OBJECTS

The project progressed in a number of phases which are outlined here. It should be noted that although the initial project is completed, the work on these resources is continuing and further development and evaluation is planned for the 2008-2009 academic year.

The first phase of the project aimed to identify appropriate topics for coverage in the learning objects. We consulted relevant staff and students to identify topics where visual demonstration would be most helpful to clarify concepts. Initially we identified four topics that were covered at all levels: user-centred design process, paper prototyping, evaluation and accessibility. However, once we started production, we realised that the first of these was going to require a longer podcast than we were aiming for so we made the focus user requirements capture (or "Know your user"). At this stage we also identified existing material currently used to teach these topics at each level and pulled out key common elements that we had to cover. This also enabled us to identify existing media assets that we could use, and new assets that we needed to produce.

The second phase of the project involved producing scripts for the videos and producing media assets. For this we wanted to involve students as much as possible, if not by literally using their voices, at least by showing their work as illustrations. We felt this would make the videos more meaningful to the students and enable them to envisage themselves making use of these processes. So we arranged for students to film their own tutorial sessions to show them using each of the approaches we were illustrating. This proved popular with the students at the time and contributed to the authenticity of the resulting videos. In addition, the videos were also played back to students one week later, during a tutorial, as a visual form of formative feedback, in order to evaluate how well processes went and how the techniques can be improved when evaluating collaboratively with users. This proved to be a very effective and popular way to engage students and give them a sense of ownership of and interest in the resulting resources. We also produced screen capture videos using Camtasia and collected Creative Commons licensed still images from Flickr.

Once we had produced or identified the necessary assets and written scripts we entered the post-production phase. Initially we had hoped to involve students in this process as well but timing did not allow this and videos were produced by members of the project team, using Garageband and Final Cut Pro on a Mac. We produced them in Quicktime format, which is viewable in any browser with a Quicktime plugin (standard configuration on university machines) but is also compatible with iPods, iPhones and other MP4 players. We provided these as web streamed video to watch online and by download subscription. A website was

established to give easy access to these resources and to additional resources, including suggested usage and additional materials on each topic. They were also packaged with metadata using IMS content packaging tool Reload, so that they can be easily stored in repositories.

4. INITIAL EVALUATION RESULTS

Due to timing of delivery we have not yet been able to evaluate the podcasts within the modules at each level (this will be done in the next academic year). We therefore invited 60 students, from levels 1, 3 and M, to review the podcasts and provide feedback through a short (10 question) survey. Students were asked to rate each of the podcasts on their usefulness, how easy they were to understand, how well they held their attention and how appropriate they were to their level of study. They were also asked about how they had accessed the podcasts, how they would envisage using them in their study and what they liked most and least about them. In total 29 students (48%) have responded to the survey and evaluated the podcasts to date. Of these 18 were Level 3, 8 Level 1 and 3 Level M. The majority of these students were studying or had studied HCI (84%), with the others being project students with interests in HCI topics.

Each podcast was rated against each criteria by each student. The modal ratings are summarized in Table 1 which shows the modes for each criterion for each podcast both by level and across level. These show that ratings are positive (scale is 1 to 5 where 1 is the highest) against each criteria with little variation between podcasts or across levels. The mode for each of questions 1-3 (across Levels and Podcasts) is 2, with question 4 (appropriateness) being bi-modal between 1 and 2.

			Mode rating			
Podcast		**Criterion**	**Level 1**	**Level 3**	**Level M***	**Mode across levels**
Paper prototype	q1	Usefulness	2	2	2	2
	q2	Ease of understanding	2	2	2	2
	q3	Attention holding	2	2	N/A	2
	q4	Appropriateness	1	2	N/A	2
Evaluation	q1	Usefulness	2	2	2	2
	q2	Ease of understanding	2	2	2	2
	q3	Attention holding	2	2	2	2
	q4	Appropriateness	1,2=	2,3=	N/A	2
Know your user	q1	Usefulness	2	2	2	2
	q2	Ease of understanding	2	2	2	2
	q3	Attention holding	2	2	2	2
	q4	Appropriateness	1	1	N/A	1
Accessibility	q1	Usefulness	1,3=	2	2	2
	q2	Ease of understanding	2	1	2	2
	q3	Attention holding	2	2	N/A	2
	q4	Appropriateness	2	1	N/A	1

* Very small number of Level M make these figures unreliable – modes only provided where all students responded alike.

= Where ratings are exactly bi-modal two figures are given.

Table 1: Modes for ratings against criteria by Level and Podcast (Scale of 1 to 5 where 1 is highest)

We also asked students to comment on how they accessed the podcasts. All of the students viewed the videos on the web using streaming video, with 79% of students finding this option easy or very easy.

Downloading to their computer was also popular, with 88% of students also choosing this option and 68% of them finding it easy or very easy to accomplish. However only 39% of students chose to download for use on a mobile device. While this may be because some of the students had completed their HCI studies, the difference between those downloading to computer and to mobile was interesting, suggesting that although they wanted to keep their own copy, they were less interested in viewing this on the move. This needs further investigation but suggests that, for these students at least, mobility of learning materials was not a priority.

In terms of usage, the key benefit identified by students was the ability to review materials and revise topics and to check their understanding rather than to replace conventional teaching. This is consistent with our own perspective, that these materials should be supplementary to face to face teaching.

Positive features of the podcasts identified by students included being informative, easy and clear to understand, easily accessible, simple and well structured, allowing students to learn in their own time. On the subject of illustrating processes, one student commented that they liked the way the podcasts illustrated processes explicitly, rather than "in class … you could not imagine what is the best way to do it." This is encouraging as it supports our aim of illustrating processes difficult to grasp in class situations.

Most negative comments focused on technical issues with slow download speeds but some felt that the podcasts were too long. Since the longest was just under 8 minutes (well within the suggested 10 minute limit [11]) this is something to consider for future podcasts. Some students felt there was a need for more variety in the narration voice, because the same narrator was used throughout; however, an equal number of students liked this. One comment was that more interactivity was needed. This could be introduced through using the podcasts within specific interactive activities.

5. LESSONS LEARNED

In considering these results we can draw a number of lessons for future developments. The students' responses to the podcasts so far are largely very positive and we feel confident that they will be beneficial for use in modules across levels. The resources themselves assume no particular set of prior knowledge. This made them suitable as introductory and revision material. The first lesson is therefore that generic, level independent materials are possible and can be useful to students with different experience, aims and objectives. It is important that the topics chosen are self contained and focused enough to be covered in a short video. Visual processes work best. Selecting robust and well established processes helps ensure the longevity (and wider reusability) of the final products.

Secondly, we found that the recommended maximum length of 10 minutes was too long for many of our students, who found the shorter podcasts (4-5 minutes) held their attention better than the longer ones. We would recommend a series of shorter podcasts rather than one longer one. This also has the advantage of giving greater flexibility in use.

Thirdly, providing web streamed material as well as downloadable files is desirable. Technically, the term *podcasting* implies subscription but in practical terms many (particularly in education) use the term to refer to any audio or video based resource, and subscription is only one of the delivery options. Our experience is that given the choice all of our students viewed on the web, so this needs to be an option. Downloading a copy for use on a personal computer is also popular and can be done through a subscription feed or through a VLE (possibly with timed release). The latter may be preferred by some staff as it has the added advantage of encouraging active engagement in the VLE. Interest in downloading to mobile devices was limited in our student group.

Fourthly, the time and resources required for the production of persistent video-based resources for long term use should not be underestimated. We found it useful to involve students in the process, particularly in developing assets and filming. This could be a useful project for students who are doing media production courses. We involved the students in filming the video clips and used these as part of their formative feedback. The production process therefore became a meaningful part of their learning process. We also used Creative Commons' licensed material from Flickr to add interest to our narrative. In our experience, time

spent on preparing detailed scripts was invaluable in speeding up the post-production process. These can also be provided to students as additional materials if appropriate.

6. CONCLUSIONS AND FUTURE WORK

This paper has reported on the development and initial evaluation of a set of video podcasts illustrating key HCI processes. Initial evaluation results are positive for these resources, with students from Level 1 to Level M. Such resources are of benefit in supporting face to face delivery rather than in replacing it.

Our next step is therefore to integrate their use into the curriculum at each level. The key is in how they are used and we will be trying different approaches to supporting learning using these resources. For example, for Level 1 students the resource could be used as part of a tutorial activity, at Level 3 as support for revision and self-directed learning, and at Level M as part of assessment. We will be undertaking a much larger evaluation within the context of module teaching during the 2008/09 academic year.

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Acknowledgements

Current versions of these podcasts, with supporting resources, are freely available under Creative Commons licensing at www.hcipodcasts.org. We would be interested to hear of experiences of using them.

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CURRICULUM-BASED INTER-INSTITUTIONAL COMPETITION

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ABSTRACT

This poster reports upon the second year of a project aimed at enthusing the better programmers within the first year of a Computing degree programme.

Keywords

Programming, enthusing students.

1. RATIONALE

At school level it is recognised that gifted students demonstrate characteristics such as the extreme need to learn at a much faster pace and process material to a much greater depth than other children. They may be so far ahead of their peer-age friends that they know more than half the curriculum before the school year begins, and their boredom can result in low achievement and grades [2]. Once these students reach higher education we are so busy providing extra help for our struggling students that their needs are often ignored.

2. THE COMPETITION

The inter-university competition has two strands, both of which attract prizes for the winners. The first is for groups of students from each institution to create a challenge for students from other institutions to attempt in pairs. The second strand involves pairs of students attempting the challenges created in the first strand. Challenge marking is normalised rather than absolute to allow for variation of difficulty levels between challenges. Teams comprise five students, four of whom attend the programming competition event; this allows students with commitments or who are reticent about competing in the programming strand of the competition to join in, as well as allowing for drop-outs.

3. THE FUTURE

The project was conceived as a pilot scheme to determine levels of interest and the practicality of running such events for more students in the future [1]. The limited budget of a development fund grant requires extra sponsorship to be sought for prizes and hosting the programming event, and also limits the number of students and institutions which can participate. The success of the scheme, however, suggests that, if funding is made available, a curriculum-based inter-institutional competition does motivate our over-performing students.

4. ACKNOWLEDGMENT

The authors wish to thank the HEA-ICS for the development fund grant which made this project possible.

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TIDDLYWIKIS FOR STUDENT DEVELOPED RESOURCES

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ABSTRACT

In this paper, the use of personal Wikis and in particular TiddlyWikis is discussed as a method of students developing their own Wikis on a particular subject area in computer systems.

Keywords

Personal Wikis, assessment, web-page alternative.

1. INTRODUCTION

A number of Wiki-like tools have been developed, and many of these are freely available[1, 2]. One such is TiddlyWiki [1] developed by Jeremy Rushton and is open source. Tiddlywikis are being used here as a method for students to produce wikis on a particular area of computer systems. No one else can alter them as they can only be accessed through the student's own area, memory stick or CD. A TiddlyWiki is described as a "reusable non-linear personal web notebook[1]". The TiddlyWiki consists of a single self-contained file, coded in HTML, JavaScript and CSS, and often produced used using Wiki Mark Up. As a single and usually relatively small file, transferring the file between members of a project team is easy, including being small enough to fit on memory sticks, making it suitable for sharing in a group exercise. TiddlyWiki can be viewed as in any websites. It also possible to alter what information is finally presented to you by opening and closing the set of links (or Tiddlers), leaving on the screen only those you feel are relevant to you.

2. APPROACH

TiddlyWikis have been used as a portable non-linear notebook before [3]. The approach here is to use them as an alternative to web pages or standard wikis and use in an assessment. The task was to produce a TiddlyWiki for one of four topics in computer systems. Usually a "Wiki allows the development of a body of knowledge. It can be edited by many people, each concentrating on their own expertise..." [3]. In the approach discussed here these can only be edited by one member of a team at a time because it is either on a memory stick or in someone's personal area, this means that others outside of the team can not alter the work before it is assessed. The single self-contained HTML file means it is easy to transfer onto CD, as there is no need to worry about associated files.

3. DISCUSSION AND CONCLUSION

Tiddlyikis [1] are Wiki-on-a-stick [3] are interesting and flexible tools.

.

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CREATION OF REUSABLE LEARNING OBJECTS ON DATABASE ANALYSIS AND DESIGN

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ABSTRACT

Databases are a fundamental area of study in information and computer sciences courses. Lack of understanding of basic concepts related to data modelling and database analysis and design have a negative impact on student understanding of more complex topics which in turn hinders their achievement. This paper reports on a project exploring the potential of reusable learning objects for enhancing teaching and learning of such concepts. Its pedagogical rationale and background are discussed, as are issues related to the design and development of learning objects, current outcomes and future developments.

Keywords

Reusable learning objects, teaching and learning Database systems, data modelling, e-learning

1. INTRODUCTION AND BACKGROUND

Databases are a fundamental area of study in courses concerned with information and computer sciences. Student results observed in the faculty of ACES at Sheffield Hallam University, supported by studies carried out elsewhere [e.g. 4, 5], suggest that there are a number of basic concepts related to data modelling and DB analysis and design that learners find difficult. Because these concepts are essential for learning more complex content, lack of understanding has a negative impact on achievement, pass-rates and retention.

The Learning Object (LO) approach has been identified as a way of enhancing the learning experience through the availability of interactive materials that may better suit the expectations and learning needs of students [1, 2, 6]. The LO approach was chosen to repurpose current learning materials into self-contained units to be reused across modules and courses as required. It is expected that by creating LOs that can be selected and ordered differently, different learning experiences would be provided to support different groups of students.

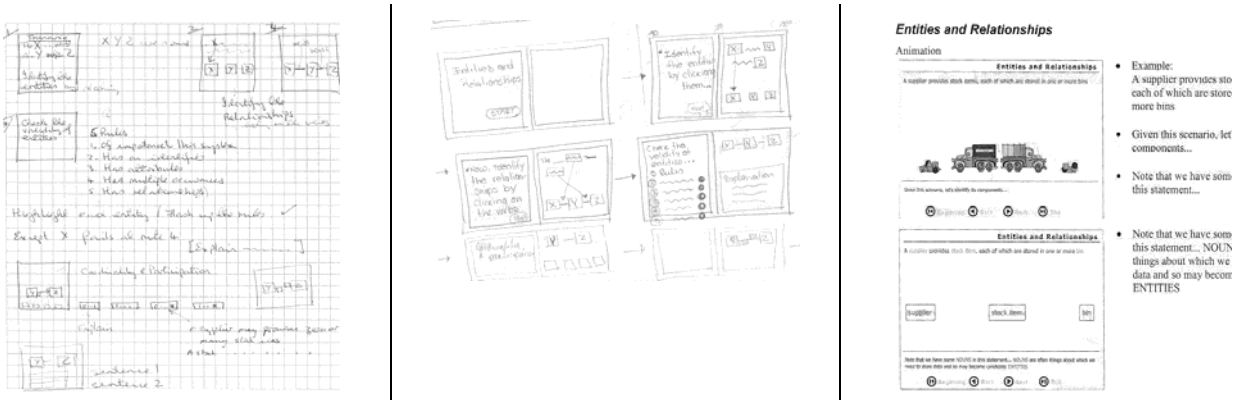
Funding for a project to create Reusable Learning Objects (RLO) was obtained from the Development Fund of the Higher Education Academy (HEA) Information and Computer Science (ICS) Subject Centre. The project aimed to create a number of RLOs to support students in the acquisition and consolidation of key introductory concepts on databases including entity-relationship models, cardinality, determinancy and normalisation.

2. DESIGN AND DEVELOPMENT OF RLOS

A number of design principles, such as cohesion and de-coupling [1, 2]; as well as pedagogical issues, including cognitive and constructivist principles [1, 8] have been taken into account for selecting, sequencing and summarising content, and also for tailoring learning tasks to specific performance levels. For each concept identified three different LOs will be produced: expository instance, example and exercise. Media format of the LOs produced will include screencasting, animations, and basic games.

An iterative development model has been put in place following guidelines for the development of user-centred multimedia content [3, 7]. Storyboards and prototyping techniques have been applied to mediate between the experience and needs of teaching staff and the design and development specifications required by developers.

An iterative design approach has been adopted where evaluation is central. Initial scenarios are proposed by the teaching staff involved in the project which the development team uses as a basis for creating detailed storyboards. Storyboards are then reviewed by the lecturers providing further comments and corrections; next these are used in the development stage. An example of this cycle is shown in Figure 1. The first set of learning objects produced comprises eight introductory instances (screencasting videos) and two examples (animations) of the concepts identified. These can be easily downloaded from the HEA-ICS or the *DBlearn* project websites.



Initial scenario | Storyboard | Animation screenshots

Figure 1. Example of the iterative design process adopted in the project

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SECOND LIFE TOOLKITS

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ABSTRACT

This interactive poster uses a combination of a paper poster and a computer running the virtual world Second Life to describe the authors' progress to date on the HEA-ICS funded project "Second Life Toolkits". It will demonstrate the use of a variety of Second Life teaching tools, together with other resources for teaching Information and Computer Science.

Keywords

Second Life, Virtual Worlds, Education, Toolkit

1. INTRODUCTION

Virtual worlds are increasingly used by HE institutions for teaching and learning. In July 2007 John Kirriemuir [1] identified over 40 UK HE institutions currently using Second Life for a range of activities including teaching, research, student support and exhibitions – and, anecdotally, the numbers involved are believed to have doubled since July 2007. Once in a virtual world, such as Second Life, academics are faced by a new environment with novel ways of teaching and a wealth of potential resources to facilitate their teaching.

This poster describes teaching tools and resources which will enable academics new to Second Life to quickly put together teaching activities without having to spend time learning the nuts and bolts of prim creation and scripting or having to make extended forays into Second Life to hunt out appropriate teaching tools. Examples will include whiteboards, powerpoint displays, lecterns, student queuing tools, assessment tools, timers and office hours tools.

In addition it will look at the development of a generic Second Life teaching toolkit (an easy to use package with incorporated instructions and details about how to customise the tools for particular activities) and a range of sample resources specifically designed to show academics ways of using Second Life to teach ICS topics together with details of existing resources within Second Life that can be used to support student learning.

2. ACKNOWLEDGEMENTS

This work is funded by grants from the Higher Education Academy-ICS and The ExPERT Centre CETL.

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SUPPORTING PRE-UNIVERSITY ICS TEACHING

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There is increasing interest in the use of ICT to support learning, both as a replacement for the presentation methods of paper and teacher, and as an extension to the availability of teaching beyond a specific time, location and date. However, although the multimedia nature of ICT represents the opportunity to do more than simply mimic traditional classroom practices and curriculum-as-content transmission, ICT is "often used as an "add-on" in many classrooms and many lesson plans" [1]. Accepted models of the learning process such as those of Kolb [2] and Dwyer [3] provide a basis for designing the inclusion of ICT but "Effective educational applications of IT match the pedagogical assumptions and the disciplinary nature of the course" [4] and a crucial element is the engagement of the learner's interest and participation in the learning process [1].

We present the progress and achievements of a project to provide an improved range of teaching materials to assist teachers with the delivery of modules within Information and Computer Science (ICS) subjects at pre-University level. From previous work we have identified that there is a need for local schools and colleges to provide an improved range of teaching materials to assist teachers with the delivery of modules within ICS subjects. In particular, we believe that putting ICS into context is an important factor in convincing students of the importance, relevance, excitement and challenge of the subject, thereby providing greater encouragement to them to consider studying ICS subjects at university. The project has developed two teaching packages that can be used to deliver communications-related material within the Information and Communication Technologies A Level and the BTEC Communication Technologies programmes. Specifically, we have focused on two technologies that are extensively used and normally taken for granted – the Internet and mobile phones. The learning materials have focused on providing an historical context, explaining how the technology functions and highlighting the impact of the technology on society. The materials used have been developed using Pedagogue, an authoring tool specifically designed to enable teaching professionals efficiently to produce high quality multimedia teaching and learning packages. The packages have been produced in collaboration with staff delivering the targeted programmes at local colleges and have been evaluated by the college students.

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(2002)

MOTIVATIONAL DIFFERENCES IN LEARNING INTERNET PROGRAMMING BETWEEN THE ARTS AND COMPUTING STUDENTS.

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ABSTRACT

This poster discusses the observations on learning differences of teaching internet programming to Arts and Computing students on a common undergraduate programming module.

Keywords

Motivational differences, personal, social, career aspirations, programming skills.

1. INTRODUCTION

This poster discusses the observations made on the motivational differences in learning between Arts and Computing students on a year long first year undergraduate programming module. Both groups of students share a common first year module as part of their BSc courses in Contemporary Media and in Computing respectively.

A module on Client-side programming which concentrates on XHTML, CSS and JavaScript has been taught for several years and until recently only to computing students, but due to a change in academic regulations students from the Contemporary Media course in the Arts School have also been offered the opportunity to take the module. This has lead to the observation that for students of similar technical background, personal, social and other factors, to include career aspirations, have a direct influence on the student's motivation to learn and acquire new technical and programming skills.

2. DISCUSSION AND OBSERVATIONS.

An interesting observation is that both student groups have little or no programming experience at the start of the module, but have differing personal and career aspirations.

This raises a number of questions to be considered, for example:

- It could be said that students from a Computing background tackle this module from a mechanistic problem solving approach, whereas students from the Arts course use a more 'seeing' and 'feeling' approach. Is this true and if so can these differences be exploited to enhance the overall student

experience?

- Can a common teaching approach and assessment outcomes be suitable for both groups?

USE OF MATLAB TO DEMYSTIFY THE TEACHING OF MEDIA TECHNOLOGY

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ABSTRACT

The teaching of media technology to computing students is often hindered by the mathematical and programming complexity of the subject. We have observed that many of our students struggle with mathematics and low level programming concepts. The use of MATLAB in the teaching of media technology is not new, but it is often used to show the effects of Fourier and other transformations. However, by taking a block building approach, the high level nature of the language allows our students to overcome their technical phobias and produce fully functioned photographic, visual and audio editing tools.

Keywords

MATLAB, video, audio, graphics, teaching, computing.

1. DESCRIPTION OF OUR WORK

This poster presentation shows how MATLAB can be used to break down media technology manipulation into a series of simple steps. By combining these simple steps using a GUI, the student appreciates that the production of a media manipulation tool is well within his or her reach.

1.1 The Approach

Many students are familiar with media packages such as Photoshop, PaintshopPro, Paint and Audition (formerly Cool Edit). Initially, the workings of such packages are a mystery to our students. We have found a route for the student to create his or her own package, with a subset of the facilities offered by the above. The students, therefore appreciate that media technology programming is well within their capabilities.

1.2 Difficult concepts

Let us look at some simple image manipulation operations that a professional package may implement. Consider how to colour correct, increase brightness, or crop an image. Although these operations are quite simple, constructing a program to implement them in a low level language, normally involves three nested "for loops". This is due to the three dimensional (width, height, and colour) nature of colour image data. The nesting obscures the basic image processing mechanisms.

1.3 Why MATLAB?

MATLAB deals with array operations very compactly. It also has a command line interface. Students can change colour, brightness and crop images using single lines of code. None of the concepts of the media operations are lost using this approach, but the obscuring nature of the nested loops is lost. MATLAB's GUI builder allows the student to implement the same lines of code through push buttons and sliders, thereby producing a media package. The student, having understood the concepts, can go on to implement the operations in other low level languages.

1.4 Results

The students are initially daunted by the idea that they can are going to build media packages, but after they have taken the first steps, they derive a great deal of satisfaction from their assignments, and take the concepts further "under their own steam".

BEYOND GOOGLE: DEVELOPING TRAINING SKILLS FOR LIBRARY AND INFORMATION STUDENTS IN THEIR WORK WITH THE GOOGLE GENERATION

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ABSTRACT

The development of the Internet as an information source and the dramatic growth of Google as a search tool have changed end-users' expectations about where relevant information resides and how quickly they should have access to it. For library and information professionals this presents a number of challenges in how they deal with and respond to these new expectations. This poster session will present a video produced by De Saulles and Chelin and funded by the HEA that is designed to be used as a re-usable teaching object in library schools and other environments where information literacy skills for the Internet age are taught.

Keywords

Information literacy, librarianship

OVERVIEW

The key objective of this project was to provide practical advice and guidance on how library and information professionals can demonstrate to end users the value of information resources beyond the public Internet. As end users of library and information services increasingly use online resources themselves, the role of information professionals often involves training their customers how to use these services. Consequently, there is a need for library courses to offer their students help with preparing for the training elements of their future employment, particularly as it is likely that students entering their first professional post may be doing so at a level that will mean they will be involved quite early on in such activities.

This project has produced a resource for library students to help them think about how they might develop training programmes. The focus is on developing training programmes and sessions around the area of information literacy, specifically identifying, searching and evaluating online resources, which is a core issue for many library and information professionals. Many libraries subscribe to online databases and resources which are not available via general search engines, ie they are part of the invisible Web. While these resources offer valuable information, end users are often not aware of them or how to use them as well as not being aware of the limitations of search engines such as Google.

The aim has been achieved through the production of a video which can be shown to library students in a variety of formats. We feel an audio-visual artefact is a particularly useful tool for demonstrating training techniques as it allows students to see some of the complexities involved in the human interaction which is at

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the centre of end user training. Video is also a good format as a reusable learning object (RLO) as it can be delivered on a variety of platforms including online and DVD. Tutors on library and information courses are able to integrate it into their virtual/managed learning environments for delivery in the classroom and as a distance and e-learning resource.

SECURING THE FUTURE OF COMPUTER SCIENCE: COMPUTER SCIENCE FOR FUN

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ABSTRACT

We overview cs4fn: a national campaign with international reach aiming to excite a new generation of school students about computer science and so increase both understanding of the subject generally and improve take-up at university nationally. It consists of a free twice-yearly magazine, a monthly webzine and a range of workshops and shows. It covers computer science research but presented in an accessible, off-beat way.

Keywords

Computer science, public engagement, widening participation, serious fun.

1. OVERVIEW OF THE CS4FN PROJECT

University applications for computer science have been dropping for several years. As a result the UK's need for qualified computer scientists is predicted to outstrip supply. A key to underpinning any revival is in motivating potential students. We must communicate the message not only that the subject leads to rewarding careers whatever your background, race or sex, but that it is also just fun in its own right. With support from EPSRC, the BCS and HEA, we are rolling out a national campaign promoting computer science. Called cs4fn ("Computer Science for Fun"). It promotes the fun side of computer science to school children.

It combines a magazine, webzine (averaging 1.5 million hits per month) and shows. A feature of its success is its accessible, non-patronising but off-beat style. We present computer science as a hobby, explicitly beyond the school curriculum, that is just fun to do. We use a range of interactive games, puzzles and magic tricks to illustrate computer science topics. We also use links to celebrities, chart music and plot-lines and characters from films both to motivate topics and to illustrate ideas. How do you describe how the Internet works? Explain how Madonna managed to crash it. Wish to describe NP-completeness? Bring in the Mission Impossible Team. How does Computer Science link to epidemiology research? Will Smith may help. We feature individual researchers as role models. We also place a particular focus on providing resources that ease the School-University transition. Called "*The FUNdamentals of Computer Science*", this area is one of the most popular.

Several Universities are using cs4fn as part of their Computer Science outreach including Queen Mary, University of London, the University of Bristol; the University of Edinburgh; the University of Dundee; Siena College, USA; Carnegie Melon University, Qatar, and the University of Manchester. A wide variety of Universities also contribute articles about their research. The project is supported by industry including Microsoft, Intel, ARM, Chromacolour, Stop Motion Pro and Equalitec. This additional sponsorship has allowed us to send free class-sets to schools UK-wide on request, an offer taken up by over a 100 schools to date.

Feedback has been exceptional from the outset: for example, from students: "brilliant magazine…!", "Your magazine really rockz.", "Your website is fantastic.", "Cool Site.", "This magazine…It's simply awesome", and from teachers: "This has to be THE most inspired bit of literature/content for getting youngsters switched onto Computer Science!", "fantastic – will do wonders for making Computer Science more accessible for my 6th formers", "absolutely brilliant…just what we need to turn more kids on to computer science".

cs4fn was singled out by the 2006 International Review of Computer Science as an example of good practice in attracting students to the discipline. The campaign has recently been awarded a 5-year EPSRC Partnership for Public Engagement award to continue its work. A key aim now is to build a network of regional partners who use cs4fn in their own local outreach work. We are keen to talk to prospective partners who share our values and passion for the subject. Computer Science is Fun. Serious Fun.

ICT EDUCATION ISSUES AND CHALLENGES IN AUSTRALIA AND THE UK

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ABSTRACT

This discussion session is concerned with exploring the issues and challenges facing ICT education in Australia and the UK. A useful outcome would be the identification of solutions to common problems such as the declining interest in ICT in schools and subsequent lack of enrolments at university. Contributions made by various professional organisations, industry and government will be explored.

Keywords

ICT education, ICT council, industry contribution

INTRODUCTION

This current national ICT education project is funded by the Australian Learning and Teaching Council with the University of Wollongong as the lead organisation and Monash University, Queensland University of Technology and the University of Technology, Sydney as partners. Strategies adopted to scope the issues and challenges have included broad discussions with academic staff, professional bodies, industry associations and attendees at a range of ICT conferences. To contribute to the employability of ICT graduates, CEOs of various ICT companies have been surveyed regarding their preferred needs. To inform curriculum development, recent ICT graduates in the workforce are being surveyed to identify what they consider important to their current employment and how well universities have prepared them.

OUTCOMES, FINDINGS AND COMPARISONS

An outcome of the project in 2008 has been the establishment of a national ICT Council of Deans with representation from all of the Australian universities that teach ICT. It is of interest how this council compares with the Council of Professors and Heads of Computing in the UK, and what strategies the CPHC is employing to address the problems facing the sector and how it relates to the HEA and relevant Subject Centres. The disciplines comprising ICT in Australia (Electrical Engineering, Computer Engineering, Telecommunications Engineering, Software Engineering, Computer Science, Information Technology and Information Systems) are often distributed across faculties of engineering, science, and economics. This fragmentation may be contributing to an ineffective approach to addressing the issues and challenges facing the ICT sector which include: declining interest amongst secondary students; falling university enrolments; and a lack of skilled domestic graduates desperately required by industry.

DISCUSSION QUESTIONS

- Is the ICT sector perceived as being fragmented?
- Are the disciplines, universities, professional bodies, industry and government coordinated?
- What approaches are being taken to arrest the declining interest in ICT in schools?
- Is there a problem with the perception of the ICT Profession?

- Does Industry contribute to ICT education?
- Are graduate employability assets of concern?
- Are good teaching practices shared and adopted in the sector?
- How well balanced are fundamental skills with generic attributes?
- Do teaching staff find it a problem in keeping up to date with technology advances?
- How important and beneficial are industry placements and industry project

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