CHEMICAL ENGINEERING TRANSACTIONS Volume 18, 2009
Editor Jiří Klemeš
 ISBN 978-88-95608-04-4 ISSN 1974-9791
DOI: 10.3303/CET0918123

The digital revolution and the teaching and learning process in Chemical Engineering

Simon Perry and Igor Bulatov
Centre for Process Integration, School of Chemical Engineering and Analytical Science,
The University of Manchester
PO Box 88, Manchester, M60 1QD, UK
Tel:+44(0)161 306 439, Fax:+44(0)161 236 7439, simon.perry@manchester.ac.uk

The availability of digitally based equipment has grown massively in the last five to ten years. Consequently the cost of this equipment has fallen, and ownership has increased. This has been accompanied by the increased availability of high speed internet connections. The combination of these two technology advances has potentially allowed teaching and learning processes in education to be revolutionised. Although there are many examples where these technologies have been adopted, there still exists the potential to make much more use of these in the education sector.

1. Introduction

The last ten years has seen a massive growth in the type, availability, and price of digitally based equipment and services. The range of equipment that is available is large, ranging from notebook computers, to personal digital assistants (PDA's), mobile phones, mobile cameras and video equipment (including television), and digital music players. The number of household that have all or many of these items has increased massively, and they are common amongst all age groups. At the same time the availability and speed of internet connections has increased, and many households now have fast internet connections through cable, satellite, or mobile services. The combination of equipment availability and ownership and fast internet connections, has produced an environment that can support rapid and inclusive communication systems and access to worldwide digital resources. This combination of equipment and digital resource availability is often referred to as the "digital revolution".

The potential effect of the digital revolution on educational provision is clear to see. For the first time very large numbers of people, from all age groups, have access to resources that have only previously been available to small sectors of the population. In addition, that section of the population who have to engage with the education sector, such as those involved in primary, secondary, and higher education, have fast access to resources, in many different formats, that were inconceivable only a few years ago.
However, despite the availability of resources, take-up and inclusion of these new technological advances in the teaching and learning process, most frequently referred to

Please cite this article as: Perry S. and Bulatov I., (2009), The digital revolution and the teaching and learning process in chemical engineering, Chemical Engineering Transactions, 18, 755-760 DOI: 10.3303/CET0918123

as eLearning, has been sporadic. Zemsky and Massy (2004), have described four stages in the adoption of eLearning;

- Enhancement to traditional course/program configurations
- Course management systems (Virtual Learning Environments)
- Imported course objects
- New course/programme specifications

In their study they found examples of varying adoptions of each of these stages. However, the majority of US universities looked at in their study, had made progress in the first two stages, enhancement and course management, but far less progress in imported course objects and new course/programme specifications. Similarly, Collis and van der Wende (2002), found that these new technologies had been introduced into higher education to mainly supplement existing teaching and learning practices. In a further study, Kirkup and Kirkwood (2005), found that these new technologies had been used to mimic existing practices, enhance quality, or to provide a central storage location for teaching and learning resources.
However, despite this apparent slowness in taking advantage of all the potential of these new technologies in the teaching and learning process, there are many examples of how these have been integrated into course or programme delivery.

2. Access to resources

In the secondary and higher education sectors, there have been recent moves from accessing resources from individual websites to Virtual Learning Environments (VLE's), such as WebCT, Blackboard, and Moodle. These VLE's are made available so that resources required for particular needs are clustered in one place, and consequently are more easily managed. The use of VLE's in Chemical Engineering based education is shown in Fig. 1.

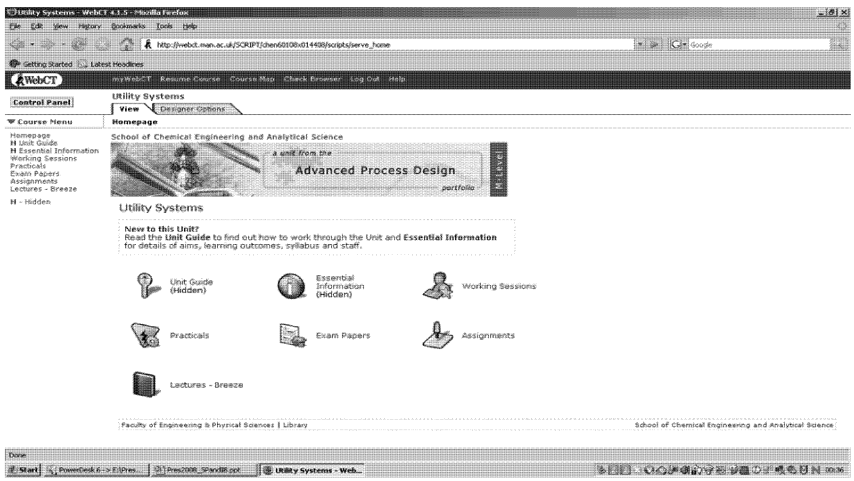

Fig. 1 An example of a course in a virtual learning environment (WebCT)

In this particular case, WebCT is used to provide course content for an MSc programme unit. The advantage of this approach for providing course content is that materials are readily available at all times, and that they can be accessed by full-time students studying at the university, but more importantly can be accesses by distance learning students who are studying away from the institution.

In addition, VLE's can also be used to provide general programme information to students. In this particular case (Fig. 2), the VLE Blackboard is used to provide information such as exam regulation, programme structures, timetables, and reference materials, related to the entire programme. It allows students to easily find information that is usually located in a number of different websites, in one easily accessible location.

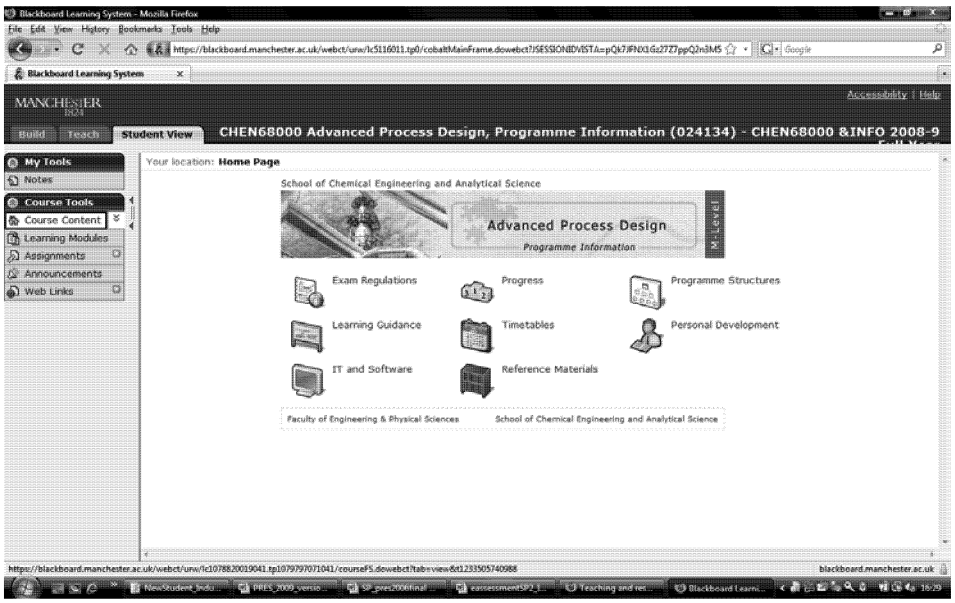

Fig 2 An example of a course in a virtual learning environment (Blackboard)

3. Types of resources

The types of materials and the formats of these materials in the teaching and learning process can vary widely. Materials can be provided in simple word processing format, HTML, Powerpoint presentations, or PDF's. However, with the availability of new, advanced technologies, and faster internet connection speeds, more complex formats for materials can be used. The use of presentation style slide shows, with each slide accompanied by an audio, has been called a "virtual lecture" (Perry 2002, Perry 2006, Perry and Klemes, 2004), and has provided a useful resource for distance learning students who are unable to attend face-to-face lectures (Fig. 3). The materials are

relatively cost effective if the same presentations which are used for face-to-face presentation, are also used for the basis of the virtual lecture.

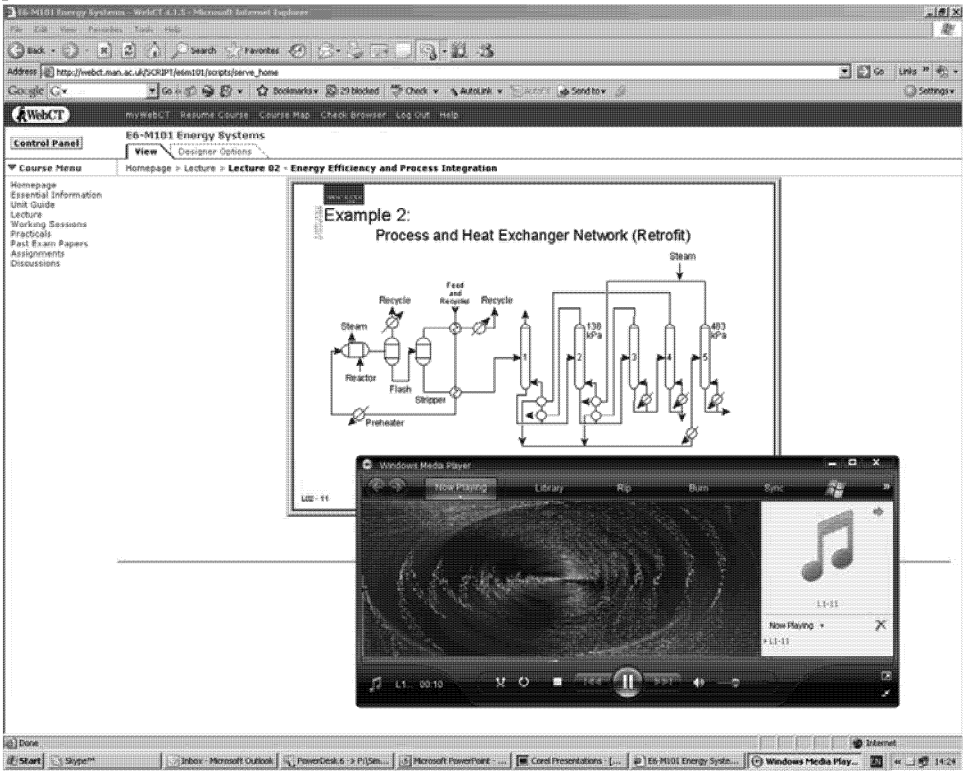

Fig. 3 Course content available through a VLE (virtual lecture)

An alternative to the standard virtual lecture, with the replacement of audio with text, and using a different creation software, is shown in Fig. 4. In this particular case, more elaborate software tools allow more advanced control of the presented materials by accessing students, and also allow materials in different formats to be included if required.

The VLE also makes it possible to distribute video based materials (Fig. 5). Although more time consuming to produce, and more effective as one-off type materials, higher speed internet connections allow these types of material to be more readily included than in the more immediate past. The types of equipment able to receive this type of material have also increased. In the past only high-end desktop computers were able to make use f these materials. It is now possible to access and display them using inexpensive laptop computers, personal digital assistants, and even mobile phones.

The diversity of type of materials available through VLE's and the speed of internet connections, also allows simple simulation tools to be made available to learners. In Fig. 6, a simulation tool using Microsoft Excel, can be made available to learners.

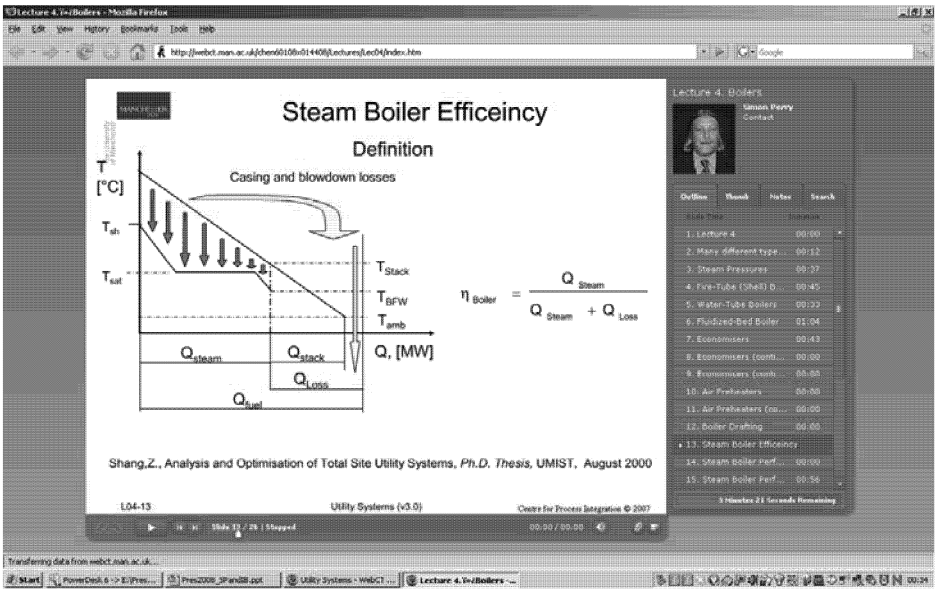

Fig. 4 An alternative format for delivering course lectures

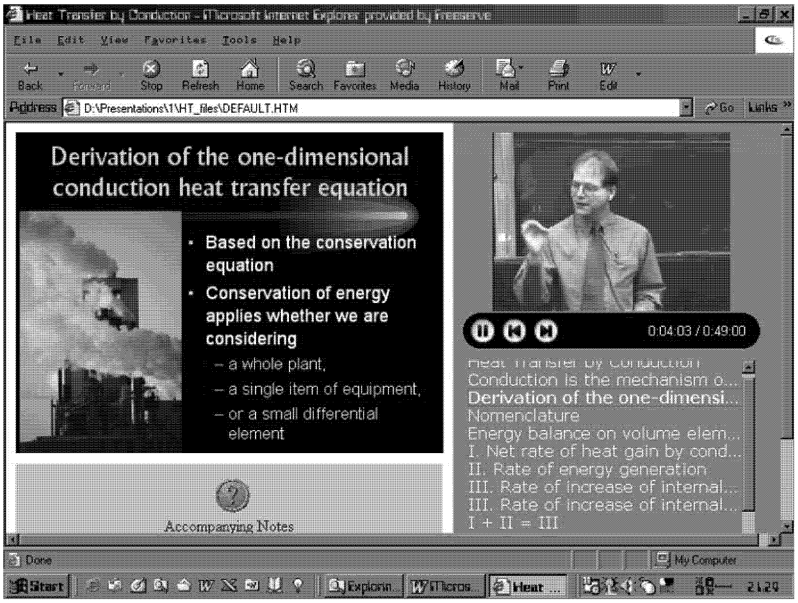

Fig. 5 The use of video to deliver course content

Although educational providers are fully aware of the digital resources that are now available, the uptake of these has been sporadic, and has principally been involved with using these technologies to provide different versions of existing materials or to provide

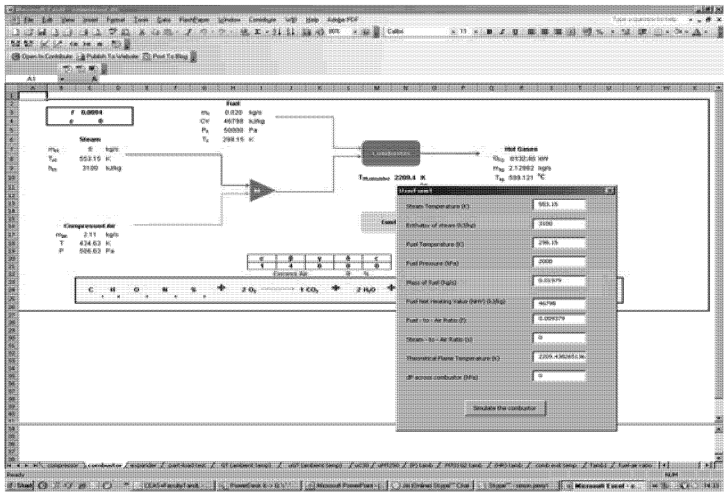

Fig. 6 Simulation software delivered over the internet

central repositories of information. There are many examples of how these uses of technology have improved the teaching and learning process, but there is still much scope to make better use of these sophisticated technologies in the educational process.

References

Collis,B., and van der Wende,M., Eds., 2002, Models of technology and change in higher education (The Netherlands, Centre for Higher Education Policy Studies). Avaialable online at www.utwente.nl/cheps/documentation/ictrapport.pdf (accessed 1st February 2009)

Kirkup,G., and Kirkwood,A., 2005, Information and communications technologies (ICT) in higher education teaching – a tale of gradualism rather than revolution, Learning, Media, and Technology, 30, 185-199

Perry, S.J., 2002, Development of E-Learning for environmental engineering education, 5th Conference on Process Integration, Modelling and Optimisation for Energy saving and Pollution Reduction – PRES 2002, lecture H3.3 [434], Aug. 2002, Prague, CZ

Perry, S.J., and Klemeš, J., 2004, Experiences and Future Developments in e-Learning and e-Teaching of Engineering Education, 7th Conference on Process Integration, Mathematical Modelling and Optimisation for Energy Saving and Pollution Reduction – PRES 2004, Key-Note Lecture F3.4 [1469], Prague, CZ

Perry, S.J., 2006, Towards a framework for learning and teaching in engineering in the 21st century, 9th Conference on Process Integration, Mathematical Modelling and Optimisation for Energy Saving and Pollution Reduction – PRES 2006, Plenary Lecture, Prague, CZ

Zemsky,R., and Massy,W.F., 2004, Thwarted innovation: what happened to eLearning and why. A report from the Learning Alliance, University of Pennysylvania. Available online at www.irhe.upenn.edu/Weatherstation.html (accessed 1st February 2009)