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ONLINE DELIVERY AND TUTOR SUPPORT OF AN INTRODUCTORY CORROSION COURSE

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ABSTRACT

An online MSc course in corrosion has been developed to mirror the existing face-to-face course. In this paper the design basis of the course and some lessons learned in the development and evaluation of the first module are presented.

Keywords: corrosion education, distance learning, e-learning

INTRODUCTION

For many years a one-year MSc course in Corrosion (referred to hereafter as 'the course' in accordance with NACE rules on trading names) has been offered by the Corrosion and Protection Centre, UMIST. With the widespread availability of Internet access, and the changes in patterns of learning (driven in the UK in particular by an increasing student debt at the end of first degree studies), it is expected that postgraduate and mid-career study will move towards part-time and distance methods. For this reason the MSc has been restructured in a modular format to facilitate part-time study, and it is now being developed in a distance learning format. In this paper we report the approach that has been used in the development of the course, and describe the experience of the first offering of the first Module.

THE COURSE

In the UK a taught MSc Course involves one year of study, with a taught element being followed by a research dissertation. The structure of taught courses in UK Higher Education is monitored by the Quality Assurance Agency for Higher Education (QAA). They provide the following guidelines for an MSc Course:

- It should involve a total of 180 credits, where 1 credit corresponds to 10 hours of study.
- The majority of the course should be at the Masters Level, defined as follows [1]:

"*Much of the study undertaken at Masters level will have been at, or informed by, the forefront of an academic or professional discipline. Students will have shown originality in the application of knowledge, and they will understand how the boundaries of knowledge are advanced through research. They will be able to deal with complex issues both systematically and creatively, and they will show originality in tackling and solving problems.*

"*They will have the qualities needed for employment in circumstances requiring sound judgement, personal responsibility and initiative, in complex and unpredictable professional environments.*"

The QAA have introduced rather more formal requirements for the specification of degree programmes than most UK universities have been used to; the overall degree programme is defined in a programme specification, while individual modules have their own module specification. The structure and content of both of these specifications is given by the QAA [2]. The formalisation of their teaching in this way has come as something of a shock to many academics, who have been used to a much less controlled approach to their teaching, but the programme specifications provide an excellent base for the design of an online course, which requires a rigorous definition of the course content. A key component of the Programme Specification is the Intended Learning Outcomes – what the students are expected to be able to do at the end of the course. As was a the programme specification, which defines the full course, individual module specifications are also produced to define the contents of each module – the detailed intended learning outcomes for the Module discussed in this paper are given in Appendix 1.

In order to facilitate part-time attendance, the course has been organized as 'short fat' modules, each two weeks long, with the required attendance being concentrated in the first week, and the second week being used for learning activities that can be undertaken remotely, either by private study, or by using WebCT[i], the virtual learning environment (VLE) that is used to manage the course. The modules of the course are listed in Table 1:

TABLE 1

COURSE MODULES

Module C00	Introduction to Corrosion
Module C01	Engineering Materials for Corrosion Applications
Module C02	Principles of Corrosion
Module C03	Localized and Mechanical Aspects of Corrosion
Module C04	Corrosion in Natural and Industrial Environments
Module C05	Corrosion Control by Materials Selection and Surface Engineering
Module C06	Corrosion Control by Cathodic Protection, Organic Coatings and Inhibitors
Module C07	Corrosion Control in the Process and Power Industries
Module C08	Corrosion Control in the Oil and Gas Industries
Module C09	Corrosion of Light Alloys and its Control

Note that Module C00 is intended as an introductory course for students who have not studied some of the requisite underlying subjects. It is not at MSc level, and it is not credit-bearing for the MSc course.

The development of a distance learning course corresponding to 1000 hours of study is clearly a major undertaking, and a progressive approach is being taken to the development (i.e. course modules are being developed as earlier modules are delivered). A factor that facilitates this is that the distance learning and face-to-face modules have identical intended learning outcomes, and can therefore be taken interchangeably. Consequently students who start with a distance learning module can later take face-to-face modules to complete the course, even if the later modules have not been completed in distance learning format.

[i] WebCT is a trade mark of WebCT Inc.

The development of the course has followed the logical progression of starting at the beginning and working through the modules more-or-less in sequence. At the time of writing, Module C00 has been trialled, while Module C02 is in preparation; this paper presents the methods used in production of Module C00, and the results of the trial delivery.

DEVELOPMENT STRATEGY

Several organizations have been active in the production of distance learning courses, notably the Open University in the UK, which has approximately 200,000 students, and which has a high reputation for the production of very high quality distance learning courses. 'Traditional' Open University courses operate with high quality written study packs (known in the trade as the 'brown paper envelope' method of distance learning), supported by local tutors who support the students. More recently they have started to produce e-Learning courses that are primarily distributed over the Internet, and particularly the World Wide Web.

Note that even with large budgets for the development of high quality learning materials, the Open University still finds it necessary to provide tutor support. With a relatively small number of students expected for online courses in corrosion, it is even more difficult to produce the highly interactive material (such as was developed in the Ecorr project [3]) that provides adequate support for independent study, and an important aspect of a successful course is therefore expected to be the provision of effective tutor support. As well as allowing more interactive study without undue development costs, the tutors provide an important human contact that motivates students and helps to increase the proportion of students that complete (this is always more difficult in online and distance course than it is for face-to-face courses). For an MSc course that will require students to study for an average of about 1 hour per day for three years, motivation is very important for successful completion. For these reasons, the development of the course was based on the availability of tutor support.

Another important decision concerns the timing of the course, and in particular whether it should run to a predetermined schedule, or whether students can start whenever they wish. While it is attractive to be able to start a course at any time, there are significant disadvantages:

- Tutor support becomes very difficult, as each tutor must remember where several different students are in the course.

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- Students cannot easily interact with each other.
- The lack of a fixed timetable leads to a tendency for students to 'drift' and make slow progress, increasing the chances of dropping out.

For these reasons the module runs with a fixed timetable, with 12 weeks of teaching followed by 4 weeks of revision, then the final examination. With 100 hours of study being expected for each 10 credit module, this implies an average of about 1 hour of study each day.

With 4 months for each module, 3 sets of modules can run each year, allowing students to complete the 9 modules required for the MSc (excluding the dissertation research) in 3 years.

It has been suggested by the reviewer of this paper that the disadvantages cited above go away with adequate online support and resources. We do not believe that this is correct (it is significant that the Open University, with very great experience of distance learning at the graduate level, adopts much the same approach as we have), but whatever the true merit of the various approaches that are possible, it must be appreciated that corrosion courses are inherently a relatively small market, and it is more efficient to provide good tutor support with relatively low cost online materials.

The key to high quality learning (i.e. learning that leads to information being retained by the student) is a sequence of events, wherein the student is presented with information, which causes it to be held in short term memory, and is then required to use or 'rehearse' the information, which hopefully causes it to be transferred to long-term memory. In the lecture situation this is achieved by asking the class questions at regular intervals, so that they use the information given to them, although there is a tendency for most students to wait for one of their colleagues to answer, so that this rehearsal may not be very effective. In more interactive methods, such as problem-based learning, the presentation and rehearsal are more intimately mixed, and for this reason such techniques are probably better than the conventional lecture. For the same reason the development of the online version of the course has predominantly used a simple, regular pattern, where the students are presented with the material in the form of a presentation of some kind, and then asked to undertake an activity that rehearse the information provided, with one presentation/rehearsal cycle each day (although in some longer activities with a more problem-based character were also used, as these are probably more appropriate for the development of higher level skills).

Various forms of presentation have been used:

- Recorded lectures with MS PowerPoint[ii] presentation, delivered using MS Producer[ii], which combines the presentation and an audio or video track to provide a simulation of the lecture. While it is nominally possible to transmit low bandwidth video and audio over a 56 kbs dial-up connection, our experience was that this did not normally work acceptably, even for audio only. Furthermore, students using company facilities often had problems with interference by firewalls, which barred access to streaming video or audio.
- Video Lecture with Image-based Presentation – this used photographs of the blackboard, taken during the lecture, or purpose-prepared images, but was otherwise similar to the previous format, and was subject to the same limitations.
- PowerPoint Presentation as a Web Page – produced using the 'publish to Web' command – this did not present many technical limitations. Some presentations were augmented by the addition of spoken commentaries.
- Information presented on a page in WebCT – this did not present any technical limitations

Of the various formats, PowerPoint presentations augmented by spoken commentaries were preferred, by those students that completed the end-of-course evaluation.

Similarly a range of types of activity have been used, including:

- Self-Assessment Quizzes, using either the formal WebCT quiz tool, or self-checked questions with pop-up answers
- Case Studies using online discussion between students, which tutor feedback
- ECorr Case Studies on CD-ROM
- MATTER Activities on CD-ROM or online
- Home Laboratory Sessions
- Online "Virtual" Laboratory Sessions
- Worked examples (tutor marked or self-marked)
- Tutor-group chat sessions

The evaluation response to the various forms of activity was quite varied, and we currently believe that we should use as wide a range of activities as possible.

A key aspect of the trail of the course was the evaluation of the various options available for tutor support. It must be recognized that tutor support is expensive. Our initial estimates, which were largely borne out by the experience of the course, was that each student would "consume" 1 hour of tutor support for each week of the course, i.e. a total of 12 tutor hours. Using academic staff as tutors would lead to a very high cost of tutoring, such that it would not be economic to offer the course, except at an unreasonably high fee. Fortunately, it was our experience that research students, with suitable training, make very good tutors (probably better than academic staff, as they actually listened to what they were taught during the course on online tutoring, and were under less time pressure).

RESULTS

The results achieved by the module have been evaluated by means of student questionnaires, and by means of student performance in the final test. This was an online quiz delivered with the WebCT quiz tool. It consisted of 32 questions drawn at random (but with a quota of questions corresponding to each broad subject area) from a bank of 140 questions covering all of the intended learning outcomes. This quiz has also been taken by face-to-face students taking the same module. The online students achieved significantly better test scores. This result may have been influenced by the ability or prior experience of the students, or by the fact that they were not tested under formal examination conditions, and could have had access to text books or the module notes. However, we generally have the impression that the module provided effective learning and was at least comparable with the face-to-face course. A less successful outcome was the relatively low completion rate, less than 50%. This was probably influenced by the rather unusual student cohort, who had taken up an offer of free tutor support. As a result some of them did not have as strong motivation as they would have had for a fee-charging module. The module should be running its second iteration at the time of Corrosion 2004, and further impressions will be available in the presentation.

APPENDIX 1

Intended learning outcomes for Module C00

Corrosion Chemistry

1. Distinguish between chemical and electrochemical reactions
2. Give examples of chemical and electrochemical reactions
3. Balance chemical and electrochemical reactions

Corrosion Kinetics Learning Objectives

4. Use supplied E-log i diagrams to identify Ecorr and icorr
5. Use supplied E-log i diagrams to derives qualitative explanations of corrosion behaviour
6. Explain the differences between E-log i diagrams and polarisation curves
7. Deduce polarisation curves from E-log i diagrams

Corrosion Thermodynamics

8. Use a supplied Pourbaix diagram to give qualitative predictions of corrosion behaviour

Localised Corrosion

9. Identify the main forms of localised corrosion
10. Provide simple explanations of the mechanisms of localised corrosion processes
11. Name chloride ions as a main environmental initiator of localised corrosion

Materials

12. State and sketch respectively the crystal lattices and unit cells (bcc, hcp, fcc) of common metals
13. Define the key mechanical properties of materials (tensile strength, yield strength, fatigue resistance, creep strength)
14. Give approximate compositions of some common alloys (mild steel, type 304 and 316 stainless steel)
15. State mechanisms of strengthening of alloys (solid-solution hardening, precipitation hardening, work hardening)
16. Name features of the microstructure of alloys (grains, grain boundaries, second phases, dislocations, vacancies)
17. Give examples of common heat treatments of alloys (annealing, normalizing, quenching and tempering of steel, solution treatment and ageing of Al-Cu)

Organic Coatings

18. Define the main components of a paint and their functions

Cathodic Protection

19. State and use the four criteria necessary for CP to be successful
20. Explain the difference between sacrificial and impressed systems

High Temperature Degradation and Protection

21. Describe the thermodynamic concepts of oxidation
22. Explain the significance of oxide growth laws
23. State the requirements of high temperature materials
24. Describe the main factors that lead to loss of adhesion of oxide scales and describe the consequences of spallation of scales
25. Compare the differences between oxides and sulphides at elevated temperatures

Inhibitors

26. Describe the three types of surface film formed by inhibitors
27. Describe four factors that affect inhibitor performance

Corrosion Monitoring and Testing

28. Give reasons for corrosion monitoring and testing (determination of corrosion rate, check on corrosion control measures, plan maintenance, select appropriate materials, select appropriate control measures)
29. Describe three methods of corrosion monitoring (coupons, electrical resistance probes, linear polarization resistance)

Corrosion Management

30. Discuss the aims of corrosion management in an industrial enterprise and the approaches that can be used

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