Striving for **authentic assessment in supervised e-Exams**

Mathew Hillier
Monash University

Tertiary Education Quality and Standards Agency Conference. Higher Education Quality Forum, 30 Nov 2018
Acknowledgements

Project Partners
• Monash University: Dr Mathew Hillier (PI), Prof. Marilyn Baird, Dr Scott Grant
• University of Tasmania: Dr Andrew Fluck.
• Central Queensland University: Dr Michael Cowling, Kenneth Howah, Mary Tom.
• Australian National University: Brandon Colquhoun, Beth Harris
• Edith Cowan University: Assoc. Prof. Paul Newhouse (deceased)
• Macquarie University: Assoc. Prof. Matthew Bower, Prof Dominic Verity
• RMIT University: Assoc. Prof. Shona Leitch
• University of South Australia: Dr Ruth Geer, Bruce White
• University of Queensland: Dominic McGrath
• University of New South Wales (Canberra)/ADFA: Dr David Meacheam, Emma Betts

Academics hosting trials
• Monash college: Nathaniel Lyons (Globalisation + Geography)
• Monash Uni: Dr Shani Tobias (Translation), Dr Charanjit Kaur (Bus Stats).
• UQ: Dr Amy Hubbell (French language).
• CQU: Dr Rahat Hossain (KM in IT).
• UTAS: Dr Wendy Balassa (Education)
• ECU: Dr Jeremy Pagram (Programming/Python)
• UNSW/ADFA: Andrew Gilbert (Air Power).

Project staff
Martin Coleman (lead software developer)
Vilma Simbag (project manager/admin)
Former staff: Lubos Rendek (software dev).
Students (summer/winter projects and casual RAs):
Chao Wang, Kim Martinow, Sayumi Umeda, Annie (Yunyi Yang), Yi Zheng, Owen Sheppard.
A key motivation - The gap

We are faced with a growing disconnect between the way high stakes testing is conducted using pen on paper exams and students’ everyday experiences of study, work and life, let alone the future!
What we are doing about it...

Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Modification
Tech allows for significant task redesign

Augmentation
Tech acts as a direct tool substitute, with functional improvement

Substitution
Tech acts as a direct tool substitute, with no functional change

SAMR Theory - Puentedura, 2012
Authentic - Engineering Problem Solving

Authentic

Not
Three dimensions - Assessment - trade offs

Pick two? ....
We need to strive for all three.
Significant evidence that e-Exams works at scale!

Austria

- Secure Exam Environment - BYO laptops Live Linux boot from network/LAN
- A university with 50% uptake of e-Exams


Finland

- Sent out 47,000 Live Linux e-Exam USB sticks last semester - BYO laptops/LAN
- All national matriculation examinations will be digital by 2019.


Both presented at e-Exam Symposium 2018 - session videos coming soon - contact us to request the links
## Study context - broader e-Exam project

<table>
<thead>
<tr>
<th>Start &gt;</th>
<th>&gt; &gt; &gt;</th>
<th>&gt; &gt; &gt;</th>
<th>&gt; &gt; &gt;</th>
<th>&gt; &gt; &gt;</th>
<th>&gt; Future &gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Get Ready</strong></td>
<td><strong>Phase 1</strong></td>
<td><strong>Phase 2</strong></td>
<td><strong>Phase 3</strong></td>
<td><strong>Phase 4</strong></td>
<td><strong>Phase 5</strong></td>
</tr>
<tr>
<td>Institutional approvals, research ethics, hardware and infrastructure</td>
<td>Paper equivalent small scale.</td>
<td>Post-paper small to medium.</td>
<td>Medium to large scale.</td>
<td>Whitelisted and logged Internet</td>
<td>Open but fully logged Internet</td>
</tr>
<tr>
<td>Crawling</td>
<td>Basic doc exams to begin!</td>
<td>Expanding the app and media landscape.</td>
<td>Adding the power of an LMS.</td>
<td>Network BYOD exam.</td>
<td>Network mixed mode BYOD exam.</td>
</tr>
</tbody>
</table>

- **Crawling**
- **Walking**
- **Running**
- **Jumping**
- **Flying!**

http://ta.vu/e-exam-roadmap

**Extension work:**
An offline e-learning platform see moleap.org

**We are here!**
Moodle resistant to network outages!
Pedagogical Affordances

Authentic assessments. It is a platform, not an app!

Scratch SDK

Exam doc

Video

LMS quiz

Specialist applications

PDF

Sims
Robust LMS - Walk through demo - Start up

BYO laptops. USBs replace paper in the venue.

Exam content resides on a server.

Connect to WiFi network (or system can automatically connect)

Linux Live Boot. Full OS + SEB + e-tools: Libre Office, SDK, sims, PDFs, Math, large media. Local cache of Moodle content. Auto backup to USB in case of network outage.
Starting the exam at the same time - password

Log into Moodle server

Password given out in class at the exam start time.
This is an offline dictionary tool ‘Dim Sum’

Moodle questions in Safe Exam Browser
Questions
Lecture test 1

A range of form based question types were used in these e-exams.
Questions

Listening test 1

Audio data files cached at the start of the exam. Students used headsets to listen.

Section 3
Indicate the tones you hear.
Please enter a number for the tone you hear in the appropriate box (e.g. 1, 2, 3, 4 or 0 for neutral).

1. chuang lian

2. cao chang

3. fang xiang

4. guo jia
1. Download file

2. Software application used to interrogate and construct a response.

3. Respond via form
Questions

Constructed response

Response via file upload. (example)

1. Open software

2. Use software application to construct a response.

3. Respond by file upload
Multi layered backup - Network Outage

a) Whilst there is a network connection student data is saved to the server each minute.

b) If there is a network outage, then student response data is saved to the USB drive in an encrypted file.
Multi layered backup - Network Outage at Submission

- If at submission time there is a network outage, then student response data is saved to the USB drive.
  - Ideally the student should try again or call an exam supervisor for help.
- If the connection cannot be reinstated then after the exam the response file is retrieved from the USB and uploaded to Moodle.
Successful Submission

<table>
<thead>
<tr>
<th>QUIZ NAVIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>User One</td>
</tr>
<tr>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>7 8 9 10 11 12</td>
</tr>
<tr>
<td>13 14 15 16 17</td>
</tr>
<tr>
<td>18 19 20 21 22</td>
</tr>
<tr>
<td>23 24</td>
</tr>
</tbody>
</table>

Quiz: Quiz Navigation

- Show one page at a time
- Finish review

Confirmed submission to server triggers USB self clean up ready for next exam.

Immediate feedback (optional setting)

**e-Exam Demo**

<table>
<thead>
<tr>
<th>Information</th>
<th>Complete the following computer marked questions.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question 1</strong></td>
<td>Moodle is the most popular LMS in the world today.</td>
</tr>
<tr>
<td>Correct</td>
<td>Select one:</td>
</tr>
<tr>
<td>Mark 1.00 out of 1.00</td>
<td>- True ✓</td>
</tr>
<tr>
<td>- False</td>
<td></td>
</tr>
</tbody>
</table>

**Question 2**

What do you call a question format in which students must uniquely associate a set of prompts with a set of options?

- Answer: matchings

**Question 3**

What was the version of Ubuntu released in April 2012?

- Answer: 12.04
If not submitted - post-exam upload to Moodle

This quiz uses fault-tolerant mode. Administrators can upload exported responses.

This quiz has been configured so that students may only attempt it using the Safe Exam Browser.

You must use an approved version of Safe Exam Browser to attempt this quiz.

From the Quiz page, Admins/teachers can upload encrypted response file(s) from USB (can be done in bulk too).

After upload: USB clean-up using Admin tool to ready for next use.
## e-Exam trials - overall scope

<table>
<thead>
<tr>
<th>Exams</th>
<th>Typists</th>
<th>Pen</th>
<th>Weight</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum</td>
<td>1750</td>
<td>1309</td>
<td>~</td>
<td>4145</td>
</tr>
<tr>
<td>Mean</td>
<td>40</td>
<td>37</td>
<td>32%</td>
<td>106</td>
</tr>
<tr>
<td>Smallest</td>
<td>1</td>
<td>~</td>
<td>5%</td>
<td>15</td>
</tr>
<tr>
<td>Largest</td>
<td>166</td>
<td>~</td>
<td>50%</td>
<td>180</td>
</tr>
</tbody>
</table>

**Typists:**
*I would recommend the e-Exam system to others.*

- 70% recommend it!
- 90% would use without concern

### Recent e-Exams 2017 and 2018

<table>
<thead>
<tr>
<th>Institution</th>
<th>Courses</th>
</tr>
</thead>
</table>
| Monash      | - Business Statistics  
- Chinese online media (‘Robust’ online)  
- Geography x 3 classes [Monash college 2016]  
- Globalisation x 4 classes [Monash college 2017]  
- Language Translation (some NAATI)  
- Introductory Chinese language (offline, Spreadsheet used as a form)  
- Introduction to Chinese (‘Robust’ online). |
| UQ          | - French language translation |
| CQU         | - Knowledge Management Principles (IT)  
- Ethics and Social Issues (IT)  
- IT management |
| UTAS        | - ICT in Education (post-paper exams)  
- Environmental Chemistry |
| MqU         | - ICT in Education |
| UNSW        | - Air power (ADFA) |
| ECU         | - Teaching Introductory Computer Programming  
- OHS for trades |
| UniSA       | - Science & Math for secondary teaching |
Key questions for this phase of work:

1) "How can we leverage the administrative efficiencies of a networked LMS for use in e-exams?"

While:

2) "How can we minimise the risks associated with the reliance on a live network during the exam?". AKA “can you run a Moodle quiz without a network?”

Finally:

3) "Do students accept the networked edition of the e-exam system as fit for purpose for undertaking supervised time limited exams?"
Robust online e-Exams in Moodle (phase 3)

Semester 1 and 2 2018, Two units each semester (first year and third year),
A series: Practice + 3 exams (two mid and finals). In-class, graded, supervised.
BYO laptops & loaners over Wifi.
Moodle LMS question types: selected response, blank fill/cloze, constructed and audio.
Findings - 3rd exam (final). Semester 1 & 2

My hand writing is neat

My typing is fast enough for exams

Caveat: Not random samples - descriptive of these groups only. Data from Semester 1 and 2 2018.
### Pre and post response trends (Moodle 2018)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Pre</th>
<th>Post 1</th>
<th>Post 2</th>
<th>Post 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written instructions were easy to follow</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was easy to start my computer using the e-Exam USB stick</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use the e-Exam system just as well as my own laptop system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was easy to use the office suite (word processor/spread sheet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was easy to use software applications beyond the word processor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was easy to save my response files into the correct place</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was easy to answer multiple-choice questions in the e-Exam system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall, I feel the e-Exam System is easy to use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel the e-Exam System is reliable against technical failures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel the e-Exam System is secure against cheating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I now feel relaxed about using the e-Exam system for my exam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would recommend the e-Exam System to others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My laptop is reliable for use in a computerised exam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My typing skills are fast enough for a computerised exam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computerised exams make me more stressed than handwritten exams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like to use a computer for exams in the future</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am concerned about network outages impacting my exam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am reassured the e-Exam system was robust against network outages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The included software was useful [e.g. DimSum]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moodle worked well as an exam environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Caveat:** Not random samples - descriptive of these groups only. Data from Semester 1 and 2 2018.
Findings - 3rd exam (final) Semester 1 & 2

Moodle worked well for exams

Can use as well as own laptop OS

Caveat: Not random samples - descriptive of these groups only. Data from Semester 1 and 2 2018.
Key Findings

a) The e-Exam system was rated well by the typists: 4+ out of 5.

b) Robust network features worked (at least one obvious wifi outage) Responses were auto saved to USB, retrieved following exam and re-joined the e-workflow in the LMS.

c) Time saved in marking essay responses: 20% to 30% over that of paper.

d) Students need transition opportunity: roughly 30% preferred paper!
Robust e-Exams - With thanks to these contributors!

Safe Exam Browser (Daniel Schneider and SEB team at ETH Zurich).
SEB Moodle plugin for keys (by Tim Hunt at Open University, UK)
Moodle Quiz fault-tolerant plugin (by Tim Hunt at Open University, UK).
Moodle Auto enroll plugin (by Mark Ward).

Note: These components cannot be used ‘as-is’. We have extended them to enable SEB to operate within the Live Linux USB implementation, modified the key exchange mechanism, added transparent auto save to local storage in the event of network outage and extended the caching of quiz components.

Our work is not done - more to do! :-(
Thank you

Mathew.Hillier@gmail.com
TransformingExams.com

Ask us about collaboration and consultancy
e-Exam process: robust online Moodle (Phase 3)

Pre-exam: prepare learning materials
2. Configure, load and test: Moodle quiz + Gateway USB
1. Teacher creates exam: Moodle quiz, media, selects apps.
3. Deploy quiz to Moodle. Gateway USBs duplicated.

Pre-session: 4. Student laptop setup & practice.
5. Network setup and USBs to venue

Exam content resides on a server.

6. Exam venue:
a. Students enter room
b. Given USB (s.o.s. WIFI dongle)
c. Start laptop from USB & connect to Moodle with key
d. Do exam in Moodle
e. Finalise and shutdown
f. Return USB & dongle
g. Leave room

8B In case of network outage: Get backup responses from USBs.

Post-exam: assessment

10. Results submission, analytics & reporting

Recycle USB & dongle for next exam. Gateway USBs can be reused as-is (from step 5) or updated (step 2).

* USB auto reset still under development.

8 Responses finalised to server (USB resets *)

7. Responses autosave to server (each 1 min)

Network Moodle.

Linux Live USB SEB + e-tools:
Libre Office, apps, SDK, sims, PDFs, large media.
Local cache of Moodle content. Response backup to USB in case of network outage.

Recycle USB & dongle for next exam. Gateway USBs can be reused as-is (from step 5) or updated (step 2).

* USB auto reset still under development.