Exploring e-exams

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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 (covered briefly later).
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.
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
• Increasing use of ICT, study, work social
  – 98% ownership of mobile WiFi enabled devices
  – 91% laptop ownership highest of any device
  – 80% of students accessing online LMS weekly
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 are the next step on from computer assisted marking and e-assessment of progressive assessments?

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

Include one or more of:

- Built in quiz tools within a Learning Management System (LMS), not designed to be e-exams environments, students have access to other tools within the LMS. Thus requires invigilation - currently requires the campus labs... Scalable?

- Tests and exams undertaken in fixed computer teaching labs on campus, spaces normally limited to 20 per room, finite number of labs, layouts often not suitable for high stakes exams.

- Proprietary testing software applications. dependent on the use of a particular operating system, few being cross platform. institution owned equipment need(?) many install invasive components into computers in an attempt to secure an inherently insecure environment.

- Outsourced testing centres or services, control is passed to other organisations/individuals. Mainly intended for small numbers, external/distance education students, costly on a per student basis(?);

- Online proctoring services, distance education /off-campus at exam time, raises risks of exam protocol breaches, intrusive software installed into student owned computers.
Developing e-exams

• Buy in a proprietary solution?
  – Needs met adequately? Pedagogically sound?
  – Software $ licence fees – costly, reoccurring
  – Closed architecture and restrictions –
    • unknown internals
    • customisation and flexibility?
    • give to students for practice?
    • pull it apart for experimentation/ innovation /research?
    • new features to meet new needs? who decides?
  – Ongoing technical and procedural support?
  – Vendor lock in, can stop supporting it, can go broke.

• Build your own? - fully known but, all risk in one institution,
  knowledge in few minds – may leave, documentation, support, back-up,
  ongoing updates?

Nup, lets try something else...
Developing e-exams

• An alternative model – the case of Moodle
  – Open source, can be fully known
  – Pedagogically based
  – Free libre, available for experimentation, innovation, research, customisation and you can give it to students to take home.
  – Open development, new features from user demands not marketing demands, anyone with the skills to do so can contribute and many do.
  – Scalable from single user on a PC or USB stick up to 100K+ user online institutions (Open U UK).
  – No licence fees (and no resources spent on tracking licences, no intrusive audits).
  – However maintenance isn't free of costs though... but you can...
    • Support in-house or outsource to multiple ‘fee for service’ and ‘hosted solutions’ providers, less risk of vendor lock-in.
    • Get help from the large, open support community of coal face users and technical developers.
  – Caution! Should be pedagogically lead, not administratively lead.
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 space? (costly and high 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?
• 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
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...
A gap still exists for...

• Scalable, sustainable, supervised e-exams platform and processes that meet the needs of students, academics, disciplines, institutions,...
A basis for further development

• The well developed ‘eExam’ system (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.
Current eExam 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....

Ref: Dr Fluck, UTAS
Post-paper - Can Include Software Tools

- Software tools can be made available in the exam

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Ref: Dr Fluck, UTAS
The Current Process – it works.

Prep

Post Exam

(credit: Dr Fluck UTAS)
Future - an e-exam system for BYOD

- Planned improvements – add:
  - LMS / question engine for computer marked question types (Moodle?)
  - Electronic answer reticulation/workflows.
- Modular architecture so academics / institutions can choose the features and mode of operation that suit them...

System prep by IT personnel

Exam prep by academic

Bootable USB stick

OS + Browser + LMS + other tools

Database for quiz (only via web interface) or Exam Script (read only)

Written answers (student editable)

Server to collate student responses

Student Owned Device

HDD, network interfaces (IP stack, Bluetooth, infrared etc) excluded or restricted

Interface components used by student: Keyboard / Screen

Assessment / Marking (auto or manual)

Student (view questions, use software tools and type answers)
Planned enhanced modes of use

- **Wireless always on** mode – where reliable, redundant and high capacity wireless network access exists in the exam room (could also use wired / as a boot image for labs)
  - Doesn't require an LMS on-board the stick
  - Web browser to access a LMS server via restricted network
  - Custom network config by institution IT (done once, reused)

- **Ad-hoc wireless** mode
  - 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.

- **Non wireless** mode
  - LMS will be 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)
What it could do

Computer marked question types (Moodle)

**Standard:**
- 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.*
Examples – Confidence questions

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

<table>
<thead>
<tr>
<th>Certainty level</th>
<th>C=1</th>
<th>C=2</th>
<th>C=3</th>
<th>No Reply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark if correct</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Penalty if wrong (T/F Q)</td>
<td>0</td>
<td>-2</td>
<td>-6</td>
<td>0</td>
</tr>
</tbody>
</table>

**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)

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.
Examples – embedded applets

Moodle Quiz

1 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: 
Submit

2 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
Choose:
Choose:

There is evidence for an intramolecular hydrogen bond
True
False

There is evidence for an intermolecular hydrogen bond
Submit

3 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
Choose:
Choose:

The most electron poor region of this molecule is
Choose:
Choose:

The lowest energy molecular orbital for the molecule is
Choose:
Choose:

The highest energy molecular orbital for the molecule is
Submit

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

Examples – Virtual Labs / Sims

Conduct experiments via locally run simulations\(^1\) or internet connected hardware\(^2\)

(1) http://phet.colorado.edu/
(2) http://www.transformingassessment.com/moodle/course/view.php?id=72
Examples – Augmented Reality Experiment

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.

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

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

AR Marker Colour Key

Choose one answer.

a. Cu(s) + ZnSO4(aq)
b. Zn(s) + CuSO4(aq)
c. Cu(s) + Ag2SO4(aq)

AR software embedded in question

http://www.transformingassessment.com/moodle/course/view.php?id=70
Examples – Virtual 3D Spaces

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

As if the student was doing the activity in the LMS

Online (Second Life) examples see http://www.transformingassessment.com/secondlife.php
Examples – Serious Games

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

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.
Further Information

Contact: m.hillier@uq.edu.au

Get these slides: http://bit.ly/EN-eexams

References upon request.

Citation