

Human Computer Collaborative Assessment
– Access by Computer (ABC) – University of Manchester



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Brief details

This is a delivery and marking system that does not seek to replace human markers but to make their job easier, partly by ordering the student responses to make marking more efficient but also by automating many of the routine tasks. It deals effectively with common question types found on paper, including multiple choice, short answer and essay questions and simple diagrams. The strength of the system is its robustness, its simplicity and its familiarity to academic end users.

Background

The system used by several departments in Manchester is Assess by Computer (ABC), originally developed by the Computer Science department for their own use but rolled out to other faculties. Its development was facilitated through a number of small grants (typically 20-30k) which paid for programming and clerical help. Structural changes at the university precipitated a loss of this funding and the decision was made to go commercial and a venture capital grant was won.

The guiding philosophy has been to interfere with existing assessment processes as little as possible and to leave decision making in the hands of human markers. This has the benefit that test construction is straightforward and while the generation of mark schemes demands no more than that with paper-based systems, the system delivers substantial savings in marking workload.

Computer science

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What was the problem

Tests which were used formatively and summatively were given to large (up to 200) groups of students and involved a considerable marking load. The variety of question types demanded responses of freely entered text of varying lengths, selected choice, diagrams and mathematical and logical symbols eg Universal Model Language (UML). Assess by Computer (ABC) was developed, taking the tests on computer, offering the facility to enter text, diagrams, mathematical symbols (eg algebra, logic, set theory). It proved successful and was offered to other departments in the University

Life sciences

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What was the problem?

Manchester has 500 students of Life Sciences annually. Part of the end of first year assessment were papers of short answer questions based on the outcomes of ongoing practical work which students answered in free text. These were marked by laboratory demonstrators, typically, PhD students. This was very time consuming and there were concerns over inter-rater reliability. The paper-based tests were completed by students over an 8 week period and students were warned not to collaborate. It was believed that students generally performed honourably but there was no easy means of checking for plagiarism.

How does the solution work?

A pilot computerisation involving half the cohort was carried out in 2004. The paper was computerised and students took it on standard browsers, in their rooms, or in college (it was, after all, an open book exam). Students were generally neutral or in favour with regard to taking the test online. By using a variety of computer-supported methods, marking load was substantially reduced (by a factor of two to three times) due to the perfect legibility of the scripts, grouping of similar answers, the speed of on-screen marking and the automatic totalling of marks . A

small number of items needed revising – eg ‘sketch a graph’ became ‘comment on the graph’ or ‘select the correct graph’ but, if anything, questions were improved by going through the necessary process of revision. Questions continued to be a mixture of multiple choice, short text and longer text (there was no attempt to build in computer question types such as drag and drop). The tests were summative in that they were a check on first year performance though the results did not count towards the final degree.

Question papers were written in Word (this facilitated circulation amongst staff members for discussion and approval) before being cut and pasted into the authoring tool.

Marking

Training of markers was completed in a single one hour session. The markers can see the mark scheme on-screen and series of responses which are all anonymised, question by question. (This means that individual questions could easily be grouped to be marked by specific markers). Responses to each question can be ordered in a number ways eg by length of response or by similarity to facilitate and speed up marking. Key words from the mark scheme or elsewhere can be highlighted in responses. Furthermore, similarities between responses can be detected in order to check for plagiarism.

Pharmacy and pharmaceutical sciences

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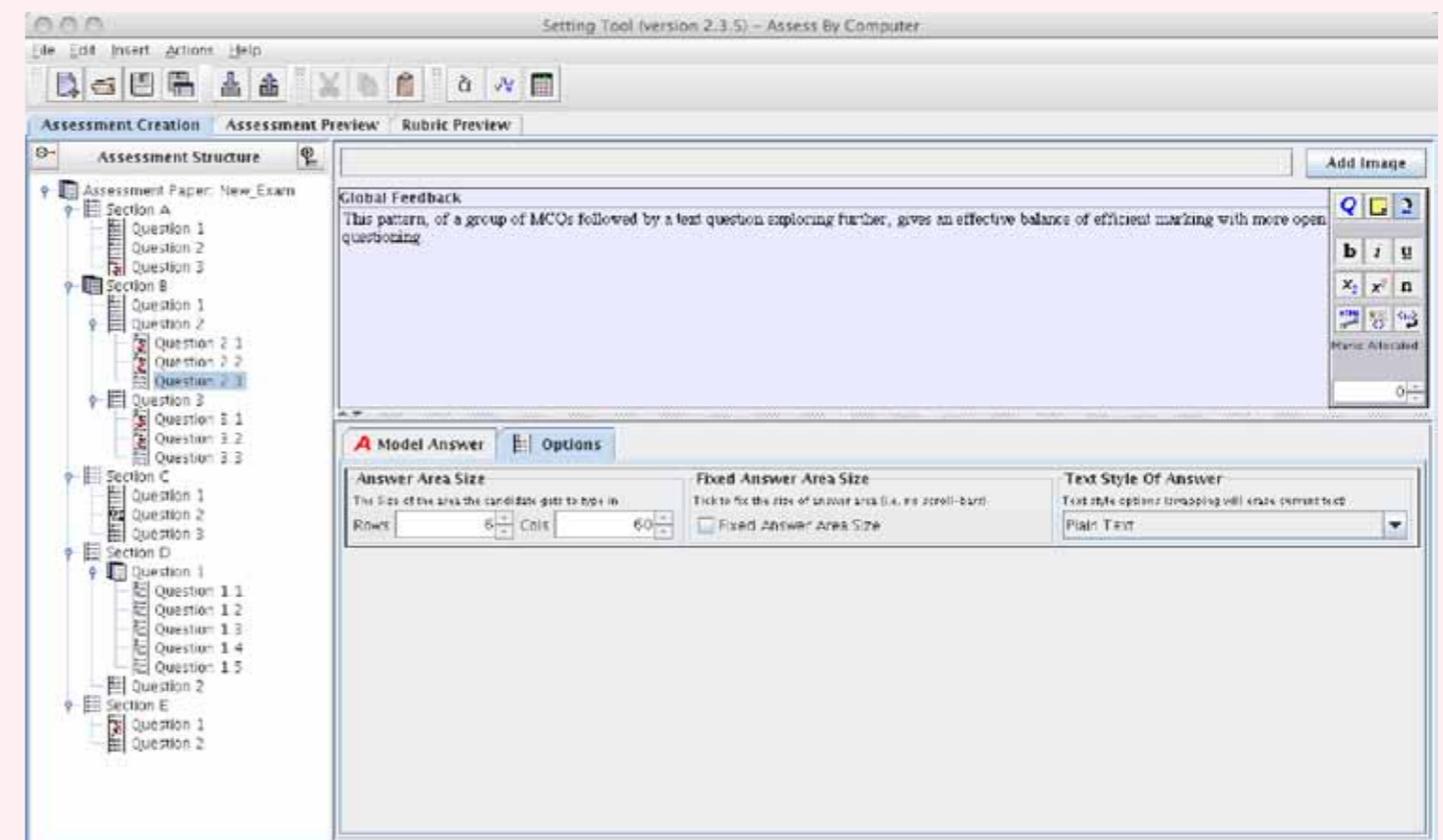
Social pharmacy is assessed through a mixture of short answer and essays. The essays were marked primarily for content but there was also a substantial mark for communication skills. The transition to computer based marking was easily achieved and was very successful in dealing with the short answer responses. A number of tools to facilitate essay marking were introduced – key words from the mark scheme or elsewhere can be automatically highlighted in responses and marks and comments can be tagged into the response text.

Benefits

Tests are generally produced in Word and then cut and pasted into the setting tool which converts it into an xml structure. There is considerable control over appearance, font, etc. The primary benefit is that the system does not require a great deal of configuration; marking is still performed by humans so no training of the software is necessary (though selected response questions can be marked automatically). Technically, the system is robust and is easily migrated and scaled.

How it works

Item Authoring



Items are entered and formatted, diagrams imported, size of text entry box constrained, model answers attached,

Delivery

The screenshot shows the 'Exam Client (version 2.3.5) - Assess By Computer' window. The candidate ID is 'pr@assessment21.com'. The exam is 'ABC101: ABC101demo00' with a total of 56 marks available. The interface is divided into sections A through E. Section A is currently active, showing a question about a 3D shape. The question asks 'What shape is in this image?' and includes a 3D wireframe drawing of a cube. Below the image are three radio button options: 'Square', 'Cube', and 'Sphere'. The 'Cube' option is selected. The interface also includes a sidebar with 'Assessment' buttons, a 'View Rubric' button, and a 'Finish Test' button. The status is '(Unlimited Time)'.

Candidates take test through the standard browser, generally a mixture of multiple choice, short answer, long answer.

Invigilation

The screenshot shows the 'Invigilation Tool - Assess By Computer' window. It displays a table of candidate progress for exam 'INV100108X'. The table has columns for Student, Location, Status, Check-in, Last Backup, Time Left, and Application Ch... The data is as follows:

Student	Location	Status	Check-in	Last Backup	Time Left	Application Ch...
UNAUTHORIZED...	DSO	Working	Fine	1 minute	25m	Fine
student1	43	Working	Fine	Never	30m	Fine
student2	42	Working	Fine	1 minute	25m	Fine

Below the table is a chat window with messages from 'jsargeant' and 'Overseer'. The messages discuss a student in DSO without a valid username and a note about extra time. The interface also includes a 'Display Options' panel with checkboxes for 'Only show working candidates', 'Only show priority candidates', 'Show candidate names', and 'Show date and time'. There are buttons for 'No messages' and 'Disable Exam Starting'. The status bar at the bottom shows 'Total Candidates: 3 Currently Displaying: 3 Server Clock Time: 11:24:29 BST'.

The invigilator can review candidates' progress on the test in real time, including checking whether s/he is visiting an outside site.

Marking

The screenshot shows the Marking Tool interface for a question titled "What single measurement would you make to confirm that an individual is anaemic?". The interface displays a list of candidate answers, each with a corresponding mark value and a status icon. The answers are:

- Candidate Answer #20:** Haemoglobin concentration. If it is low then the individual is anaemic. (Marked out of 1)
- Candidate Answer #14:** The red cell count would be taken and results compared with the normal red cell count. (Marked out of 1)
- Candidate Answer #30:** A simple blood test to measure the red cell count and amount of haemoglobin in the blood. (Marked out of 1)
- Candidate Answer #77:** A full blood count, this would look at the number, size and shape of the red blood cells. (Marked out of 1)
- Candidate Answer #7:** Measure the MCH or the level of haemoglobin in RBC. If it is reduced, the individual is anaemic. (Marked out of 1)
- Candidate Answer #80:** Take a blood count- this will test mean cell volume, MCH and mean cell haemoglobin concentration. (Marked out of 1)

Responses are grouped on the screen, by candidate number, by length or by similarity according to the personal preferences of the markers and marked on-screen. In addition, keywords (generally from the model answer) can be highlighted. This is helpful on longer questions.

The screenshot shows the Marking Tool interface for a question titled "What is haemolytic disease of the newborn? How can this be prevented?". The interface displays a model answer and several candidate answers. The model answer is highlighted in red and contains the following text:

Model Answer
 When a Rhesus (Rh) +ve (1) mother gives birth to a Rhesus +ve child some D antigens on red cells from Rh +ve child may cross placenta during birth process (2)
 No effect on first child. 2nd Rhesus +ve child, if foetal red cells cross placenta mother rapidly builds up Anti D antibodies as she has been sensitized to D antigen (1).
 Anti D antibodies from mother cross placenta and cause haemolysis/agglutination of foetal blood (1)
 Prevented by injection of Rho (D) immune globulin (RhoGAM) (1)
 a special preparation of antibodies against Rh D antigen

The candidate answers are:

- Candidate Answer #1:** As blood type is determined by both maternal and paternal genes, a baby can have a different blood type to its mother. During pregnancy the mother's antibodies can cross at the placenta. If the mother has antibodies to the foetal blood group then foetal red blood cells will be attacked and destroyed. It is often a problem with the Rh surface antigen in the woman's second pregnancy. If the mother is Rh negative, but has a first child with a Rh positive blood group, it is likely that during labour, as the placenta tears, some of the baby's Rh positive cells will pass into the mother's blood stream, and therefore the mother will develop Rh positive antibodies. Therefore, if the mother has a second Rh positive child, the antibodies will pass into the foetal blood stream and severe anaemia can occur. To avoid this, the mother is injected with anti Rh antibodies (RhoGam) at the end of the first pregnancy and during delivery. These antibodies will destroy any foetal blood cells that cross the placenta, before an immune response is triggered.
- Candidate Answer #11:** Haemolytic disease of the newborn is where during pregnancy some of the mother's antibodies cross the placenta, attack and destroy the fetal red blood cells. This disease only involves the Rh antigen and affects a mother who is Rh negative carrying a second Rh positive fetus. This can be prevented by administration of anti-Rh-antibodies during the last three months and delivery. This administration causes any of the fetal red blood cells to be destroyed before they cause an immune response in the mother.
- Candidate Answer #14:** The disease occurs when a mother, who is rhesus negative (Rh-), has a rhesus positive (Rh+) child for the second time. The mother's immune system carried out a primary response against the measles antigen of the first child's blood, during labour when some of the foetus' blood passed across the placenta, into mother's circulatory system. This primary response was not enough to harm the first Rh+ baby. However, during labour of the second Rh+ child, the mother's immune system will undergo the secondary response, which is stronger and faster, producing many antibodies to the Rh antigen, and killing the baby's RBCs, antibodies cross the placenta easily. Acute anaemia is therefore observed in the newborn child. This can be

Work can be annotated and comments added.

The screenshot shows the Marking Tool interface for a question titled "What do you need to allow you to make a project plan?". A feedback window is open over the candidate answers, displaying the following text:

Feedback for question Question 1.3
 Add item +1 -1 Enable editing Check Confirm
 A good answer but rather too long [2 marks]

The candidate answers are:

- (Locked) Candidate Answer #33:** An interview with the management, a sample of staff and possibly even an opinion from the students would need to be made. From here an outline requirements specification can be drawn up which would be pitched at management and changed as applicable. Some risk analysis would need to be made with it being a working environment and a time critical program, and a time scale would need to be made which can be stuck to for the development of the system. From there you could break the work up among
- Candidate Answer Feedback #33:** A good answer but rather too long [2 marks]
- Candidate Answer #2:** to make a project plan, you would have to first break down what is actually needed, for example, the number of meetings that may need to be arranged, and with this, take into consideration the time given till the initial and final version of the system are needed. additionally, it would be essential that if any of the 6 developers specialise in a particular part of software development (eg design) that they were assigned to something similar in this system. therefore allowing time to figure out what the 6 developers are good at will help allocate tasks in order for the project to run smoothly.

Manchester runs Blackboard (WebCT) as its VLE. Originally ABC operated as a standalone under the control of Computer Science but it has now been successfully migrated to central computer services. It is planned to link the systems so that students access ABC through the VLE.

Benefits

The actual process of forcing students to enter text on screen increases marking efficiency and marking accuracy. Tests at Manchester have demonstrated that students generally type faster than they write and the output is 'remorselessly legible' avoiding the necessity of making best guesses as to what the student meant. Comparative tests at Manchester have shown that students tend to type longer answers than they write (sometimes necessitating the restricting of answer space in the computer-based tests). Typing is particularly beneficial to students who do not have English as a first language and whose first written language is not romanised (eg Japanese, Arabic). These students frequently find handwriting difficult but have considerable text entry ability (from working on the internet). Where students' responses are similar they can be marked virtually simultaneously saving time and raising consistency.

The system appears practical, extremely robust and usable. It is particularly efficient in dealing with short text and its essay marking tools are being further developed.

links

www.assessment21.com/resources.html



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