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"CHILD OF THE DIGITAL ERA – THE CONSUMER OR THE CREATOR?"

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eExams

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ABSTRACT

eExams allow candidates to use their own computers for high stakes assessments. A particular eExam Systems has been used at the University of Tasmania and for pre-tertiary assessments since 2007. This paper describes how the system works; the activity involved for assessors and candidates; and transitional strategies for institutions contemplating adopting such an innovation.

INTRODUCTION

The eExams project is important because eExams have been used in the school sector and also the university. I believe eExams prepare the way for significant curriculum transformation through the use of computers in education. Just to illustrate the kind of curriculum transformation I am talking about, I want to spend a minute talking about another project of mine. This is the Calculus in Primary school project.

Together with some engineering colleagues from the Australian Maritime College (next door to the University) we approached five schools in different states of Australia. These schools had classes where all the children had access to a computer all day. The children were 10-12 years old.

The five teachers were given one day of training and a copy of the MAPLE software for every student. They used our learning materials to teach the children about the software and how to solve real world problems using integral calculus. You can see one of the motion problems in Figure 1 – it looks like a very complex function! But for the students, this was an easy problem to put into their computers, and work out the total distance travelled. After 11 lessons, the students wrote a test made up of questions from our engineering degree calculus exam. They all did very well, getting high marks.

So here we can see students as young as 10 doing as well as highly skilled engineers who are at least 8 years older! They used the tools a professional engineer would use. This is a significant transformation of the curriculum. But the students used a computer in the final test. That's important.

$$\int_0^{10} 2t \, dt + \int_{10}^{15} 20 \, dt + \int_{15}^{20} \frac{t^3}{6} \, dt + \int_{20}^{30} 120 - 4t \, dt$$

Figure 1: A complex integration problem for students in primary school

Before I describe our work, it's worth reflecting on what computers are. They are one of the first devices invented that can self-simulate. In technical areas, there is a current plethora of virtualised computers and servers. My own

work laptop contains three virtual computers. Computers are universal machines – they can be programmed to undertake the role of many other machines – even other computers.

What has this to do with assessment? Well, this is a very powerful concept, and if we ignore it during high stakes assessments we will be using new technology for old purposes – and probably do it very poorly. For instance, some of our earlier research questioned why schools expect student handwriting and literacy to be improved by using computers. Naturally enough, frequent keyboard use has little effect upon handwriting; and its effect upon literacy depends how you define ‘literacy’. On the other hand, if we grasp the huge potential of new technology in high stakes assessment, we can facilitate the huge revolution which has hitherto passed the education business by – despite other areas of life being revolutionised by information technology.

To test student understanding using all the facilities of a computer environment, we would like e-Assessment to provide the same full operating system to every candidate. This is an argument against web-based solutions. Complex applications do not run within the confines of a web-page in a browser. They restrict what we can assess, and therefore restrict what can be taught.

Also, online assessment purports to provide access to multimedia. However, there are likely to be some significant problems reticulating video content for mass exams. For instance, let’s say a question required an HD video clip of 3 minutes duration. Students could elect to view this simultaneously, or staggered over time. HDV (h.264) 1080i requires 25Mbps of bandwidth and therefore ~ 11GB per hour¹. Thus, 3 minutes of video will require 550MB. Over a room with 300 candidates, wireless access points will be strained well past breaking point. In a medium-load scenario, the wireless access point(s) would be expected to carry 3750 Mbps. But wireless access standard IEEE 802.11n-2009 can only provide 600Mbps – assuming there is only one user (without contention with others). These high data rates cannot be supported by existing infrastructure, so a network-based eAssessment platform is unlikely to provide the functionality required.

THE eExam SYSTEM

The eExam System we use requires each candidate to start up their computer with an alternative operating system – Ubuntu.

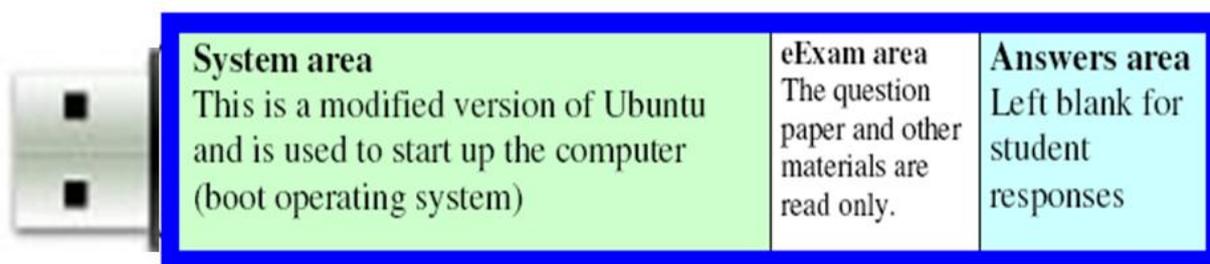


Figure 2: This is an eExam USB stick from which candidates start their computers

This approach was chosen after carefully considering the opposing policy stances for various processes involved in eAssessment (please see Table 1).

Table 1: eExam processes and opposing policy stances

<i>Area of concern</i>	<i>Opposing policy stances</i>	
Reticulation of questions and answer responses:	Networked	Standalone
Computer ownership:	Institutional	Personal
Computer functionality:	Kiosk (locked) mode	Wide range of software (sometimes using virtualization or a compatibility layer)
Candidate communication:	Function blocking	Logging/monitoring
Candidate familiarity:	Common learning environment	Test environment requires familiarization/training
Licencing costs:	Commercial	Free, open source software

¹ stackoverflow.com/questions/701991/h-264-file-size-for-1-hr-of-hd-video

We believe this USB startup stick approach minimises the impact of technical failure, making eExams as secure as paper-based assessment. In the eExam System:

- All communications are interdicted, so collusion through internet or Bluetooth is inhibited.
- Candidates have no access to local disk drives (inbuilt or USB).
- Security image on desktop background makes confirming correct bootup easy for supervisors to check.

To get the computer to boot from the eExam USB drive, you need to know which key is the one-time boot key for this make/model. For Dells it is F12. The computer **MUST** be switched off completely before commencing (on most machines, hold down the power button for 10 seconds, and it will power-down gracefully). Then plug in the USB key before power-up. Tap the power button to switch on, then quickly **HOLD DOWN** the one-time boot key until you hear some beeps or see a message about 'one time boot menu' appearing. When the menu appears, select the 'generic USB drive', and press [Enter]. This process and security system allows students to use their own computer for the exam. This overcomes the logistics and costs of providing institutional equipment.

UTAS Academic Senate Approved the use of eExaminations 4th March 2011. Thus our current procedures are recommendations – including the practice eExam beforehand for familiarisation - not UTAS requirements. We often have mixed exam rooms where eExam candidates and pen-on-paper candidates share the same space. Here are some of the comments from eExam students:

"I would not have been able to manage half of that if I'd had to hand write."

"It was an absolute blessing."

"Yes, you could just change things."

STRATEGIC APPROACHES FOR eExam ADOPTION

I'm now going to talk about the strategies to move to eExams. The first stage for any subject is to replace the pen by the keyboard. The questions are the same, but students use a computer keyboard to provide answers, instead of a pen. As we saw in the video, students can choose to use the writing implement they prefer. This is the PAPER-REPLACEMENT strategy. In this phase the keyboard is an optional writing tool. Some students may opt to use the eExam system, others may stick with pen on paper. It is most important that students have a practice eExam put onto a USB they supply, and a copy of the exam room startup instructions. This familiarisation occurs up to a month before the actual examination. The exam paper is set in the normal way, but as well as being printed, it is copied onto a USB with the eExam System. This is duplicated and a USB stick copy provided to each candidate using a computer (this can be a Macintosh or a Windows PC). At the end of the exam, all the sticks are collected, and the answerscripts extracted onto a CD-ROM. This goes with paper scripts to the assessors for marking. As confidence builds, assessors can begin to incorporate multi-media and software operational questions – making POST-PAPER examinations. They can put PDF reference documents onto the USB for students to interrogate. Some exams now include multi-media powerpoints, video scenarios, state standards documents and Windows applications. Students are not restricted to providing answers just using text. Figure 2 shows some examples of the drawings candidates can produce during an eExam.

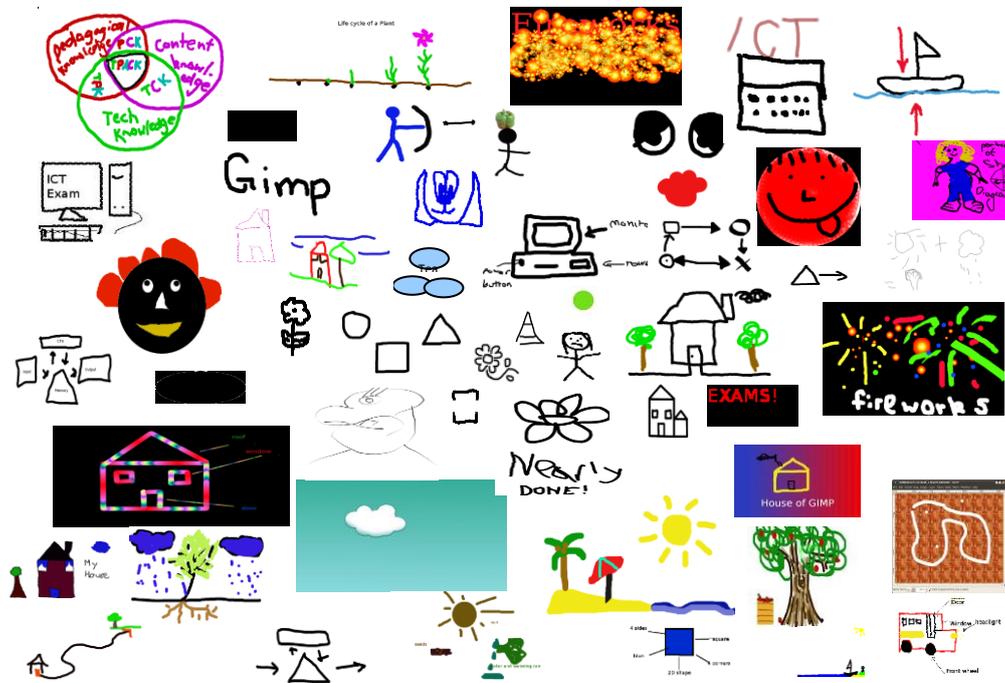


Figure 3: Examples of colourful images produced during an eExam

eExams IN THE SCHOOL SECTOR

Several high fee paying independent schools have had 1:1 computer policies for many years in Tasmania. When challenged about their lack of pressure on the TQA to put exams on computers, they explained their prestige relied upon student success in University exams. Since the university exams were all pen-on-paper, the schools worked to prepare students to perform well in such an environment. Therefore, the eExam innovation was targeted at UTAS first, but shortly afterwards, to the Tasmanian Qualifications Authority (TQA). The Authority has now conducted two eExams for Year 12 students. These exams were high stakes assessments leading to university entrance scores.

In 2011 the Authority used a paper-replacement strategy.

In 2012, the Authority used a post-paper strategy – students had to look at a local web-site stored on the USB stick, and make recommendations for improvement.

At the TQA Board meeting on 4th April 2012, they discussed E-marking and e-exams. It was noted that “the *ITS315108 Information Systems & Technology* written examination was delivered at ten exam centres using the 'e-exam' system developed at the University of Tasmania. The *ITS315108 Information Systems & Technology* written examination answers (80 students, each with answers to 2 sections) were marked over the internet using the TQA *iPad* software...In 2013 the 'e-exam' system will be used to deliver the *ITS315108 Information Systems & Technology* written examination and the student work will again be marked using the *iPad* software”.

CONCLUSION

Table 2: the development of eExams in Tasmania

From 2007	To now
120 candidates	Over 1000 candidates
Paper replacement	.. to full multimedia and questions requiring software operation.
Institutional equipment	..to personally owned computers
Educational computing	UTAS Law, Mathematics pedagogy, ICT in education; TQA Information Technology & Systems
Launceston campus	Statewide, interstate and overseas

To summarise progress, Table 2 shows how the eExams System has grown in high stakes assessment use since 2007. Starting with a few hundred students, there are now over a thousand candidates who have taken eExams. As I write, over 100 students took an eExam yesterday, scattered all over the world (in distant locations the candidates make arrangements to be supervised in local libraries, schools, police stations etc.).

Ultimately assessors will be able to require candidates run professional software within the exam. Since every candidate has exactly the same operating system and software, the assessment can be authentic yet fair and equitable. This might be an example of a question that could be set in a future examination:

Watch the video [Complex DNA](#) [95 seconds] and use the [enzyme replication simulation software](#) to construct a molecular junction inhibiting the binding process.

Notice the inclusion of multimedia (candidates view a video describing the authentic problem); and use complex software similar to that used by professionals in the field. The product is a file for this software, rather than a purely textual response.

For more details about the eExam System, please visit the web site at www.eExams.org. Note, the web-site now has a section to allow anyone to download create their own eExam USB stick.