The Open University

Computer-marked assessment: friend or foe?

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Dé Onderwijsdagen, Pre-conferentie Digitaal toetsen, 10 November 2014

Assessment can define a “hidden curriculum” (Snyder, 1971).

Whilst students may be able to escape the effects of poor teaching, they cannot escape the effects of poor assessment. (Boud, 1995).

Students study “what they perceive the assessment system to require” (Gibbs, 2006).

“When we consider the introduction of e-assessment we should be aware that we are dealing with a very sharp sword” (Ridgway, 2004).

In this talk I will

- Discuss potential advantages and disadvantages of computer-marked assessment
- Discuss ways in which we can improve our practice by
  - better assignment design
  - the use of a variety of question types
  - writing better questions
  - the use of an iterative design process
- Discuss the limitations of computer-marked assessment and possibilities for the future

Note: ‘e-assessment’ includes things other than computer-marked assessment.

The UK Open University

- Founded in 1969
- Supported distance learning
- 200 000 students, mostly studying part-time
- Undergraduate modules are completely open entry, so students have a wide range of previous qualifications
- Normal age range from 18 to ??
- 20 000 of our students have declared a disability of some sort
- 13 000 of our students live outside the UK

iCMA = interactive computer-marked assignment

TMA = tutor-marked assignment

Potential advantages of computer-marked assessment

- To save staff time
- To save money
- For constructive alignment with online teaching
- To make marking more consistent (‘objective’)
- To enable feedback to be given quickly to students
- To provide students with extra opportunities to practise
- To motivate students and to help them to pace their learning
- To diagnose student misunderstandings


diagnostic
tailored feedback
money saving
pacing
engaging
reliability
learning
instantaneous feedback
online
global
chance to retry
motivating
time saving
consistency
testing effect
feedback is private
alignment with teaching
ipsative

Potential disadvantages of computer-marked assessment

- May encourage a surface approach to learning
- May not be authentic
- There is no tutor to interpret the student's answer and to deliver personalised feedback

Comments from students

- *I discovered, through finding an error in the question, that not everybody was given the same questions. I thought this was **really unfair** especially as they failed to mention it at any point throughout the course.*
- *I find them **petty** in what they want as an answer. For example, I had a question that I technically got numerically right with the correct units only I was putting the incorrect size of the letter. So I should have put a capitol K instead of a lower case k or vice versa, whichever way round it was. Everything was correct except this issue.*

Comments from students

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Thankfully, these students were happy with computer-marked assessment in general, but particular questions had put them off.

Comments from students

- *A brilliant tool in building confidence*
- *It's more like having an online tutorial than taking a test*
- *Fun*
- *It felt as good as if I had won the lottery*
- *Not walkovers, not like an American-kind of multiple-choice where you just go in and you have a vague idea but you know from the context which is right*

And from a tutor

- *Even though each iCMA is worth very little towards the course grade my students take them just as seriously as the TMAs. This is a great example of how online assessment can aid learning.*

Not all computer-marked assessment is the same

To improve quality:

- Think about your assessment design; why do you want to use computer-marked assessment; how will you integrate it?
- Use appropriate question types
- Write better questions
- Use an iterative design process

Why have I used computer-marked assessment?

- In my work, the focus has been on ‘assessment for learning’, so feedback and giving students a second and third attempt is important (Gibbs & Simpson, 2004-5).
- We aim to ‘provide a tutor at the student’s elbow’ (Ross et al., 2006).
- However, a summative interactive computer-marked assignment that ran for the first time in 2002 is still in use, and has been used by around 15,000 students.

A Module website, showing the links to a quiz

MST224-13J

9 week planner

Entire planner

Help with this page

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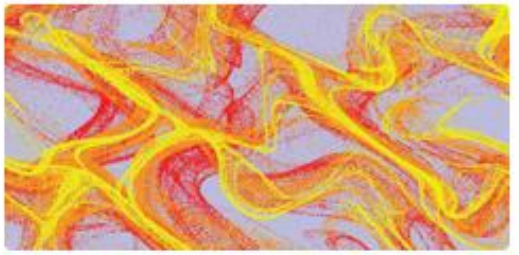
Study planner

MST224 Mathematical methods



Week Progress

Welcome

Welcome to *Mathematical methods* (MST224). The aim of this module is to provide a background in the mathematical methods for students studying physical sciences, engineering, mathematics and economics. The module has been designed to provide the mathematical background required for the third-level modules offered by the department of physical sciences, and the third-level modules in applied mathematics.

1 to 2 5 Oct

Book 1 Unit 1

MST224 Guide

Read through the MST224 Guide before embarking on Unit 1; paying particular attention to sections on assessment and the handbook.

Unit 1: Getting started 1.6MB PDF document

Practice quiz for Unit 1 (Tutor groups (MST224-13J))

ASTRO PHYS

Radio Telescope: ARROW

Robotically directed receiver tuned to radio emission from hydrogen in the Milky Way.

6 hours or more

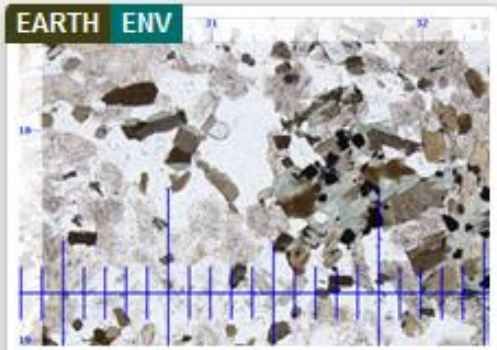
ENV EARTH

Maps and landforms

Learn how to interpret maps and how to use a compass.

1 hour

EARTH ENV



Virtual petrographic microscope

Thin rock sections viewed under a polarising microscope.

1-2 hours

ENV BIO

Treezilla

Map and record Britain's trees using Citizen Science.

GEN

Graph plotter

Import your own data to create graphs.

ENV BIO

Eating for energy

An investigation into why greater horseshoe bats are so rare in Britain today.

Overall feedback on a diagnostic quiz

This feedback is designed to give you some indication, based on your answers to *Are you ready for S104?* of your preparedness to study *Exploring science* (S104). The feedback is based on a 'traffic lights' system.

If you receive all greens then you appear to have sufficient time and previous knowledge to study S104.

If you receive one or more ambers then you may need to find more time or to revise your skills in one or more areas before taking S104. You may wish to consider studying *Science starts here* (S154) before studying S104. S154 will prepare you fully for studying S104 in the future.

If you receive one or more reds then you do not appear to be sufficiently prepared to study S104 at the present time. You are advised to study S154 *Science starts here* before studying S104. S154 will prepare you fully for studying S104 in the future.

You should also note that, however well prepared you are, you will need to find about 16 hours a week over a 9-month period in order to study S104 successfully.

If you would like more information about S154, please visit the *Science starts here* (S154) webpage.

If you would like to check whether you are sufficiently prepared to study S154, please attempt the *Are you ready for science study?* questions.

Essential Mathematics for S104

You achieved : Green

Essential English for S104

You achieved : Red

Valuable Science for S104

You achieved : Amber

Use appropriate question types

- Multiple-choice
- Multiple-response
- Drag and drop
- Matching
- True/false
- Hotspot
- Free text: for numbers, letters, words, sentences

Note: You need to think about what your e-assessment system supports.

OpenMark PMatch STACK

A basic OpenMark question

Work out $\frac{1}{5} + \frac{1}{6}$, entering your answer as a fraction using the boxes provided.

$\frac{1}{5} + \frac{1}{6} = \frac{2}{11}$

Check | Skip to answer

Your answer is incorrect.

Try again

A basic OpenMark question

Work out $\frac{1}{5} + \frac{1}{6}$, entering your answer as a fraction using the boxes provided.

$\frac{1}{5} + \frac{1}{6} = \frac{1}{30}$

Check | Skip to answer

Your answer is still incorrect.

You appear to have multiplied the two fractions rather than adding $\frac{1}{6}$ and $\frac{1}{5}$. In order to add or subtract two fractions, it is necessary for them both to have the same denominator (bottom line) i.e. for them to share a 'common denominator'.

Try again

A basic OpenMark question

Work out $\frac{1}{5} + \frac{1}{6}$, entering your answer as a fraction using the boxes provided.

$\frac{1}{5} + \frac{1}{6} = \frac{11}{30}$

Check | Skip to answer

Your answer is correct.

$\frac{1}{5} + \frac{1}{6} = \frac{6}{5 \times 6} + \frac{5}{6 \times 5} = \frac{6+5}{5 \times 6} = \frac{11}{30}$

See Section 3.5.1 of the *Maths Skills* ebook for guidance on adding and subtracting fractions.

Next

A variant of the same question

Work out $\frac{1}{4} + \frac{1}{3}$, entering your answer as a fraction using the boxes provided.

$\frac{1}{4} + \frac{1}{3} = \frac{7}{12}$

Check | Skip to answer

Your answer is correct.

$\frac{1}{4} + \frac{1}{3} = \frac{3}{4 \times 3} + \frac{4}{3 \times 4} = \frac{3+4}{4 \times 3} = \frac{7}{12}$

See Section 3.5.1 of the *Maths Skills* ebook for guidance on adding and subtracting fractions.

Next

Use appropriate question types

- Multiple-choice
- Multiple-response
- Drag and drop
- Matching
- True/false
- Hotspot
- Free text: for numbers, letters, words, sentences

Note: You need to think about what your e-assessment system supports.

OpenMark PMatch STACK

A STACK question in Moodle

MST224-13J > Assessment resources > iCMAs and practice quizzes > Practice quizzes > Practice quiz for Unit 2 > Preview

Questions

1 ✔ | 2 | 3 | 4 | 5 | 6

Finish attempt ...

Start a new preview

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Question 2

Not complete

Marked out of 1.00

Flag question

Edit question

Find the general solution of the differential equation

$$\frac{dy}{dx} + 12x^3 \sin\left(3x^4\right) = 0$$

y = sin(3*x^4)

Your last answer was interpreted as follows:

$$\sin\left(3\,x^4\right)$$

Check

Incorrect answer.

See Unit 2 Section 2.1 *Direct integration*.

Try again

A STACK question in Moodle

Questions

1 ✔ | 2 | 3 | 4 | 5 | 6

Finish attempt ...

Start a new preview

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- Week 11
- Week 13

Question 2

Not complete

Marked out of 1.00

Flag question

Edit question

Find the general solution of the differential equation

$$\frac{dy}{dx} + 12x^3 \sin\left(3x^4\right) = 0$$

y = cos(3*x^4)

Your last answer was interpreted as follows:

$$\cos\left(3\,x^4\right)$$

Check

Incorrect answer.

You need to add a constant of integration, otherwise this appears to be correct. Well done.

The differential equation can be expressed as

$$\frac{dy}{dx} = -12x^3 \sin\left(3x^4\right)$$

and then solved by direct integration (using integration by substitution):

$$y = \int -12x^3 \sin\left(3x^4\right)\, dx.$$

See Unit 2 Section 2.1 *Direct integration* and Unit 1 Section 6.3 *Integration by parts and by substitution*.

Try again

A STACK question in Moodle

Questions

1 ✓ 2 ✓ 3 4 5 6

Finish attempt ...

Start a new preview

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Question 2

Correct

Mark 0.80 out of 1.00

Flag question

Edit question

Find the general solution of the differential equation

$$\frac{dy}{dx} + 12x^3 \sin\left(3x^4\right) = 0$$

$y =$ cos(3*x^4) + C

Your last answer was interpreted as follows:

$$\cos\left(3\,x^4\right) + C$$

Check

Correct answer, well done.

The differential equation can be expressed as

$$\frac{dy}{dx} = -12x^3 \sin\left(3x^4\right)$$

and then solved by direct integration:

$$y = \int -12x^3 \sin\left(3x^4\right)\,dx.$$

This can be solved using integration by substitution:

$$\int f(y)\frac{du}{dx}dx = \int f(y)du$$

Use appropriate question types

- Multiple-choice
- Multiple-response
- Drag and drop
- Matching
- True/false
- Hotspot
- Free text: for numbers, letters, words, sentences

Note: You need to think about what your e-assessment system supports.

OpenMark PMatch STACK

A short-answer question (PMatch)

If the distance between two electrically charged particles is doubled, what happens to the electric force between them? Be as specific as possible.

*Please give your answer as a **short** phrase or sentence.*

The force will decrease.

Enter answer

Your answer appears to be incorrect or incomplete in some way.

You are on the right lines. You are correct to say that the strength of the force decreases, but by how much? Coulomb's Law states that the electric force between two charged particles is inversely proportional to the square of their separation (see Book 7 Section 10.1). So when the distance between the particles is doubled, what happens to the electric force between them?

Try again

A short-answer question (PMatch)

If the distance between two electrically charged particles is doubled, what happens to the electric force between them? Be as specific as possible.

*Please give your answer as a **short** phrase or sentence.*

The force will halve.

Enter answer

Your answer still appears to be incorrect or incomplete in some way.

You are correct to say that the strength of the force decreases, but not to say that it halves. Coulomb's Law states that the electric force between two charged particles is inversely proportional to the square of their separation (see Book 7 Section 10.1). So when the distance between the particles is doubled, what happens to the electric force between them?

Try again

A short-answer question (PMatch)

If the distance between two electrically charged particles is doubled, what happens to the electric force between them? Be as specific as possible.

*Please give your answer as a **short** phrase or sentence.*

The force will decrease by a factor of four.

Enter answer

Your answer is correct.

Coulomb's Law states that the electric force between two charged particles is inversely proportional to the square of their separation (see Book 7 Section 10.1). So when the distance between the particles is doubled, the electric force between them is reduced by a factor of four i.e. it is a quarter of its original value.

Next question

Different question types in use

TOP TEN MOODLE QUESTION TYPES (Worldwide)	Number	%
Multiple choice	40,177,547	74.85
True/false	6,462,669	12.04
Short-answer	3,379,336	6.30
Essay	2,321,918	4.33
Matching	551,404	1.03
Multi-answer	341,988	0.64
Description	149,303	0.28
Numerical	138,761	0.26
Calculated	103,103	0.19
Drag-and-drop matching	26,117	0.05
TOTAL	53,675,508	100

Hunt, T. (2012). Computer-marked assessment in Moodle: Past, present and future. Paper presented at the International CAA Conference, Southampton, July 2012.

Constructed response or selected response?

- The most serious problem with selected response questions is their lack of authenticity: “Patients do not present with five choices” (Mitchell et al., 2003) quoting Veloski (1999).
- But even relatively simple selected response questions can lead to “moments of contingency” (Black & Wiliam, 2009) enabling “catalytic assessment”, the use of simple questions to trigger deep learning (Draper, 2009)

A quiz for you

Q1. En mnoge est umpitter dan en bfeld because

A it is red

B it is blue

C it is yellow

D it is smaller so will fit through the gap between the house and the wall

E it is green

A quiz for you

Q2. The bfeld links to the mnoge by means of a

A elland
B angaster
C tanag
D introdoll
E ussop

A quiz for you

Q3. Which two of the following are correct:

1. A is bigger than B
2. B is bigger than C
3. A is bigger than C
4. A is smaller than B
5. B is smaller than C

Our advice to question authors

- Think about how you want your assessment to be embedded within the module
- Think about what question type to use (selected response or constructed response)
- Make sure that your question is carefully worded
- Think about your feedback
- Think about providing variants of the questions
- Check your questions
- Get someone else to check your questions
- Modify your questions in the light of student behaviour the first time they are used.

Monitor question performance

What is $\frac{2}{3} + \frac{5}{7}$ expressed as a single fraction? You should give your answer in the simplest possible form.

$\frac{2}{3} + \frac{5}{7} = \frac{29}{42}$

Enter answer

Your answer is still incorrect.

$$\frac{2}{3} + \frac{5}{7} = \frac{2 \times 7}{3 \times 7} + \frac{5 \times 3}{3 \times 7}$$

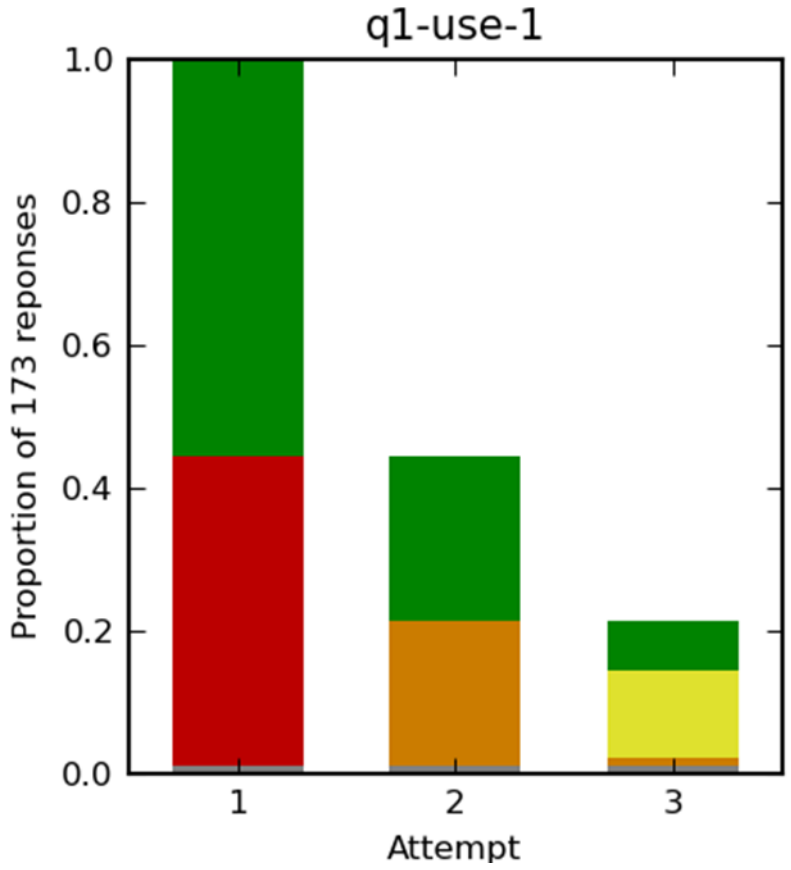
$$= \frac{14 + 15}{3 \times 7}$$

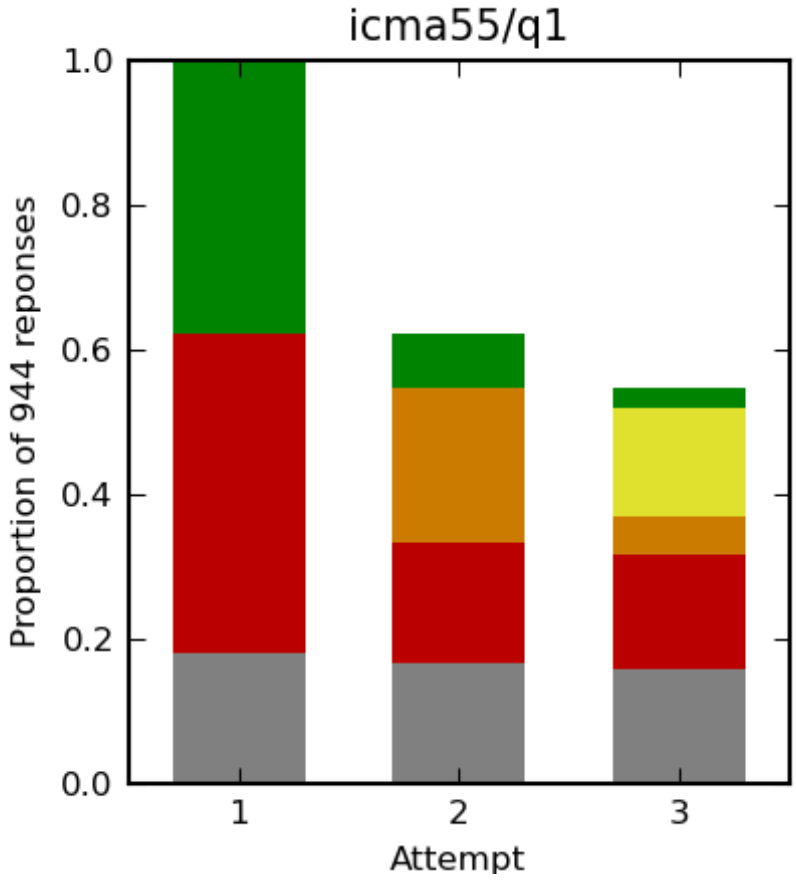
$$= \frac{29}{21}$$

Addition of fractions is discussed in *Maths for Science* Section 1.2.2.

Next question

Monitor question performance





So we have done quite well

- But writing good questions takes a lot of time and therefore money

Two possible solutions:

- Use machine-learning to develop the answer matching (especially for short-answer free-text questions)
- Share questions

Collaboration

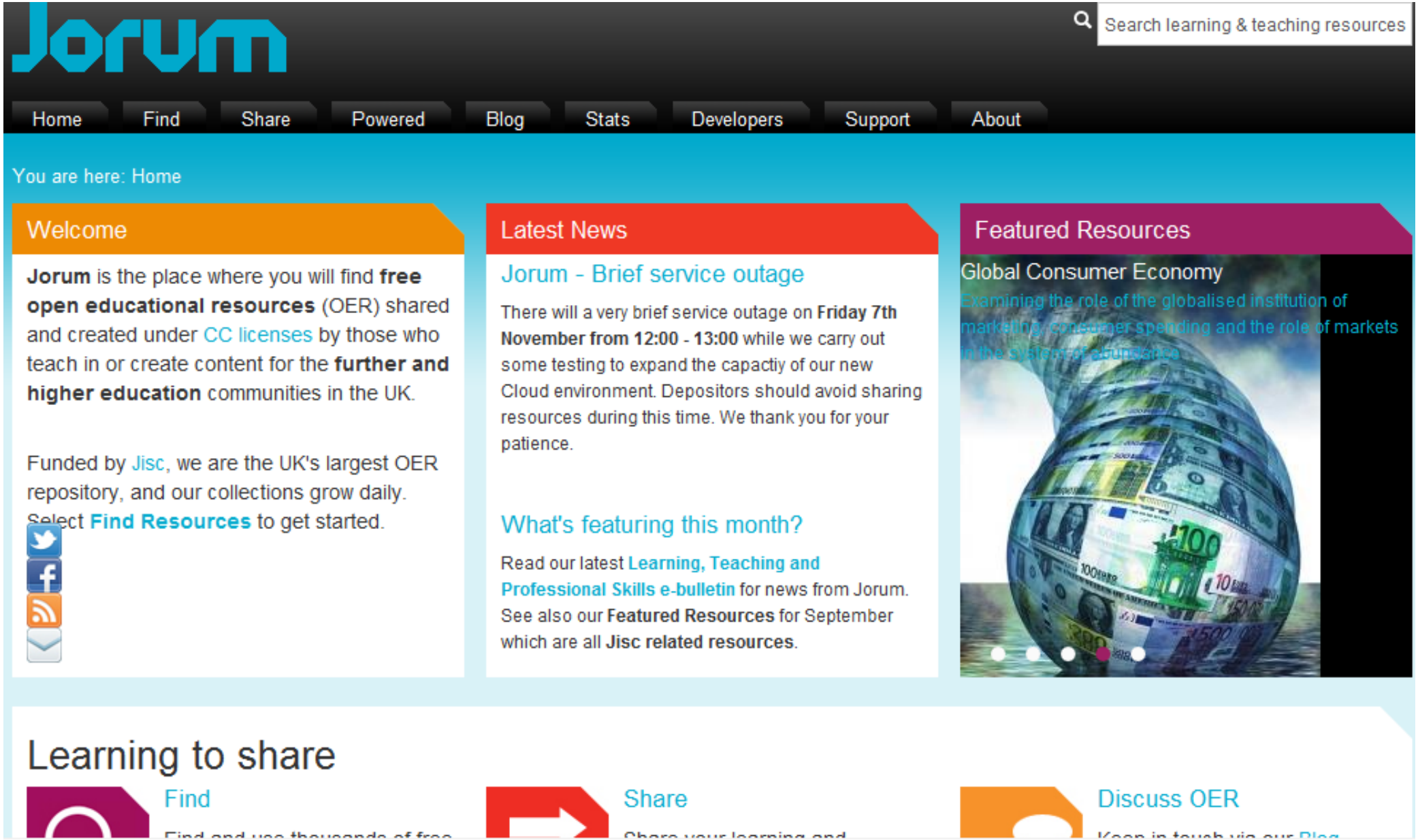
There are some examples e.g. in the US “Race to the top” ($4 billion funding) has funded

The **Partnership for Assessment of Readiness for College and Careers (PARCC):** a group of 14 states working together to develop a set of assessments that measure whether students are on track to be successful in college and their careers.

On a much smaller scale:

In the UK, the **Finding Electronic Teaching, Learning and Assessment Resources (FETLAR)** Project resulted (amongst other things) in shared STACK questions.

Sharing resources



moodle.net
COURSES & CONTENT

Home ⟩ Site pages ⟩ Course content

Course content

A collection of importable Moodle course content, such as quiz questions, database presets, IMS LTI sites and more.

Note: This area is NOT for sharing course information, lesson plans or generic course materials such as presentations or handouts.

These are not Moodle backups, but specific Moodle content that you can import into various activities in your own courses.

If you have course content that you'd like to share, please add an entry! (Entries require approval before they are viewable by everyone.)

OER Open Educational Resources

			News, publications
			Moodle, teaching
			Chemistry
			Image editing, Presentations
Maths Puzzles	Quiz questions	Any version of Moodle	Mathematics
Christmas in other Languages	Glossary entries	Any version of Moodle	Christmas, languages
Quickstart Guide to Impress	SCORM package	Any version of Moodle	LibreOffice
Theatre Glossary	Glossary entries	Any version of Moodle	Theatre
Literacy Quiz	Quiz questions	Any version of Moodle	Literacy, grammar

Why don’t we collaborate more?

“Sharing questions is one of those things which is easy to say we’d like but turns out to be very difficult in practice.”

- Some questions are systems dependent (so need interoperability: Question and Test Interoperability (QTI))
- Questions may be context dependent e.g. refer to other resources, assume particular previous knowledge.

Is a solution to share questions and allow others to edit them for their own use?

Note: questions may be confidential (especially if in high-stakes summative use)

How far is it appropriate to go?

- It is technically possible to get good answer matching for some quite sophisticated question types e.g. essays.
- But Perelman (2008) trained students to obtain good marks for a computer-marked essay by “tricks”.

- Computer-marked assessment is not a panacea.

“*If course tutors can be relieved of the drudgery associated with marking relatively short and simple responses, time is freed for them to spend more productively, perhaps in supporting students in the light of misunderstandings highlighted by the e-assessment or in marking questions where the sophistication of human judgement is more appropriate*”(Jordan & Mitchell, 2009).

References

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Draper, S. (2009). Catalytic assessment: Understanding how MCQs and EVS can foster deep learning. *British Journal of Educational Technology*, 40(2), 285-293.

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Sangwin, C. J. (2013). *Computer aided assessment of mathematics*. Oxford: Oxford University Press.

Much of what I have said is discussed in more detail in:

Jordan, S. E. (2014). *E-assessment for learning? Exploring the potential of computer-marked assessment and computer-generated feedback, from short-answer questions to assessment analytics*. PhD thesis. The Open University. Retrieved from http://oro.open.ac.uk/4111

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