CASPER: FLEXIBLE SUPPORT FOR COLLABORATIVE ASSESSMENTS AND E-PORTFOLIOS FOR WORK-BASED LEARNING

Martin Stanton, Nick Whittaker
UbiqLab, Department of Computing and Mathematics, Manchester Metropolitan University, Manchester, U. K.

Christopher Tubb
Division of Computing, University of Wales Newport, Newport, U. K.

Keywords: Collaborative Assessment, Work-based learning, Semantic web, RFID.

Abstract: This work proposes a system for flexible support of collaborative assessments that combines both physical and electronic artefacts. The project builds on current work using RFID for identifying, tracking and cataloguing physical artefacts, and also leverages Semantic Web Technologies for maintaining the relationships between physical and electronic artefacts, allowing multiple format submissions of assessment material. These relationships can be extended to any other documentation associated with the assessment (marks, feedback, moderation etc) thus permitting the use of innovative, multi-faceted assessments where less time is spent managing the submissions and more time is spent assessing and feeding back to students. The work will provide support for any collaborative assessment, but will be particularly useful in constructing, maintaining and assessing e-portfolios for work-based learning.

1 INTRODUCTION

Innovation in assessment is becoming a requirement in modern higher education and is widely reported (Galloway 2007). As employability becomes increasingly important in higher education, assessment, teaching and assessment practices are often required to reflect the multi-faceted problems that students would face in the workplace. In addition work based learning has become a strategic goal of higher education and there is a requirement to develop new forms of assessment based on prior experience and portfolios.

Academics in HE institutions have often proposed innovative approaches to Assessment, however in many institutions the administration of assessment has not reflected such innovation, often stifling the implementation of innovative practices because the processes and systems in place have been developed with the traditional view of coursework/exam, and one tutor per module/course. Even modern VLEs tend have a relatively fixed model of assessment which, whilst allowing for multiple markers and electronic assessments still maintain little information about the relationships between these assessments, or their constituent parts. Additionally, the push towards electronic assessment/feedback has, thus far, taken little account of those subjects where physical artefacts are produced and the relationship between the physical artefact and any electronic artefacts is stored in the tutor's memory or in their mark sheets.

This work proposes a system for flexible support of collaborative assessments that combines both physical and electronic artefacts. The project builds on current work using RFID for identifying, tracking and cataloguing physical artefacts, and also leverages Semantic Web Technologies for maintaining the relationships between physical and electronic artefacts, allowing multiple format submissions of assessment material. These relationships can be extended to any other documentation associated with the assessment (marks, feedback, moderation etc) thus permitting the use of innovative, multi-faceted assessments where less time is spent managing the submissions

Stanton M., Whittaker N. and Tubb C. (2010).
CASPER: FLEXIBLE SUPPORT FOR COLLABORATIVE ASSESSMENTS AND E-PORTFOLIOS FOR WORK-BASED LEARNING.
In *Proceedings of the Multi-Conference on Innovative Developments in ICT*, pages 152-157
DOI: 10.5220/0003047001520157

and more time is spent assessing and feeding back to students.

2 APPLICATION EXAMPLES

The following are based on real assessment examples, but reflect the issues surrounding assessment and feedback in many departments and at many institutions.

2.1 Product Design Course

This course requires students to develop concept art, CAD, and physical model artefacts for an assessment. The concept art if often drawn by hand, but may be submitted either physically or electronically. The CAD drawings are submitted as files on a CD, and then the physical model is housed in the workshop where it was developed. The assessor, and moderators (including external examiners), view all or part of this submission, and provide feedback, in the form or written reports. These reports are collated and then returned to the students, and are also made available to second markers and external examiners, who will also add some comment. The time taken in actually assessing the material is almost equal to the time spent distributing, collating and locating the different artefacts associated with this assessment, which therefore adds significant overhead to the assessment process and therefore the timeliness of feedback to the students. Some students will submit additional supporting material for their work which can often be overlooked by assessors as it is not part of the 'normal' assessment process and there is often insufficient time to give it proper consideration. This tends to discourage students from going beyond the assessment requirements, as they feel it is wasted time and effort.

The class is currently small but the course numbers are increasing. Therefore the assessment team is under increasing pressure to streamline the assessment process, and are considering removing some of the requirement for concept art to reduce the marking workload. This is not a satisfactory solution as it reduces the authenticity of the assignment.

2.2 Systems Development Course

Students studying a course on systems development have a number of assessments throughout the academic year. Some of these assessments are online tests, others are taken as paper based tests and exams, and others involve the development of a system and the production of a report.

Online quizzes are employed to test student's knowledge of the subject and give some immediate feedback to students on their progress. These are submitted and marks distributed using a popular VLE. Paper based tests and exams are used as it is unfeasible to use the software for such large numbers of students in one sitting. Marks for these must all be entered into the Institution's marks database and additionally some of these marks are entered into the VLE for feedback to students. Feedback is also written on answer sheets but students rarely see this as they are often never collected from the tutor.

The development project involves modelling of a given system, and implementation of a database and a user interface. This involves a combination of group and individual work, and is assessed by a number of different tutors. Unit tutors want to improve the quality of this assessment by combining it with assessment for another unit on project management, teamwork and communication skills. Given the structure of the current VLE the students may have to make two submissions of the same material or make a dummy submission. Staff will have to extract components for assessment for their particular area from the submission and also ensure that the two submissions are consistent. The benefits to the student of assessment in this way are that the project becomes more realistic and they can be given credit for all the work they do on a single project rather than having to carry out two separate projects, which is the current situation.

The overhead in assessing the unit in this way is significant, especially given the large numbers of student taking the course. Tracking the individual and group components of the submission is never easy, and additionally extracting parts of the submission for particular assessors and assessments can be time consuming. This will give rise to the overhead in managing the assessment and possibly reduce the time available for assessing and feeding back to students.

2.3 Work based Learning

Work based learning can take many forms but often is reduced to compilation and submission of a portfolio of work built up over time, using evidence of prior experience and work that may have been carried out sometime in the past. Locating elements to be included is not always easy for the learner as

these may not have been intended to be anything other than work with little consideration of future usefulness or relevance at the time of creation. The artefacts that are collected in the portfolio are often in multiple formats, with physical artefacts and paper based reports forming a significant component alongside electronic artefacts. Additionally the artefacts that satisfy a particular set of outcomes may not all be located and submitted at the same time and need to be submitted by the learner as and when they are located or completed. Learners will also need to be made aware of any gaps in their portfolio which can either be filled when artefacts are located or when new work has been completed. Some of these artefacts may also be protected by patents or disclosure agreements and the learner needs to feel able to submit these without any fear that an assessor might not be aware of such constraints. Often in assessing work based learning a single assessor may not have the necessary knowledge to adequately assess all material submitted and they will need to be able to easily access additional assessors for parts of an assessment. Some artefacts will satisfy many outcomes, whilst some outcomes may be satisfied by many artefacts, and an assessor needs to be able to link individual artefacts with outcomes to ensure that at some point all outcomes are covered and to be able to advise the learner on the sort of material that will fill the gaps in their learning (and thus their portfolio). Management of such assessment is time consuming and this leaves little time for the actual assessment and feedback process.

3 THE PROBLEM

The common themes within the above examples are as follows:

- The complex relationship between assessments and outcomes.
- The requirement for extracting information from assessments relating to multiple outcomes.
- Adequately rewarding students for all the work they submit.
- Tracking and locating multiple artefacts that may be related to one or more assessments
- Use of multiple assessors for a single assessment
- Reducing the management overhead of assessments so that more quality time can be spent on assessment and feedback
- Allowing academics the freedom to set appropriate assessments without the constraint of management overheads
- Handling physical and electronic artefacts in a uniform manner

4 THE SOLUTION

There are many partial solutions to these problems; some are technological, with others being more managerial and process solutions. However, no one system can satisfy all the assessment requirements without being sufficiently flexible itself. Current systems that support electronic submission of assessments and marks are inflexible and force the user (both student and assessor) to change their way of working to suit the system rather than the assessment requirements of their subject. There is, as always, a real requirement for the timely reporting of grades and marks, and the administrative systems that require this information are necessarily inflexible, and cannot be expected to support the learning process.

Additionally there is the necessary and invaluable timely feedback to students so that they can learn from the assessments they are given and gain more satisfaction from the hard work that they have put in.

The technologies to support a solution to these problems exist, although some are either new, or have not yet been applied to their full potential. The use of RFID to locate and track physical artefacts can also be used to generate an electronic profile of those artefacts. Ontology languages (such as RDF or OWL) can be used to create and store complex relationships between artefacts, and provides the flexibility to add or generate new relationships. When combined with RFID technology we can include physical artefacts in those relationships. The stored information can be queried in the same way as a more traditional database, and using the power of XML, results can be transformed into any required format. Interaction design for computer based systems has evolved from the traditional WIMP interface and we now create web based interactions allowing users to visualise their information in a meaningful way.

There is a significant body of work on the development of ontologies to model theories of learning (Barros et al 2002) (Hayashi et al 2006) (Mizoguchi et al. 2007). From a practical perspective, the main advantage is the flexibility of expression that is provided by, for example, RDF

triples. A more conventional systems design would require a static structure, usually stored in a relational database where the components of the assessment are fixed at design time. These components will be stored as fields in a table, and often the only way to add flexibility is to increase the number of fields to allow for a variety of options.

The storage of subject, predicate, object triples enables the development of new fields without affecting the design of the rest of the system. We are already using a similar approach to allow user defined fields to be added to products in a bespoke e-commerce system. Here the products are so diverse that it is difficult to create a standard product table to include even the concept of a price.

5 THE SYSTEM: CAsPEr

CAsPEr is an ambitious project that has a number of important facets:

- Storage of assessment artefacts (electronic and physical)
- Storage of information about artefacts
- Storage of relationships between artefacts
- Reporting information to users and other systems

These facets are drawn together to form a number of major subsystems and these are details in the following section.

5.1 System Architecture

An overview of the system architecture is given in figure 1. This provides a very general view of the system although each of the components will have their own subsystems.

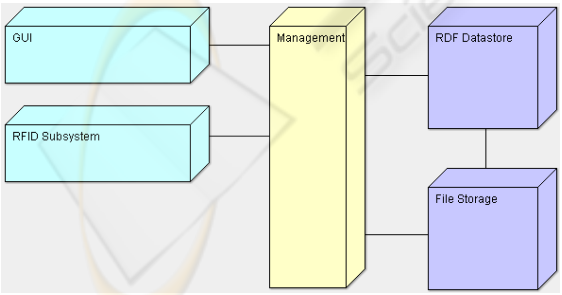

Figure 1: CAsPEr Architecture.

5.2 Components

The main components of CAsPEr will carry out the following roles:

- RDF Data Store
  This stores the information about Artefacts and other 'resources' and the triples are stored in a relational database and/or as RDFXML.
- File Storage
  The RDF Data store points to any electronic resources that are associated with an artefact. These are stored in the file system and can be retrieved and viewed locally. Additional files can be added to an artefact, such as assessments or feedback.
- GUI
  The GUI allows users to add new information. This includes the addition of new artefacts, new resources, information about them and the relationships between them. The GUI hides the complexity of the underlying system and shows the resources and artefacts as a connected set of icons. New artefacts can be dragged from the desktop (initiating the storage of files associated with them) or can be created from the GUI. Artefacts can be related to other artefacts or to students, assessors, assessments etc.
- RFID subsystem
  The RFID subsystem acts as another means of adding artefacts and information about them. It manages the tagging, registration and location of physical artefacts, and monitors any changes to their status.
- Management Subsystem
  Manages the creation and maintenance of relationships between artefacts and resources. Directs resources to their related files and physical resources. Handles queries to the RDF Data Store.

5.3 The CAsPEr Ontology

The CAsPEr Ontology is a lightweight ontology that has been developed initially as a simple RDF graph. It shows the potential for reasoning about new and complex relationships. For example, Assessments can already assess outcomes for a number of Units and an Artefact can form part of a number of different Assessments.

The Ontology is shown in Figure 2 as output from Altova's SemanticWorks software. As can be seen, Artefacts play a central role in the ontology with most other resources being related directly to them in some way.

There is more work to be done refining this Ontology but already it shows potential to add the requisite flexibility to the system.

5.4 The CAsPEr GUI

The user interface for CAsPEr will be crucial for its success and should derive from the nature of assessments as being constructed from artefacts and being related to students and units. These relationships can be expressed graphically as shown in Figure 3.

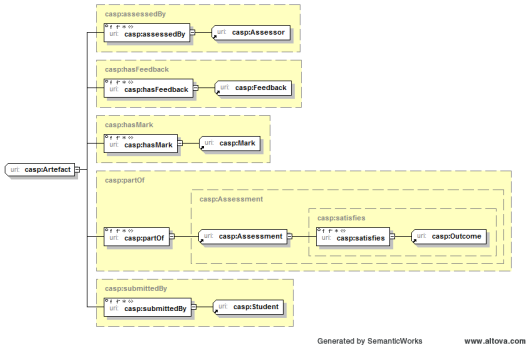

Figure 2: Part of the CAsPEr Ontology.

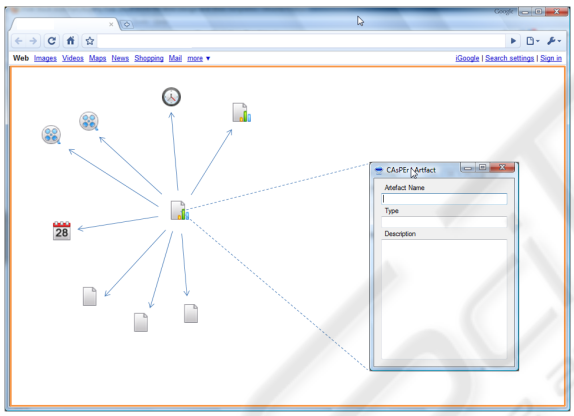

Figure 3: CAsPEr Graphical User Interface.

Artefacts can be built using the standard dialog boxes, or can be dragged into the client window. Relationships between artefacts and other resources will reflect those of the underlying model.

6 RELATED WORK

Previous work has looked at the use of ontologies in and for education but these tend to be developed for the study of theoretical aspects of learning and knowledge (Barros et al 2002) (Hayashi et al 2006) (Mizoguchi et al. 2007), or to examine a specific knowledge domain (Sosnovsky, and Gavrilova, 2006). The CAsPEr ontology is designed specifically to manage the operational features of assessment, and whilst it does take into account learning theories, such as constructive alignment, it is based on the practical use of those theories to form an information system rather than to theorise about their nature.

Sánchez-Ruíz and Welling (2008) give details of Ontology-Based assessment assistants, which whilst covering some experimental work in assessment automation, does provide a useful architecture for assessment systems. This would complement CAsPEr well as their ISA would form one part of the assessment subsystem whereas CAsPEr would handle the management of assessment artefacts. Their artefacts may have domain specific properties, and definitions, which could be merged with CAsPEr's.

Sicilia and Lytras (2005) provide a very useful overview of recent work on the use of ontologies in learning theory, and point towards the development of systems that support learning design. This provides some scope for the development of CAsPEr to support generation of appropriate assessments given the needs of learners and the design of programmes of study.

Work is being carried out on integrating semantics with existing LMSs, for example with Moodle (Lukichev et al, 2007). CAsPEr is not intended as a replacement for complex LMSs but it will be able to integrate with them, managing the assessments and providing an interface with them.

7 CONCLUSIONS

The use of innovative assessment methods to support learning within higher education is becoming more important, highlighted by strategies such as the increase in work based learning.

CAsPEr provides a mechanism by which assessment which may require a number of artefacts across a number of learning outcomes and subjects areas may be required. This is achieved through the use of an RDF ontology and Semantic web technologies.

Adoption of Semantic Web Technology is finally becoming mainstream and, no doubt, as LMS vendors scrabble to provide trendy social functionality using emerging "open and social" standards, we will see more systems built on RDF Schemas. CAsPEr is not intended to replace an LMS, as focus is on the management relationships between artefacts rather than to control/monitor the learning process. However it could be used to

complement an LMS by providing easy management and collation of artefact and performance data.

Although other systems may employ similar techniques CAsPEr has the advantage of providing a flexible and domain independent method of managing these assessments.

Importantly CAsPEr allows for the management and control of the artefacts of an assessment without imposing the rigid constraints on the forms and structure of assessment seen in many other assessment management technologies.

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