

## eAssessment at University of Nottingham

[www.mathshell.com](http://www.mathshell.com)

The Shell Centre for Mathematical Education, University of Nottingham, has developed assessment materials for the UK and US for over three decades.

### Tags:

Secondary, Numeracy, e-Assessment

### Harnessing technology system outcomes:

Improved personalised learning experiences

Technology confident effective providers

### Sectors:

Secondary

### Innovation

One trend of eAssessment is towards factual, disconnected learning that can be easily processed for summative results on demand. The eAssessment tests developed by the Shell Centre provide a counter-trend for the case of secondary mathematics. They translate and extend questions found on typical paper-based examinations into richer, computer-based tasks.

### Background

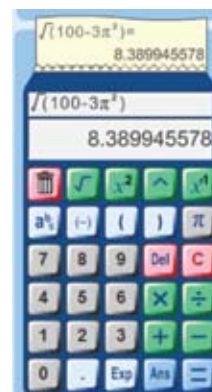
The tasks are developed using an iterative design-based methodology that involves close collaboration between designers, teachers and examiners. Tasks are trialed with large groups of pupils in various schools, and reviewed by experienced GCSE examiners using a specially designed interface. Findings inform the designers about the viability and scope of the software, and also the practical realities of schools delivering eAssessment using their

infrastructure and expertise. Findings from trials and control groups, along with pupil, teacher and examiner feedback, inform further development. The principal designer is Daniel Pead.

## Technology

The computer-based tasks are for use by pupils in examination conditions. The software combines the advantages of the precision offered by computers, such as virtual measuring instruments and graph-making tools, with the freedom offered by paper, in the form of devices that support and capture pupils' working (marks are awarded for 'showing your working' in mathematics assessments).


The 'printing calculator' tool will be used to illustrate the technology.



The printing calculator addresses two key issues of mathematics assessment: capturing working out; and allowing the entry of mathematical notation, such as fractions and special symbols. It can be embedded in structured problems and pupils can tear off and attach print-outs to their work.

**Van hire**  
Sanjay wants to hire a van to move some furniture.  
He obtains the following information from two hire companies:

**Bujit's Van Hire**



£30 for the first 50 miles  
Every mile after that costs an extra 20p

**Hurt's Vans**  
You only pay for the miles you travel

Miles travelled	50	100	150	200
Hire charge	£16	£32	£48	£64

(a) How much do Hurt's vans cost per mile?  
Answer: £

(b) Sanjay expects to travel 175 miles.  
Which company has the lower charge for this distance?  
Show all your working.

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Drop the printout from the calculator here to show your working

Drop the printout from the calculator here to show your working

Use the on-screen calculator and drag the "printout" to your answer.

30 + (175 - 50) × .2 = 55  
175 × .32 = 56

175 × .32  
56

Printing calculators can also be combined with other mathematical tools to provide interactive questions about graphs, algebra, geometry and other domains; however, this is not always clear cut. For example, using a computer drawing tool for a line of best fit is more difficult than using a ruler, whereas a computer can produce a 'least squares' fit instantly. The rich mathematics lies not in the mechanical skill, but in the choice of technique and the ability to correctly interpret the result.

**Taxi Times**

A taxi driver recorded the times and distances of all his fares on a typical day using a scatter plot.

The driver wants to make £30 an hour.  
How much should he charge each passenger per mile?

Use the calculator and graph to show how you obtained your answer.

Drop the printout from the calculator here to show your working

Answer: £  per mile (4 marks)

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The software offers automated marking for many questions, but for the trials pupils' work was marked by experienced examiners as a reference point. The examiners used a provided interface that can generate a variety of graphical and statistical views of results. Reports suitable for pupils and teachers can also be developed in the future.

The software is browser-based and programmed in Macromedia Flash, so that no special installation is needed. The hardware used in the trials was the type found in the schools. This required large numbers of pupils working with a computer simultaneously, which presents challenges to typical schools (see below).

## Teaching and learning

Summative assessment impacts dramatically on classrooms. In many subjects, the existing assessment regime atomises knowledge into short closed questions for ease of processing. This imposes a transmission model of pedagogy on teachers who are under immense pressure to deliver summative results. Current trends in eAssessment risk entrenching this regime further.

eAssessment should instead seek to use the power and flexibility of computers to transform assessment if it is to have real and sustainable impact on learning and teaching. Further, computers can produce high-quality feedback to learners and practitioners. As current technology stands, the role of experienced examiners is central to transforming the assessment regime. Automation cannot currently replace human expertise in the testing process, but it can provide professionals with more powerful tools for assessing conceptual understanding.

## Impact

Schools are not in a position to innovate GCSE assessment due to the existing examination regime, and due to the kinds of challenges set out below. The trials therefore took the form of a simulation rather than an implementation. However, this compromise means it is not feasible to test for real how computers can challenge the trend that eAssessment too easily leads to entrenching the existing assessment regime even more firmly.

## Challenges

There are four key challenges to using technology to transform the assessment regime:

1. Many pupils do not see computers as a natural medium for doing mathematics, and perceive using calculators as somehow 'cheating'. This makes the application of computers in maths exams somewhat contrived.
2. Inadequate technology infrastructure in schools.
3. A limited evidence base.
4. A trend of eAssessment towards short, closed questions that can be easily processed for summative results on demand.

## Wider adoption

The three challenges identified above need to be addressed to facilitate wider adoption:

1. The technology infrastructure found in typical schools must improve so that it can routinely and reliably support large numbers of pupils going online simultaneously. This necessitates a computer for each pupil and a high bandwidth.
2. An evidence base of demonstrable and tested eAssessment designs must be provided to convince practitioners, policy makers and examination boards of its worthiness and robustness. This will require researchers to work closely with practitioners and empirical work at all stages from the design of the tests to large-scale trialling.
3. The assumption that technology can or should replace human agency when processing assessment data needs to be challenged. Instead, multimedia technologies should be harnessed for their power to move the assessment regime towards richer, deeper measures of understanding.

