

Developing Standards based e-Learning Tools

The Distributed e-Learning (DeL) strand of the e-Learning Programme is funding the development of innovative, standards based, open source tools for students and teachers which aim to provide new opportunities for learning. This article looks at the rationale behind these projects and the tools that are being produced.

We have written other articles on this site about how a service oriented approach through the e-Learning Framework (now part of the wider e-Framework for Education and Research) focuses on the web services that would be required to provide all the functionality of the VLEs around at the moment. But many of the projects in the framework and tools strand have been developing tools for developing web services which may be invisible to the teacher. To address this, the e-Learning tools for teachers projects have and are developing innovative tools which are both standards based and open source [1] (#ref1). Developing tools which adhere to open standards will enable systems developers and users to pick and mix tools they need to integrate with their preferred learning environments. Wilbert Kraan discusses the benefits of using interoperability standards further in his article “*e-learning tech that is fit for purpose, innovative and sustainable*” [2] (#ref1). By developing tools that are open source it is hoped that they will be sustained by the user community after funding for the project has finished.

Some of the e-learning tools for teachers have also been developed as web services which would allow them to be easily integrated into service based learning environments in the future. In this article we discuss the implications of adopting a service based approach and highlight some of these new e-learning tools.

Service based tools

What are the benefits of using web service based tools and applications for teachers and learners? One of the ideas behind a framework of services approach is that user applications are separated from the services. This means that service provider functionality doesn't have to be built into every user application, making these applications much smaller and easier to develop or modify [3] (#ref3). The e-Learning Framework organises services into three layers, a common services layer, the application services layer and the user agent layer [4] (#ref3). The e-learning tools that are being developed belong to the user agent layer. In his ‘Application Tool Component Frameworks’ paper, Bill Olivier, Systems and Technology Development Director at JISC, presents a detailed rationale behind the frameworks approach and explains how e-tools might be integrated in the application layer either via desktop applications or via portals [3] (#ref3). The portal approach might be favoured by institutions wishing to integrate various web services into their central infrastructure. This approach is being used in the Enterprise Information Integration (EII) project at London Metropolitan University [5] (#ref3). The desktop approach would be important for students wishing to have their own personal learning environment, that would allow them to have customised access to a variety of learning resources which they can use to manage courses from a number of different educational institutions. A new Personal Learning Environment reference model project will be exploring this idea further [6] (#ref3).

REST or SOAP?

Broadly speaking there are two approaches to developing web services, a standards based approach using SOAP (Simple Object Access Protocol) and a more pragmatic approach using REST (Representational State Transfer) technologies. Wilbert Kraan explains the difference between the two:

“In essence, SOAP based web services work a bit like email – some even use existing email servers. It

is based around messages that can be scheduled for delivery, processed by different machines on their way to a final destination, queued for sending and much more. That makes it possible for SOAP based web services to have conversations with messages that are in a particular order and dependent on each other.

REST services can't really do that. They work much more like web pages; you send a request to an address, and a response comes back. That's it. There's no assumption that any request and answer pair has anything to do with another pair."

The REST approach seems to be more popular with developers:

"Experience so far, as recorded by both Amazon (WS-Amazon) and Flickr (WS Flickr) suggests that when offered a choice, developers prefer a simpler approach. In particular services that conform to an architectural style known as REST. REST services are more tightly bound to existing web architecture, i.e. HTTP and XML, meaning that developers have much less to learn to become productive with a given service or API, which in turn leads to more rapid development of client applications." [7] (#ref7)

In the case of the JISC service based tools that have been developed so far many have taken a REST approach to keep developments simple.

Round One projects

There have been two rounds of e-tools projects, the first round had 22 projects and ran from April 04 to March 05. A second group of projects began in May 05 and are due to complete in March 2006. The first round projects produced a wide range of tools, including blogging, assessment, content packaging and case study tools [8] (#ref8). There are a large number of tools to support e-portfolios and PDP, responding to a current need for higher education institutions to meet the UUK requirement for provision of personal development planning tools by last October [9] (#ref8) The use of a number of these e-learning tools is being piloted in some of the JISC Regional Pilot projects [10] (#ref8). The following section looks at a selection of these tools, why they were developed and what they do.

ASAP (Automated System for Assessment of Programming)

Computer science and Software engineering degrees usually contain modules on computer programming. However assessing the assignments for these modules can be difficult and time consuming for teachers. The ASAP project has built on previous projects at Kingston, Dublin City and Karlsruhe universities and developed a web service that can automatically assess Java programming tasks using a unit testing methodology. The project also developed other web services to provide automatically generated multiple choice questions and to test for plagiarism in the programming code submitted by students (RoboProf see below).

The project aimed to demonstrate integration with several Virtual Learning Environments. In addition to integration with the U-Portal system, the project created a Blackboard Building Block [11] (#ref11) to allow the services to be integrated into the popular Blackboard VLE.

The next phase of the project (PAINTS - Programming Assessment Integrated Training System) will develop the ASAP pilot software to a production stage as well as developing additional tools and web services to a pilot stage [12] (#ref11), [13] (#ref11).

The screenshot shows a web browser window titled "QH_QTI2 v1.0". The interface contains a search bar with a magnifying glass icon and a close button. Below the search bar, the text reads "Given the following code". The code is as follows:

```
int [] Num = new int[3];
for(int i = 0; i < 3; i++)
    Num[i] = 62 - i;
```

Below the code, the question asks: "What will be the contents of the array when it has executed?". There are three input fields labeled "Num[0]", "Num[1]", and "Num[2]". A "Mark" button is located below the input fields.

Prototype RoboProf Portlet for answering an automatically generated programming question

ASSIS (Assessment and Simple Sequencing Integration Services)

The Assis project developed a tool for orchestrating learning activities. Online learning often requires complex sequences of activities and tasks. Particularly difficult to create are adaptive sequences where students answer questions and the learning material that they are presented with is dependent on the answer they give to the question, so called adaptive testing. The aim of the project was to demonstrate that a number of web services can be orchestrated together to produce adaptive learning activities incorporating formative assessment and content. The project used BPEL (Business Process Execution Language) and a visual editor, ActiveWebFlow (published by ActiveEndpoints) to orchestrate web services for assessment, content packaging and sequencing.

The project provides a useful demonstration of how disparate web services can be orchestrated together to provide complex pieces of online learning [14] (#ref14), [15] (#ref14). Bill Olivier said of the project:

"The significance of the WS-BPEL approach (taken by ASSIS) is that it can potentially be used in a similar way to integrate other learning services and systems. If this proves to be the case, it provides a key that helps open the door to more flexible and capable e-Learning" [15] (#ref14)

ePet (e-Portfolio Extensions Toolkit)

This project has built on the generic e-Portfolio tool developed and piloted with medical, dental and biomedical science students at the University of Newcastle upon Tyne [16] (#ref16). The tool supports activities like:

- Planning and recording meetings with tutors
- Creating action plans linked to a "pending" inbox
- Recording course based and other events in a learning diary
- Performing SWOT analyses linked to specific tasks or skills
- Creating a CV
- Sharing aspects of the portfolio with others.

The ePet project has produced a REST (Representational State Transfer) based interface around the data structures of the e-portfolio to provide web service access to the tool data and functionality [17, 18]. This means that the e-portfolio tool can be linked to a VLE or student record system relatively easily. A key benefit of the ePet web service is the potential for students to be able to easily transfer their e-portfolio data with them when they move institution. The transfer of these learning records between FE and HE are being explored in the EPICS regional pilot project based in the North East of England [19] (#ref16). The ePet/EPICS project successfully demonstrated interoperability with a range of other e-portfolio systems at the e-Portfolios Plugfest in Cambridge [20] (#ref16).

Interactive Logbook

Although online resources for students in HE and FE are becoming more ubiquitous, students often work in situations where they do not have access to a networked computer running the institutional VLE, for example when they are working in groups, on field trips or placements. The interactive logbook project has designed a suite of software applications optimised for use on tablet PCs with a secure wireless local area network to allow access in lecture theatres, libraries and other workspaces. A combination of tools such as web browser, file manager, email, and organiser allows students to work on their PDAs (Personal Digital Assistant), to manage files, discussions and calendars, connecting to the network when needed. In the next phase of work the Interactive LogBook team at the University of Birmingham will continue to develop this open source Personal Learning Environment for the Windows, PC and mobile Java platforms by developing further plug-in tools, test with other tools such as e-portfolios and evaluate the pedagogical value of the Logbook [21] (#ref21), [22] (#ref21), [23] (#ref21).

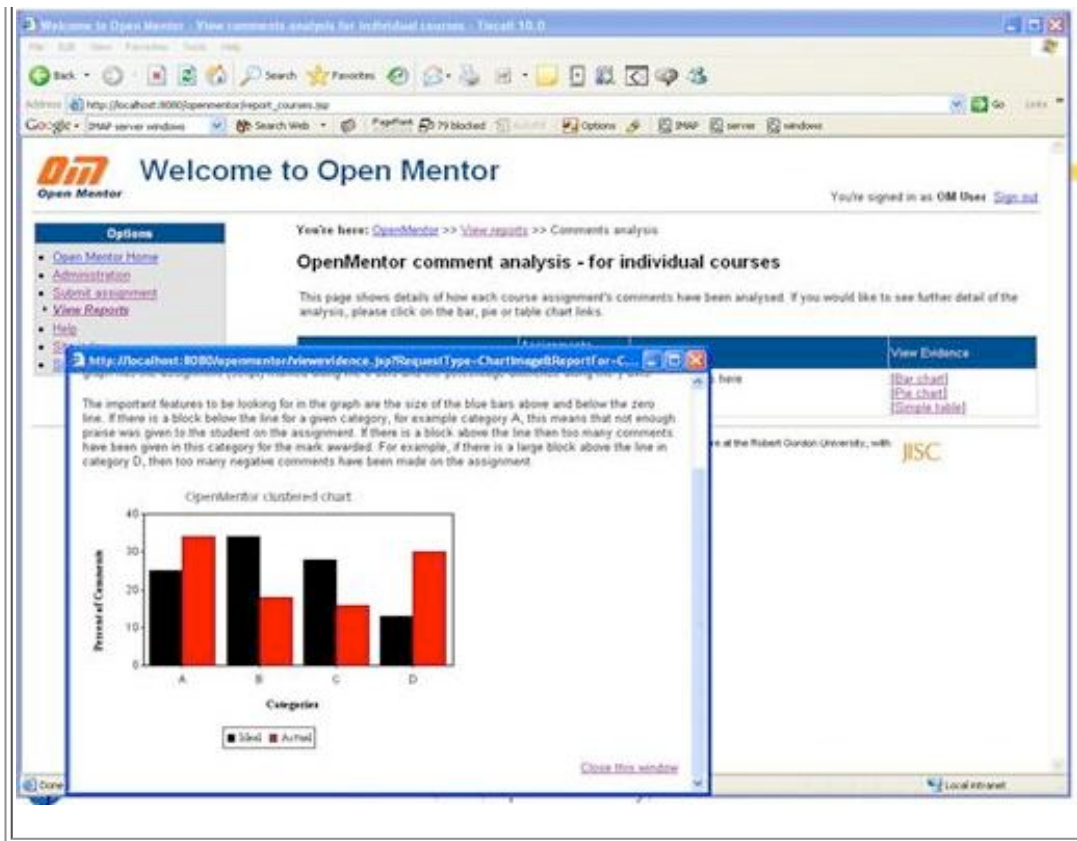
Open Mentor

Open Mentor is a tool to help teachers provide effective feedback to students about their assignments and coursework. The tool was developed by teams at the Open and Robert Gordon Universities in response to research that showed a significant link between the feedback that tutors give students and the grades students attain in assessments [24] (#ref24). Open Mentor works by stripping out the teacher comments on an electronic assignment then applying a set of rules to these comments in order to put them into four major categories. It then provides feedback to the teacher about how their comments provide support to the student [25] (#ref24), [26] (#ref24).

The software evaluators for the e-Learning Tools projects noted that Open Mentor has been extensively tested with real users and as a result rates highly for usability.

Phase two of the project will involve pedagogical evaluation, piloting in a range of FE and HE institutions and integration of Open Mentor with academic management systems for exchange of student, staff, course list and assignment data.





Analysis of Tutor Feedback in Open Mentor

RAMBLE (Remote Authoring of Mobile Blogs for Learning Environments)

Weblogs are gaining popularity amongst students and are being used increasingly in FE and HE courses. However these blogs are often unconnected with institutional VLEs. The RAMBLE project gathered requirements on the use of mobile devices by students to provide personal reflections of courses they are taking, and explored how these mobile blogs could be integrated into the Bodington VLE. Paul Trafford told us:

'The overall aim was to support learning as a more continuous process - so that it isn't restricted to particular physical spaces such as the lecture theatre, study room etc. The way we approached this was to think of a number of components that could be combined to produce a coherent workflow to support and enhance this process. We chose blogs as a simple means for content creation, ideal for personal reflection, and used mobile devices such as PDAs to enable the freedom to blog pretty well anywhere and at any time.' Chemistry and Medical Sciences students at the University of Oxford were given PDAs to record their weblog reflections. The chemistry students were asked to use the mobile devices to give feedback on lecture courses, tutorials and practicals while the medical sciences students were asked to record their learning experiences while on clinical rotation. In a recent article for Ariadne Paul Trafford, the project co-ordinator, noted that the student reflections were unexpectedly rich, and students expressed themselves very freely [27] (#ref27).

The second part of the project addressed the technical issues of transferring the student blogs from PDAs to the Bodington VLE, using syndicated newsfeeds [28] (#ref27), [29] (#ref27). Paul says:

'Blogs written on the mobile devices were not transferred directly to the VLE but rather, as an intermediate step, were stored on blog servers. From there they were then read into the VLE. By keeping the blog hosting as a component separate from the VLE, we have a setup in which blogs may be written in any external systems that supports standards based content syndication and subsequently incorporated in VLEs.'

Serving Maths

Displaying mathematics online has presented challenges for the mathematics and science communities. Equations require detailed and particular notation which if wrong can entirely change meaning, which is why MathML was developed to allow mathematical expressions to be represented on the web. In addition, while many e-assessment systems offer questions with numerical input – very few enable evaluation of algebraic expressions as an answer, or enable teachers to view the student's working out of a particular problem. This project addressed some of these issues.

The first phase of the project was based at York and Strathclyde universities and developed a web service for displaying mathematical questions that use the MATHQTI specification, RQP (Remote Question Protocol). The project produced question rendering engines and authoring tools for new question types by extending (rather than replacing) existing computer algebra and assessment systems. This modular approach allows integration of a wide variety of question types with the VLE. At York the team integrated the RQP web service with the Moodle VLE.

The second phase of the project based at Imperial College London will evaluate the tool and will build in authoring tools for making mathematical questions and tests incorporating the current MathQTI and XML schema [\[30\] \(#ref30\)](#), [\[31\] \(#ref30\)](#).

Quality and Sustainability

A Software Quality Evaluation team to survey the usability and quality of the software the projects produced. The team recognised that these projects were producing prototype tools and not shrink-wrapped final products. In their report the team emphasized the need for projects to build in quality processes from the beginning and ensure that projects fully comment their code and document their tools development [\[32\] \(#ref30\)](#). This is particularly important when projects are open source and may rely on others to further develop and sustain their tools in the future. In the new phase of tools development a peer review quality process has been put in place for projects to review the technical quality of each other's software.

Round Two projects – pedagogical evaluation

Twelve projects have been funded in the second phase of work which will complete in March 2006. The projects will build on the first phase projects,

“to mature and refine existing open source e-learning tools and invites bids to develop, trial, evaluate and disseminate open source e-learning tools for teachers and learners”[\[33\] \(#ref33\)](#)

Details of the phase two projects are below and on the JISC web site [\[34\] \(#ref33\)](#). This phase is also emphasizing the need for user feedback in the development process and Helen Beetham a consultant from the e-learning and pedagogy strand of the programme has given guidance to the projects on this. Helen says in evaluating how useful a tool is for teaching and learning projects need to ask the following questions:

“..is this tool actually useful in learning, teaching and/or assessment? How is it useful? Does it offer an appropriate solution to the demands of the learning, teaching and/or assessment context?”[\[35\] \(#ref33\)](#)

Project	Short Description
Tools for Assessment in Mathematics	Evaluating, piloting and developing the Serving Mathematics tool
DELTA 2 [36] (#ref36)	Enhancing the DELTA service to be able to cope with multiple ontologies

Horus FP [37] (#ref37)	Developing a version of Horus to support a foundation programme
Interactive Logbook 2 [38] (#ref38)	Developing the Interactive logbook open source personal learning environment
InterLoc	Developing, piloting and pedagogically evaluating the Academic talk tool
Open Mentor 2 [39] (#ref39)	Further developing this tools which allows tutors to analyse and provide reflective feedback to students
My World [40] (#ref40)	Developing the Petal e-portfolio tool to provide an offline tool for mobile devices
PAINTS (ASAP 2) [41] (#ref41)	Developing the Automatic System for Assessment of Programming project to production stage and developing additional tools
Shell-fish 2	Extending the shell-fish feedback and PDP tool to include an administration interface, user forum, based on user feedback
TRICS 2	Extending the interactive case studies tool for piloting in several institutions
V Map 2 [42] (#ref42)	Developing the V-Map e-portfolio tool for creating presentation of e-portfolios
WCKER 2 [43] (#ref43)	Piloting, and evaluating the effectiveness of this tool which creates wizards for structuring courses (based on the Reload tool)

Conclusion and Downloads

This group of projects are developing tools that will extend the range of tools currently available to teachers. Web service enabled tools like ASAP, ePet and Serving Maths are already being integrated and used from within Virtual Learning Environments to extend the system usability. The ASSIS project has produced a demonstration of how workflow between services might be orchestrated in the web service enabled environments of the future. Hopefully after the piloting and pedagogical evaluations that are currently taking place teachers from other institutions will start to use these tools and user communities will develop which will secure the longer term future of these tools.

Details of all of the phase one [8] (#ref8) and two [34] (#ref8) projects can be found on the JISC web site. The aim of these projects has been to prototype tools that will offer new e-learning functionality to teachers and learners. This means that so far projects have produced pilot rather than “shrink wrapped” products. Current versions of the tools are available to download from the SourceForge web site [44] (#ref8). A CD-ROM containing the tools will be produced in the early part of 2006. Give them a try!

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