TOIA

Technologies for Online Interoperable Assessment Project

Final Project Report (External)

Project Summary

This report provides a summary of the JISC-funded TOIA (Technologies for Online Interoperable Assessment) project which ran from 2002 until June 2007. The project was based at the University of Strathclyde, with a number of other institutions contributing to the project's development.

Formative and summative assessments are key components of learning. Consequently the development of new approaches to assessment, facilitated by information technology, offer opportunities to enhance the student learning experience in a cost-effective way.

In 2002, when the Technologies for Online Interoperable Assessment (TOIA) was originally commissioned by JISC, there was a serious lack of quality and timely feedback available to FE and HE students in the UK, as was pointed out by many of the HEFCE subject review summary documents published at the time.

The processes of **a)** presenting a question or problem to the learner; **b)** obtaining a response from them via the computer; **c)** evaluating this response; **d)** providing a mark, and **e)** responding to the learner with feedback, all required the provision of reliable systems. With few exceptions (most notably QuestionMark with their Perception system) there was a lack of software systems able to provide such functionality. This was due, in part, to the lack of an agreed format in which to exchange questions and tests.

With the release of the IMS Question and Test Interoperability (QTI) specification in 2002, developers started implementing systems which allowed assessment content creators and users to share data in a platform-independent format. At that time JISC commissioned the University of Strathclyde to develop the TOIA (Technologies for Online Interoperable Assessment) system as part of the Exchange for Learning (4XL) programme. Details of the X4L programme can be found at URL: http://www.jisc.ac.uk/whatwedo/programmes/programme_x4l.aspx

The main objective of the TOIA project was to provide a facility to allow the UK post-16 sector to investigate the benefits of computer-aided assessment, with no initial investment required on the part of the user. The TOIA assessment software was developed in conjunction with a commercial company Freedom2 Learn (a joint venture between Excelsoft Technologies and Dynamic Distance Learning). By outsourcing the software development the project was able to bring a product to the sector much more rapidly than would have been achieved by starting a development from scratch.

The TOIA product was initially offered to institutions through a download facility. While this facility was popular, it became apparent that this mode of delivery did not suit all potential users, for several reasons including:

- The existence of firewalls in some institutions, particularly in FE colleges, preventing the download of the software.
- The software itself not being compatible with all operating systems which meant that not all institutions could host it on their servers.

Consequently, in 2005, JISC funded the TOIA project team to provide a hosted service for users i.e. a service where the TOIA assessment engine and all the data contained therein resided on a server located at the University of Strathclyde. Once granted an account by the systems administrator at Strathclyde the TOIA application was accessed by users through a web interface. This service also proved to be relatively successful during the project, with a number of individuals and organisations running assessments on the hosted service.

During the course of the project, the computer-aided assessment (CAA) and e-learning landscapes within which TOIA was operating changed in several ways:

1. Commercial CAA products are becoming more sophisticated and more widely used within FE and HE. Increasingly, these are purchased and supported as part of an institutional e-learning strategy. As such, many individuals can now experiment with CAA on their institution's own system.
2. There is now a desire to integrate CAA systems with institutional VLEs. Increasingly institutions will make CAA investment decisions based on their VLE technology and platforms. An externally-hosted CAA system cannot provide this level of integration.
3. Many institutions have elected to follow an open-source strategy in relation to e-learning. This allows them to tailor products to fit their specific requirements. TOIA, a propriety, closed-source product, does not offer this functionality either in its hosted or download modes.

Consequently, while TOIA proved an excellent vehicle to promote and build capacity in computer-aided assessment it is unlikely to provide a long-term solution to institutional assessment requirements.

Phase 1– Development of the TOIA Assessment Management System (2002-2005)

The first phase of the TOIA project ran from 2002 to 2005 with the primary objectives of

1. Defining an administrative infrastructure for national UK FE/HE question and test banks.
2. Defining the technical infrastructure and developing tools for the creation, storage, online exchange and delivery of assessment content.
3. Encouraging the development of an internal market within UK FE/HE for assessment content

These objectives were achieved through focussing on the development of a free e-assessment tool for use in the UK post-16 sector. Through this product the project intended to demonstrate best practice in achievement of interoperability and implementation of the then-current e-assessment standards. To facilitate a quick development cycle, the development was outsourced to Freedom2Learn, a joint venture between Excelsoft Technologies and Dynamic Distance Learning. Excelsoft adapted their proprietary system for use in the TOIA project. The TOIA assessment software was delivered on schedule and was made available for download to education users in the UK.

The TOIA Assessment Management System (AMS) has the following features:

- Pedagogical and functional direction by leading UK CAA experts
- Sophisticated administration and reporting options
- 9 question types
- Completely web-based
- Secure and robust
- Optimised for standards compliance (IMS QTI, Content Packaging and IEEE Learning Object Metadata)
- Customisable user interface

A number of partners were involved in the specification, development, testing and dissemination of the product. They are listed below, together with their role in the project:

Institution / Project	**Activities**
University of Southampton	Involved in e3an project with a large-scale question bank. Helped with interoperability testing and produced an Offline Authoring Tool
University of Loughborough	They have a very large scale implementation of CAA. Advised on CAA Guidelines
Sheffield Hallam University	Participated in early UI evaluation and did interoperability testing.
Glenrothes College	Represented the FE Sector in Scotland and advised on their requirements.
Edexcel	Members at Edexcel provided examples of innovative question types for incorporation into TOIA tools and assisted in the trialling of the tools.
Newark & Sherwood College	Represented the FE Sector in England and advised on their requirements.
Freedom 2 Learn / DDL UK **http://www.ddluk.com**	Co-ordinated UK side of the proposal and brought in ExcelSoft who also did a lot in Interoperability testing.
ExcelSoft India **http://www.excelindia.com**	As described previously, they adapted their own assessment system which was standardised for the Project.
DeL e-Tools TIPs Project http://www.jisc.ac.uk/whatwedo/programmes/	Produced a web services integration between TOIA and Boddington VLE.

programme_edistributed/delettip.aspx	
JISC APIS http://www.jisc.ac.uk/whatwedo/projects/apis.aspx	Produced additional web service features for QTI based assessment systems.
HELM Project http://www.lboro.ac.uk/research/helm/	Used TOIA to run their assessments online for free.

This application, available free-of-charge to the UK HE and FE community proved popular being downloaded over 800 times. Its free availability allowed users to experiment with computer aided assessment prior to making any significant investment. The amount of interest received from the HE and FE sector has been significant in demonstrated the effectiveness of the project's dissemination efforts and helped promote the use of online assessment and *interoperability* of assessment items - another key objective of the original TOIA Project.

Phase 2- Hosted Service (2005-2007)

One of the unplanned consequences of releasing the TOIA system was the demand for a hosted assessment service. Initially it was assumed that most institutions would wish to install the software locally. However certain technical issues, such as firewalls which prevented downloads and incompatibility between the TOIA system and operating platform in institutions, meant that there was some demand for a hosted online assessment service.

The hosted TOIA service – based as the University of Strathclyde – allowed institutions to administer and run standards-compliant online assessments for students without installing TOIA locally. The hosted service was also free and was used in a number of ways;

a) To run formative and summative assessments for external institutions;
b) as a medium for training colleagues on e-assessment, TOIA and interoperability;
c) for evaluation purposes – by colleagues who were looking at different CAA systems

The service ran from 2005 until June 2007 on a pilot basis. In April 2007 a comprehensive evaluation of the TOIA Hosted Service was carried out Prof. Grainne Conole of the Open University.

Future Hosted Service Provision

Whilst TOIA was successful as a project there is a huge step-change between offering a pilot service to users on a 'best endeavours' basis and offering a commercial service which is robust enough to allow institutions to base both formative and summative assessments on it. These issues include not only the initial software and hardware investment required by the service provider (to ensure continuous running through phases of planned and unplanned downtime) but also the investment in staff to provide at least 9-5 cover for each normal working day of the year. Consequently this type of service is best supplied by established, commercial vendors, some of whom (e.g. Questionmark) already offer hosted assessment services.

That said, there are certain issues explored by the TOIA project that would have to be considered by any organisation that was considering using a commercial, hosted assessment service

Functionality

The experience of the TOIA project key areas of functionality that would be required of any hosted service:

- The hosted service would have to compatible with wide range of browsers e.g. Internet Explorer, Mozilla Firefox, Opera, etc.
- The application would have to support an increased range of question types than is present in the current TOIA product.
- The application would have to be compliant with existing and future QTI standards. This is a key requirement as it will involve the supplier in periodic investment in upgrading and retesting the application.
- The system would have to allow some integration or exchange of information with major VLE applications.

Service Level

The pilot TOIA hosted service was offered on a 'best endeavours' basis, allowing institutions and other interested parties to evaluate the system, and experiment with on-line assessment. The service level for any future hosted service would have to be clearly specified. This service level should include issues such as:

- Supported Hours. The hours when the systems is supported by staff. Given the time-critical nature of assessment software, particularly when it is being used for summative assessment, it may be that 9-5 support is not adequate and additional support may be required, particularly at peak times.
- Robustness and reliability. Any invitation to tender for a hosted assessment service should include statements on the stability of the system, its security against malicious attack, the robustness of internal validation procedures and the existence of audit trails to prevent data corruption and facilitate recovery of data.
- Capacity. The number of concurrent users will be a major issue. Infrastructure would have to accommodate large capacity peaks at traditional examination periods (e.g. May). This may require substantial investment on equipment that might be relatively underutilised most of the time. This may make for an expensive unit cost per assessment or per user.

Intellectual Property Rights.

The IPR of the content (e.g. questions) entered on the system would have to be stipulated in any agreement. Again, in a commercial situation, this is an area that would have to very carefully managed as there are implications for

Any potential synergies developed through shared item banks are potentially mitigated by the IPR issues surrounding the sharing of questions , answers and other related materials. These are fully explored in the IBIS (Item Bank Infrastructure Study) report commissioned by JISC (http://www.toia.ac.uk/ibis/)

Exit Strategy

As with any technology-based venture it will be important to consider the exit strategy for a hosted service especially the manner in which content can be extracted from the system, should the client decide to move to another system or service provider.

Project Outputs and Outcomes

The main outputs of the TOIA project were the TOIA Assessment Management System, which is compliant with the QTI version 2.0 stnadard. A copy can be obtained by visiting www.toia.ac.uk . Copies of the accompanying Teacher and Administrator guides can also be accessed from the website.

The project also delivered a number of outcomes:

- Increased awareness and use of online assessment within the targeted UK HE and FE community.
- Demonstration of hosting as a means of reducing institutional administration commitment thus increasing the uptake of computer-aided assessment (CAA).
- Increased understanding of the technical issues of hardware, software, security and robustness associated with managing such a hosted web application.
- Evaluation of the demand for a regionally or nationally-hosted CAA service.
- An understanding of the relative financial costs associated with setting up and administrating a completely hosted CAA service.
- Promotion of the use of question banks within the community. Hosted or centrally managed services tend to facilitate sharing of content and this would be a positive step towards fulfilling the visions of the IBIS (Item Bank Infrastructure Study) project. The IBIS report is available from URL: http://www.toia.ac.uk/ibis/
- Early adoption of QTI version 2.0 specification. As one of the first assessment management systems to implement QTI v2.0, TOIA promoted the take-up of the improved specification.

Dissemination

The TOIA project undertook a comprehensive and wide-ranging set of dissemination activities, with the aim of not only publicising the TOIA project but also raising awareness computer-aided assessment within the post-16 education sector. Dissemination activities included the following:

Publications and Publicity

Bull J, **Conole G C**, **Danson M**, **Davis H C**, **Sclater N** and **White S A** (2002) *'Rethinking Assessment Through Learning Technologies'*, Paper presented at ASCILITE 2002, Auckland NZ.

McAlpine M and **Hesketh I** (2003*) 'Multiple response Questions: Allowing for Chance in Authentic Assessments'* in Christie, J (ed) Proceedings of the Seventh International Computer Assisted Assessment Conference, Loughborough - Available online via **http://www.caaconference.com**

Clark G and **Herd G** (2003) '*Joined up or Just Lucky? Implementing CAA is Scotland*' in Christie, J (ed) Proceedings of the Seventh International Computer Assisted Assessment Conference, Loughborough - Available online via **http://www.caaconference.com**

Conole G C and **Sclater N** (2005) *'Using Evaluation to Inform the Development of a User-Focused Assessment Engine'* in Danson, M (ed) Proceedings of the 9th International Computer Assisted Assessment Conference, Loughborough - Available online via **http://www.caaconference.com**

Presentations

December 2002
Hesketh I '*Online assessment and improving feedback',* Centre for Strategic Manufacturing, University of Strathclyde.

January 2003
Sclater N *'Computer-assisted Assessment'*, LTSN Languages, Linguistics and Area Studies CAA Workshop, University of Strathclyde.

February 2003
Hesketh I '*QTI's a Mystery'*, JISC/CETIS/Jorum+/Reload/TOIA Workshop, Manchester Conference Centre.

Sclater N '*Online Assessment'*, Bolton Institute of Higher Education, Staff Development Workshop.

July 2004
Sabir J and **Sclater N** '*Gain Hands-On Experience Using the Freely Available Interoperable Assessment Tool'* – TOIA Workshop - 8th International Computer Assisted Assessment Conference.

March 2007
Sieber V ***'Introduction to on-line diagnostic, formative and summative assessments',*** Oxford Medical Sciences Teaching Centre, Staff Development Workshop.

TOIA Workshops for the JISC Regional Support Centres

September 2004	**Sabir J** - RSC Northern Ireland
November 2004	**Sabir J** – RSC Northern
December 2004	**Sabir J** – RSC West Midlands
	Sabir J – RSC London
February 2005	**Sabir J** – RSC South-West
	Nock A – RSC East Midlands

Promotional Items

TOIA produced a leaflet for distribution at the 7th International CAA Conference that was inserted each delegate packs along with a business card and a pen drive. This was a major dissemination activity that reached CAA specialists, users and developers. There was significant interest in TOIA not only from UK colleagues but some interest from European organisations e.g. University of Leuven
The latest TOIA leaflet is available online at **http://www.toia.ac.uk/docs/toia_leaflet_2005_03_03.pdf**

TOIA was also promoted to 30+ delegates at the then-latest CETIS Assessment SIG and at the ALT-C-2005 conference.

Press releases

Bull J and **Danson M** *'Computer-assisted Assessment'*, A LTSN Guide for Learning Technologists, LTSN.

Bull J and **Hesketh I** *'Computer-assisted Assessment and Higher Order Skills'*, A LTSN Guide for Learning Technologists, LTSN Generic Centre.

Sclater N and **Low B** *'Authoring Reusable Computer-Assisted Assessment'*, LTSN.

Sclater N Consultant on '*SQA Guidelines on Online Assessment for Further Education*', SQA.

Kraan W '*Exam in Hull, results from Glasgow',* CETIS Staff, December 2004. Available online at http://zope.cetis.ac.uk/content2/20041216193346

Netskills Course

The JISC funded course entitled *'e-Assessment Tools & Techniques'* was first delivered in April 2005 and has been part of the Netskills portfolio of courses until recently. The course was using TOIA to demonstrate interoperability and introduce a few different alternatives, based on the level of advancement.

Lesson Learned

The TOIA project explored a number of important issues and the lessons learned may be of interest to future projects in this area.

Outsourcing development work may provide better Value for Money
The outsourcing of TOIA's development to a software house in India has resulted in a far better product than could have been built by local programmers, primarily because it allowed TOIA to be based on an existing product, thus reducing development time, and to draw on an existing pool of skilled staff, again reducing recruitment time and reducing the risk associated with staff turnover.

Overall the experience was highly productive and we would cautiously recommend that future software (or content) development projects seriously consider the value for money which can be obtained by such an approach. The software house was able to dedicate a team of developers to the project, who were able to provide round-the-clock support and rapid updates, which would have been more difficult for a lone soft developer based within one of the TOIA collaborators' institutions.

Open-source solutions offer longer-term benefits than closed-source solutions
Despite the success of the TOIA software within the community, it is evident that the closed nature of the product dissuaded some institutions from implementing the product where it might otherwise have addressed all the requirements for an organisation.

This is apparent by working with associates from Oxford University and Liverpool Community College, both of whom had requirements that were slightly different from the features of the tool, although the tool satisfied more than 90% of their needs. They would easily have been able to tailor the system to alter or add new functionality but were unable to do so (without potentially incurring a large cost) since the source code was licensed by ExcelSoft in India.

Since the instigation of TOIA project, the increasing popularity of open-source systems, such as Moodle, substantially changed the environment within which TOIA was operating. For example, the Moodle assessment engine is being developed and improved on a regular basis and will potentially be more popular than a solution like TOIA within HE and FE institutions, due to the potential for in-house expansion and lower cost development.

Using existing Academic technologies is preferable to brand new technologies
Most HE institutions employ open-source web technologies, such as Apache, and will typically use Oracle as their database solution. Whilst this will not be the case with every institution, we found that certain systems administrators had difficulty supporting Microsoft IIS (Internet Information Server) and SQL Server as it would require retraining of their systems management staff. TOIA is very much integrated with those very technologies which has meant that certain institutions were unable to employ TOIA as part of their systems

infrastructure. However, they were still able to make use of the Hosted Service, which the staff from a number of such organisations did on certain occasions.

The need to play and explore
While CAA (Computer Aided Assessment) is still at a developmental stage, a number of institutions have not provided staff with a corporate solution to their Computer Aided Assessment requirements. Consequently, a hosted assessment service provides a very useful tool to build capacity in the sector by allowing staff to experiment with CAA , become advocates within their own institutions and drive institutional take-up.

FE sector security at odds with downloadable or hosted software.
Despite the availability of the TOIA software to colleges within the FE Sector, it became apparent that the network security in certain colleges was too tight to allow people to download software from external sites. Their firewalls limit the type of network activity that can be performed. This is not the case for every place, but we noted that most colleges had these restrictions which reduced the take-up of TOIA within areas of FE.

Conclusion

An external evaluation of the TOIA project was commissioned. This was conducted in April-May 2007 by Prof. Grainne Conole of the Open University in 2007. The executive summary of that report concludes that

……the project was timely; occurring at the start of an upsurge of interest in development and use of e-assessment across FE and HE. It formed part of a cluster of related projects and can be linked to other projects which were funded after TOIA. The project steering group worked well bringing together a range of expertise in e-assessment across FE and HE. The project explored an interest model of technical development through partnership with a commercial company and outsourcing of the product development. This enabled the project to produce a high-specification, high-functionality e-assessment system within 18 months of the project inception. The project was deemed to act as a valuable catalyst to raising the profile of e-assessment across the sector and enabled individuals to trial a high-end e-assessment system, as well as enabling them to explore its potential use for teaching and learning. The project used a range of appropriate mechanisms to disseminate the product including collaboration with Netskills to provide a suite of e-assessment workshops. The project also acted as a testbed for demonstrating proof of concept in interoperability by implementing and demonstrating the potential of the QTI e-assessment standard.

Further Information

Further information about the TOIA project which ended in June 2007 can be found at www.toia.ac.uk