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Keeping a distance-education course current through elearning and contextual assessment

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Keeping a Distance-Education Course Current Through eLearning and Contextual Assessment

Adrian A. Hopgood and Anthony J. Hirst

Abstract—**Distance education is most economical when delivered to large groups of students over several years. The Open University course T396:** *Artificial Intelligence for Technology* **makes use of electronic delivery and a carefully designed assessment strategy to address the challenge of keeping the course up-to-date while remaining economically viable. Three aspects of currency are considered: academic content, organizational context, and breaking news. An electronic study guide permits new forms of interactivity and presentational styles, while allowing the course team the flexibility to maintain the academic content of the course. The organizational context of the course is maintained through integrated Web pages. An electronic conference provides news, such as course announcements, correction of errata, data files for assignments, and lists of frequently asked questions. It also enables students to participate in an extended learning community. Continuous assessment and the final project are designed to assess the students, to allow practice and experimentation, and to provide a vehicle for constructive feedback. The assessment strategy aims to maintain currency by introducing the latest contexts in which artificial intelligence is used. Detailed marking guides ensure consistent marking and demonstrable achievement of the intended learning outcomes. In a survey at the end of the course, a clear majority of students favored the use of the electronic study guide, particularly for teaching genetic algorithms, where the interactivity enabled difficult concepts to be demonstrated in a way that would not be possible on the printed page. The same survey also gave an overwhelming endorsement to the assessment strategy and the online electronic conference.**

Index Terms—**Artificial intelligence, contextual assessment, currency, e-learning, electronic study guide, project, T396.**

I. INTRODUCTION

THE Open University course T396: *Artificial Intelligence for Technology* is a level-3 undergraduate distance-education course that corresponds to approximately 300 h of study and might, therefore, be described as a "module" in other universities. The intended learning outcomes of the course are shown in Table I. T396 was first presented in 1995 [1] and was extensively revised in 2001, including the introduction of an electronic study guide as a means of delivery. The course has been developed and maintained by a diverse team, as advocated by Oblinger and Hawkins [2], and each student is allocated a tutor who is independent of the course team. The course has consistently attracted 700–900 students per year in Europe (mostly U.K.), plus

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approximately 300 students per year to licensed versions of the course in Singapore and Hong Kong.

Artificial intelligence is a leading-edge area of computer science. Two particular problems are associated with producing distance-education materials in such a dynamic subject area.

- Lead-in time from proposal to first presentation of a course is usually 1–2 yr.
- Economies of scale mean that the life of a course, and the materials it uses, is typically 6–8 yr.

In total, the time from course idea to final presentation may be a decade or more. This paper will propose that these problems can be overcome by a combination of electronic delivery and a contextual assessment strategy. The success of this approach is demonstrated by keeping the long-running course T396 up-to-date in a subject area that is continually changing.

II. KEEPING A COURSE CURRENT

The most important consideration in keeping a course current is academic currency, i.e., whether the coverage of the existing topics is up-to-date and whether recently developed new topics need to be included. Although most of the underlying techniques of artificial intelligence are quite mature, the field is nevertheless fast-moving in the sense that these techniques are continually being used in new ways and in new areas. For instance, currently a trend has developed toward embedding artificial intelligence within other hardware or software systems [3].

In addition, the course must be kept current within the organizational context. Key to this is the exploitation of university systems that have developed since the original presentation of the course, such as the emergence of a managed learning environment. Students who experience the availability of particular resources from studying one course will expect the same level of support on other courses. In other words, student perceptions of currency need to be maintained for the course to remain attractive.

Finally, presentational currency needs to be considered, i.e., currency within a single presentation of a course. For example, even with extensive quality assurance procedures and careful editing of documents, errors may appear in the published materials. As soon as any errors are discovered, they need to be corrected promptly and brought to the attention of the entire student group. Other examples include course announcements, provision of files used in assessment, and providing an online list of frequently asked questions (FAQs) and their answers in response to evidence from the students' electronic conferences.

This paper describes how these three types of currency have been addressed through a combination of electronic delivery and
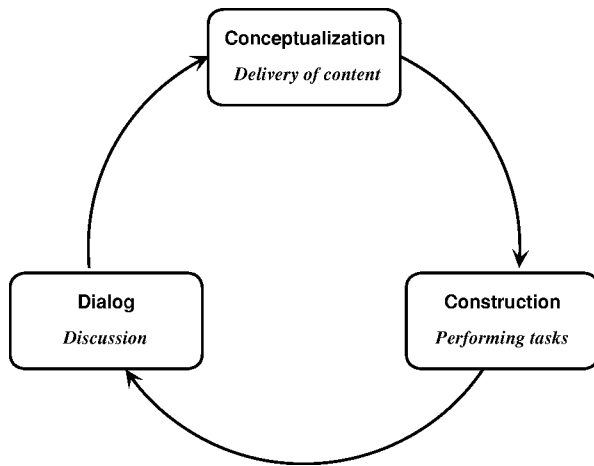
Fig. 1. A learning model.

the design of a contextual assessment strategy. The course includes two distinct types of electronic delivery: the delivery of teaching and other documentary support materials, and the provision of remote social spaces by means of an electronic conferencing system [4], [5]. The contextual assessment strategy is based on a mix of four assignments and an end-of-course project.

III. CURRENCY OF CONTENT

The original delivery of the course used printed study guides [6], [7] that were designed to provide a structured path through two course textbooks and to provide tutorial-in-print [8] support for the course software. Students were required to use two commercial software packages: LPA *Flex* for implementing knowledge-based systems and *NeuralWorks* for building neural networks.

Although many textbooks offer text questions and exercises to the reader, tutorials-in-print try to engage the student more directly. The student is expected to complete the exercise or question as if he or she were being prompted directly by a tutor [9], [10]. The original T396 study guides structured the students' reading of the books, paced their study, and provided support in the form of self-assessment questions.

The study guides provided the *conceptualization* component of the underlying learning model [1], [11] illustrated in Fig. 1. The principal components of the learning model are as follows.

- *conceptualization*—the student receives information about other people's concepts;
- *construction*—the student uses such concepts to perform meaningful tasks;
- *dialog*—the student tests existing concepts and creates new ones through dialogue with other students.

Throughout the lifetime of the course, new forms of electronic support have been introduced as proven technology has become available (Fig. 2). Electronic conferencing was seen as a key part of the course from the beginning, for example, by facilitating student discussion of course topics. These discussions are one way in which the *dialog* component of the learning model is fulfilled. The final component of the learning model

construction was provided through student exercises and the course assessment.

The course revisions, in 2001, included the introduction of newly taught components on intelligent agents and genetic algorithms to supplement the original material on knowledge-based systems and neural networks. These new topics were intended to keep the material taught current for the extended life of the course. The two textbooks were replaced by a single new edition of one of the texts [12].

A key innovation introduced as part of the course revision, in 2001, was the development of a browser-based electronic study guide (eSG) to integrate the delivery of teaching materials, software documentation, and Web-based resources. An electronic format was selected for delivery of the material on intelligent agents and genetic algorithms because it allowed the development of interactive teaching materials and enabled revisions to be made more easily than in print. The electronic study guide also provided an access point to the electronic software documentation. Each chapter conforms to a design template and, therefore, fulfills most of the requirements of a learning object [13].

The new teaching materials and all the software documentation for the revised version of the course are delivered on CD-ROM, rather than in printed form or electronic download. The principal motivation was to enable a more interactive style of teaching. However, an additional benefit has been that the falling production costs of CD-ROMs have made yearly revisions economically viable [14]. Indeed, frequent revisions are necessary for some of the teaching materials, e.g., those concerning the emerging standards for interagent communication [15]. Changes can be made year-on-year to the electronic provision because students pass through the course on a yearly basis.

Such frequent revisions are not possible with traditional printed booklets. The print schedule for the original T396 study guides was typical of most Open University printed teaching materials. They were initially printed for the first year of the revised presentation but, to minimize costs, two to three years supply was produced in corrected form for subsequent years. The assignment booklets and project guide have always been printed annually.

IV. CONTEXTUAL ASSESSMENT

A. Continuous Assessment

The course is presented once a year, starting in February, and is delivered over an eight-month period. It is assessed by four summative, tutor-marked assignments (TMAs) and an end-of-course project, all of which are designed to test fulfillment of the intended learning outcomes (Table I). Each of the first two study blocks has two TMAs. Block 1 covers knowledge-based systems, fuzzy logic and intelligent agents, while Block 2 covers computational intelligence techniques, including genetic algorithms and neural networks. The end-of-course project, forming Block 3, specifies a "real-world" problem that requires students individually to explore solutions that demonstrate their understanding. One of the assessment aims is to provide students with an opportunity to demonstrate their understanding of the types
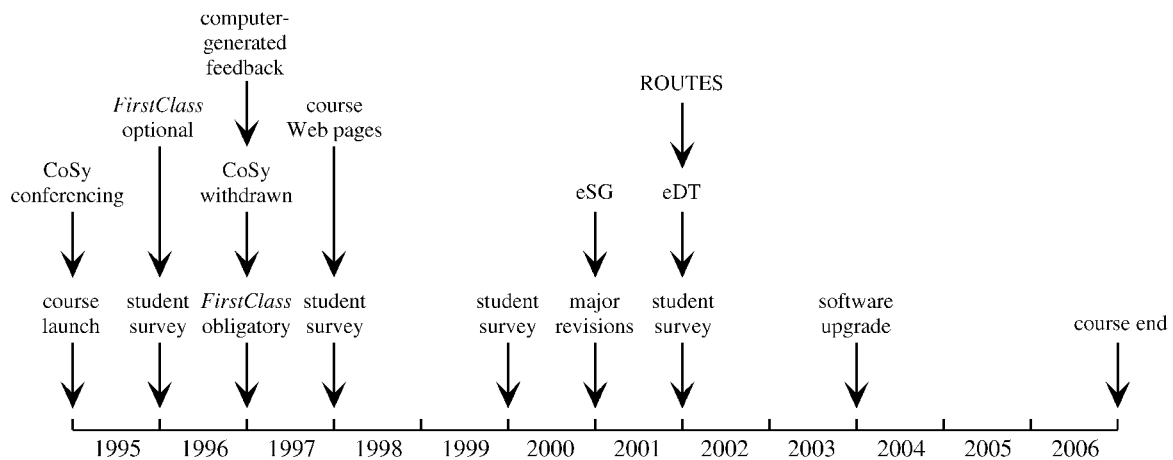
Fig. 2. Milestones in the lifetime of T396.

TABLE I
INTENDED LEARNING OUTCOMES

The course provides opportunities for students to develop and demonstrate the following learning outcomes.

Knowledge and understanding of

1. the operation of rules, inference engines, uncertainty-handling (including Bayesian updating, certainty theory, and fuzzy logic), frames, and multiagent systems
2. the principles and uses of optimization algorithms, particularly genetic algorithms
3. the principles and uses of a variety of neural network architectures

Cognitive (thinking) skills – be able to

4. recognize the suitability of different knowledge-based and computational intelligence approaches to a given technological problem
5. describe in terms of numerical iteration: Bayesian updating, certainty theory, fuzzy logic, genetic algorithms, and neural networks
6. interpret and use technical descriptions of system requirements
7. analyze and propose a suitable means of implementing a knowledge-based system, optimization algorithm, or neural network
8. design, create, edit, and evaluate a knowledge base for a particular application
9. design, create, train, test, and evaluate a variety of neural network architectures
10. use numerical scoring methods to evaluate the performance of alternative artificial intelligence solutions
11. compare and critically assess alternative artificial intelligence solutions

Key skills – be able to

12. communicate effectively about artificial intelligence and its practical applications
13. use numerical calculations to follow the behavior of neural networks, fuzzy logic, and Bayesian updating
14. use and develop IT solutions
15. problem-solve using knowledge-based systems, computational intelligence, or both

Professional and Practical skills – be able to

16. apply the principles, concepts, and techniques of artificial intelligence to technological problems
17. use the supplied knowledge-based system tools to implement a knowledge-based system
18. use the supplied software to optimize a function by means of a genetic algorithm
19. use the supplied neural network software tools to create, train and test the following types of neural network: single-layered perceptron, multi-layered perceptron, Hopfield, Kohonen self-organizing map, and radial basis function

of problem that may be appropriately solved using artificial intelligence techniques. Assessment is not a vehicle for teaching new topics [16]; all the content taught is provided by the course textbook [12] and the associated study guides (either electronic or printed). Although new techniques and theory are not introduced within assessments, novel applications can be.

The open-book form of assessment followed in T396 can lead to an effect termed "backwash" by Biggs [17], [18]. Biggs describes a scenario in which the students' learning is directed by what they need to know to pass the assessment, rather than by the curriculum that the educator has set. To make the goals of the students and the educator align, the assessment material needs to test the intended learning outcomes in such a way that the students' understanding of the material can be demonstrated, rather than rewarding them for simply reproducing material from the course materials [19], [20].

The first TMA in each of Blocks 1 and 2 assesses the students' understanding of the principles taught in the first half of the block against a simple problem within a real-world setting. This TMA assesses academic and theoretical understanding, and the ability to demonstrate an understanding of the use of the block-specific software. Tutors provide feedback on the marked scripts, using a detailed marking guide to support consistency of marking standards. The tutors have a key role in providing
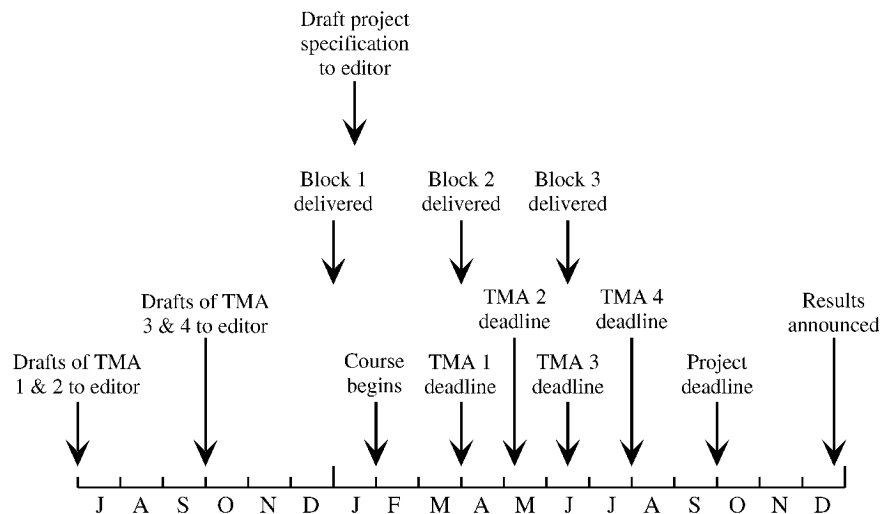
Fig. 3.   Annual presentation cycle for Open University course T396: *Artificial Intelligence for Technology.*

an up-to-date context through a combination of their feedback comments, the regionally hosted group tutorials, and the electronic conference.

In light of feedback from students who took the course in its first few years of presentation, the second TMA of each block is in the form of a mini-project. The original students had reported that being presented with a full project without necessarily having prior skills in either the performance or presentation of a project was too challenging. Examples of the mini-project include the design and implementation of a knowledge-based system to control a model of an industrial process, and the use of a neural network to analyze real-world data. As new data sets become available, or traditional techniques come to be used in novel ways, these advances can be incorporated into the mini-project specification.

Development of the assessment material begins approximately nine months before delivery to the students. The materials for each block are provided to the students shortly before study of that block is to start (Fig. 3). Hand-over of the completed assessment material from academics to editors is required approximately six months before the delivery date to students.

Electronic conferencing is used to promote dialog among students on the course. For each TMA, a dedicated conference is provided for students to discuss matters particularly relating to that TMA or the corresponding parts of the study guides. Structuring the conferences in this way, rather than by topic, might be seen as reinforcing the backwash effect. The challenge for the course team is to provide TMAs that draw upon a range of topics in the corresponding part of the course materials. The course team uses the conferences to post corrections or points of clarification relating to the assessment material.

B. End-of-Course Project

The processes of teaching and learning occur during the project and the preparation of the report, during which time students have the opportunity to interact with their personal tutor. Although the project is an individual piece of work, electronic conferencing is available for the students to discuss their

TABLE II
TYPICAL BREAKDOWN OF PROJECT REPORT MARKS

Summary (including an appropriate title)	10 marks
Introduction	10 marks
Method and design	15 marks
Results	15 marks
Discussion of results	25 marks
Conclusion	10 marks
Suggestions for further work	5 marks
Overall presentation	10 marks

work and participate in some degree of group learning. This approach has much in common with problem-based learning (PBL), where an underspecified project is presented to a group of students [21]. In T396, the work is individual, but the whole group follows the same deliberately underdeveloped guidelines.

The project report itself is used less for teaching than the TMAs are. Its principal purpose is as a means of assessment of both subject-specific knowledge and wider communications skills, as shown by the marks breakdown in Table II. Nevertheless, students are given feedback on the quality of their project report, based upon the opinions of the markers. The markers award a score for each of various aspects of the project report. For the purposes of generating feedback, these scores are placed in categories and used as the basis of personalized computer-generated letters that are sent to students. To ensure that the markers apply the same standards, a detailed marking scheme is provided; and a coordination meeting is held before marking commences, at which time the marking scheme is tested against sample scripts.

The context of the project is an important demonstration of how the techniques taught can be used in a real industrial or commercial setting, rather than just for solving artificial problems. The project is often presented in terms of 'an industrial
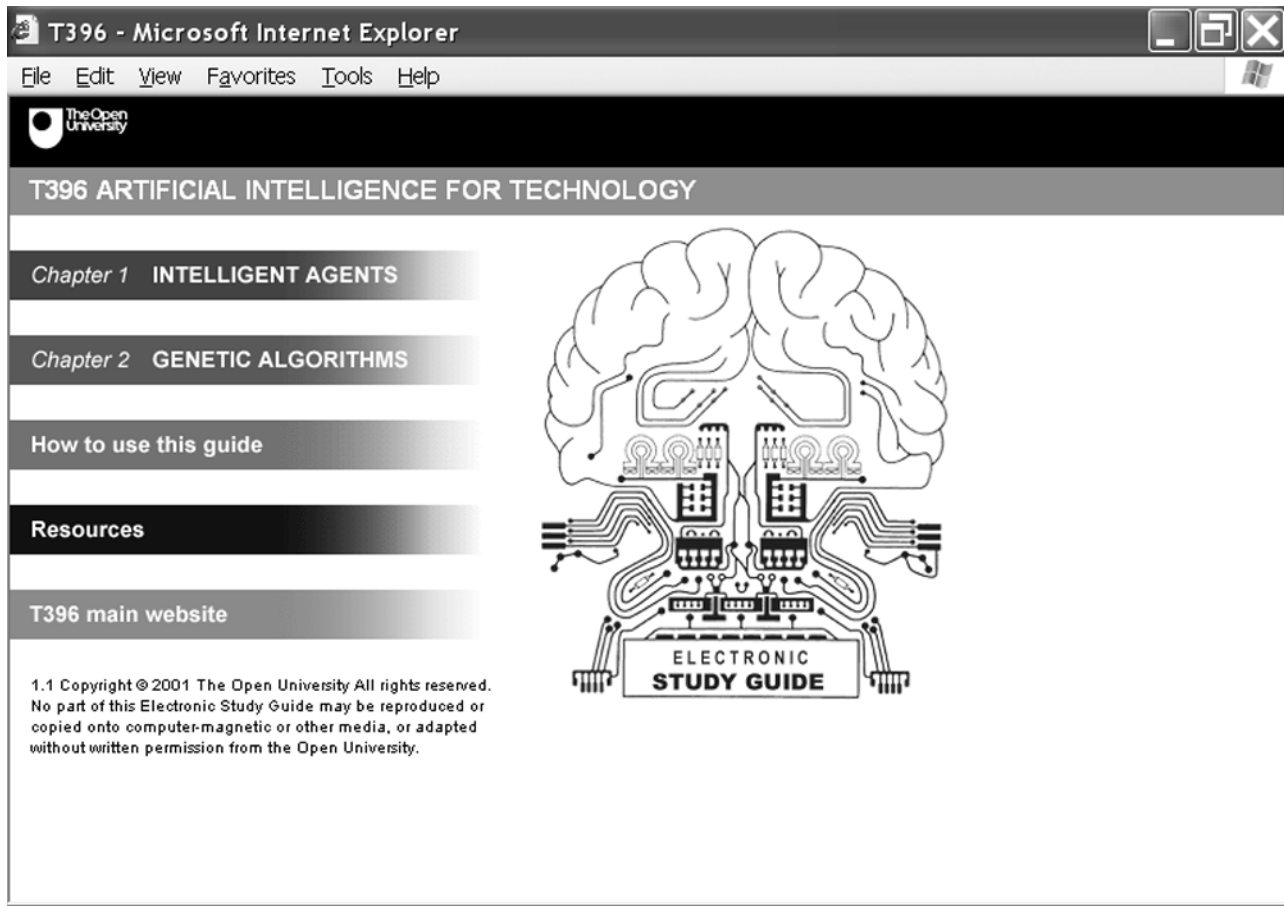
Fig. 4. Front page of the eSG.

company has approached you to perform a pilot study on...'
This approach is particularly attractive to mature part-time students (as most of the students are), many of whom face such practical challenges in their jobs. Typically, the project either requires students to compare the performance of knowledge-based systems and neural networks on a particular real-world task, or it requires them to build some kind of hybrid of the two approaches. Recent projects have included land-cover identification in satellite images, fault detection and identification in an industrial process, and classification of handwritten vehicle registration marks.

Several T396 projects have been based on the research activities of the course team. For example, a project has been based on ongoing research into intelligent and adaptive voting systems for fault-tolerant applications. In this way, students were exposed to a live research area that was well understood by the course team. Students were referred to a technical report as optional background reading. The strong interaction between teaching and research is demonstrated by the fact that the direction of the original research, specifically the design of prototype systems, was influenced by its anticipated reworking as a T396 project. Developing the specification for the end-of-course project within a tight schedule represents a significant undertaking for the course team. Developmental testing by a critical reader helps to ensure that the appropriate level of guidance is provided in the project guide.

V. ELECTRONIC STUDY GUIDE

A. Implementation

The teaching material is delivered off-line within the eSG as a set of hyperlinked HTML documents containing interactive exercises implemented using JavaScript and Java applets. The eSG, the software packages, and their documentation are all included on a single CD-ROM. Off-line presentation allows the costs to students to be minimized and avoids issues of controlled access and security. Internet access is nevertheless required in order to access the online, especially discursive, components of the course. The eSG provides a consistent browser-based interface to the electronic materials. The software documentation is primarily delivered as PDF documents, with HTML files that provide an interactive set of example programs for the knowledge-based systems software.

The use of off-line materials means that only client-side browser processing was available, i.e., processing on the student's computer without the need for an internet connection. In contrast, fully online courses enable server-side processing that can be used for hosting active documents and serving them on the student's computer [22]. This facility can also be provided off-line if the student's own computer runs a local Web server with server-side processing capabilities, although server-side processing was not necessary for the interactive exercises in the T396 eSG.
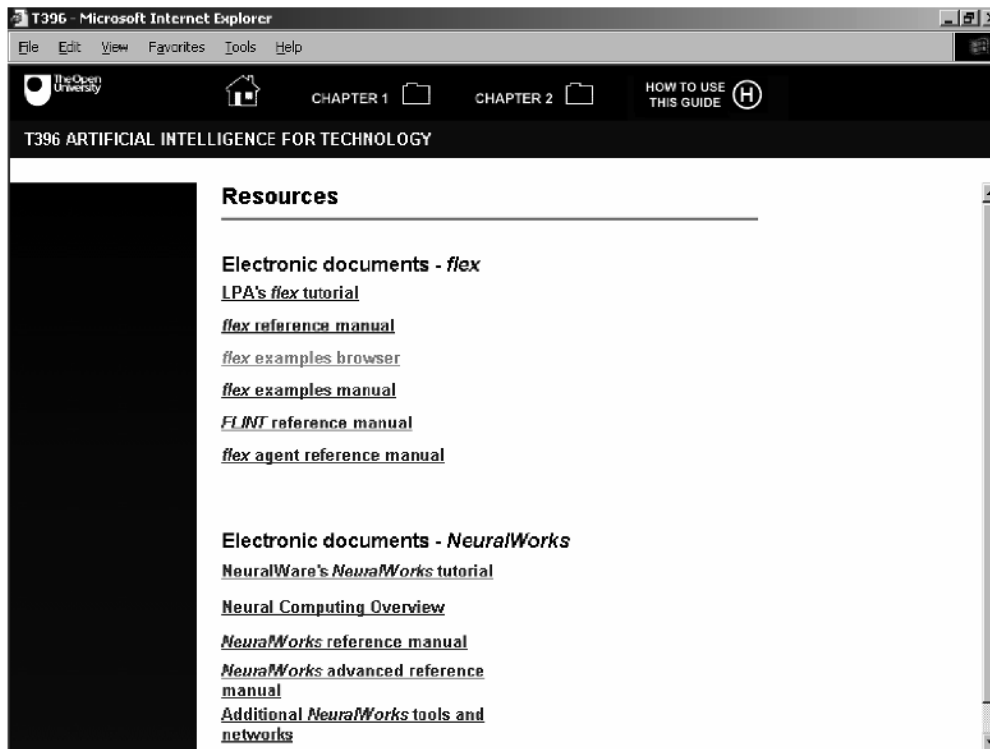
Fig. 5.   eSG Resources page.

The intention from the outset was that through the use of hyperlinks and interactive exercises, the eSG should be more than just an electronic version of a printed document. Nevertheless, the exercises have been designed in such a way that they still make sense in printed form. Following the first year of use of the eSG, course tutors requested a printable version in PDF format that they could print off and reference in face-to-face tutorials, and this facility has since been provided. The quality of the resulting documents was not up to the standards required of materials deliverable to OU students, e.g., in terms of layout and pagination, but it was satisfactory for tutor use. Despite these concessions to hard copy, the eSG is primarily intended for interactive use on the computer screen.

B. Structure and Interactivity

The eSG content currently covers intelligent agents and genetic algorithms. Other topics have remained in printed form, but will move to electronic format in the proposed Masters-level version of the course. The front page of the eSG (Fig. 4) provides links to the following, of which only the last two require Internet access:
- a study chapter on artificial agents;
- a study chapter on genetic algorithms;
- a resources page that provides links to the software documentation (Fig. 5);
- a help page on how to use the eSG;
- the course Web site;
- the Open University Web site.

The structure of the teaching in the eSG is modeled on the chapter layout of the printed study guides, providing consistency of presentation. At the start of each chapter, a set of learning objectives is declared, each of which is addressed in the subsequent sections. The layout of all pages is consistent throughout the eSG. Within a section, top-level navigation is provided back to the front page, the help pages, and the initial page of the two teaching chapters. Color-themed margins are used to identify the separate sections, using colors that are consistent with the covers of the printed bindings. The Open University logo serves the dual purposes of branding and providing a link to the university and its wider services.

Interactive exercises are used to demonstrate particular points and to keep the student engaged with the teaching materials on screen (Fig. 6). Another advantage of interactive exercises is that they provide a way of integrating teaching texts with simple computer-aided learning (CAL) [23]. This provision is most evident when a student offers the wrong answer to an interactive question since a simple diagnostic test can be run to provide the student with an informative prompt that will direct him or her toward the correct answer.

In addition to the exercises, interactive self-assessment questions (SAQs) [24] are used to test students' understanding of certain points and to allow them to identify whether a particular learning outcome has been achieved, i.e., whether a learning objective has been converted to a learning outcome. Again, diagnostic tests are used to provide additional teaching for students who give the incorrect answer or to elaborate a correct answer. Exercises and SAQs are distinguished from the instructional material by using a font color corresponding to the chapter color theme. Color is not normally available in printed materials (except the covers) because of the costs, so the eSG benefits from this additional form of emphasis to support the teaching.

Fig. 6.   An interactive exercise.

Fig. 7.   The *Flex* examples browser.

C. Linking the eSG to Other Materials

Students are provided with a visually consistent wrapper to all their course-related browser activities by a seamless browser presence across the eSG, software documentation, course Web site, and conference. Hypertext also allows incremental upgrades to the eSG during course presentation, e.g., by releasing specific pages containing updated content or revised links. A further innovation supported by the eSG is the provision, in an unobtrusive way, of links to optional teaching material and
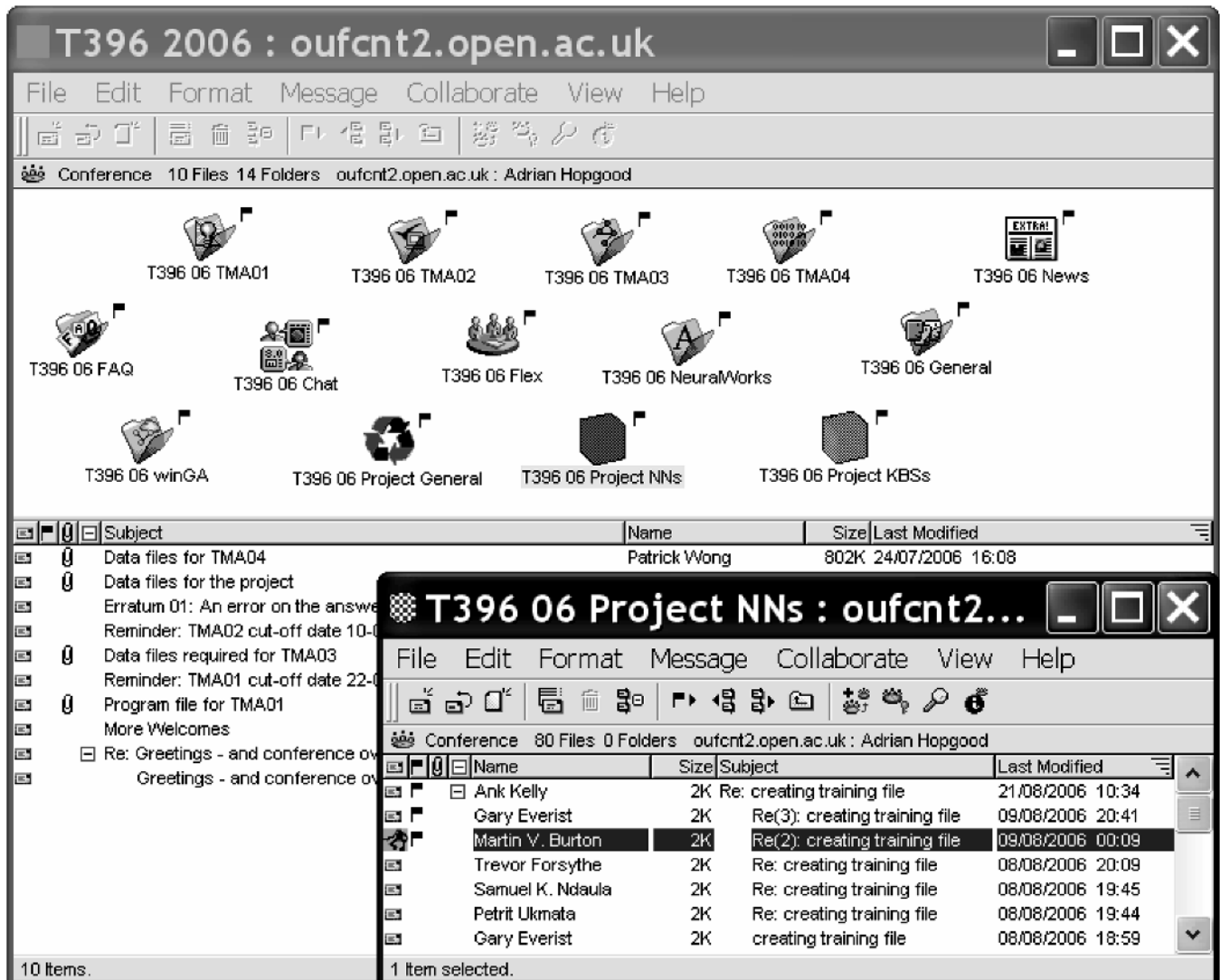
Fig. 8. *FirstClass* electronic conference. A flag denotes that the message is unread by the user or that the conference contains at least one unread message.

additional exercises that go into more depth than is strictly required for the course.

Some interactivity was introduced to the documentation provided for the LPA *Flex* software. A hyperlink from the electronic resources section of the eSG leads to an HTML version of the manual, augmented with a pair of navigational list boxes (Fig. 7). In the first list box, the user can identify the topic of interest to him or her. The contents of the second list box are then automatically created to offer the available exemplar programs that demonstrate the requested topic. Once an exemplar is selected, a short description of the program is provided, along with a link to the sample program code itself.

VI. ELECTRONIC CONFERENCING

Electronic conferencing plays an important role in the learning model used within the course. As well as being used for academic discussion, the *FirstClass* conferencing system provides the primary download area for assignment-related files. The *FirstClass* client software (Fig. 8) is provided to all

students on the course CD-ROM and a Web interface is also available. *FirstClass* also supports Internet chat for students who are connected to the server at the same time.

Course team members have full administrative rights to all course conferences. The hierarchical structure of the conference can be described by the access permissions for registered students, as follows:

- read access only (T396 main conference, T*396-FAQ*, T*396-Files for download*, and T*396-News*—see Fig. 8);
- read and write access (all other conferences in Fig. 8);
- read and write access for tutor group members only (conferences established by individual tutors, not shown in Fig. 8).

The structuring of the conferences enforces some degree of currency and relevance to the postings. For example, specific questions relating to particular assignments are only timely for a short period of time; whereas, questions relating to the software packages are likely to be relevant over longer periods. Also provided are an alumni conference and a restricted conference

Fig. 9.   The Electronic Desktop (eDT).

in which the course team and course tutors can discuss course matters.

Specific read-only conferences are used for announcements, corrections, files for download, and answers to FAQs. The FAQ conference persists and grows from year to year. The FAQs can be used to identify gaps in the study or assessment materials and identify commonly incurred difficulties with the course software.

The tutor group conferences are moderated by individual tutors for their students. These conferences tend to be used for general tutor group discussions, alternative presentations by the tutor on various topics, and dissemination of tutorial materials. They also allow for personalized support from a tutor to individual queries from with the tutor group.

VII. ONLINE WEB-BASED SUPPORT

In 1998, the T396 course team set up a Web page that mirrors some of the information on the *FirstClass* conference. It included links to 'late-breaking' information, such as stop-press announcements, dispatch dates for course materials, a file download area for data files relating to TMAs, supplementary documentation for course-related software, and links to sites of

course-related interest. Since the course team's early adoption of a course Web site, a widespread proliferation of university Web pages have emerged relating to the course. To avoid potential confusion, the Web site was redesigned to assist navigation for distinct classes of user: potential students, current students, and past students.

Since the 2002 presentation, the course has adopted the University electronic desktop (eDT) system (Fig. 9), which is only available to enrolled students in the course. The eDT for a particular course provides access to relevant conferences (through the *FirstClass* Web interface), course resources (such as files for download), and a course calendar. Also links to other university systems are available, such as course mailing information and the online library system, Resources for Open University TEachers and Students (ROUTES), shown in Fig. 10. ROUTES provides course-team identified links to authoritative Web sites relevant to the course. It also provides automated checks that these links are live, and passes on the link to an authoritative search engine used by library users in general. Course team members can submit content directly, with dates specifying when material should go live. Where file downloads are required, document identification numbers can be provided so
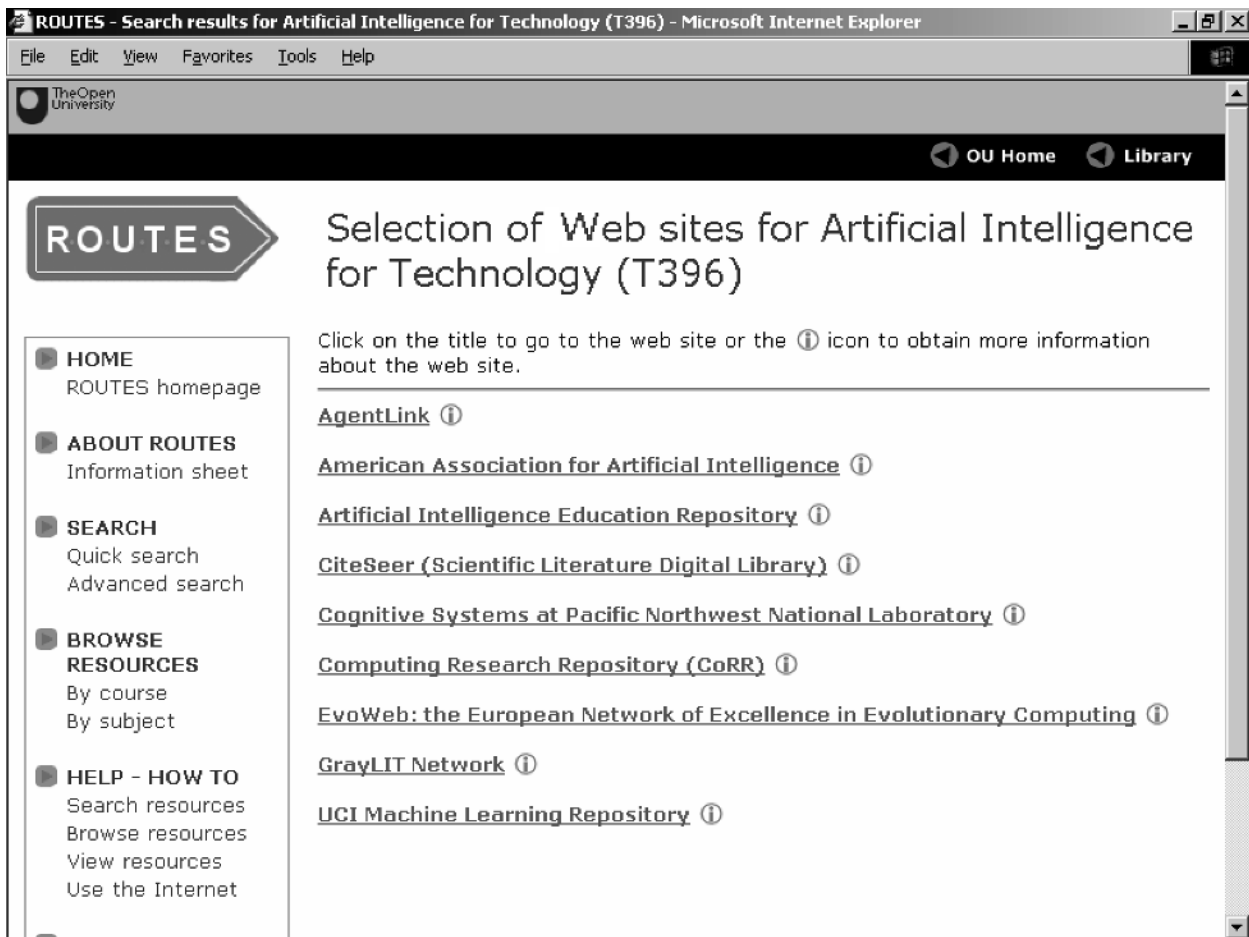
Fig. 10.   ROUTES: Resources for Open University TEachers and Students.

that documents can be retrieved automatically from the authoritative university archive instead of being uploaded by the author.

Since the original Web site is publicly accessible, unlike the eDT, it still serves as a showcase for the course. It also continues to provide course-team maintained experimental services. For example, a wireless application protocol (WAP) service enables important course announcements to be accessed from a WAP-enabled mobile phone. This service has allowed experimentation with mobile-phone accessible alerts, such as notification of stop press announcements, files available for download, the dispatch status of course materials, and reminders of TMA cut-off dates.

VIII. EVALUATION AND CONCLUSION

This paper has described a strategy for maintaining the currency of the Open University's distance education course T396: *Artificial Intelligence for Technology*. Three dimensions of currency have been identified: academic, organizational, and presentational. The strategy involves the development of online technologies and electronic delivery and the use of contextual assessment based on current real-world applications.

Although originally moving to electronic delivery was expected to reduce the time and resources to produce new materials, this expectation proved to be a misconception. In addition to the traditional team of author and editor, significant input was

also required from designers and programmers. Style files for the eSG had to be created, and the usual word-processing tools were inappropriate for use with HTML documents. The delays incurred by such technical difficulties were significant.

Surveys throughout the life of T396 have shown that students like the course and its project-based assessment. In a survey of students at the end of its first electronic presentation, 83% of 164 respondents stated a preference for submitting a project report rather than sitting an examination, and 87% felt better equipped afterward to undertake further project work. Of 166 respondents, 66% thought that the balance between experimentation and report-writing was about right; 29% thought too much emphasis was placed on the report; and only 5% thought too much emphasis was on the experimentation. Although a sizeable minority felt that too much emphasis was placed on the report itself, 85% of respondents also stated that the development of their report-writing skills was an important benefit to their Open University studies. A strong endorsement of the policy of developing project skills through the mini-projects in TMA02 and TMA04 was demonstrated by an overwhelming 92% of respondents agreeing that these mini-projects were good preparation for the main project.

Students were specifically surveyed for their opinions on the use of the electronic study guide and electronic conference. Of 162 respondents, 68% agreed that the use of the interactive
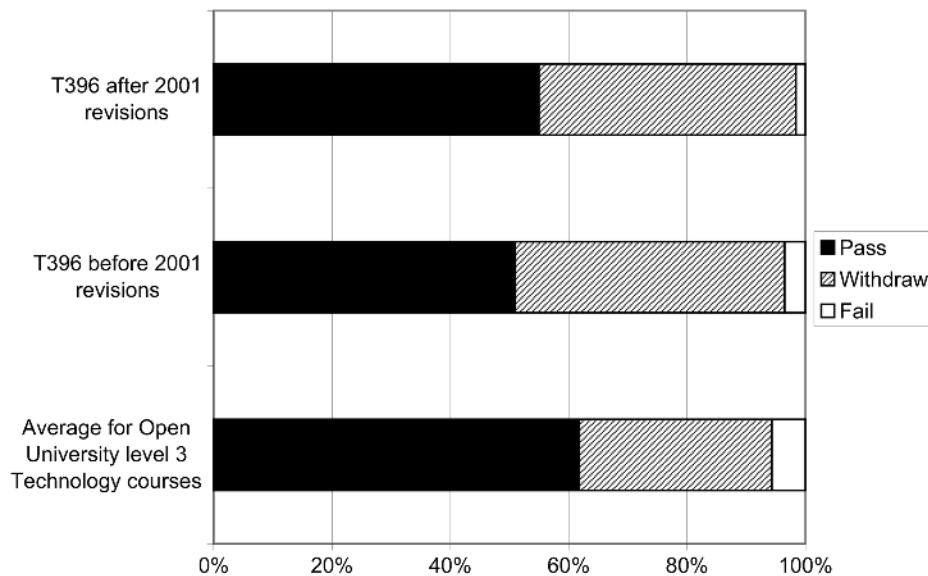
Fig. 11. Student success rates.

exercises in the electronic study guide was appropriate for teaching this course. This agreement was most pronounced for genetic algorithms, where 74% of the respondents endorsed the use of these interactive exercises compared with only 61% for intelligent agents. This finding is not surprising, since the teaching of genetic algorithms benefits particularly from the ability to demonstrate complex manipulations through interactive on-screen exercises. In the same survey, 91% of students found the eSG easy to navigate, and more than 98% claimed to have made use of it. Finally, the survey showed that 78% of 161 respondents regarded the electronic conference as useful.

The survey only measures student satisfaction and opinions. Success against delivery of the intended learning outcomes is measured through assessment, which is linked to the intended learning outcomes. As Fig. 11 shows, T396 fails fewer students than equivalent courses that use an end-of-course examination, and this difference was even more apparent after the course was updated in 2001. The course has a relatively high number of withdrawals because, at least in part, of students who recognize when they are unable to produce a satisfactory project report and who effectively make the assessment decision themselves. Noncompletion rates above 40% are commonplace for individual courses at the Open University [25], but noncompletion of a course does not generally imply withdrawal from a program of study.

All three components of the learning model in Fig. 1 can be said to contribute to keeping a course current. *The conceptualization* component is achieved through the electronic study guides. The *dialog* component includes the electronic conference which, as well as face-to-face discussion and telephone contact, can be used to share latest news, views, and information. The third component of the model is *construction*, which includes student exercises in the eSG and contextual assessment.

ACKNOWLEDGMENT

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