

# Arguing again for e-exams

Presenter: Dr Mathew Hillier  
Teaching and Educational Development Institute,  
University of Queensland

Co-author: Dr Andrew Fluck  
University of Tasmania

Get these slides (pdf)

<http://bit.ly/ascilite-eexams>

Get the demo

<http://transformingexams.com>



#### Acknowledgement

Support for this project has been provided by the Australian Government Office for Learning and Teaching. The views in this session do not necessarily reflect the views of the Australian Government Office for Learning and Teaching or participating institutions.



## Targeting...

- Supervised
- High stakes
- On campus
- Large scale

(image credit: Dr Fluck UTAS)



*What we are **not** specifically addressing here is off campus, online only, distance education, cross institutional students – there are some existing e-solutions to address these needs.*

## Drivers

### Policy

- Realising 'unfulfilled potential' in higher education
  - Also - is a lack of e-exams in higher education hampering the wider uptake of ICT in other areas of education? *Ref- TAS*
- National participation targets - Higher student numbers...  
e.g. UQ: 2007-2012 = **30K extra annual exam sittings.**
- Graduate attributes of Australian institutions - Feature current knowledge, skills for the modern world... this means ICT skills.
- Strategic & E-learning plans - significant activity with MOOCs, online learning, blended learning, flipped classrooms all depending on ICT success.
  - An internal UQ survey of senior teaching leaders placed 'e-assessment / online marking' at the top of their priority list for development.

3

## Drivers

### Practical

- Hand written assessment decreasing
- Technology provides and opportunity to enhance exam questions and scenarios
  - Some examples to follow later
  - More Examples at [TransformingAssessment.com](http://TransformingAssessment.com)
- Increasing use of ICT, study, work social
  - 98% ownership of mobile WiFi enabled devices
  - **91%** (2012 UQ survey), **97%** (2013 UQ survey) **laptop ownership** highest of any device
  - 80% of students accessing online LMS weekly

4

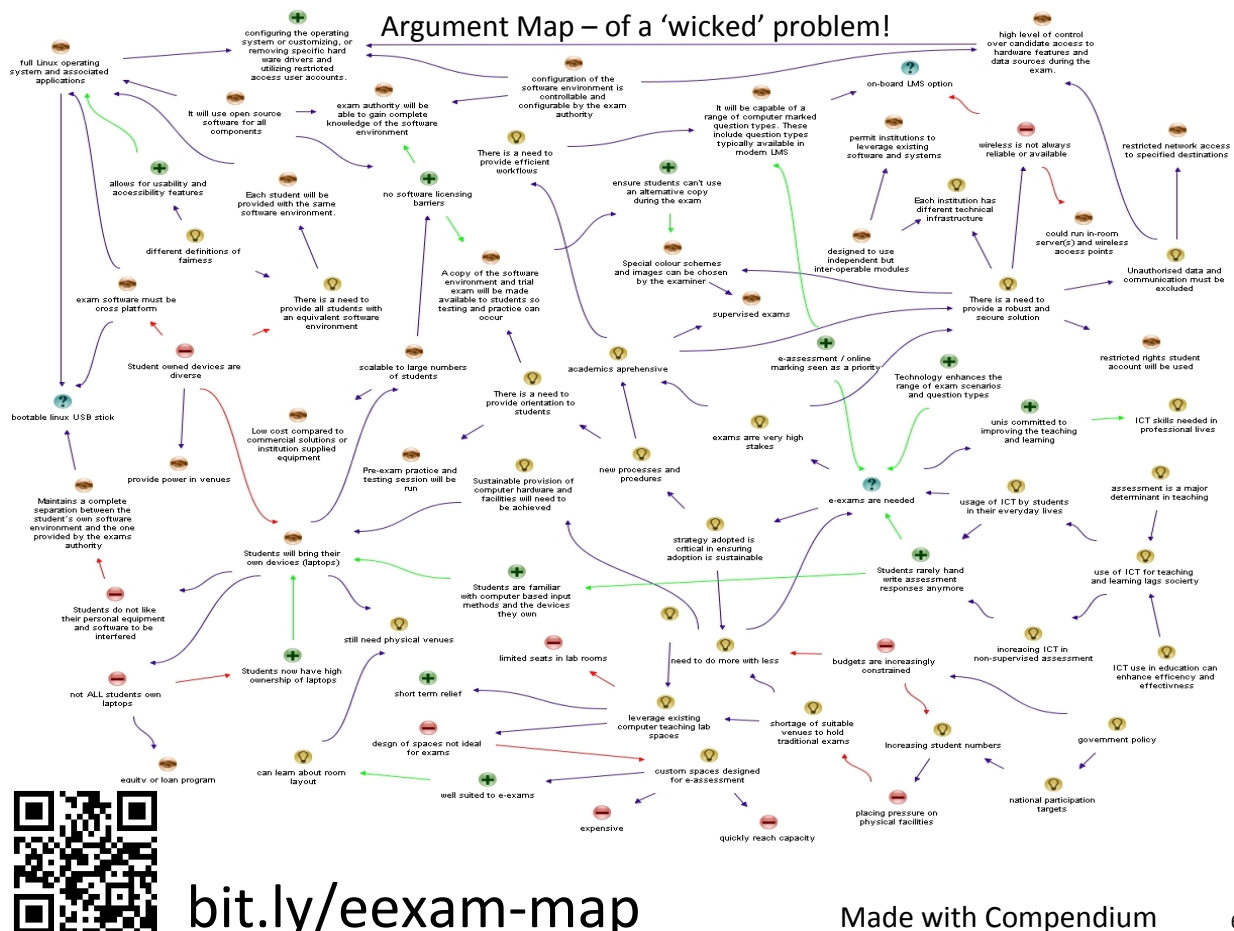
# So?

All of this ...leads to a growing disconnect between the way high stakes testing is conducted using pen on paper exams and students' everyday experiences.

Are e-exams the next step on from computer assisted marking and e-assessment of progressive assessments?

An e-exams solution is needed ... But!

5



Made with Compendium

6

## Some More Issues

- Fairness & Equity → *equivalent* environment
- Highest stakes → must be reliable and robust
- Many stakeholders - needs/concerns
- Security (end-to-end ref IT security principles)
- Invigilation (easy to identify misconduct)
- Administration (reduce manual/double handling)
- Sustainability, efficiency, facilities, spaces, equipment, set-up, logistics, processing, workflows...

7

## Sustainable facilities

Provision of facilities must be sustainable

- How to provide computer hardware and facilities for large infrequent e-assessment events (exams):
  - Use existing campus computer labs? (Finite in number, small 20~ish room size, problematic layouts/poor design [Dermo, 2012])
  - Build dedicated e-exam space? (good design, but costly, although capital cost done once, still finite, potentially low utilisation out of exam periods)
  - Hire / build temporary lab space? (costly and reoccurring)
  - Share facilities between institutions? (scheduling issues)
  - Provide each student with hardware? (costly ~ give or rent to students? - reoccurring, maintenance?, low utilisation?)
  - *Rent or build options are not scalable or sustainable.*
- Given the already high ownership of suitable equipment by students → how can we make use of this equipment?

8

## Issues - BYOD

- Given high ownership of laptops – we can leverage these
  - But ...
    - Diversity of devices (hardware, operating systems (Windows, Mac, Linux), software applications.
      - Need a 'cross platform' solution
      - Need to provide same (equivalent) software environment
    - A potential source of unauthorised assistance
      - Need ability to completely control student owned equipment for the exam duration – ref security principles.
    - Students have a lot 'invested' in their devices (for work, for study, for personal and social uses, etc)
      - Need to respect this domain, maintain privacy and integrity of student equipment.
      - Need to return student equipment as 'untouched' when done - separation of the exam environment and the student owned 'host' equipment.
    - Equipment does fail on occasion
      - Need appropriate back-up facilities and processes, data progressively saved, provide power, spare laptops etc

9

## Issues

### Varying technical infrastructure between / within Institutions

- How to:
  - Be applicable across the higher education sector
  - Fit into existing software and hardware landscapes
  - Leverage existing infrastructure
  - Cater for flexible needs
  - Not be a nightmare to support...

10

## A basis for further development

- The well developed 'eExam' system (v4) (**Andrew Fluck, UTAS**) – ticks many boxes:
  - Bootable USB sticks.
  - Full operating and application suite onboard.
  - Typed student responses (human marked)
  - Student owned equipment used as host and left untouched.
  - Open source code base, commodity components.



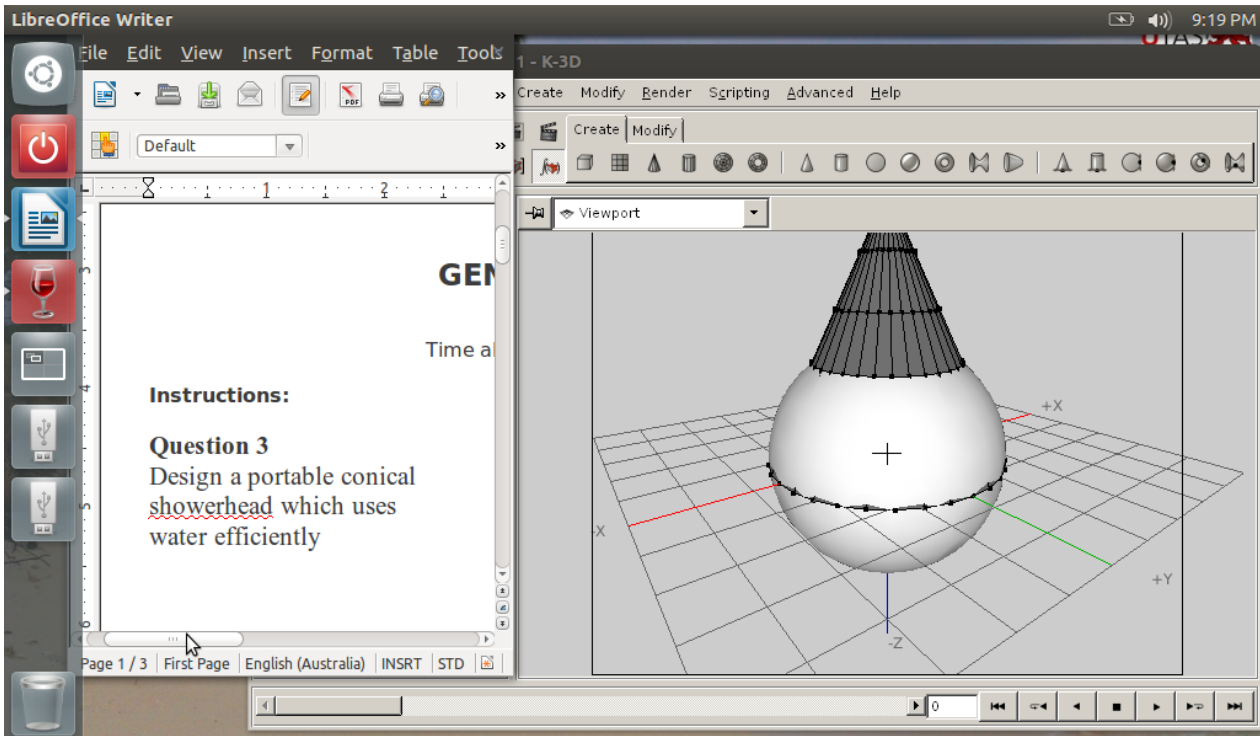
11

## eExam (v4) Modes

- Modes (phases of introduction)
  1. Paper replacement – computer optional (a typewriter) essay, short answer, limited multiple choice.
  2. Post-paper – a computer becomes compulsory
    - Adds multimedia prompts, video, audio and software tools can be made available in the exam so that ***students can construct a response.***
- Responses need to be human marked either on-screen or printed then shuffled...
  - ...the current project is seeking to address this! (v5)

# Post-paper - Can Include Software Tools

- Software tools can be made available in the exam

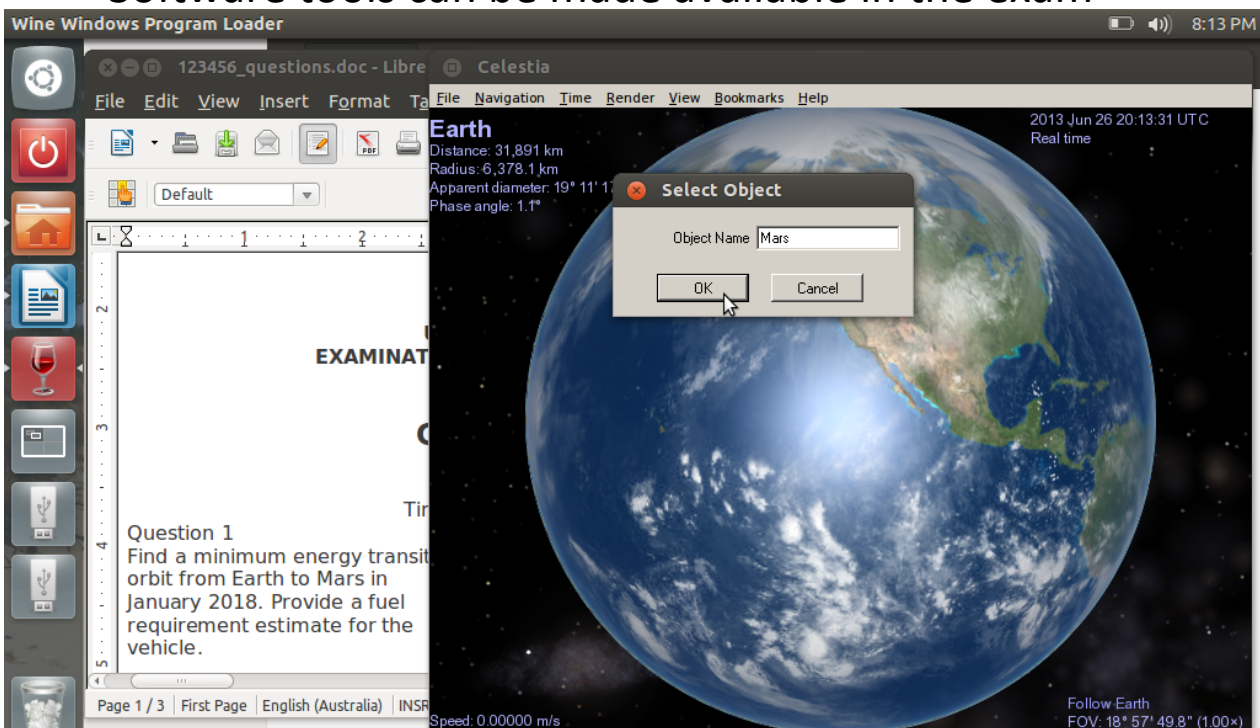


Ref: Dr Fluck, UTAS

13

# Post-paper - Can Include Software Tools

- Software tools can be made available in the exam

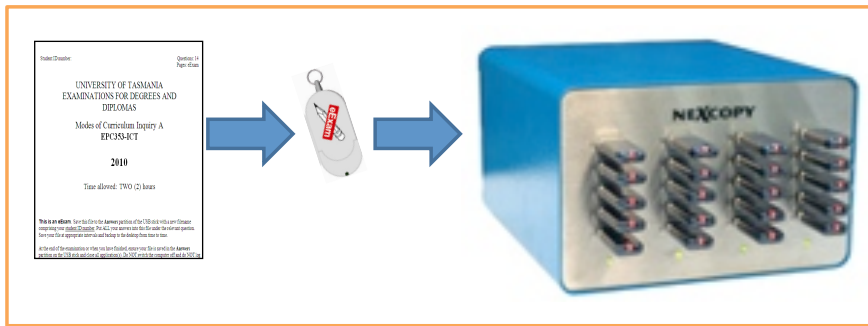


Ref: Dr Fluck, UTAS

14

# The Current Process – how it works

Prep



Post Exam



(credit: Dr Fluck UTAS)

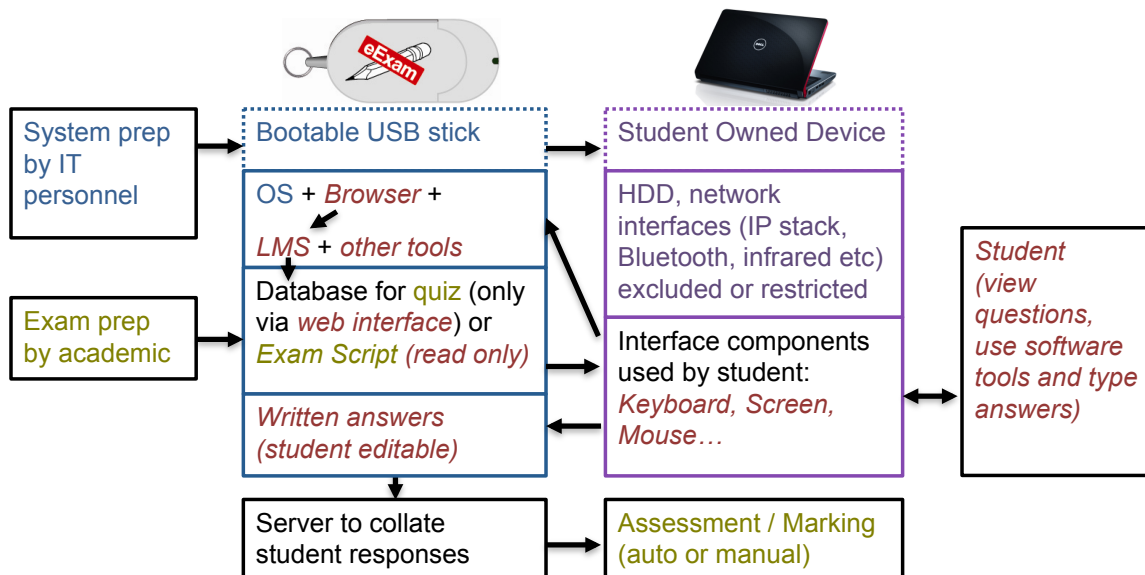
15

## e-Exam system for BYOD

Current project improvements for v5 – adds:

- On-board LMS for computer marked question types (Moodle) [demo available]
- Electronic answer reticulation/workflows [in progress - TBA]

Modular architecture so academics / institutions can choose the features and mode of operation that suit them...



16



# Modes of use

- **Non wireless mode** [*demo available*]
  - Exam / LMS is on-board the stick itself.
  - Duplicating equipment to reverse copy student answer files/ databases from the USB sticks to a collation location
  - Fall back in all cases - manual copying each student's answer file(s)
- **Ad-hoc wireless mode** [feature TBA]
  - Exam / LMS will be on-board the stick itself.
  - Periodic connections to upload/update student answers on a collation server in background or via a student initiated final submission with confirmation shown on screen
- **Wireless/Network always on mode** – [*demo available*]
  - Needs reliable, redundant, high capacity wireless/network in the exam room (best to use wired!) or just use as a secure boot image for computer labs to serve as a gateway to the institution's LMS.
  - Doesn't require an LMS on-board the stick
  - Web browser to access a LMS server via restricted connection
  - Custom network config by institution IT (done once, reused)

17

# Current e-Exam v5 Demo

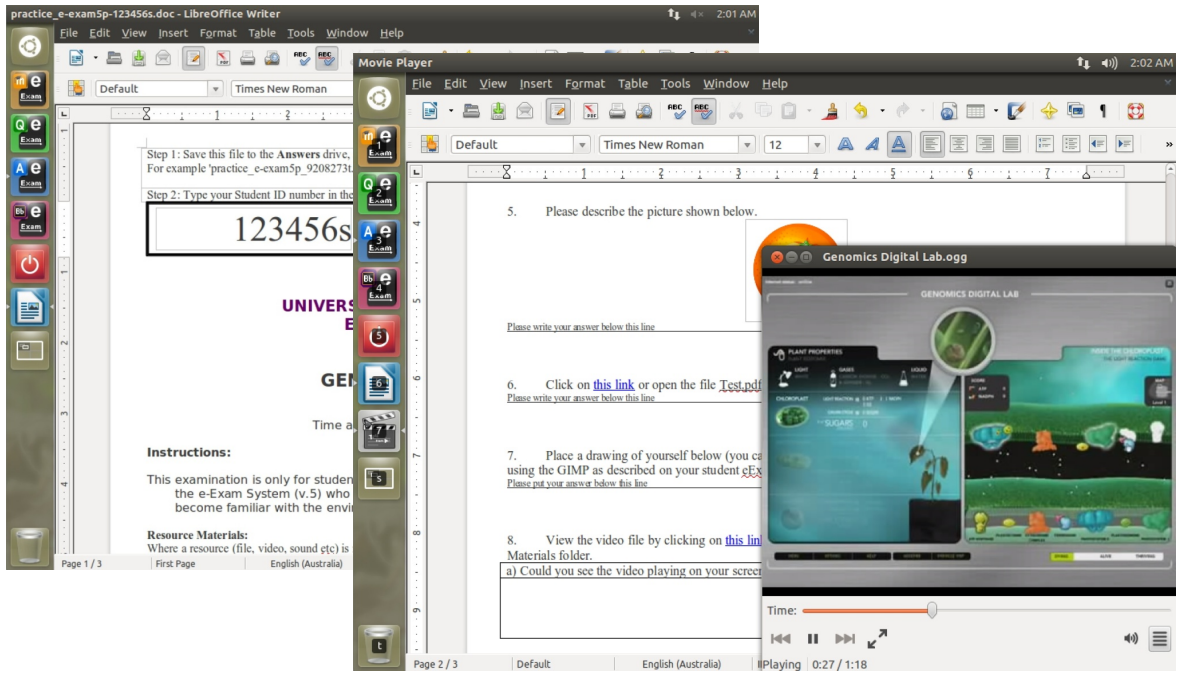
Desktop. Choice of modes. Background image unique for each exam for added security.



18

# Current e-Exam v5 Demo

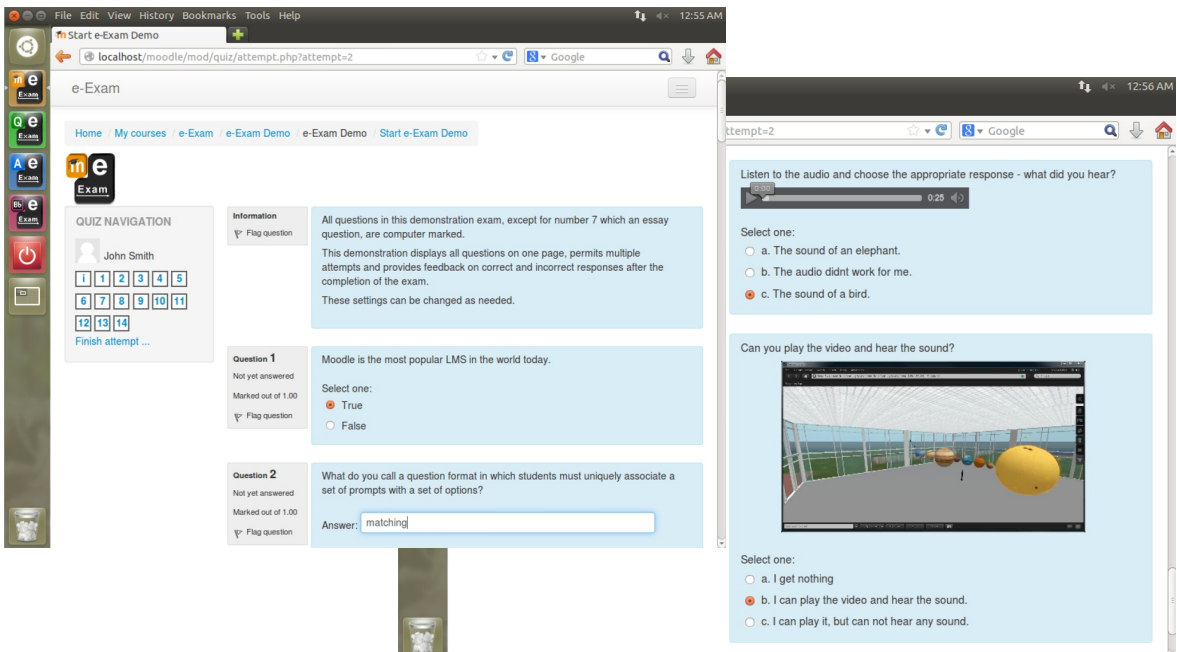
Paper equivalent and replacement exams via word processor. Links to on-board media / software tools.



19

# Current e-Exam v5 Demo

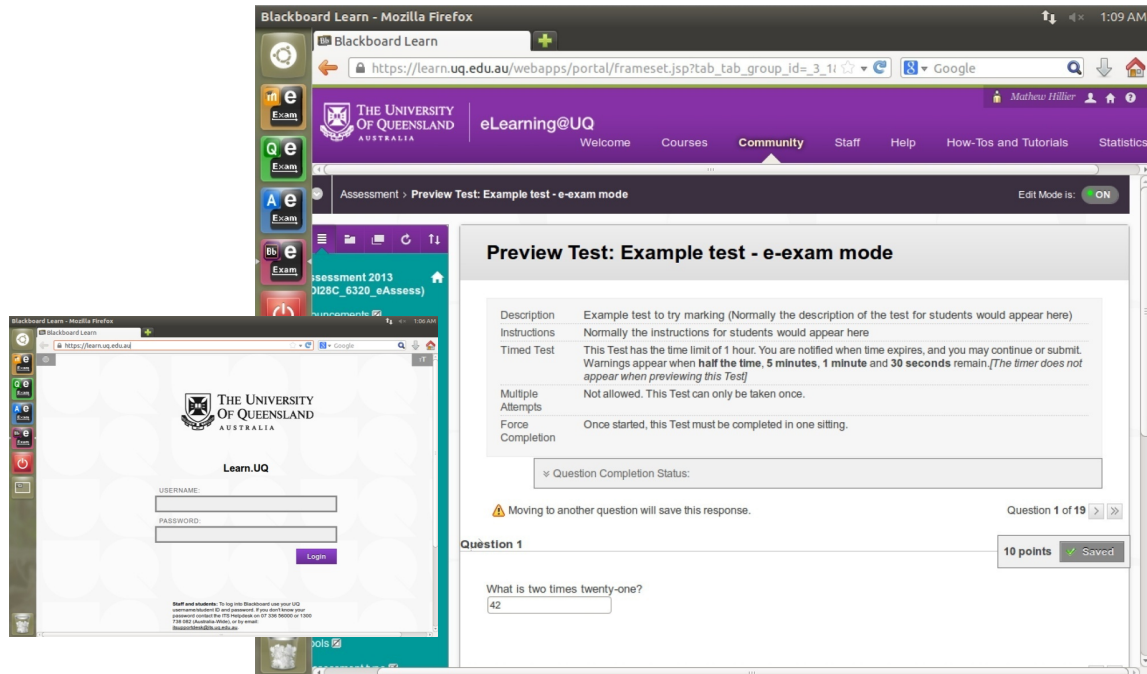
Computer marked question types via on-board LMS. Integrated multimedia.



20

# Current e-Exam v5 Demo

Computer marked question types via institutional LMS  
(needs network for restricted connection – e.g. demo can \*only\* connect to UQ Blackboard and no other server.)



21

# What else it could do

Computer marked question types (Moodle)

**Standard [already in the demo]:**

- Calculated (Wildcards and datasets, calculated MCQ)
- Matching
- Embedded Answers (Cloze Test / Gap Fill – text with multiple choice, short answers and numerical answers)
- Short Answer (sentences)
- Numerical
- True/False
- Short essay (with response template)

**Custom types:**

- Algebra, Multinumerical, Spreadsheet,
- Chemistry Molecular editor questions,
- Music (key signature, scales, intervals)
- Hot spots, drag and drop (labels, text, images),
- Set splitting,
- Missing words, Gapfill,
- Regular expression...

*Marking: delayed, Certainty-Based Marking... manual override.*

22

# Examples – Confidence questions

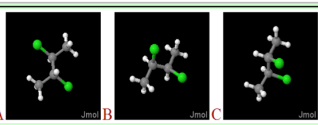
- Confidence based approaches penalise guessing. Students need to choose a response and declare their level of certainty. Available in Moodle now.

Certainty level:	C=1	C=2	C=3	No Reply
Mark if correct:	1	2	3	0
Penalty if wrong (T/F Q)	0	-2	-6	0

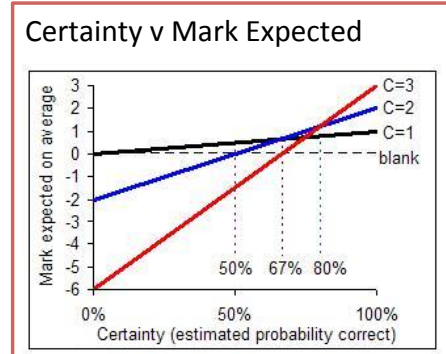
**Qu. 1:**  
Which structure shown below represents meso 2,3-dichlorobutane, A, B or C?  
[Click on the text below to open a window with the three choices]  
[Three structures, A, B and C](#)

Choose one of the following:

C  
 A  
 B



No Reply Certainty: C=1 (low) C=2 (mid) C=3 (high)



Tony Gardner-Medwin, UCL, TA Webinar 6 April 2011 <http://bit.ly/TA6A2011>  
<http://www.ucl.ac.uk/lapt/>

23

# Examples – Short text response

Students type in a short sentence response which can be marked by computer based on pattern matching.

Available in Moodle now.  
Example question

A boy climbs slowly to the top of a slide and then slides down it. At which point will his kinetic energy be a maximum?  
Note: Your answer should ignore the effects of friction.

*You should give your answer as a short phrase or sentence.*

Kinetic energy will be at maximum when at the bottom of the slide.

evaluation

Options For Entering Answers

Case sensitivity: No, case is unimportant

Allow use of subscript: No

Allow use of superscript: No

If answer is more than 20 words: warn that answer is too long and invite responsee to shorten it

Check spelling of student: Yes

Add these words to dictionary: [text area]

Convert the following characters to a space: [text area]

Define Synonyms For Words in Answers

Word impact: Synonyms stop|land|finish|complete

Word just: Synonyms prior|when|in|instant|moment|immediate|second

Answer: match\_mw (bottom|base|end|flat\*|floor|ground|horizo

Grade: 100%

Answer: match\_any ( match\_mw (fast\*|quick\*) match\_mwp4 (great\*|max\*\_velocity|speed) match\_mwp4 (velocity|speed\_great\*|max\*) )

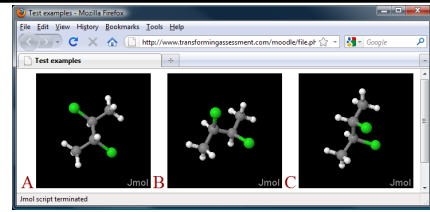
Grade: 50%

# Examples – embedded applets

## Moodle Quiz

1 <sup>1</sup> Marks: --/1  
 Which structure shown below represents **meso** 2,3-dichlorobutane, A, B or C?  
 [Click on the text below to open a window with the three choices]  
 Three structures, A, B and C

Answer:

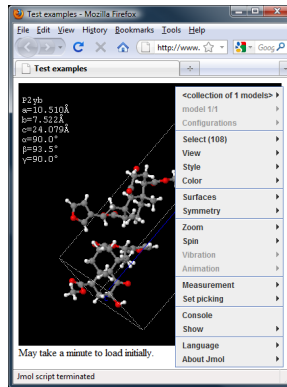


2 <sup>1</sup> Marks: --/1  
 Use the Jmol applet to view the crystal structure of the presented molecule. Use the Jmol applet display to match the following statements.

There are 7 stereogenic centres in the molecule

There is evidence for an intramolecular hydrogen bond

There is evidence for an intermolecular hydrogen bond



Students interact with tools to obtain data to construct an answer.

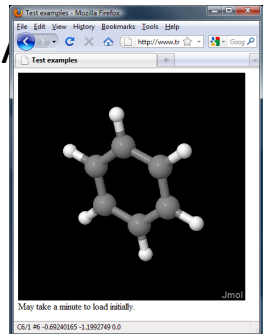
3 <sup>1</sup> Marks: --/1  
 Use the Jmol applet to view the molecular structure of the presented molecule. Use the Jmol applet display to match the following statements.

The most electron rich region of this molecule is

The most electron poor region of this molecule is

The lowest energy molecular orbital for the molecule is

The highest energy molecular orbital for the molecule is



<http://www.transformingassessment.com/moodle/file.php/27/jmol/jmol01.html>

# Examples – Virtual Labs / Sims

Conduct experiments via locally run simulations<sup>1</sup> or internet connected hardware<sup>2</sup>

1 <sup>1</sup> Marks: 1  
 What peak voltage is produced across the coil when a voltage of 3.5 is applied to the driving motor?  
 Use the remote laboratory experiment shown below to run the experiment and observe the peak voltage produced on the positive side of the scale. Note that the red bars indicate whole even numbers.  
 Enter an average of the peak values you have observed into the answer box shown at the bottom. Enter a positive number only.

**Electromagnetic induction**

View of the experiment

Electromotive voltage on the rotating coil

Voltage on the driving motor

Data recording

Choice of the measurement

Answer:

(1) <http://phet.colorado.edu/>

(2) <http://www.transformingassessment.com/moodle/course/view.php?id=72>

# Examples – Augmented Reality Experiment

AR101: Example Quiz that includes Aug...

1 Marks: 1 Use the colour coded AR Markers to simulate the mixing of Zinc and Copper Sulphate Solution. When you are done, choose the correct reaction from below.

Choose a resource

**Chemistry**  
Reactivity series of metals. Experiment with the metals and solutions and find out what reactions happen when one metal is mixed with a solutions.

**Marker key**

- Blue = Silver
- Purple = Magnesium
- Yellow = Zinc
- Green = Iron
- Red = Lead
- Pink = Copper
- Orange = Copper Sulphate Solution
- Turquoise = Magnesium Sulphate Solution
- Grey = Silver Nitrate Solution
- Black = Lead Nitrate Solution

**AR Marker Colour Key**

Blue = Silver  
Purple = Magnesium  
Yellow = Zinc  
Green = Iron  
Red = Lead  
Pink = Copper  
Orange = Copper Sulphate Solution  
Turquoise = Magnesium Sulphate Solution  
Grey = Silver Nitrate Solution  
Black = Lead Nitrate Solution

Choose one answer.

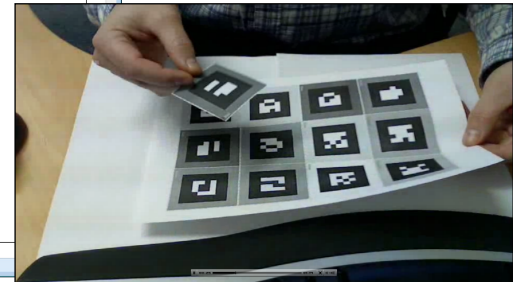
- a.  $\text{Cu(s)} + \text{ZnSO}_4(\text{aq})$
- b.  $\text{Zn(s)} + \text{CuSO}_4(\text{aq})$
- c.  $\text{Cu(s)} + \text{Ag}_2\text{SO}_4(\text{aq})$

**Results**  
zinc + copper (II) sulphate solution -> copper and zinc sulphate solution  
 $\text{Zn(s)} + \text{CuSO}_4(\text{aq}) \rightarrow \text{Cu(s)} + \text{ZnSO}_4(\text{aq})$

Web cam



AR markers



AR software embedded in question

<http://www.transformingassessment.com/moodle/course/view.php?id=70>

27

# Examples – Virtual 3D Spaces

1 Marks: 1 Click on the link for Question 1 on the external web page. Use the emission and absorption spectroscopy tool below to determine the element corresponding to the colour orange-red in the gas discharge tube.

Choose one answer.

- a. sodium
- b. copper
- c. neon
- d. barium

As if the student was doing the activity in the LMS



(e.g. Sim-on-a-stick)

Set up Quiz in the LMS. Results are stored in the in grade book.

A set of scripts for Moodle and VW that acts as a bridge.

Student undertakes assessment in the virtual world

Attempted	Attempted	Attempted	Attempted	Attempted	Attempted	Attempted	Attempted	Attempted	Attempted
Grade	Grade	Grade	Grade	Grade	Grade	Grade	Grade	Grade	Grade
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

**Chemistry**  
Molecular Model, Molecular Model

**Physics**  
Blood Pressure Cuff  
Click the red button to measure the pressure of the valve.

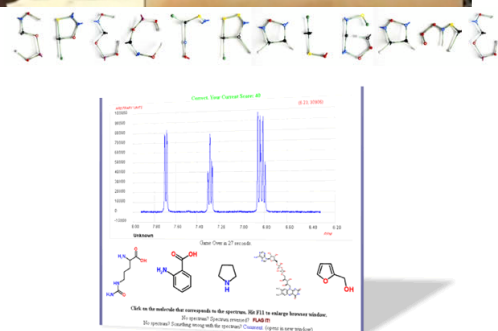
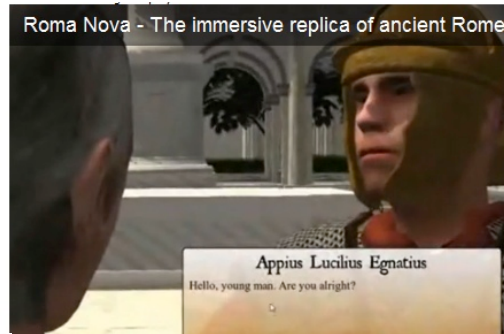
**SLOODLE 11 Quiz Chair**  
Click the red button for Question 2 on the external web page. The quiz will be graded and stored in the gradebook when keeping all answers constant.  
1. Rotate the chair around the force.  
2. Keep the centrifugal force the same.  
3. Increase the centrifugal force.

Online (Second Life) examples see <http://www.transformingassessment.com/secondlife.php>

28

# Examples – Serious Games

- Serious games, simulations, role plays. Business, science, history, language/communication.



<http://www.transformingassessment.com/moodle/course/view.php?id=38>

29

# Research program outputs

- The e-Exam system is situated within a wider research program to develop:
  - A working prototype of an exams platform and documentation allowing others to reproduce it
  - A set of example questions that can be used in e-exams
  - A research-informed set of good practice guidelines on e-exam processes and procedures.
  - A guide on preparing students for e-exams.

30

## Further Information

Contact: [m.hillier@uq.edu.au](mailto:m.hillier@uq.edu.au)

Project website and demo

<http://transformingexams.com>

References upon request.

### Citation

Hillier, Mathew & Fluck, Andrew (2013) Arguing again for e-Exams, ASCILITE conference, Sydney, 3 December.