

# **A Case Study in CAA System Migration: TRIADS to Blackboard**

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## **Abstract**

*Staff in the Centre for Learning and Teaching at the University of Derby have been exploring a replacement to the existing electronic exam system (TRIADS). The existing system has set a high expectation and there are several requirements to meet. This report describes the investigation into use of the integrated test system in the Blackboard Learn platform as a replacement; highlighting obstacles and solutions established during the process.*

## **History of TRIADS**

The University of Derby, in partnership with the University of Liverpool, and the Open University, began work developing the Tripartite Interactive Assessment Delivery System (TRIADS) in 1996 (Paul, 1999). The system has now been in continuous use within the University of Derby for both secure, invigilated, summative assessment, and web-delivered formative assessment, for over a decade. It was at one point also in concurrent use in 24 other universities (Paul, 1999), and has demonstrated potential to support independent and deep learning (Wood and Burrow, 2002).

Part of the success of the system comes from the flexibility of its question types. Over 20 templates were established for commonly used questions such as multiple choice, diagram labelling, classification etc., which authors could quickly repurpose to their needs. However, it also included an authoring environment in which completely

bespoke question types could be created; as complex as simulations of medical scanning equipment (Maghan and Mackenzie, 2004). The time taken to create questions varied widely, with MCQs only requiring a small amount of text to be edited, but even the customisation of templates could take over 2 hours per question if particularly complicated (Wood and Burrow, 2002).

## Need for transition

TRIADS still meets all of the University's current requirements for a assessment delivery system, and is used by other satellite departments in the University for external clients. However, two primary motivations for moving to a new system were identified:

- The existing TRIADS eAssessment system is built upon technology that is not longer supported, and may not be compatible with future University systems.
- Enabling academics to take ownership of their exams frees-up developer time for other, more cost-effective tasks, and reduces bottle-necks to scalability.

TRIADS is built upon the now discontinued *Authorware* platform (Adobe, 2007), and requires custom 'player' software to run. Recent trials established compatibility issues with Windows 7, which the University will be upgrading to as of September 2011. Although a solution may exist, this cannot be guaranteed in the future.

In 2009/2010 the University piloted use of Question Mark Perception. It was rejected as a solution at that time for a number of reasons, which can be briefly summarised as cost, difficulties connecting the student authentication system, and some minor issues with the various authoring environments.

## Facilities in Blackboard

At the time of TRIADS' development, the most common response to which Course Management System the participating institutions used, was "None" (9); with Web CT, and "In house" being the second most popular choices with half the number of responses each (4) (Paul, 1999).

The Blackboard Learn platform includes a fully featured system for creating online tests and managing the results. Since this system is already available to every course at the University, it would give academics direct access to the tools needed to deliver computer-based tests. They would be able to create and edit your own tests with relative ease, and have instant access to student results and engagement statistics.

In total Blackboard supports 17 different types of questions. However some, such as the Likert Scale, are not useful in a test situation, and others, such as the True/False,

are essentially just variations on the multiple choice question. However, there is still over a dozen useful options. Test results are also accessible in the same course areas where the tests are authored, and the level of detail ranges from viewing a table of final scores to seeing each student's answers for individual questions.

A survey distributed to academic staff identified that there was existing sporadic use of Blackboard-tests throughout the University for both formative and summative purposes. 12 academics responded to the survey, but an analysis of server statistics showed that that actual usage was up to 3 times as much. Of the respondents  $\frac{3}{4}$  of respondents said that they would use Blackboard-Tests again. There was negative rating in the areas of *time taken to produce exams* (2.67 on a 5 point Likert scale) and *viewing of results* (2.43). There was a marginally positive rating in the areas of *ease of creation* (3.11) and *effectiveness at demonstrating learning* (3.2). Several negative issues were identified, but the majority had the potential to be addressed through training and support.

These factors gave the department confidence in pursuing the use the of Blackboard's test system as a potential replacement to TRIADS.

## Training and Support

The issues identified by previous academic use were combined with those found through initial investigations by the department's learning technologists. It also became apparent relatively early that the Blackboard test system could not provide all of the features that the TRIADS system had established an expectation for. Since the aim of the project was not an unbiased comparison, but instead a successful replacement, attempts to solve all of these issues were made, and are described below.

### Training Materials

Several identified problems – such as confusion over which of the numerous routes for creating tests was most appropriate, and where to include exam instructions – were identified as training issues. Many of the academics who had previously used Blackboard tests did so of their own volition, and had not sought guidance.

Following standard procedures, paper-based instructional materials and screen-capture-based annotated video demonstrations were produced. In addition – in-line with the scalability objective - a self-directed training course, consisting of eight 30 minute exercises was produced, including example tests.

### Results Formatting

A common concern with academics has been the formatting of results, particularly in relation to summative exams. The university uses a PeopleSoft system to centrally manage student details and progress. Academics have established systems for entering student grades into the PeopleSoft system, and were not happy with the

presentation methods offered by Blackboard. The facility for downloading test results includes all related information, including question text and chosen options.

As an interim solution a VBA macro was created for Microsoft Excel, which allows the choice of which columns to automatically remove. The score columns still need to be summed, but the clutter is greatly reduced. An issue is that the version of Excel currently in use at the University (Excel 2003) has a limit of 256 columns (Microsoft, 2011a). With 6 columns per question, and an additional 3 for student details, the result is that exams with more than 42 questions cannot be loaded. However in later versions (2007+) the limit has been raised to a level that makes it no longer an issue (Microsoft, 2011b).

In general there is close integration between the University's PeopleSoft and Blackboard systems, with module areas being automatically populated based on student records. At this stage it could not be expected that the results would automatically be transferred, but this may be functionality developed in the future.

## Quiz Export

Paper-based versions of tests can be required for several reasons:

- As a back-up in case of technical failures
- In rare cases where a student's specific needs are not compatible with eAssessment
- To be stored on file
- For external examiners

Blackboard includes a facility for downloading tests in their entirety, but in a format that is expected to be transferred between course areas. Content is contained in a zip package, with the question description based on the IMS QTI format.

Initially a tool was developed as a Microsoft Word macro in VBA; however since the question text is stored in html this approach would require an extensive amount of formatting. As an alternative an Adobe Air application was produced to convert the question export to a single html page, which can then be printed. The software includes the option of outputting either a student version or an academic version (with answers included).

## TRIADS Conversion

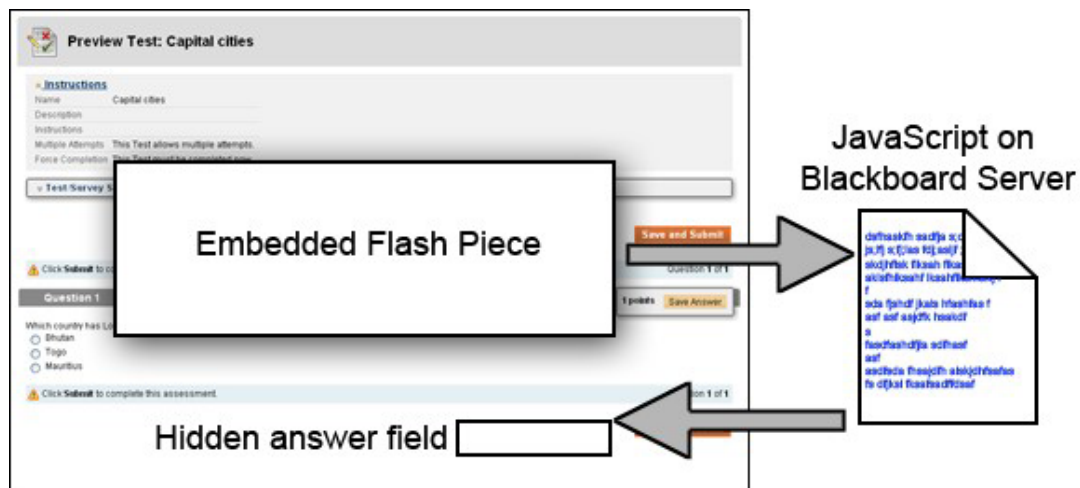
A significant number of question-banks are currently stored in the TRIADS format, which would need to be migrated to any new system. Although the question details are embedded within TRIADS packages (rather than being stored in external files),

the benefit of working in an open system is that custom code can be added as required. In this case the code was to create a custom exporter.

Blackboard has the ability to import tab delimited files describing seven of the available question types (A-B Tech, 2009). Functionality was added to the TRIADS engine that exported compatible question types into this format during the initial set-up phase, and since a large percentage of questions used at the university are in one of the compatible forms, this has greatly reduced the time taken to convert exams.

## Custom Questions

A benefit of using the TRIADS system was the ability to develop bespoke questions, such as custom drag-and-drop layouts, graph manipulation, numerical tables etc. A system has been developed to incorporate a degree of this flexibility into the Blackboard-Test environment. An overview of the system is shown in figure 1, but in essence the question text is replaced with a Flash interaction.



**Figure 1.** Overview of system for embedding Flash pieces

When the question loads, the following general process is followed:

### 1) Hide answer field

The Flash pieces makes a call to JavaScript on the web-page, which interacts with the DOM structure to hide the area where the student would normally enter their answer. This is not a security measure, but simply to reduce potential confusion for the students. The *fill in multiple blanks* question type is used as a base because it can support multiple parameters, and does not support the "Visual Editor" option – which breaks the DOM connection. For simplicity, questions are also set to display one at a time, so that all text field objects on the page belong to the question currently being viewed.

### 2) Try to load existing answer

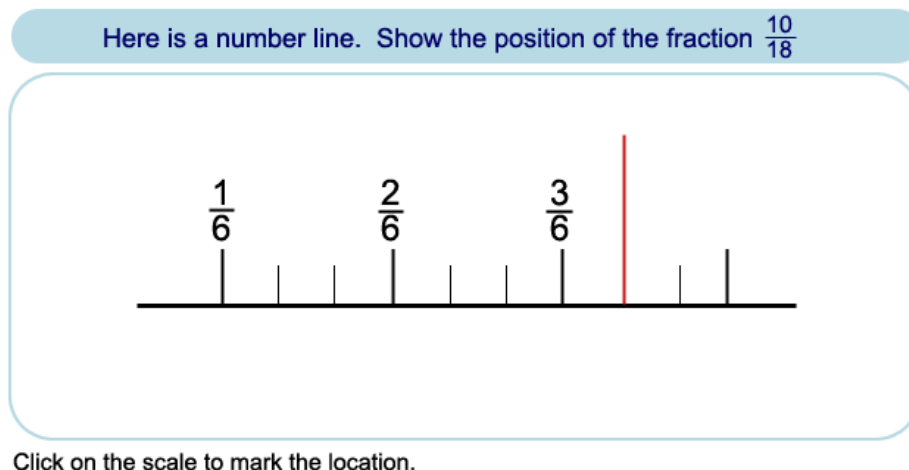
After a short pause the Flash piece makes a further call to JavaScript on the page to load any parameters already stored, i.e. if a student has already entered an answer and is returning to the question to check their answer. With the questions display one at a time, the JavaScript can simply return an array of all text field objects on the page.

### 3) Pass student's answer to page

The Flash piece passes the student's answers back to the hidden text fields on the page, via JavaScript. The frequency at which the page is updated depends on the question type. Where the student makes discrete interactions, such as dragging and dropping labels, then the update can occur when the student makes their selection. Alternatively the update can be triggered on a timer.

The storage and evaluation of results is performed by the Blackboard system itself; exactly as if the student had manually entered the grade themselves.

If the exam is set to provide feedback at the end, then extra consideration is required to ensure that the answer passed from the Flash piece to Blackboard makes sense. Consider the question shown in figure 2, where the student must mark the location of a fraction on a scale. For feedback to be meaningful for the student it must report the actual fractional value that the student selected.



**Figure 2.** Title of figure

If the same question is used in a summative exam, then the requirements are very different. The system used is in no way secure, especially given that modern browsers include tools for exploring the DOM structure of a page. If the correct answer that is being checked for is "10/18" then the student could potentially just enter this value. Instead the answer must simply reflect the students choice, ideally in a format that the academic can interpret to reveal common misconceptions. In this case labelling each mark from A to J would be appropriate.

Flash has also proved to be particularly prone to mathematical discrepancies (e.g.  $0.1 + 0.1 = 0.20000000001$ ), and so additional checks need to be put in place.

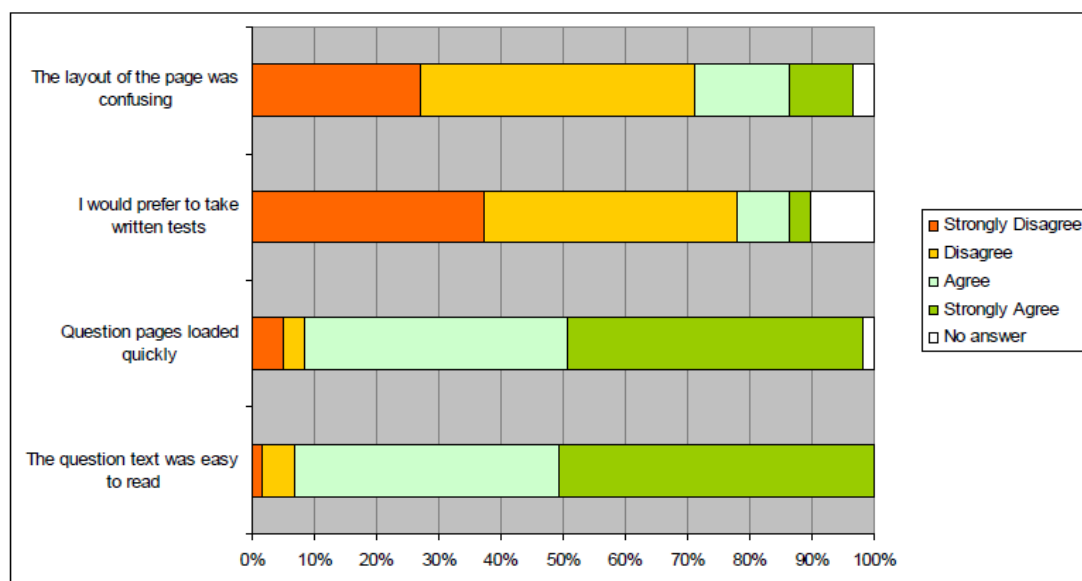
Creating bespoke questions requires the efforts of CeLT developers, which goes against one of the main reasons for investigating the Blackboard-Test system. However the majority of benefits still remain; multiple people can contribute to the same exam, and academics could still author the standard questions themselves.

## Initial Trials

Initial trials focussed on non-critical uses. In the first usage a previously TRIADS delivered formative exam was converted to a Blackboard test, including custom flash-based questions, and a paper-based alternative was provided as a back-up. 30 out of 86 registered students opted to take the Blackboard version, and no technical issues were reported.

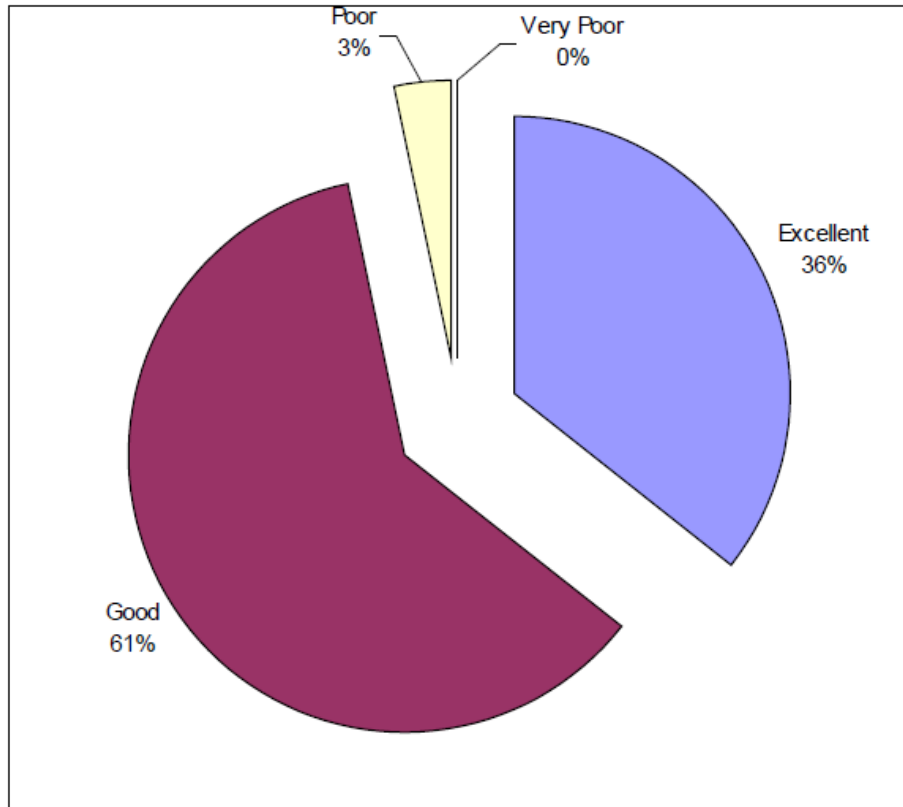
Subsequently the test system was used as a survey tool, allowing student results to be tied to specific modules. 84 students completed the "test" registered across 4 modules, and again no technical issues were reported. As with the previous "exam", both the question authoring and results formatting were performed by CeLT.

Following these successfully trials a test was run in which 358 students submitted results within a 10 day period. All results were recorded, and the only technical issues reported were linked to Internet connection issues. The students involved in this test were surveyed, and the results from the 59 respondents is shown in figures 3 and 4.



**Figure 3.** Title of figure

All results were positive with respect to the Blackboard system, with questions focusing primarily on usability and student preference. In an additional question the overall experience was rated positively by 96% of students (from 17% of the cohort that responded to the survey).



**Figure 4.** Title of figure

The only issues are those that affect Blackboard itself – most notably server up-time. This is typically high, but downtime on key dates could have a significant impact. The facility to create paper-based alternatives will mitigate this remote risk.

## Load Testing

Various load tests were run on the designated *test server* to see how many concurrent users could be supported, which would then be used to establish a safe limit for the *live server*. Tests involved the creation of automation scripts, which reproduced the mouse/keyboard input required to take the exams. In most cases 50 question exams were used, and testing was performed with a maximum of 43 PCs.

It became apparent that the system was not working as expected; with error pages being displayed frequently. The error was recoverable, since simply refreshing the page allows the test to continue, but it was decided that its appearance at all constituted a failure. It would not be acceptable for a student to repeatedly encounter such a screen during exam conditions.

It was ultimately determined that the issue was the configuration of the test server itself. To-date the same errors have not been experienced on the *live servers*, despite delivering tests to over 80 concurrent users; and a non-concurrent formative test in a module with over 350.

## Summative Trials

Following the successful early trials two summative exams were chosen to be delivered through Blackboard in the January 2011 exam period. The first involved 13 students taking a 34 question exam, while the second involved 86 students taking a 23 question exam. Direct observation of students identified a potential issue when students navigated away from the exam page while part-way through. Correct configuration of the exam settings allows students to simply resume from their last answered question.

In the May 2011 exam period a further 12 summative exams were delivered, totalling 784 students. Some issues arose due to incorrectly configured exam settings in two of the exams, but they were quickly corrected. A check-list system has now been put in place to reduce the possibility of the errors re-occurring.

One of the main requirements for migrating was to find a system that could be scaled up to University-wide adoption. From the combined total of 14 summative exams, academics authored their own questions in 5 of them. In all cases the academics have been positive about the ease of the process.

Academics have also been extremely positive about the ability to view results immediately after the exam, but as mentioned previously some have raised concerns about the limited ways that results can be formatted – for example to present to external examiners, or to feedback to the students.

Traditionally all summative exams were delivered through a hand-full of rooms which had the specialised TRIADS software installed. Use of the Blackboard system allowed one of the exams to be delivered on a different campus, although in an unsecured manner.

## Respondus LockDown Browser

To-date the majority of summative tests have been run through Blackboard in an open setting, but under invigilated conditions. One of the 15 exams did employ the LockDown browser, and it proved useful in preventing one of the more common user errors – navigating away from an exam before completing it. However, it did make another potential error – where users click on the navigation elements too rapidly – potentially unrecoverable.

The choice of whether or not to use the LockDown browser in the future could potentially affect the locations in which exams can take place. As mentioned previously a benefit of the Blackboard system was that it could be used in any computer lab. Although the LockDown browser has been purchased on a site-wide licence, and can be run from any PC, we have Identified some security issues which means that it would be preferable if students did not launch the software themselves. Although it would certainly remain more secure than not using it, there is a potential for complacency in its use.

## Future Work

The test system integrated into Blackboard has been demonstrated as a potentially viable replacement to the existing TRIADS system. The University will continue to increase its usage in the next exam period, but as with the introduction of any new system there are likely to be unforeseen issues that must be addressed.

In the Summer of 2011 the university will be upgrading to Blackboard 9.1 service pack 5, which promises to address at least one of the outstanding issues – the appearance of an error screen when users rapidly click on navigation buttons. The Respondus authoring environment is also scheduled for evaluation.

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