

Virtual Learning Environment for e-Math System

Yukari Shirota *

Abstract

In this paper, I describe the virtual learning environment in which I will use the e-Math Interact Agent system that I developed. As university instructors, we require various instructional tools in our lectures in addition to the teaching materials we have developed ourselves. Two distinguished virtual learning environment (VLE) systems, Bodington and Sakai, meet instructor requirements in this area. Currently, the Tetra project is working to combine these systems to develop a next-generation VLE. In this paper, I shall describe the features of WebLearn and Tetra from the viewpoint of how I shall run and use my e-Math system on WebLearn and in the future on Tetra.

1. Introduction

In this paper, I shall consider features of a total virtual learning environment (VLE) which would be suitable for “e-Math Interact Agent”, the system that I developed. The e-Math Interaction Agent system (hereafter e-Math system), was created to help mathematics lecturers develop their teaching materials¹. The purpose of the system is to release lecturers from tedious Web programming work by leveraging automation tools. The e-Math system is a courseware generator and the generated teaching materials can offer students various presentation materials.

As university instructors, we require various instructional tools in our lectures in addition to the teaching materials we have developed ourselves. Two distinguished virtual learning environment (VLE) systems, Bodington and Sakai, meet my requirements in this area. During my sabbatical research term at the University of Oxford, from September 2006 to March 2007, I have had the opportunity to use WebLearn system². This is Oxford’s branding name for Bodington, which is free open software³.

Since Oxford University Computing Services (OUCS) offers staff and students several courses on the

* Faculty of Economics, Gakushuin University, 1-5-1 Mejiro, Toshima-ku, Tokyo 171-8588, Japan.

E-mail: yukari.shirota@gakushuin.ac.jp

1 Yukari Shirota: “Methodologies for the Automation of Web-Based Interactive Courseware for Mathematics”, Gakushuin Economics Papers, Vol. 43, No. 1, April 2006, pp. 39-52 (http://www.gakushuin.ac.jp/univ/eco/gakkai/pdf_files/keizai_ronsyuu/).

2 Oxford University Computing Services: “WebLearn”, Oxford, at <http://www.weblearn.ox.ac.uk/>.

3 Full details of the Bodington project can be found at <http://bodington.org>.

effective usage of WebLearn, I attended the courses and learned how to use WebLearn. During my stay in Oxford, the system offered me a comfortable research environment. Even during my Christmas holiday, which I spent in Japan, I was able to use the Internet to access the materials I had developed from the server without any difficulties. As long as my University Card remains valid, I can access WebLearn via the Internet from anywhere. The most splendid feature of WebLearn for me has been the access control function, which I shall describe later. In addition, I have installed the system software on my PC, so that I can use it even after my sabbatical research term expires.

Another distinguished VLE is Sakai. The University of Cambridge is one of Sakai's power users. The CARET (Centre for Applied Research in Educational Technologies of Cambridge) team is in charge of developing Sakai at the University of Cambridge. I held discussions with CARET members in Cambridge regarding whether my e-Math system could run on the Sakai system. The technical problems we discussed are described later in this paper.

In the next section, I shall explain some of the features of WebLearn that can help lecturers conduct courses. In Section 3, Sakai will be explained. In Section 4 I shall describe my plans regarding usage of these VLEs for my own mathematical classes. This is followed by a discussion of some technical points that we at Gakushuin should consider regarding VLE management. In addition, OxCLIC, an Image Management Project at the University of Oxford for using slide images as teaching materials, will be described.

2. WebLearn at the University of Oxford

The WebLearn virtual learning environment is used throughout the University of Oxford, which consists of many colleges and departments.

First let me explain the features of WebLearn. This VLE offers the following tools:

- **Pigeon Holes:** A system for students to submit assignments as files. Gakushuin University also offers a similar system as the report system.
- **Logbooks:** An online study diary for students through which their supervisors can monitor their writing and offer comments and advice. Because the system makes it possible to restrict access rights, private use by researchers is also possible. For example, a researcher can conduct research, collect useful information from the Web and enter it in the logbook for his/her own use (See Figure 1). In the case of students, they can also share the logbook with some friends, which is useful as the individuals involved can learn from each other and answer questions posted by students. The best case of the logbook would be for writing a long paper, such as a thesis.
- **Questionnaires:** A survey function for a teacher to create secure feedback forms and collate responses, as shown in Figure 2. The survey can be restricted to specific groups, for example, students registered for the class "Economics Mathematics A". The forms allow for multiple choice or free text. The analysis functions for the questionnaire responses are included in the survey function. In addition, this tool can also export the questionnaire responses as a CSV file, so that other analysis tools, such as Excel, can read the files. The questionnaire form developed can be published on the Web for anonymous users outside the university. For example, for a researcher in the management department, it may be helpful to



Figure 1. Logbooks display images. On the left side, a list of entries is displayed. Each entry can include questions and answers. The system offers both the function “Edit Question” and the function “Give Feedback to Author” from a lecture and from colleagues. In this example, I answered one of my questions myself. It is an effective practice to write down any questions you may have immediately in the Logbook.

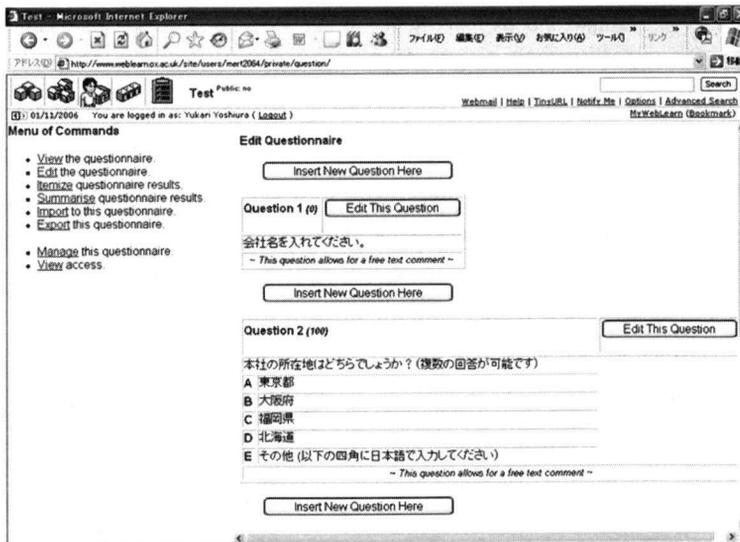


Figure 2. The display image of the questionnaire during editing. In this example, I am making a questionnaire in Japanese. The editor can insert a multiple choice or free text input question.

collect data from industries via the Web. To make the questionnaire and data secure, the URL of the form should be hidden from the public and revealed only to the target industries.

- **Quizzes:** Multiple choice quiz functions with automatic marking functions. The marking functions are a great help to lecturers. For example, lecturers can manage the time by entering the correct answers in advance. After marking a quiz, a lecturer can also modify the mark, taking into consideration the student's contributions. The automatic marking function may be the most desirable tool for lectures. Later I will describe my usage plan for this tool in my mathematics classes on our campus. The quizzes can be exported to an IMS QTI (Question & Test Interoperability) file. IMS QTI is a specification, which enables the exchange of questions and result data between authoring tools, learning systems, and so on⁴.
- **Message Rooms:** This is a discussion room to which registered participants can post their messages under the designated themes.

Next I shall explain the technical features of these WebLearn tools. The current features are as follows:

- (1) **Publish material on the Web:** WebLearn has an upload function, which allows the user to put files up onto the Web via the Internet in a matter of seconds, even from home. For example, when I uploaded files to the university server from my home in Oxford, it took only a few seconds. In addition, every location on WebLearn is given a unique URL, so that the user can refer to it in other Web materials, such as course guides. The function is also very useful when we try to run Web programmes in WebLearn because programmes sometimes need to refer to other files. Book marking is also available for each location. For example, a book mark linked to one's own private space location would be essential. (1)
- (2) **Control access:** WebLearn contains information on all staff and students at Oxford. Using the registration data, access control is applied to every set of materials on WebLearn: The controlled rights include read, write, view, see, post and so forth. The owner of a resource can alter access control via the panel (See Figure 3). For setting access control, the system offers a group category menu in which many categories, such as colleges, departments, courses, and divisions, are included. At the University, it is common for a lecturer to belong to both a college and a department. This double structure means that the system administration/ management must work twice as hard in such cases. The database management system controls access to each one. From the viewpoint of a database researcher, the access control patterns are of necessity complicated because the same user may belong to several groups, which can have different access patterns. Therefore, when I see WebLearn functioning properly at such a large university with sophisticated access control patterns, I am filled with wonder. I think that the task of registering data just before the beginning of the new term must be very hard.

4 IMS Global Learning Consortium, Inc.: "IMS Question & Test Interoperability Specification", at <http://www.imsglobal.org/question/>.

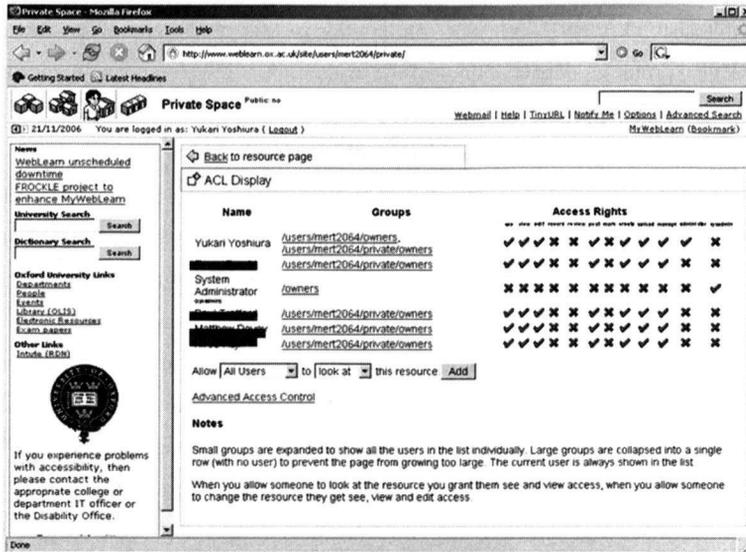


Figure 3. The owner can set the access rights for each set of material. The number of rights that can be controlled is twelve.

- (3) **Date limitation:** Every tool has a date limitation function, which the owner can use to set the period of time for which a particular set of materials is available. For example, the quiz can be set up so that it is accessible during one specific hour. To enforce the deadline for submitting a report, and to limit the period during which Web published teaching materials are available, a date limitation function is essential in a VLE.

In addition, the WebLearn system offers Easybuilder, which is a tool for creating a collection of WebLearn resources, and an HTML editor.

3. Bodington and Sakai

Now I shall explain the global position of Bodington as a virtual learning environment (VLE) system. Another VLE, Sakai, will also be described in this section.

WebLearn is Oxford's branding name for the Bodington system. The University of Oxford started to use WebLearn/Bodington in 2002. Bodington was customized to meet the university's needs. Because it is open software, I was able to install the system on my computer during my stay in Oxford.

Another distinguished VLE system is Sakai, which is also free and an open source Collaboration and Learning Environment⁵. The Sakai Project was formed in 2004. It was developed and is maintained by the Sakai Community, and is named after Hiroyuki Sakai — a long-time favourite on the television programme

⁵ The Sakai Web site is at <http://sakaiproject.org/>. Sakai Community site is at <http://collab.sakaiproject.org>.

“Iron Chef” in Japan^{6*}. The Sakai partners now include many universities, such as the University of Michigan, MIT, Stanford University, Indiana University, Nagoya University, and the University of Cambridge’s CARET. I think CARET plays a role similar to that of the computer centre at Gakushuin University. CARET also promotes debate about and the evaluation of developments in educational technologies⁷. CARET joined the Sakai project in 2004 and the University of Cambridge launched CamTools, which is the branding name for Sakai⁸, in 2006.

Sakai offers a variety of tools for use in courses and on project sites. The following are the core teaching tools: Assignments, Grade Book, Module Editor, QTI Authoring, QTI Assessment, Section Management, and Syllabus. To observe Sakai running on the campus, I visited CARET in Cambridge in January 2007.

Important to the future of these VLEs is the Tetra Collaboration, formed among the Universities of Oxford, Cambridge, Hull, and the UHI Millennium Institute following a series of meetings and a major summit held in September 2006.^{9,10}. This project will combine elements from Bodington and Sakai. At the University of Oxford, Dr Paul Davis, Acting Head of the Learning Technologies Group of OUCS, described the Tetra Collaboration to staff at a presentation titled “WebLearn: Future Directions of the University Virtual Learning Environment” held at OUCS on 8th November, 2006. One announcement about the project said, “The goal of the Tetra Collaboration is to coordinate activities across the member organizations so as to more efficiently develop and deploy open source enterprise applications of use to UK and European universities and colleges.”⁹

I think the problem would be the compatibility of users’ resources between WebLearn and CamTools, and between them and Tetra. The transfer of teaching materials that have been developed between Oxford and Cambridge would, in particular, be an important issue for some lecturers. Concerning user interfaces, the following was said, “Tetra will both maintain and evolve the Bodington user interface as well as making the Bodington toolset available to Sakai users.”¹⁰ Although I am not on the faculty of a UK or European university, I would anticipate that Tetra could offer us much better functions and am anxious to see which kind of user interfaces is to be offered.

4. e-Math on WebLearn

In this section, I shall consider some potential problems that I would encounter when I use e-Math system on WebLearn. The most important issue for me is whether e-Math can technically run on WebLearn and, in the future, on Tetra. After discussing this problem, I shall describe my plan regarding WebLearn usage in my maths classes.

6 The Sakai Foundation: “Sakai” (leaflet).

* Although I would like to know for whom that programme is a favourite, there is no description on that in the leaflet.

7 The site of CARET is at <http://www.caret.cam.ac.uk/>.

8 CARET: “CamTools”, at <https://camtools.caret.cam.ac.uk/portal>.

9 The Sakai Web site: “Announcing the Tetra Collaboration” at http://www.sakaiproject.org/index.php?option=com_content&task=view&id=468&Itemid=312.

10 Bodington.org: “Announcing the Tetra Collaboration” at <http://bodington.org/tetra.php>.

4.1. Technical Problems

First, let me discuss whether e-Math can technically run on WebLearn. The problems discussed here will also be problems for me when I use Tetra.

We can consider the e-Math generator separately from the teaching materials that is the output of the generator. Although my final plan is to run the generator on demand while students are using the teaching materials, for my current purposes, I can completely separate the e-Math generator and the teaching materials that are its output. The e-Math generator can be run on other development computers with WebEQ.

Therefore the problem is whether the XML and other files that are generated can be run on WebLearn. I expect that we will be able to run the generated Web-based materials on WebLearn if the following conditions are met:

- Each file has a unique URL address
- (Maple,) Microsoft Agent functions are installed on the local computer

Because the XSLT programme needs to refer to the XSLT stylesheets, it is necessary that the stylesheets have a unique URL address. Another issue that we will have to consider is the possibility of access control restrictions in order to run the e-Math teaching materials on the local computer. The lecturer needs to be able to set up a date limitation and an access range limitation on e-Math-generated teaching materials as well as other plain Web teaching materials. If the lecturer wishes to limit access to certain e-Math exercises, will it be possible for the e-Math XSLT programmes to be run properly through the access control functions? In general, when we try to run programmes, they occasionally do not run properly due to unexpected access restrictions. Therefore, with regard to this issue, it is necessary to conduct an experiment in the real environment to clarify whether the programme can be run on WebLearn. However, I anticipate no technical problems in this area.

In addition, in my discussion with CARET members on 25 January 2007, I confirmed the following: XML/XSLT programmes and Flash animation files can run in CamTools/Sakai in its current form. In addition, some sophisticated molecular courseware can run interactively in the CamTools/Sakai system. Therefore, I expect that there will be no technical problem in running my e-Math teaching materials in Sakai and Tetra, either.

4.2. Student Registration and the Quizzes

In my maths classes, I plan to use the quiz function offered by WebLearn. It is very effective to use quizzes to get students to review immediately after a class. In maths classes, the students have to remember new maths definitions that are introduced in each session. If they are absent from one class, they will not be able to understand the classes that follow. Therefore, such review exercises are necessary. For example, the lecturer can set up a quiz with the date limitation being the date of the next class. This would be effective even if the quiz contents were only multiple choice questions, which are easy for students to answer. Even simple questions can be very effective and get students to review their textbooks and class notes.

If the lecturer wanted to mark the quizzes, it would be necessary to register student IDs in advance.

However, the registration task is too complicated for a lecturer to conduct. Therefore I think lecturers should wait until such time that the university's other system can provide registration data to the VLE. Until then, the situation is such that the lecturer cannot mark quizzes. In the meantime, some motivation is needed to get students to take the quizzes. As a temporary solution, I will choose one or two quiz questions to use as examination questions, which should get the students to take the quizzes. In other words, even if other examination questions are too difficult for students to solve, they will at least be able to solve the one or two quiz-based questions in the examination if they have taken the quizzes. Limiting the period during which the quizzes are exhibited on the Web would also be effective in getting students to take the quizzes.

4.3. Other Requirements of WebLearn

During more than five months of WebLearn usage in the Oxford environment, I have come to think that the following tools would make it much more convenient for a system administrator:

- Back-up tools for an entire Message Room and an entire Logbook
- A student ID registration tool

To make back-up files, a back-up function is offered just for each file. However, I would like to make my own copy of the whole image of the Message Room or the Logbook. In addition, some student ID registration methods are needed so that instructors can skip the hard work. Consideration of a student registration at a university should also include the relationship between a VLE and the syllabus system. In general, student information, such as which student is taking which courses, is first stored in the syllabus system. At almost all universities, the registrar's office is in charge of the data arrangement. First we get the syllabus system to output the student information and then we have to arrange the data so that the VLE can read it. The difficult thing about data registration is that small changes are constantly being made to the data. For example, students change courses frequently although they are not allowed to change them after the reception date. To avoid inconvenience, the transfer of data from the syllabus system to the VLE should be executed automatically or semi-automatically.

As a Japanese user, I discovered a locale problem in Bodignton. Although I can write Japanese in the contents, part of the text menus written in English cannot be displayed on my computer, perhaps due to the locale setting. It is possible that this problem only occurs on PCs with Japanese-language OS.

5. OxCLIC, Image Management Project

Next, let us consider the management of still images as teaching materials. In their courses, lecturers also use still images as slide material. The power users of such images are probably lecturers in the History of Art. However, lecturers in Chemistry, Physics, and Economics maths also use many images, such as molecular diagrams and graphs. These teaching materials are valuable contents on whose development much energy

11 Peter Robinson: Presentation titled "OxCLIC - Sharing, storing and presenting digital images", held on 29th November at OUCS, at http://wiki.oucs.ox.ac.uk/Itg-public/OxCLIC_overview_document.

is spent. Furthermore, they should at a minimum be shared within the university community. However, to protect the licenses of these images, access control functions are needed. As I believe that seeing a good example from the University of Oxford would be helpful for us at Gakushuin University as we consider our future requirements, I shall describe the on-going Oxford project concerning image management for teaching and research¹¹.

The project is called OxCLIC. At the University, many digital images are used for educational purposes. This project focuses on slide collections held by the Department of the History of Art and the Classics, Archaeology and Oriental Studies faculties. The centre of the system is an image database. Lecturers must scan the slides in advance, add the metadata to the images, and restore the images to the image database. The metadata are used as indices so that others can easily retrieve the images from the database. The metadata are mainly based on Dublin Core 15 fields and VRA which is a set of metadata terms specifically designed for describing images and works of art.

In preparing for their classes, lecturers can retrieve the image database and collect the images they require. Having collected the images, they can lay them out in their preferred format, as hand sets or Power Point files. There are also authoring tools available that make it possible to show the images easily to students in the classroom. These authoring tools can help instructors make slide shows and thumbnails of the images. Instructors can also publish the teaching materials that they have developed on their WebLearn spaces.

We could also expand the system to cover other materials, such as movies, Flash animation materials, and Maple maths materials. The point is the existence of a central database of teaching materials. The teaching material database would be required on campus so that all the lecturers could share teaching materials for which they have permission. The issue of permission is very important. One of the technical issues is that the system offers users an access control function. Image owners have to register access control information for the images, defining user groups and giving each group the appropriate permission set, such as “view” and “see”. It is too complicated for a lecturer to set up access rights from scratch.

For example, I have found that permission to “use in the classroom as teaching material” is completely different from permission to “view on the Web”. Namely, even if an instructor were allowed to view a slide on the Web for research, sometimes he/she may not necessarily have permission to use the slide image as teaching material. A greater number of permission types would be required than the set currently defined on WebLearn. CamTools at the University of Cambridge provides some access control pattern models to help novice users. In a class, for example, three models are offered: an instructor, a student, and a teaching assistant model. In the same way, some typical, pre-defined user access models should be offered to staff users.

A teaching material database, especially an image database similar to the OxCLIC project, would be necessary in future so that we could share and deliver our teaching materials around the campus.

6. Conclusion

In this paper, I have described the features of WebLearn from the viewpoint of how I can run and use e-Math for my maths classes. My experience would be helpful for other system administrators who would like to start using WebLearn.

For me, the most attractive point about WebLearn is the access control function. The fact that this function runs well on such a large campus without any trouble greatly impressed me. Currently there is no VLE with an access control function on our campus at Gakushuin University. However, in the future when we need a function that allows the user to create access rights controls for each set of material, the University of Oxford's WebLearn and the University of Cambridge's CamTools would be a good sample. In addition, a login system or an authorization system is needed for the access control function. WebLearn uses a login system called WebAuth and CamTools uses one called Raven. A user can be identified by the system via the login process.

I will try to run my e-Math teaching materials in the WebLearn environment. Because WebLearn allows each set of materials to have a unique URL address, perhaps the teaching material would be able to run on WebLearn. Immediate feedback from students is also important for lecturers to improve the contents of their courses. In this sense, the questionnaire function is one I would like to use. In addition, I think that a short quiz immediately after every class would be effective in my maths class because it would make students review their notes and textbooks soon after the session. Therefore I will offer a quiz after each my maths class using the WebLearn Quiz function.

During my stay in Oxford, an announcement of historical importance to VLE researchers was made: The launch of the Tetra Collaboration. I was very fortunate to have been in Oxford at that time. As a big collaboration of this nature is rare in the VLE world, I will look forward to the specifications that the Tetra system will offer.

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