Exploiting new technologies in mathematics support

John Goodband, Roy Bhakta and Duncan Lawson

sigma - Centre for Excellence in Mathematics and Statistics Support, Faculty of Engineering and Computing, Coventry University CV1 5FB

Abstract

In their pre-university education, teenagers in the UK are increasingly using the internet as a learning resource. Universities in the UK have responded to this phenomenon initially in an ad hoc manner by staff making learning resources available on their own web-sites and then in a more structured way by adopting virtual learning environments such as WebCT or Blackboard. In mathematics support, the mathcentre web-site was created to make a wide range of mathematics learning resources freely available. However, teenagers use of the internet is not restricted to (or even primarily) focused on learning. Many teenagers use the internet as a tool in their social lives – as a medium for communication and for collaborative gaming. Since the majority of new undergraduates are familiar with these technologies, it is worth considering if they may be used for educational purposes within universities. In this paper we will describe some initial steps being taken at Coventry University to explore the use of the social communication package Facebook and the multi-user virtual environment Second Life as tools in mathematics support. We will present some preliminary results from an embryonic Facebook community of students studying mathematics and demonstrate a prototype mathematics support environment in Second Life.

Introduction

Facebook was established in 2004 by Mark Zuckerberg, a Harvard undergraduate, as an on-line social space for Harvard students. Facebook is an internet-based communications tool allowing members to interact virtually with other users through messaging and playing games. Membership of Facebook is free and available to anyone with an email address. Members can use search facilities to find other members, and share material with friends via postings on a profile page. The postings range from messages written using a "wall" facility to pictures and videos. Facebook supports all of the common image and video file formats and also facilitates the creation of groups and external applications. A group can be created by anyone who is a Facebook member, that member consequently becoming the administrator of the group. Group membership is controlled by the administrator, who may choose to invite members or alternatively allow membership from anywhere in the Facebook community. Many thousands of applications have already been added to Facebook. Most of these are quizzes and games, with a few, such as the chess application, allowing on-line playing between members. Within four years, membership of Facebook has increased to 65 million active users (Facebook (2008)). Whilst the early growth in membership had been amongst college students, it appeared that the majority of the new membership has been drawn from the adult age group.

Second Life is one of many online experiences (such as World of Warcraft and Guildwars) in which participants can immerse themselves within a virtual environment and communicate with other users in real time using either voice or text chat. Users are represented in the world by an avatar which can be customised and made to interact

with both the environment and other users. Linden Labs, the creators of Second Life, have made the environment open for public use since 2003. At the time of writing the total number of unique accounts in use has reached approximately 12 million. It should, however, be noted that actual usage is currently significantly lower than this: 11% of accounts have been used in the previous 60 days and 4% during the previous 7 days (Second Life (2008)). Data from Linden Labs does, however, suggest that usage is increasing on a monthly basis not only from individuals but also by businesses. Where Second Life differs significantly from alternative online experiences is in its focus on the individual user's ability to change his or her virtual world. Experiences such as World of Warcraft offer a narrow experience in the sense that users roles are pre-determined (i.e. exploration and completion of quests or fighting duels in a pre-created world). Users of Second Life potentially do not have these limitations placed upon them. Both the environment and the role of user can be freely defined. Those who choose to make use of the Second Life environment are able to build objects such houses and clothes.

This paper presents a study on the use of both Facebook and Second Life at Coventry University. Description and discussion is given of an embryonic Facebook community of students studying mathematics, followed by a demonstration of a prototype mathematics support environment in Second Life.

The study

Facebook groups at Coventry University

In the early years of this millennium, the main thrust in eLearning was based around virtual learning environments and course management systems such as Moodle (see http://moodle.org) (Everett (2007)). Little thought was given to the potential of social networking sites. However, the growth in popularity of this technology has forced educators to re-think their priorities. Facebook is now listed by the Centre for Learning and Performance Technologies as No.17 in the list of top 100 learning tools (Hart (2007)), with Moodle only a little ahead at No.12.

The rapid growth in membership of Facebook now means that students who are not members are sometimes considered to be outsiders by their peer group. Most educational establishments have at least one Facebook group associated with them. Some groups, such as those set up by local students' union members, have a membership composed almost exclusively of undergraduates. However, not all undergraduates are impressed with Facebook and prefer other tools. According to Conneely (2007): "*It's [Facebook is] so bad and boring it makes Bebo look half-decent – and I've seen maths teachers using that."* At the other end of the spectrum, groups representing Centres of Excellence in Teaching and Learning (CETLs) draw membership from those employed to teach or carry out pedagogical research.

In May 2007, two second year mathematics undergraduates at Coventry University asked **sigma** staff to create a Coventry Maths (CM) Facebook group. The aim was to

gain membership from across the faculty, in terms of both students and lecturers, in order to air views and discuss mathematical topics. Early membership of the group came from within the 2nd year cohort, with a few 1st year students joining after the existence of the group was mentioned to them. The 3rd years were, understandably, less interested since it was immediately before their final examinations.

Membership of the group increased during the summer months so that by September 2007 it had reached 32 members, distributed as shown in Table 1. The UG year classification indicates the stage of the course the student was about to commence.

Classification	Staff	2nd year UG	3rd year UG	Graduate
Number	5	10	15	2

Table 1: Coventry Maths Membership immediately before new intake, September 2007

In October 2007, the new intake of mathematics students were informed during their induction lectures of the existence of the CM group. After one week, only one student had joined. During the same week, five of the 1st year students formed their own Facebook group, calling it the Numeracy Team (NT). At the end of October, the group was entirely composed of 1st years. During this period, 1st year students had also started to join the CM group.

By the end of January 2008 the membership of the 2 groups was as shown in Table 2.

Classification	Staff	Randoms	1st year UG	2nd year UG	3rd year UG	Graduate
Number (CM)	8	0	10	10	15	5
Number (NT)	1	31	19	5	11	2

Table 2: CM and NT group memberships January 2008.

The figures for membership of the NT group are somewhat distorted by the addition of 31 members who are not actually associated with Coventry University and are simply friends of 1st year UGs who have been asked to join in order to increase membership. Predictably, most staff have remained members of CM and not joined the 'unofficial' group. Less predictably, several of the 2nd and 3rd years have joined the group. The total number of students in each cohort are: 1st years: 33; 2nd years: 36; 3rd years: 37.

The CM group had, by this time, posted 9 discussion topics. The topic "Help! I have a maths problem" has stimulated some varied question and answer strings. Amongst these was a question posted by a 3rd year maths student: "Linear Algebra – Why?" which elicited lengthy responses from 2 members of staff. A 1st year student also asked "when you use the dot product you get a number. What is that number?". It is interesting that both questions were about conceptualisation of the maths. So far, questions asking

explicitly how to answer coursework have not appeared. The latest update for any topic in the CM group is 5 December 2007. The CM wall numbers 109 posts. These range from students posting links to maths websites to staff arranging convenient times for focus groups.

The NT group had, in the period from October 2007 to January 2008 posted 26 discussion topics. These range from football talk to lecture quotes, with no serious discussion of maths problems. The only wholly maths related topic posted was the "Mathematics Name Game" where participants had to add names of mathematicians whose first names had the same initial as the family name of the previously added name. Whilst having little or no educational value, the various topics have kept the group active, with topic updates appearing on a regular basis. The latest topic update for the NT group is 17 January 2008.

Links to various maths websites have been posted on both groups. Some of the 2nd and 3rd year students have reportedly found them useful. Many of the students have also joined Facebook maths related groups such as "I wish I were your derivative so I could lie tangent to your curves" (which has over 100,000 members). The group "Tex, \LaTeX, and such \ldots" (over 2,400 members) has become particularly popular with 3rd year students who have been writing projects in LaTeX. The great advantage of these groups is their ability to give rapid responses to enquiries made by members.

Before the creation of the Coventry Facebook groups communication between the separate cohorts of maths students was minimal. Since the creation of the groups, there are now regular Friday evening social events encompassing all UGs for all three year groups, with the occasional inclusion of members of staff. The most noticeable connection has been between 3rd and 1st year UG students. The 1st years appear to find it reassuring that they can ask advice from more experienced students. It should be noted that formal mentoring is not implemented at Coventry University.

8 staff members of the Coventry University maths department have joined Facebook. These have all join the CM group, and many have also received and accepted "friend" requests from students. Occasionally, students ask staff members questions about mathematics or statistics problems, typically during the evening when the university itself is closed. When staff are on-line, these queries are usually be answered immediately.

Second Life at Coventry University

Several institutions in the UK are experimenting with using Second Life to provide an educational experience in a virtual environment to supplement what is on offer in the real world. For example, Imperial College (Virtual medical centre where students can practice diagnosing virtual patients) and University of Plymouth ('Sexual Health' Public Education and Outreach simulation) have established a Second Life presence aimed at enriching the learning experience already obtained on the real life campuses. A detailed survey of current Second Life usage in the UK has been carried out by Kirremuir

(2007). There are also attempts to use Second Life specifically for mathematics education (Caprotti & Seppala (2007).

Second Life offers a number of features that can be of great use to educators:

- Opportunity for students and staff in different geographic locations to meet.
- Virtual conferences.
- Use of the environment to perform simulations (Physics/ Engineering).
- Construction of virtual outreach centres that can provide support which is accessible anywhere in the world.
- Facilitation of collaboration between groups in different geographical locations.

The sigma Mathematics Support Centre forms part of the Coventry University virtual campus which is currently being developed. Figures 1 and 2 show the Mathematics Support Centre in Second Life.

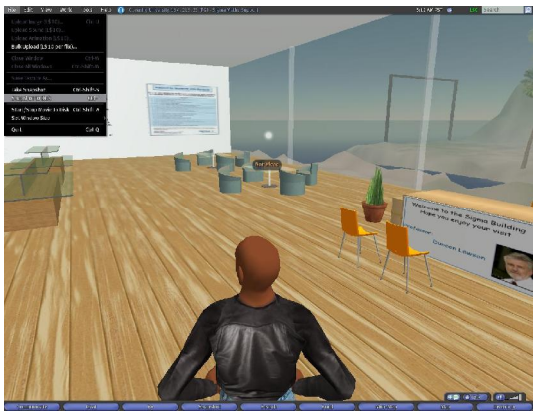

Figure 1: Reception and informal talk area located on the ground floor

Figure 2: Virtual conference room

The mathematics support centre in the virtual Second Life campus at Coventry University is currently under development with a view to supplementing the existing real life support centre and web based resources. With this in mind the goal of sigma is to try and utilise the uniqueness of the 3D environment rather than replicate materials which can already be downloaded from the internet. Sigma's Second Life support centre, once completed, will offer services for both students and staff that may or may not be separated geographically. Upon completion it is envisaged that students and staff will be able to visit the virtual support centre and be greeted by a 'virtual' member of staff who can assist with queries regarding services on offer (in real life and second life). Amongst the services that will be offered are:

- Virtual conference room (see Figure 2) - where users can attend virtual conferences and lectures. Presenters have the ability to use streaming video or images as part of the presentation. The unique feature here which is not available in other web conferencing systems is the facility for different users to interact

with the same object. For example, if a presenter has created a conic object, other users who are in the conference room can interact with the object and modify it. Although cumbersome at present, in the future it maybe possible for users in different locations to construct virtual parts of a more complex machine and link them together in this environment.

- Community Area - where students and staff can mingle and chat. This is similar to the virtual chat rooms which are currently found in abundance on the internet. However the anonymity often associated with chat rooms does not necessarily transfer to the Second Life environment, as the community area is visible and seems tangibly real. In addition, users are able to uniquely customise their avatar.
- Physics and Games Laboratory. Currently under development, this will enable students to engage with virtual experiments exploring various topics such as forces and moments in 3 dimensions.
- Dissemination and other materials – It is also possible to supply users with hyperlinks or documents to further information about specific services e.g. notes for a virtual conference or instructions for a virtual experiment.. Current research carried out by staff can also be disseminated to staff, students and external visitors.

Conclusions and discussion

Although discussion is frequent and vibrant in the NT group, very little is specifically concerned with mathematics. Conversely, the "official" CM group now receives very few posts, although these tend to be on maths related subjects. More importantly, perhaps, social interaction between student cohorts has taken place. This has not occurred in previous years, and may lead to informal mentoring of students by those in higher years. Whether this results in better overall engagement and retention rates remains to be seen. At the moment the majority of existing Coventry University staff over the age of 50 are not members of Facebook. It would be unrealistic to insist that all staff join, and most argue that students can contact them by conventional e-mail if they need to. Perhaps the biggest advantage in using Facebook compared with other media in mathematics education is the facility to communicate informally with other students in the worldwide mathematics community via Facebook groups.

The potential of Second Life is only just beginning to be appreciated. Much of the work being carried out by various institutions is exploratory and as such the effectiveness of it at this time is not easy to assess. However, it would seem that there are many exciting possibilities for using Second Life as an educational tool.

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