SPAID (Storage and Packaging of Assessment Item Data)

Final Report

Rowin Young, Sheila MacNeill. Dave Adams, Mhairi McAlpine

Dr Rowin Young
Alexander Turnbull Building
University of Strathclyde
155 George Street
Glasgow G1 1RD

t: 0141 548 2298
f: 0141 548 4216
e: rowin.young@strath.ac.uk

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Executive Summary

The Storage and Packaging of Assessment Item Data (SPAID) project scoped and implemented services to facilitate the packaging of assessment items for storage in an item bank and the search and retrieval services necessary for the use of item banks.

The project produced a number of deliverables:

Content packaging service for assessment items
The project work included the development of a content packaging web service for assessment items implementing the IMS Question and Test Interoperability v2.0 specification. This enables item content packages to be exchanged between compliant services. As the zipping of content packages is not a mandatory part of the IMS Content Packaging specification, but is agreed to be good practice and necessary for the transportation of files over the internet, a separate zipping service was developed.

Customisable metadata tagger
A metadata tagger was also developed as part of the project, which is customisable to allow users to reflect their individual profiles. Many metadata fields can be completed automatically by extracting data from an item's XML. The tagger therefore provides the functionality to extract this information and complete metadata fields as one of its services. Automatic generation of metadata is widely recognised as greatly enhancing the quality and fullness of metadata records, and therefore increasing the visibility of resources within repositories.

Sample item repository
A file-based repository system was developed which can be further enhanced by the addition of a database by implementers.

Item bank web services
Web services to support package insertion, simple searching and item retrieval were developed to support the sample item repository.

Usage data scoping
It was intended that the project would implement the usage data part of the IMS QTI *Meta-data and Usage Data specification v2.0*. However, it rapidly became apparent that this specification is not implementable in its present form, and is heavily biased towards US use. A detailed critique of the current usage data specification was produced and forwarded to the IMS QTI v2.1 working group, and a meeting between project staff and members of the IMS working group is planned for later this year.

Domain scoping and reporting
The project included a domain scoping phase, which involved the gathering of use cases and scenarios around item packaging, banking and retrieval, and development of a draft UK application profile of the QTI v2.0 LOM application profile.

Project management and requirements gathering
SPAID adopted the SCRUM Agile project management approach for day to day management and delivery of the project together with a Joint Application Development (JAD) technique to gather requirements for the technical development phases of the project deliverables. A detailed discussion of this methodology is available on the project website at http://www.learningservices.strath.ac.uk/spaid/spaid.html.

Achievements and conclusions
Because of the discrete nature of the services produced by SPAID, it will be possible to further develop each of the outputs into a separate toolkit, generalised for use beyond item banking. Project staff are actively involved in seeking partners for future work on this.

This work has made a significant move towards the development and usability of interoperable assessment item banks, and it is hoped that it can be further developed to benefit developers, teachers and learners across the education sector.

Background

The development, population and operation of item banks are becoming increasingly important issues for the UK education sector. Interoperability specifications such as those produced by IMS facilitate the production of assessment resources in formats which enable sharing and reuse, yet there is currently little understanding of how this can be done on the medium or large scale across the assessment community. Recent initiatives such as the Item Banks Infrastructure Study illustrate the pressing need for further work to be undertaken in this area.

The IMS Question and Test Interoperability (QTI) v2.0 specification incorporates a *Meta-data and Usage Data* document, consisting of an application profile of the IEEE LOM extended to allow the recording of detailed information on assessment items, and a specification for a separate usage data class. Both are bound to their assessment item through Content Packaging as defined in the QTI v2.0 *Integration Guide*.

SPAID built on initial work undertaken in this area by the Scottish Qualifications Authority (SQA), who have been building a small item bank based on the QTI v2.0 specification. They have been converting paper-based mathematics questions to an electronic format and storing them as individual files. They have also been creating linked metadata with their own application profile which has been developed for their needs from the UK LOM Core, the CanCore guidelines and the TOIA/COLA assessment metadata profile. Metadata is currently held separately due to problems with content packaging QTI v2.0 items. Although the items and their associated metadata are browsable, there is no search and retrieval mechanism currently associated with this work.

Aims and Objectives, outputs and outcomes

The project scoped and implemented services to facilitate the packaging of assessment items for storage in an item bank and the search and retrieval services necessary for the use of item banks.

The project aimed to produce a number of deliverables:

Content packaging service for QTI v2.0 assessment items
The project work included the development of a content packaging web service for QTI v2.0 assessment items to facilitate the storage and retrieval of item content packages between compliant services. As zipping is not a mandatory part of the IMS Content Packaging specification, but is agreed to be good practice and necessary for the transportation of files over the internet, a separate zipping service was developed.

Customisable metadata tagger
A metadata tagger was also developed as part of the project. The default for this tool is the LOM application profile and QTI extensions defined within the IMS QTI *Meta-data and Usage Data* v2.0 specification. It is however recognised that item bank managers will wish to develop their own application profiles, either of the QTI profile, of the LOM itself or (within the UK) of the UK LOM Core. The tagger is therefore be customisable to allow users to reflect their individual profiles.

Many of the fields within the LOM and its application profiles can be completed automatically by extracting data from the item's XML. The tagger therefore provides the functionality to extract this information and complete metadata fields as one of its services. Automatic generation of metadata is widely recognised as greatly enhancing the quality and fullness of metadata records, and therefore increasing the visibility of resources within repositories.

Usage data file generator
It was originally intended that the metadata tagger would also generate a customisable usage data file to accompany the item metadata. Unlike metadata, usage data is inherently dynamic, and highly context-specific, and SPAID investigated the services necessary to support this unique feature of item banks. While the exchange of metadata with its item is desirable and often necessary, for example, in order to convey copyright and rights information, usage data is often proprietary and confidential. There are conflicting use cases for the treatment of usage data when storing and exchanging items. 'Retired' items supplied to an item bank by an examination board, for example, may require the

stripping of sensitive usage data during the process of transferring the item from the in-house item bank to the community resource. By contrast, the IBIS model proposes that the terms of use for community item banks should include a responsibility to return usage statistics in order to improve the quality of items contained and assist users in identifying appropriate resources.

It was intended that the project would implement the usage data part of the IMS *Meta-data and Usage Data specification* v2.0. However, it rapidly became apparent that this specification is not implementable in its present format. Additionally, the item statistics recorded by the specification are highly US-specific, and does not reflect the information required by UK organisations.

A detailed critique of the current usage data specification was produced and forwarded to the IMS QTI v2.1 working group for incorporation in the v2.1 workplan, together with a suggested VDEX glossary of important statistics, and a meeting between project staff and members of the IMS QTI working group to work on v2.1 of the usage data specification is planned for later this year.

Sample item repository for storage of assessment items
It was initially intended that the sample item bank would be stored in an MSDE database. However, during development of other parts of the SPAID project it became apparent that there would not be enough time to fully implement this concept, and to produce a file-based repository instead. As all access to items within the item bank would be through the item bank web services detailed below, a database could be introduced at a later stage without affecting the original code.

Item bank web services
Web services to support package insertion, simple searching and item retrieval were developed to support the sample item repository.

Domain scoping and reporting
The project included a domain scoping phase, which involved the gathering of use cases and scenarios around item packaging, banking and retrieval, available on the project's SourceForge page. A draft UK application profile of the QTI v2.0 LOM version was also developed.

Methodology

The project used a Joint Application Development (JAD) requirements gathering workshop together with SCRUM project management to plan and monitor the technical development phases of the project deliverables. SCRUM is an Agile project management approach which has been highly successful in this project. More detailed information on the SCRUM approach can be found at http://www.controlchaos.com.

JAD is a results-oriented approach to collecting high quality information and developing project deliverables in a compressed timeframe using facilitated workshops.
A facilitated workshop uses a facilitator to guide participants through a structured process. The process is designed to produce one or more project deliverables interactively with the workshop participants. The process is developed as a detailed agenda before the workshop takes place.

Goals
The goals of a JAD workshop are to:

- improve the communication between business users and a project team
- speed up the development process by performing several tasks in a single workshop that otherwise may take several weeks or months to complete using more traditional information gathering and decision making approaches
- improve the quality of deliverables by promoting involvement from all parties interested in the deliverable
- increase creativity by involving many people in design activities
- remove project teams from the function of intermediary in the negotiation and resolution of conflicts by directly involving all interest groups

Benefits

JAD can be used for many activities involved with project management, strategic planning and solution development. It can also be used in any situation where a consensus is required on a subject from a group of people. The most common uses are for strategy development, defining the scope of a project, gathering requirements and developing business models (use cases) or business object models.

By adopting the JAD approach, the following benefits can be recognised

- Potential reduction from normal schedule
- Improvement in progress visibility
- Potential to improve final product quality
- Effect on schedule risk (decreased risk)
- Effect on project cost (decreased cost)
- Chance of first-time success
- Chance of long-term success

A report on the SPAID project management methodology is available on the project's webpage.

Implementation

A two day JAD was held on 9 -11 May, 2005 with all project members and a small number of invited experts in the areas of web-services and assessment. Detailed information on the structure of this workshop is available on the project website at http://www.learningservices.strath.ac.uk/spaid/spaid.html. During these two days each of the project deliverables was discussed in detail as were possible technical approaches to development. Basic use cases were used to decide what aspects of functionality would be considered in or out scope for development. Most time was spent discussing the meta data generator and item bank functionality. The later included discussion around content packaging/unpackaging. A detailed report was generated from the workshop, available at the link above. This report was signed off by the project board. The outcomes of the JAD provided the starting point for planning the workflow for the development team. Development priorities were explicit by the end of the JAD.

A development schedule was drawn up based on four 30 day work cycles referred to as 'sprints'. Each sprint stared with a 'scrum' meeting between the development team and the 'client', in this case the project executive (Mhairi McAlpine, SQA) took this role. From this meeting a detailed schedule was drawn up for each member of the development team. During each sprint, daily team meetings were held. This allowed the team to monitor and adapt (if and when necessary) on a daily basis. Weekly reports were circulated to core staff, and a representative from the University of Strathclyde (usually Rowin Young) attended the Friday SCRUM and update meeting.

Conclusions and implications

Because of the discrete nature of the services produced by SPAID, it will be possible to further develop each of the outputs into a separate toolkit, generalised for use beyond item banking. Project staff are actively involved in seeking partners for future work on this.

This work will make a significant move towards the development and usability of assessment item banks. By following where possible good practice in the use of digital repositories in general, and adhering to appropriate standards, specifications and research findings (IMS Digital Repositories Interoperability, JORUM+, etc), SPAID will enable not only the sharing of assessment items for use in test scenarios, but also offer first steps towards the use of item banks side-by-side with other digital repositories.

References

- IMS Question and Test Interoperability v2.0, v1.2. http://www.imsglobal.org/question/index.html.
- QTI v1.2-to-v2.0 conversion tool. Python source: http://pyassess.ucles-red.cam.ac.uk/; Windows version : http://e-learning.surf.nl/six/toetsen_en_assessment/2416.

- IEEE LOM, http://ltsc.ieee.org/wg12/.
- UK LOM Core – application profile http://www.cetis.ac.uk/profiles/uklomcore.
- IMS Content Packaging v1.1.4. http://www.imsglobal.org/question/index.html.
- IMS Digital Repositories Interoperability specification where appropriate. http://www.imsglobal.org/digitalrepositories/index.html.

Appendixes

Detailed project documentation, including a review of the project management methodology, can be accessed at http://www.learningservices.strath.ac.uk/elearning.html.

Source code is available from the project's SourceForge site at http://www.sourceforge.net/projects/spaid.