Community Based Virtual Learning: A WebCT Physics course.

Tim Barker
Computer Based Learning Unit
University of Leeds, Leeds, LS2 9JT, UK
Email: tim@cbl.leeds.ac.uk

Abstract

Chapeltown and Harehills Assisted Learning Computer School (CHALCS) seeks to address educational problems born of social factors inherent in inner-city Leeds. CHALCS was established in 1987 to try to provide positive alternatives that address these educational problems through out of school tuition for English, Science and Information Technology. This work hypothesises that these aims can be partially met by an Internet-delivered Physics course based on WebCT, utilising a proposed pedagogical framework and trickle-down training of CHALCS’ staff. To test this hypothesis the project is being evaluated for effectiveness in terms of these goals. This has, so far, indicated that WebCT is easily learned but has also led to a need for further support and subsequent implementation of additional functionality such as a Learning Companion. Conclusions reached indicate the need for future enhancements needed to improve the interface to WebCT to allow external applications to provide some of this functionality.

Keywords: Virtual Learning, WebCT, Pedagogy, Learning Companion.

Introduction

Work currently being carried out at the Computer Based Learning Unit, University of Leeds in conjunction with Chapeltown and Harehills Assisted Learning Computer School (CHALCS) seeks to address socially related educational problems inherent in this inner-city area. To this end, it is hypothesised that the development of an Internet based Physics module in Astronomy and Optics using WebCT together with an appropriate pedagogy and trickle-down training will work towards solutions to these problems. This necessitates an evaluation of the implementation’s effectiveness leading to an analysis of emerging factors and subsequent required further work.

Context

The current research project between CHALCS and the University of Leeds aims to address some of the problems occurring within an area of inner-city Leeds whilst having wider implications for related work.

CHALCS

The Chapeltown and Harehills district of Leeds faces the problems often associated with inner-city ethnic minority areas, notably poor housing, single parents and high unemployment. These factors combine to create a culture of crime such as vandalism and drug abuse. These social problems in turn create educational problems
such as truancy and low aspirations. CHALCS was established in 1987 to attempt to address these educational problems through out of school tuition for English, Science and Information Technology (Barker, 1997).

The constitutional aims of CHALCS are listed in Table 1.

<table>
<thead>
<tr>
<th>CHALCS Aims</th>
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<tbody>
<tr>
<td>1. Provide computer facilities and activities which will develop and enhance the educational potential and performance of young people (particularly in English, Mathematics and Information Technology) from the Chapeltown and Harehills districts of Leeds.</td>
</tr>
<tr>
<td>2. Encourage a supporting role for parents and parental groups to the CHALCS activities and to local schools.</td>
</tr>
<tr>
<td>3. Provide support for the work of local schools and a suitable environment for young people to do their homework and out of school assignments.</td>
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<tr>
<td>4. Help raise the expectations and aspirations of both parents and children for a better future.</td>
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Table I. CHALCS Constitutional Aims

An evaluation of a science programme at CHALCS (Mohammed, 1996) concluded that “CHALCS Science-like materials and instruction are effective in encouraging interest, attitudes and participation which get students involved in science. The problem of effectively linking this to improved performance in the school science curriculum, and classroom, remains. The use of **electronic support**, focused on school tasks under the community schools concept could help to achieve this objective…” Furthermore, an evaluation of CHALCS (Ravenscroft, 1998) suggested that “...the links with schools may be strengthened. At the moment the pupils make the link via their learning activities, and this may be a useful basis (aided by **electronic communication**) to strengthen inter-communication with schools.”

This work addresses these key issues and the CHALCS aims by providing such electronic support in the form of an Internet-based Physics course.

**Research Agenda**

There are a number of research aims pertaining to the success of the CHALCS project. Firstly, there are those concerned with the evaluation of the project, that is identifying effective models of the collaborative use of Information Communications Technology (ICT) within an educational context and subsequently investigating emergent factors affecting learning in terms of both problem-solving and the key employability skills (e.g. communication, information handling and task management). Secondly, it is seen as crucial to foster trickle-down training in the use of ICT within CHALCS so that staff will be able to maintain and develop courses utilising this technology themselves.

**Pedagogy**

We are proposing a three tiered pedagogical framework for the successful implementation of a Virtual Learning Environment such as the one at CHALCS. These three stages are known as Acquisition, Argumentation and Application.
Acquisition is concerned with obtaining the requisite knowledge from the course material and/or the tutor/peer interaction. It can be likened to the processes of accommodation and assimilation (Ausubel, 1985) where ‘verbal information’, ‘intellectual skills’ and ‘cognitive strategies’ (Gagne, 1975) are acquired. The next stage, Argumentation, is concerned with corroborating internalised knowledge by seeking evidence, comparing or explaining, possibly in a social context. At a scientific level this would involve the formal process of deduction (Johnson-Laird, 1988) particularly relevant in Physical experimentation. Taking a broader view, argumentation can be taught in terms of linguistic techniques, exploring the connection between narrative and argumentative composition in both speaking and writing, examining planning strategies and the provision of argumentative resources (Andrews, 1995). Finally, Application emphasises skills of both quantitative and qualitative problem-solving (Ploetzner, 1998) in an attempt to reinforce student’s newly acquired skills and knowledge. Furthermore, collaborative problem-solving (Teasley 1993) exposes students to alternative viewpoints and corresponding explanations thereby challenging their own ideas and forcing them to adopt new problem-solving protocols.

With this pedagogical framework in mind we can begin to find a suite of tools that provide the necessary functionality.

Why WebCT?

WebCT was chosen in favour of similar solutions due to its comparable facilities combined with logistical advantages.

Comparison with other Virtual Learning Environments

Table 2 summarises features of the web-based Virtual Learning Environments as reviewed at the beginning of the project.

<table>
<thead>
<tr>
<th>Features</th>
<th>Learning Space</th>
<th>Top Class</th>
<th>WebCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTML design knowledge</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Security</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Private student space</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Quizzes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Student management</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Email</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bulletin board</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Chat</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table II. Comparison of Virtual Learning Environments

It was clear from this survey that WebCT, in comparison with the alternatives, had more of the features we required to implement the course.

Comparison with component solutions

Other possibilities were considered in the form of ‘component’ solutions, i.e. stand-alone software packages offering a limited functionality. Of those reviewed at the time the following were of most interest:
1. **EventWare** offers collaboratively annotated web-pages and synchronous chat.
2. **Ceilidh** and **Tree of Knowledge** are web-based threaded discussion tools.
3. **Netmeeting** provides a whiteboard, application sharing and synchronous chat.
4. **Inspiration** is a concept mapping tool.
5. **Composer/Writers Assistant** allows scaffolding of the writing process.

However, none of the above offer the integrated features of the VLEs although some of their features are still crucial and form part of the ongoing research effort.

**Licensing Accessibility**

The WebCT licensing package is such that courses can be developed at no cost. Instead, licenses are granted per number of students taking the course. This is certainly an incentive to trial the software thus enabling a full evaluation prior to purchasing. Furthermore, the implication is that course costs can be passed onto the student so that for a minimal personal cost they have access to the numerous facilities available. This model has been adopted for the CHALCS Physics course.

**Platform Independence**

The WebCT server can be installed on both UNIX and Windows NT platforms. Clients access the system from a standard web browser such as Netscape or Internet Explorer, although the former is recommended. Therefore, once the server is installed it is possible for students to access the course from any number of platforms supporting web-based Internet connectivity. This is an obvious advantage for students connecting from CHALCS, school or possibly home.

**Support**

WebCT Educational Technologies provide first class support over the Internet. This takes the form of email, discussion lists and web pages. This was undoubtedly a deciding factor in the uptake of WebCT at CHALCS.

**Implementation**

Aside from authoring and uploading course notes to the WebCT environment it is also necessary to consider how classes are to be run using the appropriate tools. The three pedagogical stages are mapped onto the tools provided by WebCT (plus face-to-face and MS Word) as shown in Table 3.
Table III. Mapping tools to aspects of the pedagogy.

Using this derived mapping and a knowledge of the pedagogy it is then possible to design suitable tasks. Table 4 lists example tasks taken from a CHALCS Physics lesson. These are arrived at by firmly grounding the appropriate tools for each stage in the Physics material.

### Example Lesson Tasks.

1. Use the whiteboard and chat to solve the following problem as a group: “A person stands at the end of a swimming pool 8 metres in length ...What is the depth of the pool ?...”

2. Discuss solutions to the following two problems using the bulletin board: a)... b) Ideally, how thick and how smooth should a glass window in a house be ?

3. Start to compile the Physics course notes then cut and paste them into word, adding your own thoughts as you see fit. These are your own notes. Complete this as homework.

Table IV. CHALCS “Reflection and Refraction” Lesson Tasks.

The outcome is a genuine Physics Virtual Learning Environment based on an underlying pedagogy. The course itself can be found at: [http://chalcs.org.uk:8900/](http://chalcs.org.uk:8900/) (Email [tim@cbl.leeds.ac.uk](mailto:tim@cbl.leeds.ac.uk) for a guest account). The ‘Properties of Light’ module was used for the purposes of this pilot. Figure 1 shows a course notes screen. The top right window is a glossary definition of the term ‘electromagnetic spectrum’ obtained by clicking on the hyperlink. The left hand frame in the main browser window shows the course pathway and the top frame shows the tools and navigation icons. The main frame shows the course content for ‘Properties of Light’ including a diagram scanned from the course textbook. The ‘gears’ icon represents an activity whilst the ‘URLs’ icon is a link to external resources such as encyclopaedias.
Pilot Evaluation

Inherent in the design of the study is the requirement to gather and analyse appropriate data. It is proposed to combine qualitative and quantitative approaches. It is worth noting that WebCT provides a wealth of data, such as chat logs, student tracking, bulletin board contents, etc. In addition, more traditional data such as video and questionnaire results are also being gathered. There is therefore a requirement to systematically store such data to aid subsequent analysis. Currently, Atlas ti is being considered for this purpose.

Pre-test questionnaires were completed by the three CHALCS subjects, one male (age 16) and two females (age 17). All subjects had good GCSE results and are currently studying mostly Sciences. Furthermore, the questionnaires indicate that the subjects are comfortable with computers, realise the importance of soft skills and would like further help with them but presuppose encountering problems with using the Internet even though they have never used it in an educational context. Video and audio footage was gathered of one subject’s on-screen interactions together with observational notes and of course on-line data was captured and periodically saved.

Preliminary data analysis indicates that the students soon become accustomed to using the WebCT facilities. During the first session the students only had a mean hits score of 33 with 3 articles read or posted to the bulletin board. However, this increased to a mean hits score of 43 with 24 articles read or posted in the follow-up session. Chat, in particular was used extremely effectively to develop arguments with the tutor and peers but time limitations cut short the session. However, inappropriately placed postings were made to the bulletin boards indicating that the concept of fora...
and threads were not properly understood. It became apparent that the Acquisition stage is best carried out outside of face-to-face contact time as it required little tutor intervention therefore freeing classroom based sessions for the more interactive Argumentation and Application phases. Tutor intervention was, however, periodically required to guide the subjects through the notes or to encourage them to use the on-line encyclopaedias. The ‘my notes’ facility provided by WebCT proved cumbersome to use to structure course note extracts and annotations, especially if images were required. The whiteboard was problematic in terms of identification of contributors which exacerbated problems inherent in collaboratively authoring diagrams. Finally, it became apparent that the tutor’s job was very time-intensive involving administration overheads as well as lesson-based work.

**Discussion**

A number of issues have arisen out of experiences in implementing the pilot and the subsequent evaluation.

**Network Infrastructure**

Prior to commencement of the project there existed at CHALCS a number of IBM PCs linked by a Local Area Network. However, there was no Internet connection so this was obviously the first priority in the early stages as connectivity was central to the research goals. Obtaining this functionality was fraught with problems, mainly due to inadequacies on the part of the installation contractors, the result being that implementation of a VLE was postponed until these problems were overcome. Finally, Internet connectivity was established at CHALCS consisting of a PC running RedHat Linux supporting the World Wide Web server as well as the WebCT service.

**Organisational**

There are currently emerging two distinct teams involved in the implementation of the on-line Physics course. These might be named the development team and the delivery team. The development team consists of the author of the Physics content, two secretaries to enter the material into Word and the WebCT course designer who uploads the course notes, creates the course appearance, etc. The delivery team consists of two Physics tutors (the material author and the CHALCS tutor) and a WebCT technical consultant. There is obviously some overlap in these role definitions and they are dynamic.

**Further Support**

There is a longer-term research goal of integrating a (limited) Learning Companion (Chan, 1996) to provide additional support. Potentially suitable technologies include PROLOG, JAVA, Visual BASIC and Active X. Precisely how to manage inter-process communication is presently unknown but there is a need for the Learning Companion to communicate with WebCT. One possibility is to provide Agent-based support at the level of each of the tools, e.g. a peer to chat or use the bulletin board with, a coach for use of the whiteboard or the bulletin board, a guide to
course notes navigation and ‘my notes’ construction and a tutor to aid dialogues in all three pedagogical stages using chat, bulletin boards and email.

A peer Learning Companion would allow students to collaboratively develop arguments when no suitable real peers are logged on which would encourage access from outside of the classroom-based face-to-face session, i.e. home, school or CHALCS open access times. A coach could provide more technically-based help in the form of the proper use of threads and fora in the bulletin board or the best way to draw diagrams collaboratively in the whiteboard. A guide could intervene in navigation by analysing information already available in student profiles thus ensuring that course notes and external resources are used appropriately and sufficiently. The guide could also support a more scaffolded approach to ‘my notes’ construction in the form of context-sensitive, question-based organisers used in conjunction with a threaded index. Finally, the tutor would be used across all three stages to decrease the workload of the real tutor by aiding course administration such as bulletin board editing and email filing as well as possibly answering Frequently Asked Questions.

The problem can be better tackled when the specification for the Learning Companion emerges from the detailed analysis of the collected data. Other possible technologies requiring integration include concept mapping tools and wordprocessors.

Training

It will be necessary at some stage to hand over the responsibility of developing, administering and delivering the Physics course to the staff at CHALCS. This will be problematic due to the voluntary nature of CHALCS tutors and the skill base and time limitations of the permanent staff. Part of the remit, however, for the current project is to facilitate this hand over. This needs to be firmly born in mind for future work.

Further Domains

There is currently another project at CHALCS which aims to increase support in the domain of literacy and writing skills. A sample course has been developed in WebCT named ‘Study Skills’. Further support is being considered in the Humanities discipline.

Conclusions

The current development of an on-line Physics module at CHALCS using WebCT raises a number of interesting research questions and will lead to a suggested model of implementing ICT-based courses within a learning community such as the one found in inner-city Leeds. A number of issues have arisen out of a preliminary analysis of pilot work. Chiefly amongst these is the problem of integrating additional functionality, such as the Learning Companion, within WebCT. Presently, on-line data such as real-time chat, whiteboard user interactions and student profiles are not available to external applications and even if this was the case a method is required to allow communicative acts by third parties. In short, a more open systems approach is
recommended which would lead to a fuller functioning Virtual Learning Environment beyond that originally envisaged by the designers.

The introduction of the WebCT Physics module to CHALCS students and staff is now complete. Consequently, they can be seen to have mastered the necessary technical abilities and have begun to appreciate the corresponding teaching style. This will serve as an important foundation for their future Virtual Learning experiences.

Acknowledgements

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References


