Improving the Effectiveness of World Wide Web Delivered Courses.

Tim Barker & Rachel Pilkington¹, Computer Based Learning Unit, University of Leeds, LS2 9JT, U.K. 
Email: tim@cbl.leeds.ac.uk Telephone: +44 (0)113 233 4626

This research forms part of an ongoing collaboration between the University of Leeds and Chapeltown and Harehills Assisted Learning Computer School (CHALCS). CHALCS, founded in 1987, is situated within a deprived inner-city area of Leeds. Its constitutional aims are to “provide computer facilities and activities which will develop and enhance the educational potential and performance of young people”. CHALCS also stresses the need to work with local schools and parental groups to “help raise the expectations and aspirations of both parents and children for a better future.” (Barker, 1998). Previous work by Mohammed (1996) and an evaluation by Ravenscroft (1998) have highlighted the possibility of using electronic support to “improve performance in the school science curriculum” and “strengthen inter-communication with schools” respectively.

In light of this previous work and the CHALCS aims this PhD. research seeks to achieve the following aims:

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<td>1. To review educational benefits of collaboration between Agents (human and/or artificial)</td>
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<td>2. To review the educational benefits of ICT in the classroom</td>
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<td>3. To evaluate pedagogical models of effective ICT within a collaborative framework</td>
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<td>4. To adopt and test one pedagogical model for working collaboratively with ICT through the development of appropriate example materials in the Physics context at CHALCS</td>
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<td>5. To adopt a formative evaluation framework to test this pedagogical model by collecting data that will enable an investigation of emergent factors affecting learning in the context</td>
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<td>6. To draw conclusions concerning those factors affecting learning both in the pedagogical model and in developing key skills</td>
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<td>7. To draw conclusions concerning those characteristics of WebCT which are effective for learning</td>
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<td>8. To specify mechanisms for the inclusion of relevant characteristics within WebCT to improve its support facilities - these mechanisms being to adopt an Agent-based approach to a user-centred design of a (limited) Learning Companion.</td>
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Table 1. Research Aims.

A three-phase pedagogical model has been developed and is being continually evaluated at CHALCS and in the nearby future in other schools. It briefly consists of Acquisition, Argumentation and Application. Acquisition is concerned with the students obtaining the requisite knowledge from the course material and/or the tutor/peer interaction. The next stage, Argumentation, is concerned with the students corroborating internalised knowledge by seeking evidence, comparing or explaining, possibly in a social context. Finally, Application emphasises skills, of both quantitative and qualitative problem-solving in an attempt to reinforce student’s newly acquired knowledge.

¹The authors can now be contacted at tim@timbarker.org and r.m.pilkington@bham.ac.uk, respectively.
WebCT is a web-based learning environment providing student tools such as chat, bulletin boards and email as well as course notes and student management tools such as results databases and tracking facilities. It was chosen as a delivery mechanism for an on-line Physics module in Astronomy and Optics at CHALCS. This software decision was made on the basis of a survey of web-based learning environments and component solutions made in the early stages of the research together with such pragmatic concerns as favourable licensing arrangements, platform independence and support (Barker, 1999).

There is, however, a problem with WebCT and the ‘my-notes’ facility (Figure 1) in particular. It is not inherently interactive and 'my-notes' does nothing to scaffold or demonstrate the summarisation process. Therefore, the proposed solution is to design an artificial Learning Companion, in-keeping with the notion of Social Learning Systems (Chan, 1996), with which students collaborate to produce a summary document. Chan states that Social Learning Systems "are environments where multiple participants, either computer simulations or real human agents, work at the same computer or across connected machines, taking various roles via a wide range of activity protocols". This vision is particularly relevant to the U.K.'s National Grid for Learning (DfEE, 1999), a network of publicly accessible learning resources.

Therefore, the aim of an investigation carried out at CHALCS was to identify student’s needs in terms of Information Communications Technology (ICT) support when creating their own summary. It involved two CHALCS Physics students who were asked to summarise a portion of the WebCT ‘Lenses’ module. Microsoft Word was used for the purposes of constructing the summary. Initial results have indicated a number of additional support features which would be of benefit to the three stages of summarisation decision-making, transfer and reflective review (Barker, 2000). These features currently include a scratch-pad for jotting ideas and diagrams, a decision-aid to selecting pertinent text, a database of equations, diagrams and definitions, a cohesion aid, a flexible underlying process model and a complimentary ‘personality’.
As the Learning Companion will need to operate autonomously in a
distributed environment (the Internet, or more specifically WebCT) it is proposed to
adopt an Agent-based approach to it’s design. A suitable model of collaboration was
proposed by Chan (1988) where an Agent (human or artificial) first attempts a
problem, asks the collaborating Agent if they cannot reach the problem goal or asks a
teacher Agent if neither can reach a solution. Frasson (1996) has suggested
improvements to Chan's model of collaboration, instead suggesting a 'troublemaker'
utilising a 'learning by disturbing' approach to tuition. However, as Frasson states
"learning by disturbing gives better results for people having a good knowledge of the
subject matter and seems to be dangerous for people with unconfirmed knowledge".
As CHALCS students have little exposure to note-taking then this approach is deemed
unsuitable.

Other factors affecting the Agent’s behaviour include the incorporation of
personifications such as a heavy-handed, intelligent peer through to a weak, less able
collaborator (Hietala, et al 1998). These personifications will be realised in the form
of appropriate dialogue including the use of colloquialisms and other language traits
common amongst CHALCS’ students (Barker, 1999). A further consideration for the
design of the Agent is the nature of it’s Graphical User Interface, such as appropriate
animations, e.g. gesturing, applauding and writing, text-to-speech synthesis and voice
recognition. Inclusion of these techniques could lead to the ‘persona effect’ and
consequent increase in student motivation (Lester 1997) . This is in-keeping with the
work on Animated Pedagogical Agents (reviewed in Johnson et al, 2000).

Future research will concentrate on the formative evaluation phase of the work
by repeating the current case study with a larger number of students. This will be
followed up with a more informed design phase of the Learning Companion in
keeping with further factors emerging from the study. However, this approach
excludes the necessity of implementing the full Learning Companion system as
computer software. Instead, it is proposed to evaluate the design using a Wizard of Oz
technique (Kemp, 1997) with a large sample of students and the Graphical User
Interface element of the Learning Companion. This way an intelligent systems
component can be simulated and iteratively validated leading to a complete design
specification and partial implementation. Further work would then be to integrate the
intelligent component with the Graphical User Interface and WebCT itself.

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