

DEVELOPING TOOLS TO SUPPORT ONLINE DISTANCE LEARNING

S.M.Furnell, M.P.Evans and P.S.Dowland

Network Research Group, School of Electronic, Communication & Electrical Engineering, University of Plymouth,
Plymouth, United Kingdom

email: sfurnell@plymouth.ac.uk

KEYWORDS

Online Distance Learning, Courseware, Authoring tools,
Online lecturing.

ABSTRACT

This paper considers the emerging concept of Online Distance Learning (ODL), which utilises Internet and the World Wide Web technologies to deliver educational courses to remote students. Many authors have conjectured that ODL has the potential to revolutionise educational provision, facilitating, for example, concepts such as lifelong in the workplace. However, online courses cannot be created and offered effectively without the provision of appropriate supporting tools for use by academic staff and students. The paper describes two specific tools that have been developed to support online course delivery. The first is a Module Authoring Tool (MAT), for use by academic staff wishing to create course materials for web-based dissemination. The MAT provides a number of features and optimisations that make it more suited to this purpose than standard web authoring tools. The second tool is a software-based framework for the delivery of interactive online lectures over the Internet. This enables remote students to participate in a traditional lecture scenario and includes features for video and audio broadcasts, as well as supporting elements such as slideshow and whiteboard facilities. Such tools are considered to represent core elements of an overall ODL solution.

INTRODUCTION

The establishment of the World Wide Web as a common medium for information exchange has provided a global platform through which Online Distance Learning (ODL) can be effectively delivered to students, regardless of their location. Many people have discussed at length the advantages this can bring, and the potential revolution in education provision that could result (Bröning and Hornung 1998; Cochrane 1995; Thomas 1997). Potential benefits could include:

- students obtaining more flexible access to expertise and resources, opening up opportunities such as lifelong learning within the workplace, where education can be pursued in conjunction with normal employment (DFEE 1998);
- students creating themselves a tailor-made course, using components from several different institutes, regardless of where they live;
- lecturers creating an online module, and licensing it to different institutes, allowing them to become ‘virtual lecturers’, free from the ties of any one academic institute;
- universities expanding their programmes, offering courses in subjects they had previously not had the resources to teach.

Of course, the realisation of the benefits described above is dependent upon a number of factors, including the availability of appropriate technologies and acceptance of the ODL concept by both lecturers and students. This paper focuses upon the former aspect and describes work that has been conducted to provide appropriate tools to support both the creation and delivery of online course materials.

The authors have been involved in an 18-month initiative to design and develop an ODL framework for the delivery of technology-based MSc modules and industrial short course programmes. The findings from the 6-month feasibility stage of this work have already been described in an earlier paper (Furnell et al. 1999). This paper discusses the continuation of the work, with a specific focus upon two software tools that have been developed to support online course delivery at the University of Plymouth. The first, a ‘Module Authoring Tool’, enables the lecturer to quickly and easily create a new online module using pre-built templates, without having any knowledge of HTML or other web technologies. The second, a framework for the online delivery of lectures, enables the lecturer to interact with students and deliver material at a distance. The discussion begins by considering the requirements analysis that was conducted to formalise the software designs.

IDENTIFYING REQUIREMENTS FOR ODL SUPPORT TOOLS

The feasibility stage had established that the concept of ODL is generally attractive to both academic establishments and industry (who represent a likely source of many potential online students). From this foundation, it was necessary to determine a set of software features to meet the expectations and validate them with the groups concerned.

The academic staff consulted during the study were all involved in the provision of Masters level modules in a traditional face-to-face context. A number of these modules have the potential to be offered as industrial short courses and, as such, were considered to represent good candidates for online delivery. The discussions with academics focused upon what they would wish to do with ODL and the software features that would be required to support this. Two main concerns emerged from this group:

- that they lacked the technical skills necessary to develop web pages;
- that, even with the skills, they would lack the time to undertake such activities.

It was concluded from this that some form of software assistance would be valuable to simplify and speed the task as much as possible. Although a software tool would not overcome the above issues, the feedback received suggested that staff would welcome it as a step forward.

It had already been determined from the earlier feasibility work that the concept of ODL would be welcomed by industrial contacts. This finding was based upon a postal survey distributed to 100 companies to assess their expectations of online courses and the availability of the required technologies within their workplace. A total of 18 responses were received, leading to detailed follow-up interviews in eight cases in order to obtain additional information. Having established the desirability of ODL, the subsequent consultation focused upon how industry would expect materials to be provided and the consequent features that this would demand from the delivery framework. The organisations contacted were generally from within the same geographical region (i.e. the South West of England) and many were familiar with allowing their staff to attend university courses on a part-time basis. The ability to conduct activities online would be welcomed to avoid the time and expense of travelling to the university and, where possible, the dependency of working to a university-imposed timetable (which may occasionally clash with employer priorities). The latter aspect requires an on-demand, self-paced learning environment, which it is considered could be adequately provided by the delivery of appropriately structured

web-based courses. However, this would essentially represent a passive learning experience and the industrial representatives were particularly keen that the facility should exist for interactive participation in lectures on a remote basis (ideally from within the workplace). This suggested the need for an Internet-based approach, linking the remote students with the learning provider.

As previously mentioned, the findings from the feasibility and requirements analysis stages have led to the development of two main elements of software: namely a module authoring tool and a framework for interactive online lectures. These are described in the sections that follow.

MODULE AUTHORING TOOL

If courses are to be offered via ODL, one of the essential requirements for lecturers is to be able to create appropriate content for online modules. While standard web editing tools (such as Microsoft FrontPage) can be used to achieve this, they may offer excessive functionality for academic staff who are not interested in learning the full details of web development. In addition, such tools do not include any specific provision for designing academic course materials. For this reason, a prototype Module Authoring Tool (MAT) has been developed to provide a simple and straightforward environment in which lecturers may create online materials. The resulting outputs from the MAT are standard web pages, but the tool aims to provide specific elements of support for academic users that would not be found in standard web editing packages.

The MAT is designed to help a lecturer create professional web-based lecture material without having to understand any of the underlying technology. The tool uses a simple drag and drop user interface, and employs word-processor-like text editing which users of other word-processors (such as Microsoft Word) should be familiar with.

The MAT automates many repetitive tasks involved with the creation of an online module, enabling the lecturer to focus more on the content of an online lecture than on its creation. Templates, for example, are a feature which provide the lecturer with a partially-completed module, with visual components such as navigation buttons already provided. This saves the lecturer time, and helps to create a standardised look and feel to the completed module. Once an online module has been created, the MAT can automatically publish the whole content to a web server (via FTP) in a simple one-button operation. The MAT monitors the module creation process, and a Module Creation Wizard facility guides the lecturer, and updates them on the

progress of the module. The Wizard will only allow the module to be published once certain key features (copyright, email address, etc.) have been entered by the lecturer. These features are described in more detail below.

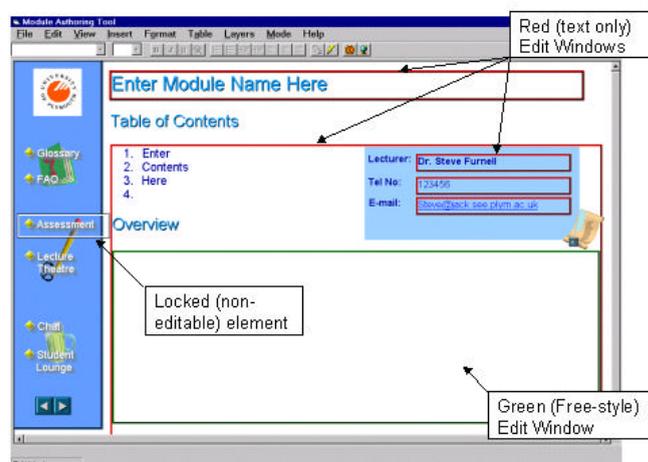
MAT content can be created in a number of ways that will be familiar from standard Windows applications. Text and images can be entered directly, or they can be imported from other applications using cut & paste or drag & drop facilities. This gives the MAT the baseline level of functionality that most users would naturally expect. The tool also has support for font control (i.e. type and style), bulleted and numeric lists, tables and the creation of hyperlinks – most of which would be expected to be familiar to users from standard word-processing applications. However, in addition to these standard features, the MAT includes a number of specific functions that are intended to enhance its usefulness for creating academic content. These aspects are described in the sub-sections that follow.

Module templates

The MAT allows templates to be created within which lecturers will subsequently create their course content. These are intended to provide a means of ensuring a consistent ‘look and feel’ for modules from the student perspective. This is considered preferable to simply presenting lecturers with a blank canvas, from which all modules could potentially adopt a completely different interface (which could become confusing for students). In addition, they provide a means of enforcing a minimal level of content that the lecturer should provide. This should ensure a baseline level of quality between different modules. It is envisaged that the templates would be defined by schools or faculties as appropriate, and then distributed for use by the underlying staff.

The templates themselves allow elements of the expected layout of a module interface to be explicitly defined. In the prototype implementation, templates are defined using a password-protected template design mode, which is not accessible to normal users. The template designer can include text and images, the positions of which will subsequently be locked to prevent manipulation by the user. In addition, editable areas of the page can be defined which allow lecturers to insert their content. The acceptable use of these areas can also be defined, in the sense that the template designer can specify whether they can hold text, formatted text (i.e. using different font sizes and styles) or free-style content (which may include formatted text and images). These restrictions can be used, for example, to ensure that certain elements always appear in a consistent text style or to prevent lecturers from inserting images into inappropriate areas. In order to make any template restrictions clear to the user, the

MAT has an option to display the borders of edit windows, which are colour-coded to denote the content that they will accept (red for text only, yellow for formatted text and green for free-style). An example of a



MAT template view is illustrated in figure 1 below.

Figure 1: Elements of a MAT template

Module Creation Wizard

The Module Creation Wizard (figure 2) is based upon the same principle as interactive assistance facilities in other applications and is provided to guide lecturers through key elements of the module creation process and to ensure that certain key tasks are undertaken. The wizard incorporates four key elements of support:

1. **Help for creating online modules:** This feature provides general advice and instructions for module authors, including use of MAT features and considerations for structuring their module content.
2. **To Do List:** This presents a number of key tasks that lecturers creating online modules ought to undertake. The MAT automatically tracks whether certain key tasks (e.g. image copyright declarations) have been addressed and will not permit the module to be published if this is not the case.
3. **Copyright Control:** This feature is included to prevent unacknowledged use of external images. It is recognised that if lecturers are able to easily ‘drag and drop’ images into their modules from various sources (including web browsers), then they could inadvertently include an image that they have not personally created. If this is the case, then the source of the image should at least be acknowledged. The copyright control feature will not permit the module to be published until copyright details have been explicitly provided for

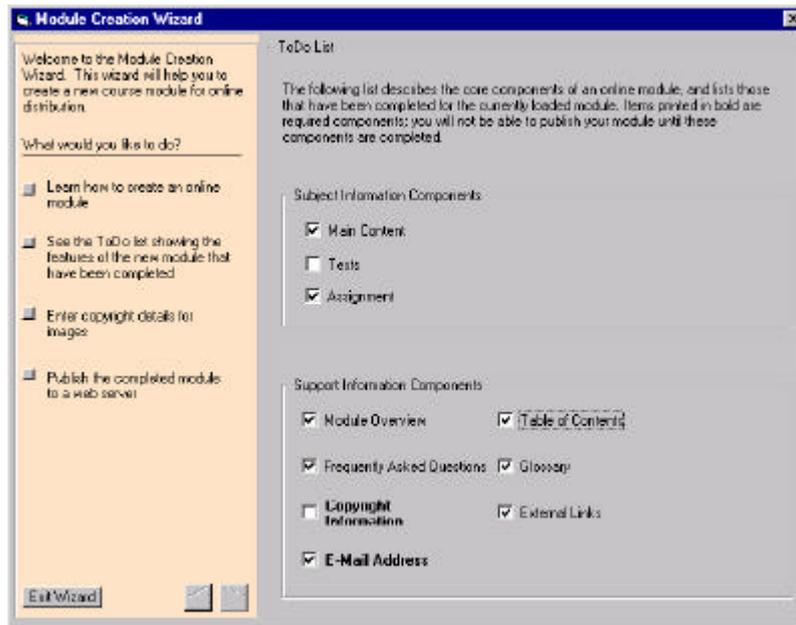


Figure 2: The Module Creation Wizard (showing ToDo List feature)

all images. Therefore, if images are published with a false copyright declaration, the lecturer can be held directly responsible.

4. **Publish to server:** Once the mandatory tasks have been completed, the wizard will permit the module to be published. Selection of this option will automatically upload the module to a nominated web server (for which a valid user id and password must be provided).

Support features

The MAT also includes a range of built-in features that are intended to optimise tasks that will frequently be required by lecturers creating online modules. The current features include the pre-formatting of contact details and the maintenance of glossary of terms and Frequently Asked Questions pages.

The first thing that the lecturer is required to do when creating a new module is to provide basic registration details, including the module name and details of the main academic who will lead the course (including an email address, which is considered to be an essential requirement to enable remote students to make contact). Once obtained, these details are held by the MAT and can be automatically utilised at defined points within the template. This is illustrated by the earlier screenshot from figure 1, where the lecturer's details have been automatically placed into the template (in this case into editable areas that the lecturer could later change, but they could equally well have been locked fields).

The fact that ODL students are remote from the lecturer and, potentially, other relevant resources, means that it is less straightforward for them to find information and ask questions than it would be for face-to-face students. As such, ODL modules should contain supporting information, to supplement that main factual content associated with the topic. One such useful reference in most subject contexts will be a glossary of terms. The MAT includes a means of easily automating the creation of such a resource, by allowing the module author to highlight a word in the current document and then insert a glossary definition for it. This definition will be automatically added to a separate glossary of terms page (which the selected word will then hyperlink to), as well as being established as a 'tool-tip' that will appear whenever a remote student hovers their mouse pointer over the word. The MAT offers the option for the hyperlink and tool-tip to be added to the currently selected instance of the word, or all occurrences of it within the module page.

The concept of a Frequently Asked Questions (FAQ) page is already familiar to many people from their use of the WWW and Internet-based discussion groups. The concept lends itself well to use within the ODL context, as remote students will generally face more difficulty getting their questions answered by a lecturer. A FAQ page could be a valuable first point of reference. In addition, many students are likely to pursue study in a self-paced manner, with the result that similar questions may occur to them at different times. If the lecturer can identify these trends, then he/she can create a FAQ entry rather than spend time responding to each question on an individual basis. For these reasons, the MAT incorporates a facility to automate the creation

and management of a FAQ page. From whichever page is currently being edited, the lecturer can simply open the menu option to insert a FAQ and provide the required question and answer. This will then be automatically added to a separate page within the online module.

MAT summary



Figure 3: An example of a MAT authored page

In summary, the MAT approach is considered to offer a number of advantages, as listed below:

- ease of use;
- in-built features to assist module creation (e.g. glossary and FAQ management);
- module templates, to enable creation of modules in standard format;
- module creation ‘Wizard’ to guide the module creation process;
- easy integration into a structured online learning environment.

A tool such as the MAT will be of less obvious benefit to someone who is already familiar and comfortable with a fully-fledged web development package such as Microsoft FrontPage. The feature set is somewhat restrictive by comparison and some elements do not work in the manner that would be expected by users familiar with other web applications (e.g. by default, page and image names are managed by the MAT rather than by the author). However, for users who are unfamiliar with web development, such relative simplicity will be beneficial and will minimise the learning curve required to become familiar with the program. In addition, a number of the core skills acquired would still be transferable to a different package at a later time.

However, even with the use of the MAT, a reasonably significant amount of effort is required to create an online module. Software support is only a partial solution and the creation of ODL modules will still require an appropriate allowance of staff time to make it viable.

ONLINE LECTURE FRAMEWORK

In theory, it should be possible to utilise a tool such as the MAT to develop an online course that remote students can follow without requiring traditional face-to-face lectures. In practice, however, many students (and indeed lecturers) regard attendance at lectures as an intrinsic element of the educational process (as illustrated by the feedback received during the requirements analysis phase). Indeed, if online courses were simply presented as a series of static web pages, there would be little difference between them and the traditional correspondence courses that have been followed by distance learners for many years. A survey conducted by Saunders and Weible (1999) reveals that 65% of academic respondents would not consider this method alone as an appropriate mechanism by which to offer degree level qualifications. For these reasons, the project continued to develop a further application that would support the delivery of lectures in an ODL context. Given the relatively short timescale of the project, Microsoft NetShow (Microsoft Corporation 1999) components were used to provide the fundamental audio and video facilities.

The resulting online lecture framework provides the software foundation required for the delivery of online, Internet-based lectures to remote students. Lectures would be delivered from a central location, but participants could conceivably be located at any point on the Internet (i.e. potentially world-wide). The only facilities required by remote students would be standard multimedia PCs with an Internet connection, making the approach very accessible when compared to standard video conferencing. The lecturer’s requirements are similar, but with the addition of some form of camera to capture the video stream. The online lecture includes facilities to support the following:

- broadcast of video and audio from the lecturer to the students;
- lecturer-controlled slideshow presentation (using slides exported from PowerPoint);
- shared whiteboard facilities;
- text-based messaging, to enable student questions and feedback.

This combination facilitates remote delivery of the main elements that would normally be used in a face-to-face lecture. Two applications have been developed, for use

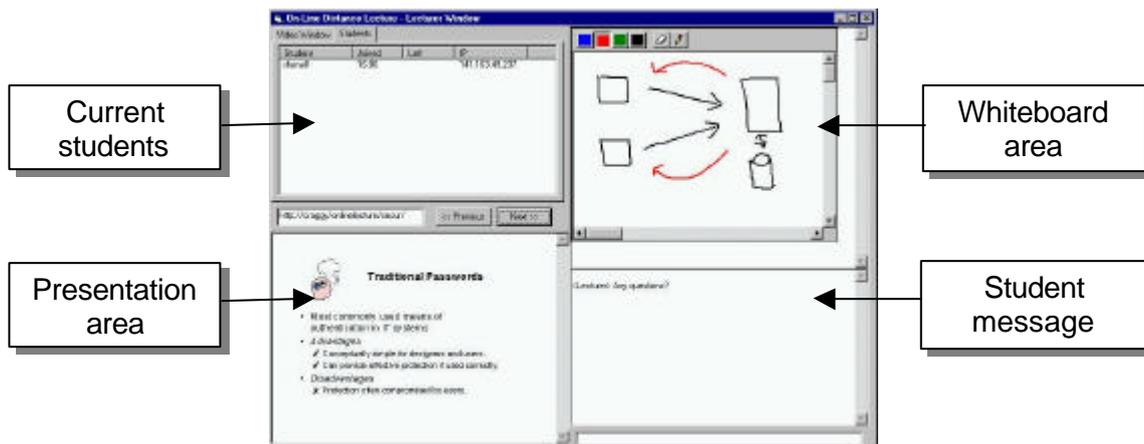


Figure 4: Online Lecture - Lecturer viewpoint



Figure 5: Online Lecture - Remote student viewpoint

by lecturers and remote students respectively. These are illustrated by the screen shots in figures 4 and 5.

Considering firstly the lecturer viewpoint shown in figure 4, this interface facilitates a number of actions, as listed and described below.

1. **Self view / Current students:** The lecturer can toggle the content of the upper left hand window to alternate between showing a copy of the current video stream being captured by the camera and a list of the remote students currently logged into the lecture (the latter being the variation shown in figure 4).
2. **Control presentation:** Back and forward controls are provided, to enable the lecturer to move through his/her slideshow. Actions here also affect the slides displayed to the remote students.
3. **Whiteboard annotation:** Basic controls are provided to facilitate drawing on the whiteboard in various colours, along with the ability to clear the display.

4. **Message box:** Enables text-based responses to questions or comments submitted by the students.
5. **Block student:** A facility is provided to enable a selected student (from the list of current attendees) to be excluded from the session. This would obviously be used only in extreme circumstances, where the student was disrupting the session by continually misusing facilities such as the whiteboard or message box.

The student viewpoint, illustrated in figure 5, offers a very similar interface, but differs in terms of the level of control that is provided. The interface again permits the remote students to perform a number of activities, as described below.

1. **Control presentation:** Back and forward controls are provided, but the student is not able to advance the presentation forward beyond the slide currently being discussed by the lecturer. The controls are provided to allow students to go back to slides that they may not have finished reading when the lecturer advances the slideshow. A synchronise

button is also provided to enable them to return directly to the slide currently under discussion.

2. **Whiteboard annotation:** In addition to viewing what the lecturer has drawn, the same annotation controls are available for student use. However, protocol would suggest that these would only be used by students at the lecturer's invitation.
3. **Message box:** This facility is used in the absence of an audio channel from student to lecturer to enable questions and comments to be submitted. As with a spoken question in a traditional face-to-face lecture, the question would also be visible to all other students in the session.

A number of limitations can be identified with the current implementation of the online lecture. Firstly, the audio stream currently operates in the lecturer-to-student direction only, due to performance limitations with the server application (taken from the Microsoft NetShow components) when used on the trial hardware platform (a 450Mhz Pentium II). The processing conducted by the server prior to broadcasting the media stream imposes too great a delay for two-way audio to be viable (approximately 15 seconds from video/audio capture to broadcast). In order that remote students are still able to communicate with the lecturer, a text-based chat facility has been included, enabling typed questions and comments to be entered. This latency is also one of the reasons why the current realisation of the system does not incorporate video of the students back to the lecturer. The other reason for this is that it is not essential to the delivery and would demand extra facilities at the student-end in terms of a camera and appropriate capturing hardware.

The real-time nature of the online lecture requires students to be available online at a particular time in order to participate in the session. As such, it would potentially be impractical for certain remote students (e.g. those in employment or located in different time zones) to attend. In view of this, it is considered advisable for course developers to avoid making participation in online lectures an essential element of the module, if they wish to maximise the number of potential students on the course. The core elements of the course should be made available via MAT pages, with the online lecture representing a value-added element for those students who are available to participate. An alternative option would be to make pre-recorded versions of the lectures available for people to access on demand, but with the obvious drawback that it would not be possible to ask questions in real-time.

The framework described is considered to provide an appropriate basis for activities such as lectures, which are largely lecturer-led with occasional inputs from the students. However, more interactive contexts, such as

seminars and tutorials, would not generally be facilitated due to the limitations of student communication.

CONCLUSIONS

The tools that have been developed represent core elements of an online distance learning solution. The MAT allows the creation of online resources, which remote students may use in a self-paced manner. Where a more interactive environment is required, the online lecture framework enables lecturer-led delivery of a session, along with the opportunity for students to pose questions and provide real-time feedback.

The work conducted in this project has addressed the development of tools for the creation and delivery of online courses. It should be noted that this omits the issue of online tutorials and assessments, which would also require specific attention in an online environment. Although static information (i.e. like a worksheet) could be presented via pages created in the MAT, it is more desirable to incorporate a computer-assisted aspect to guide the remote students. Such work was not addressed in this project as it is being tackled by a complementary initiative within the authors' establishment (Culverhouse and Burton 1998). In addition, there are commercially available systems that may assist with this aspect (Question Mark 1999).

The availability of appropriate tools is, of course, only one element of an ODL solution. Staff need to be trained how to use the tools effectively and, moreover, may need to be encouraged to accept the concept of ODL before a successful approach will be achieved. As such, the provision of the tools discussed would need to occur in parallel with other forms of ODL support by the host organisation.

REFERENCES

- Bröning, S. and Hornung, C. 1998. "I*net-based Training on Demand Potential of the Usage of Modern IT-Technologies in Industrial Training, Re-Training and Qualification", Proceedings of OnLine Educa Berlin 98 (December 2-4, Berlin, Germany): 99-103.
- Cochrane, P. 1995. "The Virtual University", *Business of Education*, Issue 5, March 1995: 17-18.
- Culverhouse, P.F and Burton, C.J. 1998. "MTutor: a tutorial shell for supporting problem solving", in *Bringing Information Technology to Education*, Eurelings A (ed.), Kluwer Amsterdam, ISBN 90 268 320 60.

DFEE. 1998. *The learning age: a renaissance for a new Britain*, Department for Education and Employment, The Stationary Office, ISBN 0 10 137902 1.

Furnell, S, Evans, M, Phippen, A, and Ali Abu-Rgheff, M. 1999. "Online Distance Learning: Expectations, Requirements and Barriers", *Virtual University Journal*, vol. 2, no. 2.

Microsoft Corporation. 1999. "NetShow 2.0", <http://support.microsoft.com/support/NetShow/Content/Docs/>

Question Mark. 1999. Question Mark Perception v2. Question Mark Computing Ltd., London, UK. <http://www.qmark.com/perception/>

Saunders, G. and Weible, R. 1999. "Electronic courses: old wine in new bottles?", *Internet Research*, vol. 9, no. 5: 339-347.

Thomas, P. 1997. "Teaching over the Internet: the future", *Computing & Control Engineering Journal*, vol. 8, no. 3: 136-142.

BIOGRAPHY

Dr Steven Furnell is the research co-ordinator of the Network Research Group at the University of Plymouth (UK), a post-graduate and post-doctoral team encompassing ten full-time and part-time researchers. Dr Furnell holds a first class honours degree in Computing & Informatics and a PhD in data security. His current research interests include Internet and WWW technologies and information systems security, as well as application areas such as online learning. Research within the Network Research Group encompasses a range of industrial and European projects and details can be found on the WWW at <http://ted.see.plym.ac.uk/nrg>.