Can the Utilisation of an Integrated Learning System (ILS) such as Web Course Tools (WebCT) Aid Teaching and Learning in Design and Technology?

Ray Bland, University of Greenwich

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Abstract
Charles Clarke, in the foreword of *Fulfilling the Potential* said:

> In support of our commitment to higher standards for all children and young people, I want every school to make excellent use of these (ICT) opportunities, particularly to develop and deliver e-learning, where there are considerable benefits to be gained. (DfES 2003)

E-learning is developing momentum as the associated technology continues to improve at a staggering pace. Integrated Learning Systems (ILSs) support E-learning and have the potential, or so the developers maintain, to significantly enhance the quality of learning and teaching. The purpose of this paper is to explore these claims through the introduction of one such ILS, namely Web Course Tools (WebCT), and examining its potential impact on learning and teaching in design and technology, particularly in the subject area of Electronic Systems and Control.

Why introduce WebCT?
E-learning has been described as "learning and education with the assistance of the experiences created with the aid of information and communications technology tools. These ICT tools may include the Internet, intranets, computer-based technology, or interactive television" (CEDEFOP, 2003). Although the range of ICT is quite broad, this research has been based solely on the use of computers, though with a view to examining other aspects of ICT at a later date. Computers have many applications, but a fundamental question which this research examines is how they can be used "effectively" to assist the process of learning and teaching, particularly through the utilisation of an Integrated Learning System. There are several such software systems on the market: Blackboard, First Class, Digibrain, Think.Com to name but a few, most of which are fairly expensive (though the latter is free and worth teachers exploring). The choice in my own case was fairly straight forward, as the University had already adopted Web Course Tools (WebCT) and therefore it made

sense to focus on this software, at least in the first instance. This paper will explain how the need to explore such software originated, the problems encountered in its construction and application, and finally discuss both positive and negative outcomes.

The humble hyperlink, in the author's opinion, is one of the most powerful aids to teaching and learning to have been introduced in education for many years, as it opens up a wealth of possibilities to assist teachers in catering for individual learning needs. It was the pursuit of its application, to make learning and teaching more effective utilising a computer, which led to the design and construction of a web site (see Figure 1).

Figure 1: *Website*

However, after a while a point of disenchantment with developing this web site was reached, for whereas an active approach to learning was encouraged, these web based materials unfortunately only allow for one way communication, i.e., from teacher to learner. What was needed was much greater interactivity, such as the provision of feedback. It is essential that both parties are aware that learning has taken place so that each can make the necessary adjustments for future work. It was timely that the University was developing Web Course Tools (WebCT) as a preferred Integrated Learning System, for this software not only has the facility for assessing and providing feedback which can be instant, but also it can record the results so that the progress of the learner can be tracked. WebCT has many other features which were to be developed over time, but from the outset these were the basic requirements.

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Contemporary learning theories posit that the forms of learning design most appropriate to higher education are those based on constructivist learning principles. WebCT and indeed most ILSs, can provide the vehicle for a constructivist approach to learning and teaching. According to Marlowe and Page (1998):

> passively accumulating disconnected knowledge is not learning… To learn a student has to be mentally and often physically active. A student learns when she discovers her own answers, solutions, concepts and relationships and creates her own interpretations.

They highlight that constructivist approaches support the position that learners are not passive recipients of transmitted knowledge. Constructivism emphasises the active role students play in acquiring knowledge personally and socially through engagement with meaningful tasks. Rather than being given specific information on how a task is performed, constructivist approaches encourage learners to find their own way through the tasks, developing and creating their own knowledge. In the words of Roelofs and Tewel (1999):

> Learner autonomy and initiative are accepted and encouraged, and knowledge is created by doing, researching and experiencing real life situations.

As the term suggests, learners attempt to "construct" individual meanings based upon what they currently understand and know. Constructivism assumes that all learners have had different experiences therefore individual understanding cannot be the same between people. Marlowe and Page (1998) provide the following guidelines:

- Teachers should emphasise the promotion of learning via questioning and problem solving.
- Teachers should de-emphasise the transmission of knowledge.
- Work in the classroom should retain the importance of the content to be unearthed and reflected upon.
- Individuals' conceptions of the content are foreground to help learners decide between the relevant/meaningful and the irrelevant.

The materials produced for WebCT followed these guidelines, in order to accommodate a constructivist approach to learning and teaching. The government believes that "ICT and e-learning have a massive contribution to make to all aspects of their reform agenda" (DfES, 2003). They state examples of how this can be achieved:

- ICT can make a significant contribution to teaching and learning across all subjects and ages, inside and outside the curriculum.
- ICT can provide opportunities to engage and motivate children and young people to meet their individual needs.
- ICT can help link school and home by providing access to teaching and learning materials, an to assessment and attendance data, from home.
- ICT can enable schools to share information and good practice in networked learning communities.
- Intelligent information management systems within schools can support school leadership.
- Integrated curriculum and management information systems can help schools monitor individual pupils' progress for assessment for learning as well as for administrative purposes.
- Use of shared drives in schools to bank lesson plans and other resources can produce vast savings in time and effort for teachers.

WebCT software can address all of these issues, as indeed could most ILSs, such is their versatility.

Such web-based environments contain a number of tools to help facilitate teaching and learning and this research sets out to examine which tools and in what ways they can assist in this process.

Teachers need necessarily to keep up to date with developments so that we can be good role models for our trainees. It is also important that we are mindful of the fact that we are not preparing trainees for the "here and now", but rather for that which they might expect in the immediate future. Trainees need therefore to be kept abreast of modern developments and to examine their contribution to learning and teaching, both their advantages and disadvantages. WebCT is just one such example of E-learning software,

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but an examination of its potential could provide greater insight into the contribution ILSs can offer generally. Using it "appropriately" and "effectively" needs necessarily to be practiced, the good aspects accommodated whilst the not so good, changed or eradicated. It is true that what is good for one teacher may not be so good for another, but by pooling and sharing our own learning and experiences we move forward more rapidly as a profession.

What was achieved?
Over the summer term of 2002 a basic shell structure (template) was constructed using WebCT software (see Figure 2), which would be most appropriate for the needs of the various pathways currently running in the School of Education and Training (Secondary) at Greenwich.

Figure 2: Homepage

The decision to adopt a policy of a whole pathway approach, rather than individual courses, was in order to develop a holistic use of WebCT to aid learning and teaching. Within the structure it was important to include, information for trainees on how to set up their computer in order to facilitate WebCT, a calendar to inform trainees of essential dates, provide electronic course guides (see Figure 3) with a view to reducing the amount of paperwork handed out to trainees, and a contents section (see Figure 4) which stored a resource bank of course readers, lecture notes, and activities. Evaluation tools were included to help the trainee assess learning outcomes and produce instant feedback and monitor progress. A section on web site links was provided to ease access to a wealth of information. The communication tools, it was felt, would be useful for three reasons:

- assist trainees to internalise concepts through discussion;
- promote group work;
- provide peer support facilities.

For undergraduates approaching higher education for the first time, Study Tools were included to help trainees develop confidence in working at degree level and to support them outside normal contact time.
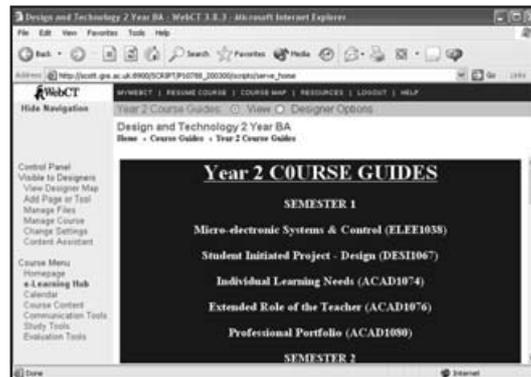

Figure 3: Course Guides

Figure 4: Course Content

At the beginning of the 2002-2003 academic year, trainees were introduced to WebCT. In an effort to cut down on the quantity of paper used by the School of Education and Training, the first years were not presented with a traditional paper-based course guide handbook, but instead were directed to the materials which could be found for constant reference on WebCT. Previous research findings had shown that trainees only really use the course guide for its assessment schedule, i.e., to play the "numbers game" in order to maximise their final coursework mark, and these individual pages can be printed off independently, as and when required.

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The course content section contains the subject materials with the first to be included into WebCT, that of Electronic Systems and Control. It was very important to follow the guidance provided by the National Curriculum and adopt a 'top-down' structured approach to learning, i.e., working from electronic building blocks, through practical construction to a theoretical understanding of the parts of the blocks. In other words a whole circuit approach is adopted from the outset (Control Studio Software), working down to individual components (Livewire Software) and not the reverse. These electronics materials have been developed from my original website and are enriched with the use of digital photography. Not only is the use of this technology a much quicker system of including photographs within the materials, but also the close-up quality is enhanced, allowing trainees a much better understanding of the subject matter being examined (see Figure 5).
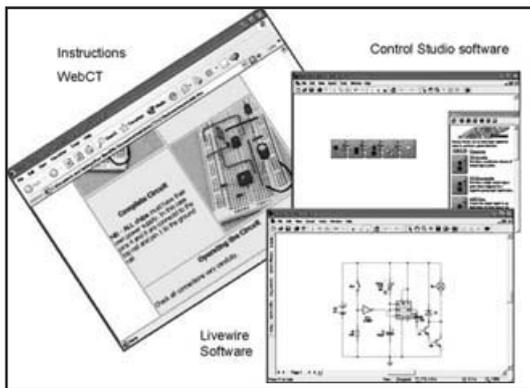

Figure 5: *Practical Sessions*

As explained above, the materials were designed to develop a constructivist approach to learning and were structured in order to provide metaphoric 'coat hooks' on which to hang their learning as well as provide the necessary guidance. Within this Electronic Systems and Control section, information is provided to guide simultaneous practical circuit construction/testing on prototype boards, as well as utilising software packages opened concurrently, which support the learner to experiment in a 'virtual world'. This works with great effect and the cost of the electronics software has been more than paid for by the savings on upgrading and upkeep of hardware. Trainees can make mistakes and the damage is nil. Theories can be put to the test, and conclusions arrived at quickly and effectively.

The emphasis of the teaching is upon 'practical' electronics, i.e., extracting the theory from the practice, rather than vice versa. It was Marion, G et al (2000) who pointed out that:

> The devaluing of life experience has led the traditional professor to ignore an important "hook" into learning, especially for the adult learner. Traditional teaching tends to begin with theory, then introduces application. It is interesting that the logic of teaching is the inverse of the logic of discovery, which moves from observation to theory. Learning is a process of discovery and should start with experiences, observations, and lead toward theory.

Trainees build circuits, they test them, and then are encouraged to analyse the findings. Discussions which follow are simply to ensure that all are conversant with the essential learning gained from the research. As learners they invariably want all the answers at once and all at the beginning, however, if this were permitted information overload would soon be the result. Instead, the theoretical aspects of the work are restricted to a minimum and on a need-to-know basis. Personal experience has shown that a constant drip feed of information is much more beneficial than a sudden flood, for as in the real geographical world, the latter invariably creates time consuming repairs or even in an extreme case, irreparable damage.

Most trainees have limited previous experience of electronics and the word itself, especially for the more mature trainees, is highly emotive. It was important to make the materials as accessible as possible, with an appropriate pitch and pace to cater for all types of learner and there particular needs. Research showed that all trainees had access to their own personal computer as well as access to the internet, which is a positive development and has not been the case in the past. The materials being made available online meant that the pace element was removed because trainees could access the materials at any time. The "here and now" element of learning was changed to "anytime". The materials had to be pitched appropriately so that all could understand and all agreed that although it was a steep learning curve that they were all pleased with their personal achievement, such as the

distance travelled. Quizzes were made available to help make the trainees aware of their progression (see Figure 6).
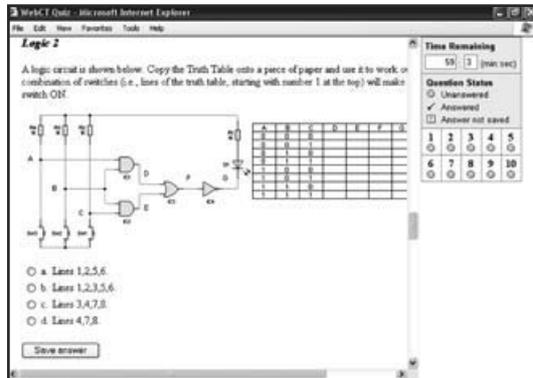

Figure 6: *Quiz*

Failure to grasp basic concepts would be highlighted by incorrect answers and they would then be encouraged to return to the text to try to establish where they had gone wrong. Peer support was essential and it was most impressive in the way they pulled together to help each other. The majority of the trainees agreed that this was a significant contribution to personal learning and one they would encourage in their own teaching.

What Were the Issues Raised?
It can not be disguised that the initial learning of how to use the WebCT software, the creation of the required structure and populating it, did take time. As with learning any new software package, the time factor is very important, however, if this is expressed as "access time", i.e., the time it takes to begin to be able to use it, then it did not take long. It perhaps is best not to put a factor of time to this exercise, rather a benefit factor. What has been interesting about this move towards the application of E-learning to enhance learning and teaching has been the change in the role of the teacher from that of a "sage on the stage" to a "guide on the side" (Grainne Conole, 2001). The traditional role of the teacher being a figurehead at the front of the group directing proceedings and steering leaning, has been transformed to that of a backseat driver letting the machine take more of the control. Some people may be very fearful of this situation, although it must be said that the teacher is not totally powerless, as they would have generated the learning and teaching materials in the first instance, and can step in as and when things go out of control. What it does mean however, is that the preparation time in

putting the course materials required has left more time in the taught sessions to help those trainees who need extra support. More time to spend dealing with individual needs has been a great bonus and statistically the percentage of trainees who felt that lecturer support was either "good" or "very good" had increased over previous years.

The move to "anytime anywhere" learning (at home) from the "here and now" learning (contact sessions) does show that the one supports the other and does not replace it. It means however, that the trainees must make the time and effort to go to the computer outside of contact time, which for some in the past has been an obstacle. However, the findings did indicate that the majority of trainees did actually work in non-contact time developing greater confidence in their own ability. It was also shown that the trainees developed a greater acceptance of the computer as a friend and appreciated its benefit as an aid to learning.

The decision to adopt a whole pathway approach, e.g. three year BA Hons, two year PGCE, or one year PGCE, meant that not only were several courses/units required per year group, but that also, dependent upon the length of the pathway, up to three year groups could be involved and this adds up to a considerable number (3 x 8 courses/units per year = 24). WebCT was really only developed for individual courses/units and so I was exerting pressure on the system. This became clear when a calendar was required for each year group, but only one was allowed. Much more importantly, it was discovered that 're-useable learning objects' (RLOs), i.e., courses/units shared by more than one pathway, needed to be copied to each pathway which was very time consuming. What is required is to have a separate website to include these course materials and then to hyperlink to them from WebCT as and when necessary. By doing so, files on a theme or topic need only be required in one place, not the same files being reproduced in several places. When changes are needed to the materials it is much easier to do this in one place and not several identical modifications in a number of places, thus ultimately saving time and effort in the longer term.

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The "no paper policy" interestingly created quite a stir. The change from paper to no paper (or at least less paper), was on reflection too sudden, but it did prove to be highly beneficial in that it got people thinking and promoted discussion. A similar policy of no paper course guides handbook was to be adopted with the second year trainees as well as those in the first year, though other staff were involved and were unable to come to terms with this new approach. With regard to the trainees, 20% of the group were against the idea from the outset of the course and still against it at the end. In terms of how many had to print of paper copies, 75% of the group admitted to printing out some if not all of the course guides. It would be fair to say that the net effect was a culture shock to the system. In basic terms, the problem lies in the fact that people are being asked to be reliant upon the computer in a way not asked of them before. For some people to work solely on the computer with the materials makes them feel very insecure without a paper copy. It therefore means, for the immediate future certainly, that trainees need to be given the option, though with a view to encouraging more to move in this direction. Another surprise lay in the fact that this academic year again no issue of handbooks was planned, but this decision was over-ruled by my colleagues because of an impending OFSTED inspection. Hopefully, and in the not too distant future, people will begin to be at ease with less paper, as more paper does not necessarily mean that a system is more effective, and it will save a few forests.

In terms of tracking trainees' progression, it would be very pleasing to report that the introduction of quizzes, (which was why WebCT was introduced in the first instance), had been a stunning success, but unfortunately too few trainees actually took advantage of this new facility. Only 25% of the trainees did all, or a good proportion of the quizzes. It could be argued that this may have been caused by my own teaching placing insufficient emphasis on their importance. From a teaching perspective this highlights that not only is the quality of the materials important, but also how they are delivered needs to be effectively undertaken. However, what was considered to be the more likely cause was the fact that the whole pathway structure and assessment criteria did not

encourage certain trainee behaviour to foster in depth learning of Electronic Systems and Control. As a direct result of this research, a number of major changes have been made to take account of these issues. Firstly, the individual course requirements have been altered significantly because overall it was felt that trainees were undertaking too many whole design and make projects, and that what was needed was a more multifaceted approach to coursework. Within the Electronic Systems and Control Course, mini research exercises have subsequently been introduced to provide greater breadth than a single focused project and these have been included as part of the final assessment criteria. A second major change has been to add a final WebCT quiz as part of the final assessment criteria. The function of this is two fold:

- by making trainees aware that the course materials quizzes will provide a good guide as to what to expect in the final quiz, and therefore more will be forced to undertake to do all of the quizzes;
- it will provide a much better guide as to the breadth of personal learning in the subject area of Electronic Systems and Control.

A third major change has been to encourage trainees to examine and evaluate their own personal learning during the course. A written statement is required as part of the final assessment, to examine what helped them to learn, which teaching methods were more suited to their learning needs, and so on. The shift with all these changes has been to try to put back the importance of learning, rather than simply doing.

This research had other interesting revelations. Just when one feels they have "plugged one hole in the dyke, another leak appears elsewhere". As mentioned above, digital photography allows wonderful clear close-ups, which are useful for electronics in that it captures fine detail. From my discussions with the trainees it transpires that work on the prototype board, into which electronic components can be simply be pressed and thereby preventing the need to solder (a source of great problems for beginners), has encouraged a "painting by numbers" approach to electronics. Trainees were using the highly visible numbers on the prototype boards (see

Figure 7) as a guide as to where the components were to be placed, rather than the schematic electronics circuit diagrams being utilised for this purpose. The net effect was simply rote learning, merely copying the layout. This methodology can be an advantage to gain confidence the first time a circuit is constructed, but unfortunately it was the easier way out (the path of least resistance) and that which was the adopted practice of too many trainees. This will need to be addressed in future, not so much as a change in materials, but rather as a point to be emphasised and discouraged through teaching.
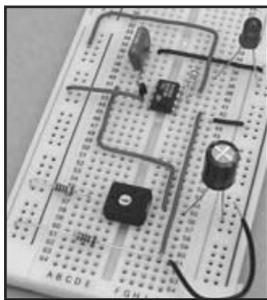

Figure 7: *Prototype Board*

Time spent on the development of the materials meant that the use of the discussion tool was not fully developed and even though few trainees used this facility, its potential was demonstrated. Initial discussion topics were created for trainees to share useful websites and articles with the group. In future more will be made of the discussion tool as another means of support, i.e. peer support. Small groups of trainees can share their difficulties and how they overcame them, or indeed asking for suggestions as to how to solve their own particular problem. Trainees need time and space to assimilate and internalise new learning and the discussion tool provides the perfect vehicle for this to take place. Too often we as teachers are afraid to ask for support/help because either we lack self confidence and are afraid to demonstrate failing. The discussion tool promotes collaborative learning, encouraging sharing and co-operation, working as a team, essential ingredients for any course.

Reflecting upon this research overall has strengthened my personal belief that a blended approach to teaching and learning needs to be examined further in a subsequent study. With 25% of the group of trainees not

being happy placing so much emphasis on a computer to support learning, what is evident from this research is that no one computer software application is going to cater for all trainees. At the outset, WebCT was developed as an holistic approach to learning, in the hope that all trainees could be catered for in one environment. What has been made clear is that this can not be the case, certainly with WebCT. It has useful tools and can be a central place for guidance, but a more mix and match approach would be better, dependent upon individual learning styles. On a close inspection of my own teaching, I find that it is currently a blend of the following;

- books, to provide another medium of learning/teaching support for those learners not adjusting to the computer medium;
- videos, to bring into the classroom examples of electronic systems in practice (e.g., sensors controlling the water level of the Fens, Norfolk);
- software applications, to undertake real learning in a virtual world (e.g., Control Studio, Livewire, and PCB Wizard);
- CD ROMs, with simulations of complex concepts (e.g., electron flow);
- a website, for storage of stimulating factual data with relevant practical exercises (http://www.gre.ac.uk/~eduweb/d&t.htm);
- an Integrated Learning System (WebCT). This has several assisting features but primarily provides a source for the central core of guidance materials, around which all of the above feed their contribution into the learning/teaching process; a medium to promote discussion to aid the internalisation of new knowledge, as well as another source of peer support; but perhaps most importantly, a place for trainees to establish the quality of personal learning which has taken place and for this to be recorded so that progress can continually be monitored.

A blended approach to teaching adds a much greater dimension to this research because the sequence of events would necessarily need to match the correct learning style of a particular trainee. What would be required is to apply the most appropriate mix of stimulating guidance material with learning environments to match the needs of the learner and learning objectives. This will be examined in future research.

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In conclusion, this research has been extremely worthwhile in that it has provided greater insight into ILS' and their application to enhance learning and teaching. It has shown that one such ILS, namely WebCT, is simply a collection of web based tools, which are to be used like any other tool in the workshop, i.e., used only if it is the best tool for the job. Unfortunately, how does one know whether it is the best tool to use if one does not know what it is able to do? This ultimately was the reason for the investigation in the first instance and having undertaken the experience, one is in a much better position to make future decisions. It is clear that such web based environments will revolutionise the way in which we teach, but what is consoling is that it would appear they will not replace us, at least for the foreseeable future. We are still needed to make decisions as to the materials we expose trainees to, and prepare some of those materials. We need to help and guide trainees through the correct blend of materials dependent upon individual learning needs. WebCT can provide this assistance. But above all, we as teachers just need to be there for them, in time of need. One closing thought, just imagine how much easier it all would have been for us as teachers, had we come through an education system which had involved us learning using a computer from our very young days!

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