

Bond University

# Legal Education Review

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Volume 29 Issue 1

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2019

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# USE OF E-EXAMS IN HIGH STAKES LAW SCHOOL EXAMINATIONS: STUDENT AND STAFF REACTIONS

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## I INTRODUCTION

While now common in law schools in the United States and some other jurisdictions, Australian law schools have just begun to move towards e-exams.<sup>1</sup> There are a number of drivers encouraging Australian universities to introduce e-exams,<sup>2</sup> including economic

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<sup>1</sup> For example, Harvard Law School conducts e-exams using 'Exam4' which was trialled in this project: Harvard Law School, *Examinations* (Web Page, 2019) <<https://hls.harvard.edu/dept/registrar/examinations/>>. 'ExamSoft' was also trialled in the current project and is also very popular with United States law schools Vermont Law School, ExamSoft Instructions (Web Page) <<https://www.vermontlaw.edu/academics/registrar/examsoft-instructions/>>; University of Washington, ExamSoft (Web Page, 2019) <<https://www.law.washington.edu/students/exams/examsoft.aspx>>; Boston University School of Law, ExamSoft Guidelines and Instructions (Web Page, 2019) <<https://www.bu.edu/law/current-students/exam-information/examsoft/>>; Chapman University School of Law, ExamSoft (Web Page, 2019) <<https://www.chapman.edu/law/student-resources/computing-email/examsoft.aspx>>; Colombia Law School, Laptop Exams: Spring 2019 (Web Page, 2019) <<https://www.law.columbia.edu/registration/exams/laptop-exams>>. The National University of Singapore has steadily increased its use since trialling in 2014: Amelia Teng, 'More unis opting for e-exams over written tests', *Strait Times* (online, 17 October 2017) <<https://www.straitstimes.com/singapore/education/more-unis-opting-for-e-exams-over-written-tests>>. In Australia, e-exams have been used at the University of Tasmania since 2007 and are now available for all disciplines. Trials have also been conducted at the University of Queensland. Other law schools in Australia are also undertaking trials.

<sup>2</sup> An e-exam is characterised generally by a student completing an examination by typing their answer on a computer instead of by traditional handwriting. We distinguish this from situations in which a student may be completing other assessment via a computer, or more generally engaging in 'e-learning' or 'computer-based learning'. A university may have a dedicated computer lab for students, or the student may supply their own laptop computer, known as a 'bring your own device' ('BYOD') scenario. Students will often have installed software to launch the exam interface which appears similar to common word processing

pressures, a desire to reduce administrative burdens, and changes to workplaces.<sup>3</sup> The broader recognition of the changing workplace is reflected in various university and faculty mission statements and strategic plans focusing on Technology Integrated Learning ('TIL'), which aspire to produce technologically literate graduates who are 'ready' for the modern workplace.<sup>4</sup> Thus not only do e-exams offer efficiencies for markers and administrators, they can also be seen as one way to further inculcate students into a technological environment.

Pedagogical arguments in favour of e-exams rely on the fact that students already use technology daily and complete the bulk of their university work on computers. In this context, handwriting an exam has been described as an anachronism.<sup>5</sup> More specifically, traditional handwriting of examinations in contemporary contexts is seen as a 'misalignment of assessment practice to the learning environment'.<sup>6</sup> Such misalignment can result in diminished learning outcomes.

However, there is little literature addressing the adoption of e-exams for a formal *high stakes* summative exam. Much of the research to date has focused on small scale, informal low stakes tests in non-law disciplines. Within Australia, whether e-exams are appropriate or effective has been the subject of a number of reported trials, but none have specifically reported on law students. In 2016, the University of New South Wales ('UNSW') Faculty of Law sought to rectify this and undertook a trial of formal high stakes e-exams.<sup>7</sup>

This article provides empirical insight into the process and student perceptions for a high stakes summative e-exam. It analyses students' attitudes and concerns *prior* to the introduction of the e-exam platform, as well as after they had completed the exam. We also provide insights into the important procedural aspects associated with high stakes exams and staff responses to the process, issues not previously reported on.<sup>8</sup>

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software. As students type a response it is saved and uploaded to a server to be accessed later for marking. As this article and the literature identifies, there are benefits and some challenges associated with this format of completing examinations.

<sup>3</sup> Ernst & Young, *Can the universities of today lead learning for tomorrow? The University of the Future*, 2018 <

<https://cdn.ey.com/echannel/au/en/industries/government--public-sector/ey-university-of-the-future-2030/EY-university-of-the-future-2030.pdf>>.

<sup>4</sup> Mathew Hillier and Andrew Fluck, 'Arguing Again for e-Exams in High Stakes Examinations' (Conference Paper, Australian Society for Computers in Learning in Tertiary Education Conference, 1–4 December 2013) 385.

<sup>5</sup> Nora Mogey and Andrew Fluck, 'Factors Influencing Student Preference when Comparing Handwritten and Typing for Essay Style Examinations' (2015) 46(4) *British Journal of Educational Technology* 793, 793.

<sup>6</sup> Nora Mogey et al, 'Handwriting or Typing Exams – Can We Give Students the Choice?' (Conference Paper, International Computer Assisted Assessment Conference, 8–9 July 2008).

<sup>7</sup> Alongside the Law trial, the Faculty of Science also trialled medium-stakes exams.

<sup>8</sup> Mathew Hillier, 'The Very Idea of e-Exams: Student (Pre)conceptions' (Conference Paper, Australasian Society for Computers in Learning in Tertiary Education Conference, 24–26 November 2014) 77–88. Note that, Tobias Deutsch et al, 'Implementing Computer-Based Assessment – A Web-Based Mock Examination Changes Attitudes' (2012) 58(4) *Computers & Education* 1068, 1068–1075, did look at attitudinal changes pre and post e-exam. It was not high stakes, as it was an optional mock examination consisting of 29 multiple choice and 1 free text question. It was,

## II PREVIOUS RESEARCH

With computer technology now ubiquitous in the home, workplace and higher education, there is concern that continued use of paper-based examinations, in which students handwrite answers, is no longer reflective of actual study and workplace practices. As a result of this apparent disconnect between assessment and learning, the transition to e-exams as a preferred format choice has been portrayed in the literature as inevitable.<sup>9</sup>

### *A Literature on Advantages, Barriers and Concerns Associated with E-Exams*

An assessment item is generally considered more valid if students are assessed in a format that is comfortable and familiar.<sup>10</sup> There has been previous anecdotal evidence that students found handwriting exams physically uncomfortable,<sup>11</sup> and mostly use word-processors for coursework.<sup>12</sup> There is some evidence students perform better in exams when they are assessed in the same format as they study, possibly because this congruence in exam format triggers state-dependent memory cues developed while studying.<sup>13</sup>

E-exams are said to overcome traditional barriers in the fluency of writing of paper-based exams—shifting the focus from the ‘mechanics of production’,<sup>14</sup> to the content of student work.<sup>15</sup> When typing exams, students have been found to produce more words,<sup>16</sup> and are more likely

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however, quite a large trial with around 449 medical students participating. Similar to findings in the current UNSW Project, they found that students generally expressed a positive attitude towards computer-based learning after the trial, if they did not before the trial.

<sup>9</sup> See, eg, Nora Mogeey and Helen Watt, ‘The Use of Computers in the Assessment of Student Learning’ in Greg Stoner (ed), *Implementing Learning Technology* (Learning Technology Dissemination Initiative, 1996) 50; Nora Mogeey et al, ‘Students’ Choices between Typing and Handwriting in Examinations’ (2012) 13(2) *Active Learning in Higher Education* 117; Hillier and Fluck, *Arguing Again for e-Exams in High Stakes Examinations* (n 4); Matthew Barrett et al, ‘Technology in Note Taking and Assessment: The Effects of Congruence on Student Performance’ (2014) 7(1) *International Journal of Instruction* 49; Mogeey and Fluck, *Factors Influencing Student Preference* (n 5).

<sup>10</sup> See generally Mogeey et al, *Handwriting or Typing Exams?* (n 6).

<sup>11</sup> Rebecca Ratcliffe, ‘Exams make our hands sore, say students’, *The Guardian* (online, 25 January 2012) <<https://www.theguardian.com/education/mortarboard/2012/jan/25/exams-make-our-hands-sore>>.

<sup>12</sup> See, eg, Hillier and Fluck, *Arguing Again for e-Exams in High Stakes Examinations* (n 4); Mogeey et al, *Students’ Choices between Typing and Handwriting in Examinations* (n 9).

<sup>13</sup> See, eg, Barrett et al, *Technology in Note Taking and Assessment* (n 9).

<sup>14</sup> Hillier and Fluck, *Arguing Again for e-Exams in High Stakes Examinations* (n 4) 385.

<sup>15</sup> See, eg, *ibid*; Mogeey et al, *Students’ Choices between Typing and Handwriting in Examinations* (n 9).

<sup>16</sup> Kif Augustine-Adams, Suzanne Hendrix and James Rasband, ‘Pen or Printer: Can Students Afford to Handwrite Their Exams?’ (2001) 51(1) *Journal of Legal Education* 118; Kif Augustine-Adams, Candace Berrett and James Rasband, ‘Speed Matters’ (2017) 61 *Howard Law Journal* 239.

to edit their work.<sup>17</sup> This is considered to permit exploration of a greater breadth of content,<sup>18</sup> and greater engagement with the structure and argument of their responses.<sup>19</sup> Typed work has also been found to be more decipherable for markers than handwriting.<sup>20</sup> For these reasons, e-exams are seen as providing greater opportunity both for students to exhibit their capacity and for markers to reward it.<sup>21</sup>

However, the literature suggests that students' own perceptions of e-exams are mixed. While in several studies students reported greater editing of their exam responses when typing, they also reported that their changes were more often cosmetic rather than substantive.<sup>22</sup> Students in some studies have felt the greater capacity to cut, paste and delete detracted from the flow of their thoughts, rather than facilitated meaningful engagement with their writing; yet in other studies the ability to edit increased writing quality. Much appears to depend on the student's affinity with technology.<sup>23</sup> Outside of law,<sup>24</sup> it was found typed scripts were only marginally longer than handwritten scripts. Yet in US law exams the opposite has been found to be the case.<sup>25</sup> This could indicate it is difficult to generalise how students respond across exam settings to e-exam format.

There is concern about how the different approaches students report taking to coursework essays versus examinations will translate in e-exams. While students report paying closer attention to structure, argument and grammar in coursework assessments, final examinations are often approached more as memory tests, considered a natural consequence of time-limitations and stress.<sup>26</sup> Though students report approaching e-exams more like in-semester assignments,<sup>27</sup> there is anxiety markers will bring the same expectations to both assessments, without making the same considerations for the impacts of time limitations and stress on the quality of exam responses as for

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<sup>17</sup> See, eg, Mogeys et al, *Handwriting or Typing Exams?* (n 6); Mogeys and Fluck, *Factors Influencing Student Preference* (n 5).

<sup>18</sup> Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16).

<sup>19</sup> See, eg, James Hartley and Päivi Tynjälä, 'New Technology, Writing and Learning' in Päivi Tynjälä, Lucia Mason and Kirsti Lonka (eds), *Writing as a Learning Tool: Integrating Theory and Practice* (Springer, 2001) 161.

<sup>20</sup> See, eg, Walter Way, Laurie Davis and Ellen Strain-Seymour, 'The Validity Case for Assessing Direct Writing by Computer' (Information White Paper, Pearson Assessments, April 2008); Jing Chen et al, 'Effects of Computer Versus Paper Administration of an Adult Functional Writing Assessment' (2011) 16(1) *Assessing Writing* 49.

<sup>21</sup> Mogeys et al, *Handwriting or Typing Exams?* (n 6); Mogeys et al, *Students' Choices between Typing and Handwriting in Examinations* (n 9); Mogeys and Fluck, *Factors Influencing Student Preference* (n 5).

<sup>22</sup> Mogeys et al, *Handwriting or Typing Exams?* (n 6); Mogeys et al, *Students' Choices between Typing and Handwriting in Examinations* (n 9).

<sup>23</sup> A comprehensive review of these issues is contained in Nathaniel Hunsu, 'Issues in Transitioning from the Traditional Blue-Book to Computer-Based Writing Assessment' (2015) 35 *Computers and Composition* 41.

<sup>24</sup> Mogeys et al, *Handwriting or Typing Exams?* (n 6).

<sup>25</sup> Augustine-Adams, Berrett and Rasband, *Speed Matters* (n 16); Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16).

<sup>26</sup> Mogeys et al, *Handwriting or Typing Exams?* (n 6); Mogeys et al, *Students' Choices between Typing and Handwriting in Examinations* (n 9).

<sup>27</sup> Mogeys et al, *Handwriting or Typing Exams?* (n 6).

paper-based exams.<sup>28</sup> There are concerns that e-exams may unfairly advantage the computer proficient,<sup>29</sup> though this can also be seen as the reverse of the current advantage enjoyed by fast hand writers. Some authors have recommended some standardized typing competency be a requisite of university entry,<sup>30</sup> and maximum word lengths may ameliorate speed advantages.

There is also uncertainty to date as to how markers will respond to e-exams. On one hand, some studies suggest a small but consistent 'format bias' in favour of typed answers resulting in slightly higher marks awarded for them.<sup>31</sup> Augustine-Adams et al found in US law exams that the mark received generally increased with the length of exam scripts.<sup>32</sup> Typed scripts, being generally longer, received consistently higher marks, from which the authors inferred a possible tendency for markers to over-reward length, though acknowledging the precise source of the 'format effect' advantage may not be clear. Relevantly, markers have been found to more readily award marks for content knowledge than structure or argument.<sup>33</sup> The introduction of e-exams may simply reinforce merit of memory over critical thinking. Alternatively, change in format may add little to the variation that already exists between markers.<sup>34</sup>

On the other hand, there is some evidence, as students fear, that markers grade typed scripts *more* harshly.<sup>35</sup> However, this effect is ameliorated when the potential format bias is flagged to markers and typed scripts are presented in cursive.<sup>36</sup> This could suggest format bias has little to do with content, and more to do with poor grammar and layout being more obvious in typed work than written.<sup>37</sup>

From the absence of clear trends in how students and markers respond to e-exams, it seems necessary changes in marker expectations evolve incrementally. If e-exams carry the potential for pedagogical

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<sup>28</sup> Ibid; Moge et al, *Students' Choices between Typing and Handwriting in Examinations* (n 9).

<sup>29</sup> Moge et al, *Handwriting or Typing Exams?* (n 6); Moge et al, *Students' Choices between Typing and Handwriting in Examinations* (n 9); Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16).

<sup>30</sup> See, eg, Moge and Fluck, *Factors Influencing Student Preference* (n 5); Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16).

<sup>31</sup> See, eg, Moge et al, *Handwriting or Typing Exams?* (n 6); Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16).

<sup>32</sup> Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16).

<sup>33</sup> See, eg, Effie Maclellan, 'Authenticity in Assessment Tasks: A Heuristic Exploration of Academics' Perceptions' (2004) 23(1) *Higher Education Research & Development* 19. Cf Gavin Brown, 'The Validity of Examination Essays in Higher Education: Issues and Responses' (2010) 64(3) *Higher Education Quarterly* 276.

<sup>34</sup> Nora Moge et al, 'Typing Compared with Handwriting for Essay Examinations at University: Letting the Students Choose' (2010) 18(1) *Research in Learning Technology* 29.

<sup>35</sup> See the discussion in Chen et al, *Effects of Computer Versus Paper* (n 20); Hunsu, *Issues in Transitioning to Computer-Based Writing Assessment* (n 23). Cf Way, Davis and Strain-Seymour, *The Validity Case for Assessing Direct Writing by Computer* (n 20).

<sup>36</sup> Michael Russell, 'The Influence of Computer-Print on Rater Scores' (Research Paper, Boston College Technology and Assessment Study Collaborative, April 2002).

<sup>37</sup> Hunsu, *Issues in Transitioning to Computer-Based Writing Assessment* (n 23).

change — to discourage strategic learning and better reward students for deep analyses and structured argument in exams — it is recommended this change involve clear communication between educators, and between educators and students.<sup>38</sup>

The logistics of e-exams are also addressed in the literature. As soft-copy exam scripts can be accessed and shared by markers instantaneously and remotely, e-exams are hailed for the potential to reduce the time and resource costs of paper-based processes.<sup>39</sup> Of major concern are the financial costs of this transition.<sup>40</sup> A ‘bring your own device’ model is preferred, to minimise equipment costs to the institution.<sup>41</sup> With laptop ownership almost universal among students and mandated by increasing numbers of universities,<sup>42</sup> access is a less pressing issue now than in earlier papers.<sup>43</sup> It can also be affordably addressed by a loans scheme.<sup>44</sup>

Finding the appropriate software presents a greater challenge.<sup>45</sup> Hillier and Fluck provide a framework for what they consider to be the ideal e-exam software. It should be capable of installation without disrupting the operating system of students’ laptops, it should lock access to all other computer functions while in use, and it should preferably be available on an open license, so that it can be customized for use across courses. E-exam software is generally expensive, particularly at smaller scales, and it has been recommended universities adapt software for which a license is already held in order to reduce costs.<sup>46</sup> Desk space, charging outlets and stable internet connection or some other process of offline exam collection in exam rooms are other relevant infrastructure considerations.<sup>47</sup>

### B *Limitations of Current Research*

The existing research does not specifically take account of issues and anxieties that only arise in the context of large-scale high stakes summative assessment. The majority of empirical research has worked with small, self-selected cohorts, unlikely to represent the range of ages, gender and typing proficiencies present in the student population.<sup>48</sup>

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<sup>38</sup> Moge et al, *Handwriting or Typing Exams?* (n 6); Moge et al, *Typing Compared with Handwriting: Letting the Students Choose* (n 34); Moge et al, *Students’ Choices between Typing and Handwriting in Examinations* (n 9).

<sup>39</sup> See, eg, Moge and Watt, *The Use of Computers in the Assessment of Student Learning* (n 9); Hillier and Fluck, *Arguing Again for e-Exams in High Stakes Examinations* (n 4); Barrett et al, *Technology in Note Taking and Assessment* (n 9).

<sup>40</sup> Hillier and Fluck, *Arguing Again for e-Exams in High Stakes Examinations* (n 4).

<sup>41</sup> *Ibid.*

<sup>42</sup> See, eg, Deakin University, *Computing Requirements* (Web Page) <<http://www.deakin.edu.au/courses/how-to-apply/computing-requirements>>.

<sup>43</sup> Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16).

<sup>44</sup> Hillier and Fluck, *Arguing Again for e-Exams in High Stakes Examinations* (n 4).

<sup>45</sup> *Ibid.*

<sup>46</sup> *Ibid.*

<sup>47</sup> *Ibid.*

<sup>48</sup> See, eg, Moge et al, *Handwriting or Typing Exams?* (n 6); Moge and Fluck, *Factors Influencing Student Preference* (n 5); Moge et al, *Students’ Choices between Typing and Handwriting in Examinations* (n 9); Moge et al, *Typing*

Most studies have trialled e-exams in mock or other types of low-stakes examinations,<sup>49</sup> and in non-law disciplines.<sup>50</sup> Though ethics concerns have previously limited study of high-stakes assessment,<sup>51</sup> that there is little data on the impact of e-exams in the context for which they are intended is concerning. No studies have addressed whether the impact of e-exams varies between question types. In a study conducted in 2008, students recommended the e-exam format only be used for multi-choice quizzes or essay examinations.<sup>52</sup> This raises the possibility that word-processing may have greater benefits for extended answer exams.<sup>53</sup>

This paper seeks to address many of these limitations. Our study worked with both small and large cohorts of UNSW Law students across a range of courses, all completing their final examinations as e-exams in formal examination conditions. The cohort completed an extended response exam on their own laptops in an exam room layout akin to that for paper-based exams. Unique to research in this space, law students in this study completed an open-book exam, a format which takes the emphasis off memorisation. Of further interest in this study was the opportunity to observe whether students experienced the summative e-exam format as suited to the research essay-style answer open-book assessment encourages.

Student affinity with computer technology is greater now than when much of the existing research was conducted. The current study considers the impact of e-exams in a more relevant context, where the issues of typing proficiency, confidence with technology and accessibility are far less pressing than in studies preceding it.

### III THE UNSW E-EXAM PROJECT

The UNSW E-exam Project involved the trial of two commercially available e-exam software packages: Exam4,<sup>54</sup> and ExamSoft,<sup>55</sup> in the Faculty of Law. The Faculty of Science also held a trial using Maple

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*Compared with Handwriting: Letting the Students Choose* (n 34); Nora Mogyey and James Hartley, 'To Write or to Type? The Effects of Handwriting and Word-Processing on the Written Style of Examination Essays' (2013) 50(1) *Innovations in Education and Teaching International* 85.

<sup>49</sup> See, eg, *ibid*. See also Barrett et al, *Technology in Note Taking and Assessment* (n 9).

<sup>50</sup> In 2014–2015 the London School of Economics Department of Law conducted a small pilot trial using ExamSoft which was 'mock' and formative only. It was not conducted under strict exam conditions (but was timed) and sought to evaluate the platform for use with essay type questions. See Athina Chatzigavrill and Tarni Fernando, 'Law E-Assessment Pilot Study: Findings of the LL205 and LL4K9 Pilots' (Research Paper, London School of Economics and Political Science, 2015).

<sup>51</sup> Mogyey et al, *Students' Choices between Typing and Handwriting in Examinations* (n 9).

<sup>52</sup> Mogyey et al, *Handwriting or Typing Exams?* (n 6).

<sup>53</sup> *Ibid*; Mogyey and Fluck, *Factors Influencing Student Preference* (n 5); Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16); Mogyey et al, *Students' Choices between Typing and Handwriting in Examinations* (n 9).

<sup>54</sup> Exam4, *Secured Word Processing Environment for High-Stakes Essay Exams* (Web Page, 2019) <<https://www.exam4.com/>>.

<sup>55</sup> ExamSoft, *Secure Assessment Software* (Web Page, 2019) <<https://learn.examssoft.com/>>.



TA,<sup>56</sup> (within Moodle). Exam4 was trialled in semester one 2016, and ExamSoft was trialled in semester two 2016. Maple TA was trialled in Science across 2016. As noted previously, this article focusses on findings from the Law trial.<sup>57</sup> The Project was funded under a UNSW Strategic Educational Development Grant.<sup>58</sup> Monitoring and evaluation of the Law trial was undertaken through each project stage using a modified Analysis, Design, Development, Implementation and Evaluation ('ADDIE') framework to track coherency and achieve project deliverables under the Project Plan.

The Law trial required students who chose to participate to bring their own laptop computers. All students in the Law trial were able to opt in or out of the trial and handwritten exams were run parallel to e-exams. Both e-exams and handwritten exams were formally invigilated by the UNSW Examinations Unit. The examinations counted for between 40–60 per cent of the student's final grade in each participating course. At UNSW, 'course' is used to describe subjects or units, and that terminology is used in this article.

In terms of their functionality in an exam setting, both Exam4 and ExamSoft were similar software packages.<sup>59</sup> Students downloaded the software onto their own computer prior to the exam. When the exam began, students activated the software which prevented them from accessing any other program or screen until they electronically submitted their final answer. The exam questions were handed to the students in a physical printed form. Both programs presented students with a basic word processing package with a set font and format.

Throughout the semester leading up to the exam, students received support in the installation and use of the software. Both due to logistics and lessons learnt, there was substantially more support provided to students in the second semester — which was the larger trial. In the first semester trial, the software only became available partway through the semester and students were given a class demonstration of software and some email support. In the second semester trial students received much more intensive student assistance from the beginning: in class demonstrations, emails with videos, special meetings, and extensive email support.

The first semester trial, which was in logistical terms a pilot study, involved four separate courses with selected individual classes participating, rather than the entire course cohort. The largest exam was of 33 students and the smallest nine students. The selected courses were the first-year undergraduate introductory course; a first-year graduate

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<sup>56</sup> Maplesoft, *Overview of the MapleTA Package* (Web Page, 2019) <<https://www.maplesoft.com/support/help/maple/view.aspx?path=MapleTA>>.

<sup>57</sup> For an analysis of the Science trial, see Ananthan Ambikairajah and Christopher Tisdell, 'E-Examinations and the Student Experience Regarding Appropriateness of Assessment and Course Quality in Science and Medical Science' (2019) 27(3) *Journal of Educational Technology Systems* 1.

<sup>58</sup> Namely, the UNSW Learning and Teaching Grants and Fellowship Program Strategic Educational Development Grant 2016.

<sup>59</sup> Differences in the software include the degree of student and staff support, analytics available, underlying algorithms to prevent academic misconduct, and the administrative setup.

course (where students had already completed a semester of law studies); and two later year elective courses.

In the second semester, a larger trial was undertaken. This time three compulsory later year courses were involved, and all enrolled students in all sections were invited to be part of the trial. The students were predominantly undergraduate students with three to five years of university study already completed. The largest exam involved 274 students and the smallest 106 students. In semester one, 174 were enrolled in relevant courses. Seventy-two individual e-exams were delivered representing a participation rate of 41 per cent. In semester two, 1010 students were enrolled in the relevant courses, with 518 choosing to do an e-exam representing 51 per cent of the cohort.<sup>60</sup>

As a result, we trialled exams in formal examinations for first year and later year compulsory courses, and small electives.<sup>61</sup> As noted, the Law trial in both semesters involved formally invigilated three-hour examinations. In addition, all exams were open-book, meaning students could bring personal notes, material downloaded from the internet and textbooks into the exam room. All exam questions required extended writing style answers. Specifically, answers required both responses to extended legal problem scenarios and essay style questions. Answer lengths were in the general range from 2000–4000 words.

The primary foci of the project were to test the use of software on the students' own computers ('BYOD'), to evaluate the viability of such an approach during formal examinations, and to assess students' reaction to the use of computers in formal examinations requiring essay length answers. The trial was evaluated through both student surveys (pre- and post-exam) and staff interviews.

Overall, the use of the software was considered a logistical and pedagogical success. Valuable insight into financial and personnel costs were gained, and a report prepared for the university.

#### IV RESEARCH METHODOLOGY

Although the primary focus of the trial was to test whether e-exams were logistically feasible, we thought it important to also understand student and staff perspectives on e-exams. This was undertaken using a mixed methods approach, surveying students — both quantitatively and qualitatively via free text response — and interviewing staff. The use of mixed methods permits a more comprehensive picture of a phenomenon than merely one method.<sup>62</sup>

Students in selected courses were invited to be a part of the e-exam trial and their involvement was both voluntary and not linked to involvement in the attitudinal research.

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<sup>60</sup> Noting that students could do multiple e-exams if enrolled in multiple subjects. In semester two there were actually 591 individual e-exams delivered.

<sup>61</sup> The inclusion of smaller electives was a significant factor in the logistical aspects of conducting the examinations, but the survey results from the electives were too small to be reliable and are not analysed in this paper.

<sup>62</sup> Louis Cohen, Lawrence Manion and Keith Morrison, *Research Methods in Education* (Taylor & Francis, 8<sup>th</sup> ed, 2017) 31–51.

Ethics approval was obtained to run surveys of students before and after the e-exams,<sup>63</sup> and to conduct interviews with staff associated with the trials.<sup>64</sup> Answers to survey questions on student feelings towards e-exams were forced choice Likert scales. Questions evaluating their exam experience asked students to identify whether pen or computer was a favoured medium, or both were equally as good. A concluding free text question allowed for further student comment and introduced a qualitative element to the survey. Students were invited in class and via email to complete the survey anonymously online.

Students were surveyed before and after taking e-exams in both semesters. The surveys before the exam were open to all students enrolled in courses where an e-exam was to be offered, the survey post the exam was only offered to those who had taken the e-exam.

The questions asked were largely based on previous questions developed by Mathew Hillier and Andrew Fluck.<sup>65</sup> This was to allow comparison between e-exam trials in various universities that chose to use the same questions and to permit a meta-study at a later point in time. Questions were designed to explore students' comfort with e-exams and their perception of how they performed relative to pen and paper-based testing. We acknowledge the expertise and work that went into designing those questions and are grateful that Hillier and Fluck shared them with us.

#### *A Limitations in Research Methodology*

This study was limited to the experiences of students at one university. The generalisability of these results may be restricted, as the open-book examination format employed by UNSW Law has not been adopted by all Australian law schools for example. However, the research design itself was not tailored to an open-book format. The survey used, and even the experimental design, could be replicated at other institutions. Further, the positive response to e-exams in open book situations provides a new perspective on the issue.

The cohort in this study was self-selecting, so may not have been truly representative of the student body. Assuming students will be more risk averse when making decisions regarding major assessments, it is unlikely students who had inhibitions about trying out the e-exam format would have been captured by this study. This may have included, for example, slower typists, students without access to an adequate laptop, or students accustomed to typing in a language other than English. As the results may have overrepresented wealthier, type-fluent, English-fluent students, it may not be appropriate to draw from this data generalisations about student attitudes towards e-exams.

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<sup>63</sup> For student surveys in semester one and two: UNSW Human Research Advisory Panel B: UNSW approval numbers HC15859; HC15860.

<sup>64</sup> For approval for staff interviews: UNSW Human Research Advisory Panel B: UNSW approval number HC16456.

<sup>65</sup> See, eg. Hillier, *e-Exams with Student Owned Devices* (n 3) 582; Hillier, *The Very Idea of e-Exams: Student (Pre)conceptions* (n 8); Moge and Fluck, *Factors Influencing Student Preference* (n 5).

However, given the limitations around conducting experimental research in high stakes assessment settings, it is unlikely a truly randomised sample is attainable. Nevertheless, considering there is a current dearth of data on e-exams trials conducted in high-stakes examinations, sacrificing representativeness for ecological validity may still have been a valuable trade off.

Between the first and second trials, the size of the sample cohort, and the percentage of students in each cohort who responded to the survey, varied greatly. The cohort size in the first trial was smaller than that in the second, but a high proportion of the total cohort responded to the survey. Conversely in the second trial, while the sample size was large, only a small percentage of the total cohort responded to the survey. It is uncertain whether the samples in the first and second trials captured the same variance in the student cohort. Had the data been statistically analysed for differences between trials, the discrepancies in sample size may have detrimentally impacted the statistical validity of results. This could be better controlled in future by taking equal sample sizes in replicate trials.

Both the software used, and the extent of user support provided, differed between trials. Exam4 was used in the first trial, and ExamSoft in the second, with greater technical support provided to students in the latter trial. Because both the software used and the level of user support provided changed between trials, rather than one of these variables controlled, no meaningful comparison could be made to determine either which was the preferred software, or which level of support resulted in smoother trials. Though the change in the level of technical support between trials was inadvertent, there simply being more resources available to run the second trial than the first, future studies could deliberately control these variables. Which software and level of technical support is more effective, are both important logistical considerations for transitioning to e-examinations, and should be more closely investigated.

Many of the questions asked of students in the survey were forced Likert scales. While this removed the ability for a student who was genuinely undecided or neutral on the question to provide that response, we felt that the number of students in that category would be small, and we wished to avoid respondents avoiding a reflection on the issue by providing a neutral answer. Given the aim of the research was to support a decision as to whether to implement e-exams we felt it appropriate to require the respondents to form an opinion on the issues.<sup>66</sup>

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<sup>66</sup> Cohen, Manion and Morrison, *Research Methods in Education* (n 61) 484.

The qualitative interviews with staff are also subject to a number of limitations. As with all qualitative research, the comments are only the views of a small number of individual staff, rather than a survey of all teaching and administrative staff. The sample was based on any staff identified with the trial who was available to be interviewed, and thus the sample is one of convenience rather than purposive. However, the size of the sample was considered sufficient to capture most viewpoints on the trial.

While a range of viewpoints were captured, the subjects were interviewed individually rather than in a focus group, so responses could not take account of alternative viewpoints that might have altered the subject's opinion or emphasis. Further the experience is likely to differ significantly between the interviewees' roles. This meant that little reliance could be placed on the quantum of agreeing views on any particular issue.

The summarising, coding and collation of comments, which was done by only one researcher, may have affected the interpretation of the results. A further limitation on the interpretation of the responses was the involvement of the project team in the teaching, convening, marking and administration of courses involved in the trial. As such there was less arms-length objectivity in the research. The analysis of the interviews should therefore be seen as a form of action research and interpreted in that light.

## V PRE-EXAM STUDENT SURVEY RESULTS

### *A Pre Exam Surveys*

The pre-exam survey was undertaken by students after they had been exposed to the examination software but before they made a choice as to which form of exam they would undertake. The results thus represent a cross section of student attitudes.

We analyse the combined results of both semesters in the discussion that follows. The participation results of the semesters are individually reported in Table 1 and 2. Responses to select questions are extracted in Chart 1.

**Table 1**  
**Pre exam response rates Semester One 2016**

Course name	Students enrolled in classes offered e-exam	Pre-exam survey responses <sup>67</sup>
Introducing Law and Justice	56	19
Criminal Laws	71	34
Public International Law	23	16
International Human Rights Law and Advocacy	20	5
	<b>170</b>	<b>74 (44%)</b>

**Table 2**  
**Pre exam response rates Semester Two 2016**

Course name	Students enrolled in classes offered e-exam	Pre-exam survey responses <sup>68</sup>
Administrative Law	206	23
Court Process Evidence and Proof	473	45
Equity and Trusts	331	35
	<b>1009</b>	<b>84 (8%)<sup>69</sup></b>

Fifty-two students also provided additional free text comments. As these comments were optional and no suggestion was made in the survey for comment on particular issues, no conclusions can be drawn from the number of responses raising any particular matters, other than that for each individual response the matter was of substantial enough significance that the student felt the response was warranted. We reproduce a number of these comments as introductions to the issues addressed by the quantitative analysis.

### B *Demographics*

Students saw themselves as very fluent in English in exam settings, with 69 per cent seeing their fluency as ‘very good’, 23 per cent as ‘good’ and six per cent as ‘poor’. Thirty-one per cent of students did not have English as a first language. Neither of these language factors had any impact on the distribution of responses.

<sup>67</sup> In semester one there were in fact two surveys, before and after at trial use of the software. The questions in the second survey were replicated in the post exam survey and no significant differences were reported to the results of the post exam survey.

<sup>68</sup> In semester two the pre-exam survey was run after students had had an opportunity to test the software.

<sup>69</sup> A number of students were enrolled in multiple courses involved in the trial. 84 responses were received but potentially 103 e-exams could be sat.

Sixty-eight per cent of respondents were aged 23 or less, and hence likely to be undergraduate LLB students. Twenty-five per cent were between 24–30 years old, and three per cent over 30 years of age. One potential issue was whether age would be a factor in a positive attitude to e-exams. However, no significant quantitative variations associated with age appeared in either the pre-exam or post-exam surveys.

### *C Student Attitudes Towards E-exams*

The data captured by the pre-exam survey provides an insight into a cross-section of the law student population and provides answers to a number of questions.

The use of computers in the workplace and at home may make handwritten answers feel out of date. As one student put it:

I believe it is important that universities continue to adapt to the modern workplace. While handwritten notes are still popular in the law workplace, a vast majority of work still involves the use of a computer and I believe that eventually handwritten notes will be phased out almost entirely.

This was a sentiment shared by 80 per cent of students who agreed that it was important to explore new technological ways of completing exams (31 per cent strongly). But this strong acceptance of the need for change did not mean there was similar belief in personal advantage as a result of such a change. To explore that issue a number of questions were asked about students' perceptions of their use of computers.

A first issue is whether the student found typing or handwriting a more natural process for completing exams. One student commented:

It seems easier and faster to type a response than to hand write. Also, when I think of what to write, because i [sic] type faster than i write it is easier to get all my thoughts typed down instead of forgetting mid-sentence where i was going with my idea.

On the other hand, another complained:

HATE THE IDEA OF TYPED EXAMS HATE IT I CANNOT TYPE AND THINK I ONLY TYPE SO THAT I CAN RESTRUCTURE MY NOTES BUT IN ORDER TO THINK AND CONVEY MY THOUGHTS I CAN ONLY HANDWRITE I still need to handwrite all the thought patterns of my exams/assessments.

When asked whether computers or pens felt a more natural way of composing text, the result was fairly evenly split between those who found typing on a computer (33 per cent), writing with a pen (38 per cent) or both equally natural (29 per cent) — with a slight weighting to those who found use of a computer less natural.

Despite this balanced preference for writing styles, there was overwhelming use of computers to take notes in class (79 per cent) and to prepare for exams (91 per cent). However, two students commented that this question was unfortunately phrased in that they used both pen and computers, depending on the content taught.

This raises the question of whether students think they type faster than they handwrite, a perception mentioned in many of the comments. One student commented:

I'm a very slow writer. This contributes to my exam marks being much lower than my marks in any other form of assessment. I therefore experience exams as a rather unpleasant and unfair test of how fast I write. As typing is much faster and more natural for me, computer-based exams will mitigate this and help me to approach exams with a more positive attitude.

This appears to reflect a large number of students' experiences. Seventy-four per cent reported that their typing was faster than their handwriting, with 15 per cent who reported being faster at handwriting.

Thirty-four per cent considered that they would be at a disadvantage to other students in an exam where students typed their answers. Partly this anxiety might be based on a relative sense of speed. As one student put it:

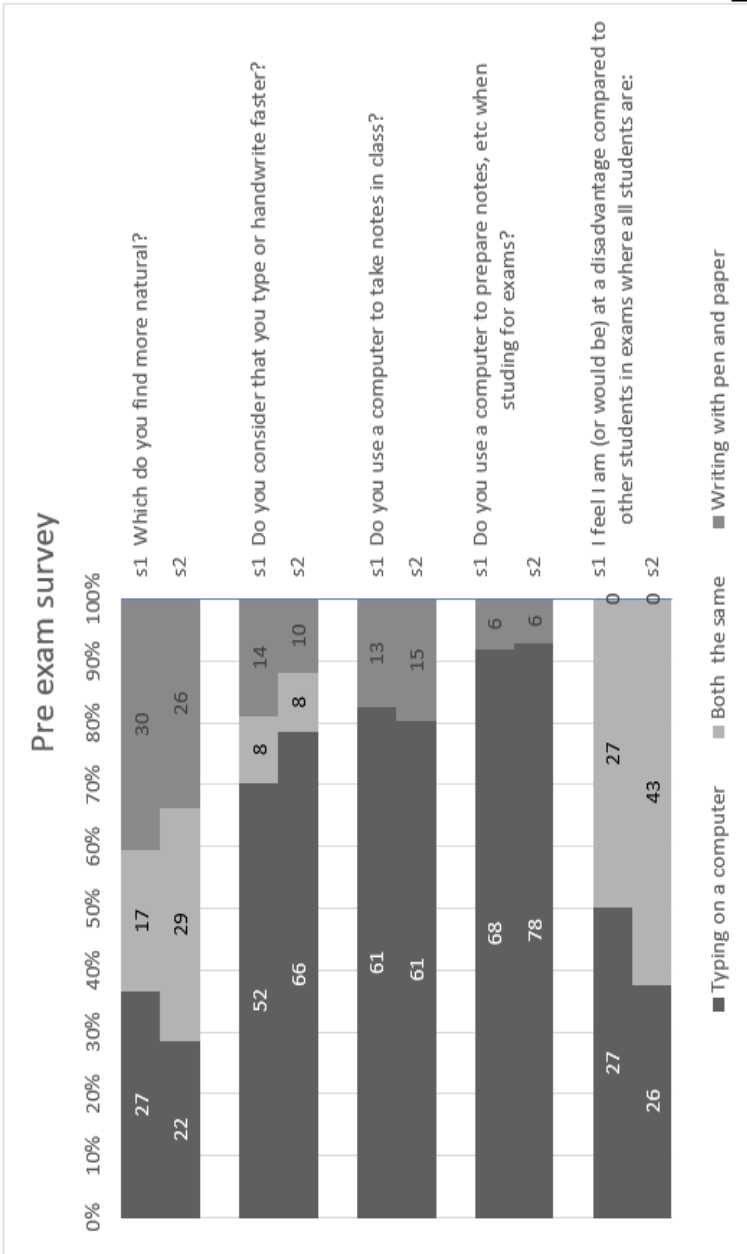
I can type-write faster than I can hand-write, but I type slower than others. I feel like I am going to be at a disadvantage either way.

These results were quite different if only those who saw handwriting as more natural were considered in isolation. For those students, 33 per cent believed they wrote faster than they typed (though 53 per cent said they typed faster) and 62 per cent thought they would be at a disadvantage if all students typed their answers (25 per cent considered there was no advantage either way). Of this group 37 per cent did not take notes in class with a computer, but only 15 per cent did not use a computer to prepare for exams. There is therefore unsurprisingly a correlation between those who find handwriting more natural and who felt they would be disadvantaged in an e-exam

This correlation was even stronger for the small percentage of students who believed they wrote faster than they typed — 38 per cent did not type notes in class, but only 13 per cent did not type when preparing for exams. Unsurprisingly, 83 per cent of this group thought they would be at a disadvantage if all exam answers were typed.



**Chart 1**  
**Pre exam survey**



(NB) the answers to the bottom three questions did not have a ‘both the same’ option. The exact options were worded slightly differently but to the same effect. We report the answers in this format to enhance comparison and avoid multiple tables.

### D *Other Issues*

The qualitative comments from the students also raised a range of matters not captured by the quantitative data. Four students expressed concern about whether differences or biases would exist in the marking between written and typed answers, eight commented on their fear that typing would mean they would not reflect on their answers as much as when they wrote.

I think when I use pen and paper I tend to think more critically, at least a little more thoughtful especially in exam condition. I am afraid that I might waste more time if I was to type the answers using the computer.

There is something intrinsically connected between writing down thoughts in response to queries — I am concerned that the performance I have in exam conditions would not transfer to a type [sic] exam. I listen less and gain less from a class when using a computer. It would be a disadvantage to me to have an exam where computers are used or even a blended option as there may be inherent bias of the marker towards a typed response.

I always tend to write essays and assignments by hand first. I think much better on paper.

I find my flow is better when I am writing in pen and I will not constantly be rereading over my answers.

A number of comments referred to concerns about the use of technology:

My fear is that I will touch something that would delete all my answers and I am more comfortable with writing than with typing.

uncertainty about whether the computer will last, for all sorts of reasons.

However, those students expressing concerns about technology were balanced by those who were positive about e-exams, with a large proportion of students positive about their ability to type faster than they could write, the enhanced ability to edit their work, and the prospect of not suffering wrist pain from writing. These comments presaged the results of the post exam survey.

## VI POST EXAM STUDENT SURVEY RESULTS

### A *Post Exam Surveys*

Students were surveyed after the e-exam in each semester, and overall response rates are set out in Tables 3 and 4. While the number of students offered the trial in semester one was smaller, the response rates were over 47 per cent. While the response rates in semester two were 21 per cent the number of responses in each survey, and their general similarity with the results in semester one suggests that they approximate a representative sample.

**Table 3**  
**Post exam response rates Semester One 2016**

Course name	Students enrolled in classes offered e-exam (LLB/JD)	Students who took e-exam (LLB/JD)	Post-exam survey responses
Introducing Law and Justice	56 (LLB only)	33	15
Criminal Laws	71 (4/67)	17 (1/16)	10
Public International Law	23 (18/5)	9 (8/1)	3
International Human Rights Law and Advocacy	20 (16/4)	13 (12/1)	6
	<b>170</b>	<b>72 (41%)</b>	<b>34 (47%)</b>

**Table 4**  
**Post exam response rates Semester Two 2016**

Course name	Students enrolled in course	Students who took e-exam <sup>70</sup>	Post-exam survey responses
Administrative Law	206 (133/73)	106 (77/29)	
Court Process Evidence and Proof	472 (338/134)	273 (214/ 59)	
Equity and Trusts	331 (287/44)	213 (193/20)	
	<b>Total 1009</b> <b>Total LLB 758</b> <b>Total JD 251</b>	<b>Total 592 (59%)</b> <b>Total LLB 484 (64%)</b> <b>Total JD 108 (43%)</b>	122 (21%)

*B Post Exam Survey Demographics*

Of the students who chose to take the exam, all considered their English proficiency in an exam as ‘very good’ (84 per cent) or ‘good’. Nineteen per cent reported that English was not their first language. In terms of age, 74 per cent reported as being 23 years old or younger (an approximation of LLB enrolment) and 23 per cent over 23, with six per cent 31 or older (an approximation of JD students). There was no discernible effect of age on responses, though sample sizes for older ages were too small to be reliable.

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<sup>70</sup> Some students undertook multiple exams as they were enrolled in multiple courses.

### C *Student Reactions to the E-exam*

Students who had taken the e-exam were overwhelmingly in favour of the format in both semesters. Ninety-three per cent agreed it was a positive experience, (47 per cent strongly agreeing), 92 per cent would recommend the system to a friend (51 per cent strongly). Both software systems were overwhelmingly seen to be easy to use (94 per cent),<sup>71</sup> and 96 per cent liked being able to use their own computer (59 per cent strongly). This is a resounding endorsement of the use of computers in law exams by those who have trialled it.

In terms of negative responses, thirteen respondents would not recommend the system to a friend. Of those 13 students, nine were 23 years old or younger, eight spoke English as a first language, but none considered their English to be poor. Eight students did not find the software reliable against failure and five did not like having to use their own computer. Ten students did not have a positive experience. Nine students preferred handwriting to typing, and only three thought typing was more normal than writing (two saw no difference). Ten students got more distracted in an examination involving computers (three saw no difference). This suggests no clear demographic was disadvantaged by the trial, but that a small number of students maintained a preference for written answers.

Students were a little more circumspect when asked if computer-based exams should replace paper-based ones. Seventy-four per cent thought the change should occur. Of the 40 who did not think this should happen, 28 would still recommend e-exams to a friend. This suggests the reluctance may arise out of a removal of choice rather than a negative experience (10 had a negative experience).

### D *Student Reflections on their Performance*

When asked to compare their approach in an e-exam to their usual paper-based format, there was again an overwhelmingly positive response. Students were asked to identify whether use of a computer or a pen was more advantageous or whether both had an equal effect against a range of statements (Chart 3 below). In interpreting the results, a percentage of responses that the student's experience was the 'same equally' across both formats could be aggregated with responses in favour of either use of computers or pens to establish a finding that the approach was *not* disparaged. If 'same equally' was a very large percentage, it could also be implied that the advantages of either option were not great. As it transpired, 'same equally' was a small percentage for many questions.

There was a strong endorsement of e-exams in terms of students' sense of their performance with 67 per cent considering they had

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<sup>71</sup> The ExamSoft system gained a 52 per cent 'strongly agree' response, whereas the Exam4 system only received a 26 per cent 'strongly agree'. That may have been attributable to the more extensive support that was offered to students in second semester.

performed better in the e-exam format and only eight per cent considering they would have performed better if writing by hand.

Students overwhelmingly agreed that use of computers enhanced the speed and quantum of their answers. Eighty-four per cent reported that they wrote faster with a keyboard and 74 per cent thought they wrote more words. Despite this apparent increased output, a near unanimous 94 per cent reported that their hands got less tired using computers in exams.

Questions on the effect of use of a keyboard on their cognitive processes generated interesting results. Fifty-seven per cent found typing a more normal process than handwriting, and 24 per cent saw no difference. Of the 27 who found a pen more natural, however, only 10 students would prefer a handwritten exam after experiencing the e-exam trial.

There was a significant impact of typing on editing. Eighty-nine per cent thought they 'changed, moved or corrected words or phrases more' when typing — only three per cent thought they edited more with paper. To a corollary question on whether students tried to avoid 'making changes unless they are really necessary', 79 per cent of students reported that writing by pen had that effect (17 per cent equally).

This reluctance to edit when handwriting may well have influenced the 45 per cent of students who said they thought more carefully *before* starting to write when using a pen. However, 31 per cent thought the format made no difference and 22 per cent reported that they thought more carefully *before* starting to type. While that question focussed on time before beginning to write, another question asked about whether they 'paused to think more *when* using' the computer or pen. Here the percentages were reversed. Forty-eight per cent reported that, *when* typing, they paused to think more, as opposed to 20 per cent who paused more *when* using pen and paper. If these results are taken together with the reluctance to edit when writing discussed above, it seems that for many students when writing by hand the answer is planned prior to writing, and then written without further reflection. The typed answer, by contrast, appears more likely to be constructed as part of an ongoing reflective process, rather than planned.

From the student perspective, the process of typing with a computer and editing as they go results in a better examination answer. Eighty-two per cent of students thought their typed answer delivered a better 'overall structure/argument'. This also flowed into their time management with 67 per cent considering typing led to a more effective use of time (19 per cent thought there was no difference) and 57 per cent thought that typing meant they read back over their answers more (36 per cent saw no difference). Correspondingly 64 per cent thought they were more likely to run out of time to answer if writing by hand (27 per cent saw no difference).

Finally, a majority of students (54 per cent) thought that handwriting answers was more stressful than typing and only nine per cent were less stressed when writing.

Within the cohort there were only 20 students (14 per cent) who preferred to write rather than type exam answers, and 12 students (eight

per cent) who thought that writing would have meant a better exam performance (10 of whom preferred to write answers).

### 1 *Free Text Responses*

In line with the quantitative data, free text responses were overwhelmingly positive.

Some sense of the student reaction can be seen in these representative samples:

I love it! Please make all the law exams an e-exam next semester!

E-exams allowed me to respond to my potential — no hand fatigue, ability to move between questions, write more and put more thought into my response.

It was really really positive. I think the format helped me get a better mark in my course.

Surprisingly loved it — did much better than I thought I would have and felt my essay standard was far improved — I'll be hoping to use this method in the future!

Loved it, hope it gets implemented in every exam. Would never go back to pen and paper if I had a choice.

I am not computer savvy and was very nervous about e-exams when I heard about them. This software was so easy to use and made my exam experience almost enjoyable! I would recommend it for every [course].

The ability to edit was also highlighted:

My way of answering is likely a bit haphazard and sometimes things occur to me while I am on another question and I like to switch back to that first question and add a little note or something to that answer.

Overall, I would highly recommend the e-exam as it allowed for me to structure my answers in a more coherent format in a much quicker time frame.

Students also saw other positives:

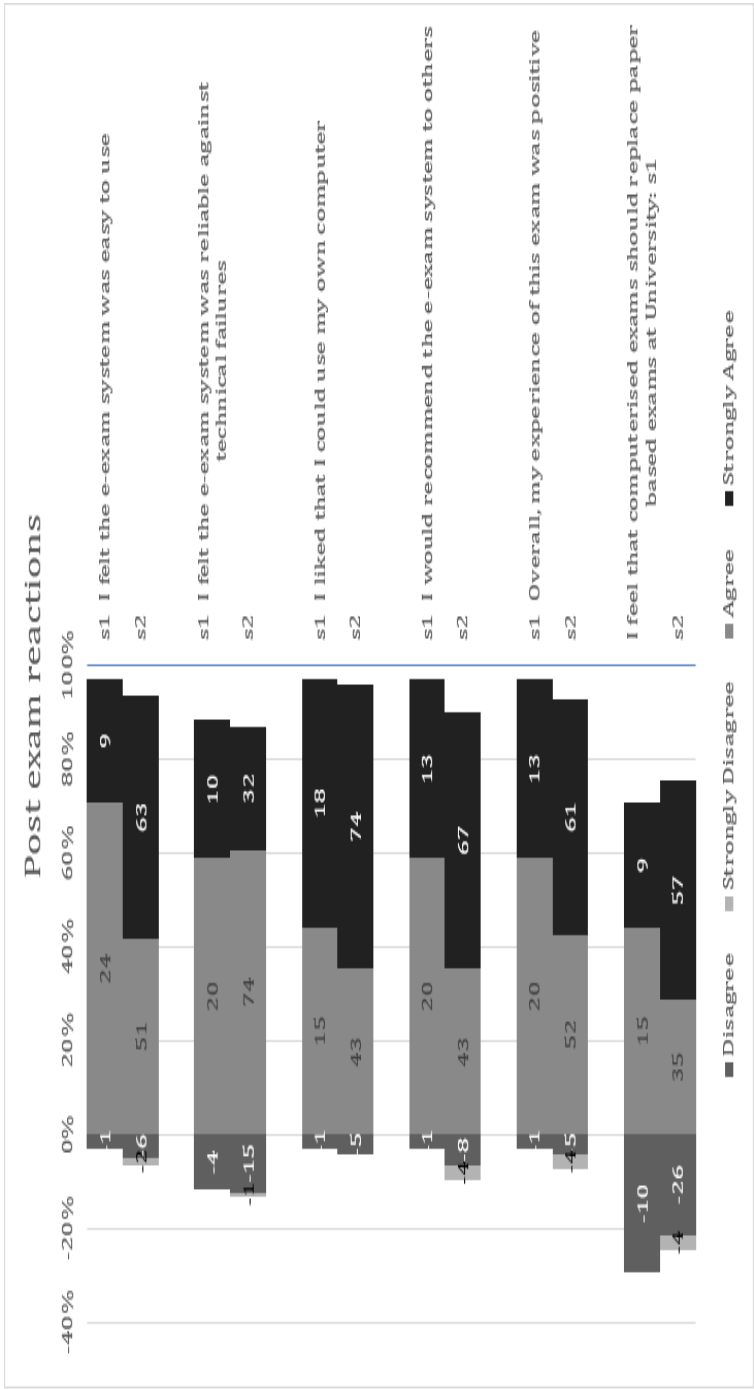
Typing my exam was a much more comfortable experience than handwriting previous exams has been.

As someone who has been penalised in exams for his handwriting — THIS IS THE BEST PROGRAM/SYSTEM EVER. I was skeptical at first but it's incredibly easy to use.

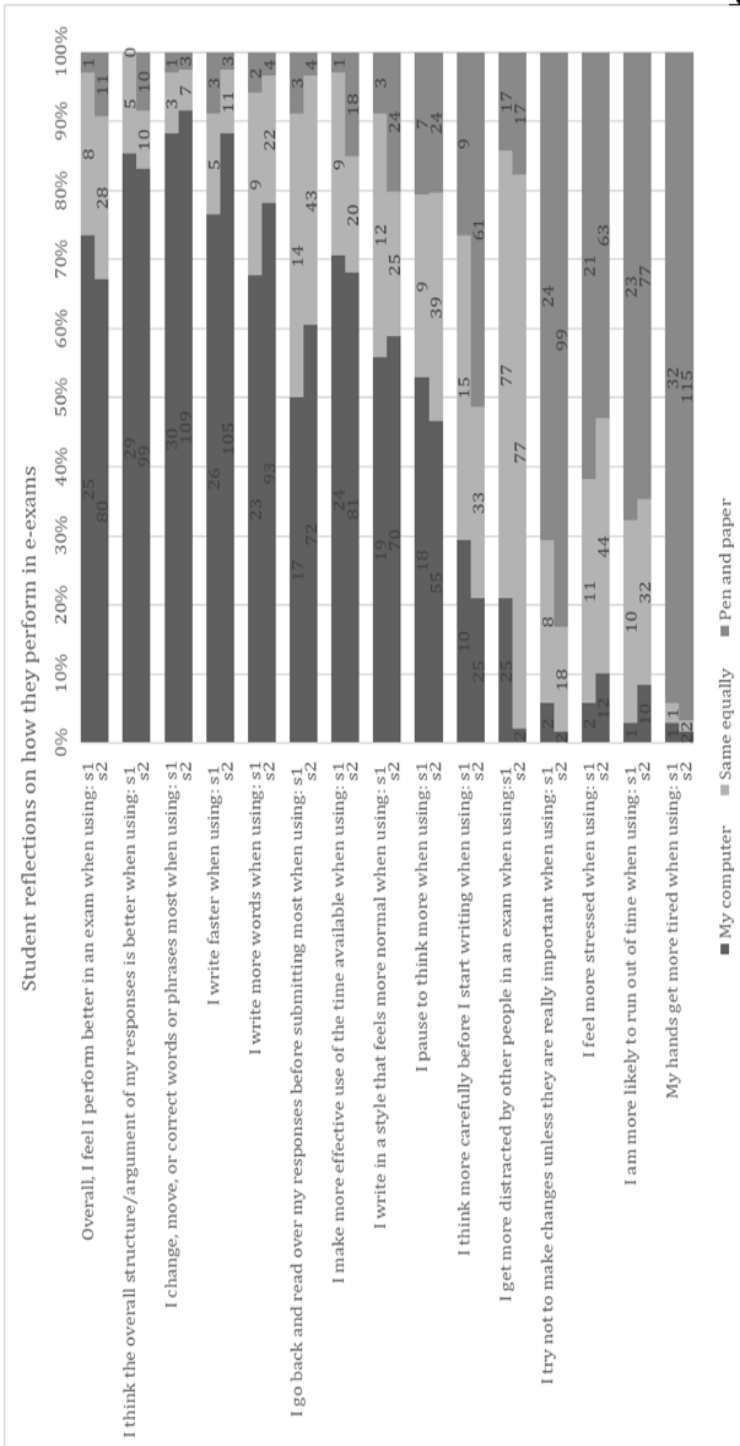
Can we please have this as a special consideration measures for those with frequently illegible handwriting?

Negative comments generally came from those who had found the e-exam a negative experience and highlighted their concerns over the 'clunky' nature of the software and word processing functions. One student suggested height adjustable seating, another larger exam desks, and another that the university provide laptops for students.

**Chart 2**  
**Post Exam Reactions Semester One and Two**



**Chart 3**  
**Student reflections on performance Semester One and Two**





## VII PRE AND POST EXAM STUDENT SURVEY DISCUSSION

Both the quantitative and qualitative results demonstrate a very high degree of satisfaction with the use of computers in exams. None of the questions in the post exam survey had an overall negative response from the students. Only three questions had responses below 65 per cent in favour of BYOD exams. Five responses had over 80 per cent agreement. What was particularly striking was that the responses to these questions related to the core benefits said to be associated with BYOD exams. Over 80 per cent of respondents felt that their hands got less tired than when using pen and they wrote faster with a computer, they edited their work more, and felt freer to make changes to their answers and their structure/argument was better with computers. The possible negatives of the use of BYOD did not arise for most of the responding students: 79 per cent found it equal or less distracting than the use of pen and paper. Interestingly the negative free text responses raised concerns about the lack of features in the exam software and its slower response times. A couple of responses noted that they had been caught out by lack of experience with such exams — one editing too much, another not realising the differences in technique required for reverting to paper exams.

Overall there is overwhelming student support for BYOD e-exams amongst those who completed the trial — over 90 per cent would recommend it to others and found the experience positive. The overwhelming nature of the support is significant in light of the voluntary basis of the trial. As discussed above a range of reasons were given by students for not taking an e-exam, and those concerns need to be addressed. On the other hand, the fact that almost all those who took the e-exam found the experience positive, and that there was an increased take up rate in the second and much larger trial suggests e-exams can be introduced without significant student disquiet.

Law students represent a particular subset of tertiary students. Entry into a law degree is very competitive and learning and assessment is strongly based on reading and writing at length. As discussed above, results from previous research suggest that such students are likely to find more benefit from typed answers than other cohorts where examination is more of a ‘short answer’ variety. Additionally, within the trial itself no student who took the e-exam identified as having anything below a ‘good’ proficiency with written English in an examination. How e-exams are experienced by those who struggle with English is unexplored.

This paper does not explore issues around student anxiety and e-exams in detail. However, an awareness of the impact of student assessment anxiety informed planning and implementation of the trial. There was an emphasis throughout on providing cogent technical support to students, and communicating that no student would be disadvantaged by the form in which they completed the final exam.<sup>72</sup> The overwhelmingly positive response post exam suggests that for

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<sup>72</sup> Communications were both in class and via email.

many students, expressed concerns or anxiety about the functional aspects of the trial had dissipated post exam. This observation should be considered though in the context of this being an 'opt-in' trial, and students who had significant concerns, including not being particularly computer confident, may not have undertaken the e-exam to begin with.

## VIII POST EXAM STAFF INTERVIEW RESULTS

We conducted 18 staff interviews in total (excluding those solely related to the Science trial). There were 16 research participants in this component of our study, with two being interviewed twice due to their involvement across both semesters of the trial. In total, we interviewed seven course convenors or co-convenors, of whom five also marked e-examinations and one of whom was also a member of the research team; as well as five administrators (including e-learning support), one of whom took on an additional marking role in the second semester; three people who marked e-examinations but did not convene the course; and one person who had been involved in the grant application for funding the e-examination trial. There was thus a total of nine participants who had marked e-examinations. Despite seeking interviews, we were unable to interview anyone involved in negotiating contracts with software suppliers. Throughout this section, we use C if an interviewee is speaking as a convenor, M for a marker, and A for research team or administrator. Where a person has multiple roles, the relevant role is used.

The goal of the interviews was to explore the success of the trial and willingness of participants to consider e-examinations in the future, identify advantages of e-examinations, identify any issues, concerns or disadvantages of e-examinations, and explore what elements might be necessary or important for successful implementation of e-examinations at UNSW at a later date. The analysis is conducted on the basis of 'n=16', in other words the number of participants not the number of interviews. Where one participant changed their view in relation to a particular issue, this is specifically noted; otherwise, issues raised in either interview were counted. Nine participants were interviewed by Lyria Bennett Moses in relation to the semester one trial. Nine participants were interviewed by Peter Blanchard in relation to the semester two trial.

The interview format was semi-structured. We found, however, that research participants often responded to one question while answering another, either because they remembered something new in response to a previous question, or because they were anticipating related matters in response to an existing question. The coding of the interviews thus recognized that responses to a question could occur at any point of the actual interview and were not confined to the response to a specific question.

### *A Analysis of Data*

Overall, almost all participants (13) expressed the view that e-examinations ought to be conducted in future at UNSW, with some suggesting that this would be conditional on matters such as administrative support or the continuation of a student choice model. One participant (A) was of the view that e-examinations should be part of a mix of assessment approaches, and that their impact on the learning experience should be further explored and equity issues resolved. Only two participants were negative about the future of e-examinations at UNSW; one of these (M) simply responded that e-examinations ought not be conducted in the future at UNSW while the other (C) was of the view that it should only be done if the advantage to students could be demonstrated and equity issues managed.

### *B Advantages*

Research participants identified a range of advantages associated with e-exams and captured in Table 5.

**Table 5**  
**Advantages of e-examinations identified by research participants (n=16)**

<b>Advantage</b>	<b>Number of research participants (n=16)</b> *
<b>Legibility</b> of student responses	14
<b>Less paper</b>	10
Student <b>familiarity</b> with computers and typing	7
The ability for students to <b>edit</b> exams (and thus correct errors and better organize text through cutting/pasting between responses)	3
<b>Administratively easier</b> and/or cheaper for the university	2
Appropriateness in a <b>modern</b> society	2
E-exams may be <b>able to permit Internet use</b> during exams (where appropriate) enabling more efficient open book exams or the ability to test research skills under a controlled environment	2
The ability to put <b>instructions/questions into the e-exam</b>	1
Enables <b>text diagnostics</b> for feedback to students	1
<b>Enables home-based</b> time-limited assessment (possibly with cameras and external monitoring by invigilators)	1
Possibility of introducing <b>plagiarism check</b>	1

\* Multiple coding permitted.

As can be seen, the main three advantages suggested by research participants were: legibility of exam responses; the reduction in paper-based processes; and the familiarity and comfort it was believed students had with typing and computers (compared to handwriting and pen/paper). It is also worth noting what is omitted in this table. In particular, as one research participant pointed out, none of the advantages are associated directly with enhanced or deepened student learning (A).

Increased legibility was said to offer a number of advantages, including enhancing the ease, speed and accuracy of marking. Ease of marking was particularly important for one research participant who is visually impaired and unable to mark handwritten exams, but many expressed a preference for marking e-exams. As one participant (M) stated, ‘when I went to the handwritten ones, [I was] going “oh no”.’ The issue of marking speed is particularly crucial in light of given increased marking loads in many universities. Marking accuracy is also important, given that with handwriting ‘you tend to skip over certain things’ (M). Not only may one ignore errors as a result, but it may be ‘easier ... to find marks’ in a typewritten exam (M).

The reduction in paper was said to offer a number of advantages, including environmental and financial benefits, and the easier distribution of scripts post-exam (so markers get their papers earlier and can collect them from any location).<sup>73</sup> E-exams also reduce the risk of lost exam papers, since they are uploaded and stored locally and in the cloud immediately, so that any papers that failed to upload can be immediately addressed. E-exam scripts are also more portable so that ‘you could just take them with you’ when travelling (M).

The extent of the reduction in paper depends on the ability and willingness of markers to grade papers online. While one participant did so, most relied on paper printouts as a result of software limitations (it did not plug into online grading tools such as Turnitin) or personal preference. One research participant (M) would prefer to mark on-line were the tools available, observing that there could be ‘a tool that would import a grade onto a spreadsheet’ creating additional efficiencies. However, most markers preferred using paper scripts. The paper printout system, while faster than traditional distribution of paper exams, obviously reduced the environmental and financial benefits, as well as taking additional time and resources.

The third most common advantage identified by participants was that they believed students were more familiar with computers and typing than with handwriting. For example, some participants observed that students generally take notes on a computer and use computers to write. This is ultimately an empirical question, and one participant raised some doubts pointing out that slower typers might feel disadvantaged in an e-examination. Assuming that students *are* more familiar with computers and better typers than hand-writers, greater familiarity could mean reduced anxiety and superior competence

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<sup>73</sup> In semester two, the turnaround was about 2.5 hours, as compared to 1–2 days for traditional exams.

(‘students seem to be better at typing than writing’ (C) as well as a greater sense of ‘authenticity’ (A). One participant also felt that typing was a more useful, transferrable skill for students to develop compared to handwriting (C). These observations align with the student responses reported above.

### *C Disadvantages and Barriers*

While one research participant felt that there were no disadvantages, the remainder raised at least one, all captured in Table 6. It is worth noting that six research participants described the disadvantages to which they referred as ‘teething’ or temporary problems that would resolve themselves over time, in part as a result of staff and students being more familiar with the format and its requirements.

**Table 6**  
**Disadvantages of e-examinations identified by research participants (n=16)**

<b>Disadvantages</b>	<b>Number of research participants (n=16)*</b>
<b>Set up and ongoing costs</b> , including infrastructure, human resources, training, facilities and systems (with support)	6
<b>Students not following instructions</b> and related human error (forgotten chargers, late installation, failure to update operating software, insufficient specs on computer, contacting wrong person)	5
Students <b>require training and support</b> to be able to use software (taking class time)	4
Typing involves <b>different thought process</b> (less planning, less filtering)	3
<b>Increased risk</b> , including possibility that device may crash during exam	3
Some student laptops used <b>incompatible operating systems</b> (older software, Windows 10), meaning those students could not participate	2
Students write more, so answers are <b>longer</b> (more time to mark)	2
Poor spell-check, more <b>spelling errors and typos</b>	2
Difficulty accessing software support and concerns about system disruption, particularly for <b>company based overseas</b>	1
Need for <b>larger tables</b> for students in exam rooms, requiring more space	1
Challenges <b>working on a screen</b> (particularly for older students)	1
Some students are <b>slow typers</b> , who will be disadvantaged	1

\*Multiple coding permitted.

The concern about typing involving a different thinking process is an important one. While this was only explicitly identified as a disadvantage by three participants, it was the subject of extensive commentary by nine participants in comments as to the differences in performance for students sitting e-exams and conventional exams. A proper analysis of any such difference ought to be large scale and quantitative, based on a double-blind trial, rather than relying on the unprompted opinions of convenors and markers for relatively small cohorts of self-selected students. We briefly set out their views here to capture a range of opinion on this issue rather than to make any inferences as to the fact of any difference. It should also be borne in mind that, if there is different thinking or different performance in an e-exam, skills in online editing may be of greater ongoing benefit to students than improved handwritten work (A).

While research participants were not specifically asked how the cohorts (typers and hand writers) performed relative to each other, eight participants (convenors and/or markers) commented on this in their responses to other questions (in particular in identifying advantages and disadvantages of e-examinations). Of these, six believed that typing made no overall difference to quality, two felt that typed exams were on average of higher quality (greater clarity, understanding of course material and/or coherence of answers), one felt that typing may have been a distraction for some students, four observed that typewritten answers were (unexpectedly) of similar length to or shorter than handwritten answers, and three observed an equal (one) or higher (two) rate of spelling mistakes for typed answers. However, one participant commented that it was themselves, as a marker, who was more aware of grammatical and punctuation errors in e-examinations compared to handwritten examinations. This, they thought, was due to enhanced legibility of the papers. These observations are an interesting counterpoint to the student perceptions, who thought their errors were diminished when typing.

In addition to the disadvantages set out in Table 6 above, there were some problems that were experienced *in this particular trial* that could be rectified in future. These include the need for better co-ordination with Disability Services so that students with special provisions can participate in e-examinations with necessary modifications and the challenge of allowing students to ‘opt out’ of e-exams at the last minute, creating administrative and room-planning challenges.

Conversely, there were a number of issues that did not arise in the trial but were described by research participants as issues that would arise if e-examinations were used ‘at scale’ across the university. The most important of these issues related to infrastructure, in particular the need for higher capacity, stable Wi-Fi and a greater number of power points available to students taking examinations as compared to that available currently. In addition, one participant commented on the need to provide training and support to students and staff (including casual staff). Because these factors may prevent greater uptake of e-examinations, they may be better described as ‘barriers’ rather than ‘disadvantages’.

Both advantages and disadvantages associated with e-examinations assume that they will be able to proceed. Three participants stated they did not believe that there were any barriers to greater uptake of e-examinations. However, many research participants identified barriers that might prevent greater uptake of e-examinations. The most common barrier mentioned (six participants: five first semester, one second semester),<sup>74</sup> was student anxiety and conservatism (eg ‘they appear to have thought that doing something different was dangerous’) which, in the context of the opt-out system we implemented, led to fewer participants in the trial. This was described as being a more significant barrier for mature age and international students. Had e-examinations been compulsory, this would have been a ‘disadvantage’ rather than a barrier. Another barrier described by two participants was the conservatism of the faculty and staff, captured neatly as ‘[h]ow backward everybody seemed to be about what is a clearly obvious thing to do’ (A).

#### *D Conditions for Success*

Perhaps the most important question for the future of e-examinations at UNSW is knowing what the conditions for success are. A full analysis and implementation plan goes beyond what can be identified from 18 interviews. However, the participants did provide some useful insights into the kinds of things that will need to be addressed for a successful implementation of e-examinations at UNSW. These are captured in Table 7.

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<sup>74</sup> The take up of e-exams differed from 41 per cent in semester one to 59 per cent in semester two, and significantly more support was provided to students in semester two. This may have influenced the responses of those staff involved in the semester one trial.

**Table 7**  
**Conditions for success of e-examinations in the Faculty of Law at UNSW Sydney, as identified by research participants (n=16).**

<b>Conditions</b>	<b>Number of research participants (n=16)*</b>
<b>Student choice.</b>	12
<b>Project management and academic leadership.</b>	10
<b>Preparation</b> well in advance, by both administrators and academics.	10
<b>Minimise manual processes.</b>	8
<b>Quality software.</b>	6
<b>Infrastructure</b> (space, power points, Wi Fi).	6
<b>Student equity.</b>	6
<b>Timing of introduction.</b>	3
<b>Separate rooms</b> for those typing and handwriting exams.	3
<b>Staff confidence</b> (including in its benefit to students), requiring staff training.	3
<b>Word limit</b> imposed for e-examinations.	2
<b>Integration</b> with other software and systems (including Moodle, ECCLES and student enrolment).	2
<b>Trained exam supervisors/invigilators.</b>	2

\*Multiple coding permitted.

Each of these conditions is discussed at greater length below. It should be emphasised generally that, while we were able to describe suggestions made by research participants, we are not able to state numbers in favour of or opposing each of these suggestions. That is because we did not put suggestions made by one research participant to other research participants, which would have given them a chance to agree or disagree. Rather, agreement or disagreement with any of the above suggestions was instigated by each research participant independently as part of that participant's own suggestions for future roll-outs of e-examinations. This analysis should therefore be used primarily as a way to identify issues to be considered in any implementation of e-examinations, not as a poll of opinion as to the usefulness of any particular proposal.

Due to ethics requirements, the e-exam trial allowed students to opt-out. Perhaps because of this feature of the study, the question of student choice as to whether to sit an e-examination (and whether this be opt-in or opt-out) was a common topic raised by research participants in the interviews.

Of those commenting on the question of student choice (12 participants), eight were explicitly in favour of student choice, with three of these expressing a preference for an 'opt-in' mechanism to an



'opt-out' mechanism, at least until the 'status quo' shifts (C). For some participants, the importance of student choice overlaps with concerns about student equity, an issue discussed below, while others were concerned that 'nobody felt disadvantaged' or anxious as a result of the introduction of e-examinations. Two participants (2C) stated that the need for an opt-out mechanism might fade over time, as e-examinations became increasingly standard. But not everyone agreed with giving students a choice. Two other participants were of the view that the fairest mechanism was to force all students to type their exams on the basis that typing was 'just a skill that they need to develop' (C) or because 'there is a serious advantage in being legible' (C). Further, two participants in administrative roles had no view on whether students be given a choice but stated that *any* mechanism should be finalized earlier than it was in the trial, so that '[w]e couldn't just let students go on and opt out the minute before the exam' (A).

After the question of student choice, the factor most commonly identified as crucial for the success of the e-examination trial was having a good project manager focused on assisting staff and students and liaising across the university with other relevant departments in addition to having encouragement and assistance from academic champions. This was to a large extent a credit to the project manager and academics who were involved, with many participants explaining their enthusiasm for e-examinations based on the support they received. The project manager needs to be someone who is 'comfortable working on computers' and with 'technical instructions' and good at 'building relationships with other stakeholders' (A). As one research participant explained, 'Having a [name omitted] to get the bugs out is absolutely critical' (C). In the context of a broader university roll-out of e-examinations, the project manager may need an assistant or a small team. This ensures that additional workload is not placed on current academics and administrative staff (A), a matter that some participants felt to be essential to any future implementation.

Eight research participants raised the importance of factors that we have grouped together as involving advance preparation by both administrators and academics. This aligned with the view of some participants that, in the trial, some things happened 'a bit late' (C) although others were comfortable that information was provided in a timely manner. Some delays in the trial in semester one were for external reasons, such as the delay in obtaining a licence for the software. The specific issues raised in terms of the importance of advance preparation included the need for clear and consistent information to staff and students 'right from the beginning' of the relevant semester or even their degree program (4C, M, 2A), earlier availability of software for download and practice (C, M, 2A), the conduct of an in class practice exam (C), proper training for exam invigilators and supervisors (2A), and the development of a clear written 'e-exam procedure', available to staff and students and online, clarifying matters such as the availability of an e-examination in the supplementary exam period (2A).

Another significant issue during the trial was the amount of manual processes involved. To operate efficiently at scale, these need to be automated. For example, in the trial, opt outs were processed manually, and students were given until the day of the exam to opt-out. This was necessary as a question of ethics for a research trial, however if implemented as part of an assessment policy any opt out (an issue discussed below) should be processed automatically through an online portal by an early deadline (A). Further, in the trial, emails to particular sub-cohorts had to be done manually (A) as did the process of linking papers to students and teachers/tutors (C). In a related issue, two research participants stressed the importance of better integration between e-examination software and other university software and systems, including learning management systems, assessment records software and student enrolment.

Six participants felt that good software was important, in particular that it be reliable and effective (blocking other functionalities) and that the service provider be responsive (including in relation to contracting). Some participants felt it important that the software be tailored to the specific form of assessment, so that text-based courses are not weighed down with complex, unused tools (A). Ideally, it should also enable online marking that is 'of the same standard as Turnitin' (M) and enable the university to filter different classes and teachers/tutors for marking allocation (2A).

Student equity was an important issue for six of the research participants. In particular, it was felt that students who did not use a laptop or used an incompatible laptop would be disadvantaged. Suggested solutions included the university providing laptops to some students (for exams and practice sessions), and subsidized sales or loans of laptops.

While two participants felt the timing of the introduction of e-examinations to students was important, they had opposite views on what that timing should be. One (A) felt that students should start with e-examinations in first year, so that they would get used to it early. The other (C) felt that e-examinations should not be introduced in first year, at least until such time as the final secondary school examinations use e-examinations. A third participant (C) felt that what was most important was consistency, which would also suggest an introduction in first year.

Three participants stressed the importance of having separate rooms for students sitting e-examinations and students writing their answers by hand. This had also been an issue in the trial, where in some cases students were required to share a room, which research participants described as resulting in student anxiety and (in one case, C) a student expressing annoyance after the exam. One participant (C) expressed a contrary view, pointing out that while their students had been anxious about it, 'in the end they all sat in the classroom and there were no complaints about that.' The concerns were not a feature of the student surveys.

Two research participants suggested imposing a word limit for e-examinations, while a third expressed the contrary view. Any such

limit should only be imposed if typed answers would otherwise be significantly longer, an empirical question, and one that would be run counter to the observations of a number of research participants.

### *E Comparison Between Staff and Student Responses*

Considering both sets of data together there is a clear conclusion that the trial was a success. Most staff interviewed concluded that e-exams should be conducted in the future at UNSW, 92 per cent of students would recommend it to others. Staff broadly identified the same advantages of e-exams that students were asked to comment on — and which students largely endorsed. While staff did not mention that e-exams enhanced student learning this may not be the point of summative assessment, and the student responses that e-exams meant their hands hurt less, they could write more, and could edit more effectively may well mean that depth of student learning may more readily be evidenced in an answer.

However, while students felt they were able to better present their understanding in a typed answer, the responses from the marking staff were more equivocal. The majority thought there was in fact no difference between typed and written answers, and a minority thought the written answers were better. Given the high numbers of students who said they edited more when typing, it significant that this apparently did not lead to better answers. This may suggest that for law exams the quality of the student's answer is largely assessed on the level of critical thinking rather than answer formatting. A significant limitation with the marker responses is the lack of longitudinal analysis of individual students. As this was a mixed trial it is difficult to assess changes for individual students.

Marking staff were also critical of the number of spelling and grammatical mistakes in the typed papers, something possibly more forgiven in written papers. The software provided to students included a basic form of spellchecking, but this had to be initiated manually,<sup>75</sup> and it is likely many students did not do so. Thus, while a high percentage of students agreed that they corrected words or phrases more with a computer, their time management may not have given them sufficient time to correct all their spelling mistakes. Spelling mistakes when handwriting are more directly a result of mistaken belief as to spelling. Mistakes when typing can be higher as a result of finger coordination issues. This is an issue that may require greater student attention in e-exams.

The extant literature provided conflicting views on whether e-exams led to harsher marking.<sup>76</sup> In this trial, at a Faculty level no reportable

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<sup>75</sup> One reason for this is to avoid the situation where a word is auto-corrected to an incorrect term, and a student loses a mark as a result.

<sup>76</sup> See, eg, Moge et al, *Handwriting or Typing Exams?* (n 6); Augustine-Adams, Hendrix and Rasband, *Pen or Printer* (n 16); Maclellan, *Authenticity in Assessment Tasks* (n 33); Brown, *The Validity of Examination Essays in Higher Education* (n 33); Moge et al, *Typing Compared with Handwriting: Letting the Students Choose* (n 34); Chen et al, *Effects of Computer Versus Paper* (n 20); Hunsu, *Issues in*

changes in grade distributions occurred. This suggests that while students felt their performance was improved, any systemic change was not significant. This may mean that the most significant impact on students is on their sense of wellbeing. Further research is needed into the impact of e-exams on individual students. Further research is also necessary into the implication that students may be utilising different thinking processes when writing by hand or typing in a high stakes e-exam. Certainly, the student responses suggested they began to type early into the exam, but as noted before despite increased editing there was not, for most markers, an increase or decrease in quality. This may suggest differences in thinking processes are less critical in a high-stakes exam.

Despite no measured impact on student grades as a result of the e-exam trial, the marker's responses on legibility, ease and speed of marking do suggest a significant reason to move to e-exams. In this area staff provided a range of helpful comments on logistics.

## IX CONCLUSION

The UNSW e-exams trial was a success both from a logistics and student experience perspective. With high 'opt-in' rates in Law (59 per cent in the selected courses in semester two) there is confidence in results showing that 93 per cent of those students who completed an e-exam found it to be a positive experience. Students particularly found the software programs easy to use (keeping in mind students were provided with some training and support) and appreciated being able to use their own computers (96 per cent). For most staff interviewed as well, there was a feeling that e-exams should be part of a future assessment approach.

The results also confirm that while students overwhelmingly use computers in class and to take notes, they remain divided on whether typing or writing feels more natural. Moreover, while students generally type faster than they write, there is a fear that others type even faster and so typing exams may be to their disadvantage. This fear is not unfounded,<sup>77</sup> but similar disadvantages may exist with handwriting speed. These fears may well be natural uncertainty about new modes of assessment. Given the positive reactions of those who went on to take the e-exams, it seems likely that these concerns could dissipate with some experience in low-stakes assessment.

The high take-up rate of the e-exam, which seems significantly higher than in other trials,<sup>78</sup> suggests law students may be a student cohort especially benefitting from e-exams. The open book exam and the perceived need to write as much as possible in the time period suggest faster typing speeds are a significant driver.<sup>79</sup> Any

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*Transitioning to Computer-Based Writing Assessment* (n 23). Cf Way, Davis and Strain-Seymour, *The Validity Case for Assessing Direct Writing by Computer* (n 20); Russell, *The Influence of Computer-Print on Rater Scores* (n 36).

<sup>77</sup> Augustine-Adams, Berrett and Rasband, *Speed Matters* (n 16).

<sup>78</sup> See, eg, Hillier, *E-Exams with Student Owned Devices* (n 2).

<sup>79</sup> Augustine-Adams, Berrett and Rasband, *Speed Matters* (n 16).

disadvantages caused by slower typing speeds might well be alleviated with an imposition of word limits on answers. The student responses also indicated that beyond volume of words they edited their answers more and felt their answers were better structured. They felt less stressed and less likely to run out of time. Their hands were less tired when typing and there was no increase in levels of distraction.

Across the range of questions asked in the post exam survey there was no set of responses that indicated any negative impact of e-exams. For the students who took the e-exams it was overwhelmingly a positive experience. Similar positive responses were made by staff involved in the trial. Legibility of answers was seen by most as an advantage, with its concomitant increase in marking speed and efficiency. The ability to easily distribute scripts and store them on servers were also seen as significant improvements over paper scripts. Interestingly a number of the staff interviewed expressed concerns about the impact of typing on thinking processes. This has been explored to some extent in other contexts<sup>80</sup> but a detailed study on the effect on law examinations may be important. That said, students have long written essays on computer, so the effect is likely to be limited to the impact on processing in a time-limited examination. Largely, markers did not notice significant differences in answer length or quality between the typed and written responses, but did highlight a range of logistical issues that would need to be addressed if e-exams were implemented university-wide. None of these were insuperable.

Findings of the present study are thus largely in line with the extant literature, but overall more positive. As our surveys did not identify individual students, we could not track whether students who were ambivalent about the e-exams nonetheless took them and overcame that ambivalence. However, the 60 per cent take up rate in the second semester does suggest a strong underlying vote in favour of e-exams. Given the positive responses in the survey we could anticipate an even higher take up if we had had another semester in which to trial the software.

At the very least, positive staff and student reactions to the UNSW trial demonstrate that e-exams should be part of a best practice approach to an assessment mix which seeks to maximise student learning opportunities.

Relevantly, a significant number of students perceived that they performed better typing their answer, even if final results showed the marks were similar overall. Such survey responses raise pedagogical questions that are outside the scope of the current paper but indicate the need for further inquiry. If students *think* they are doing better using their computer, does this actually assist with deep learning objectives via engagement, motivation and self-efficacy? Despite no clear evidence to date, can e-exams be set in such a way as to encourage students to cognitively engage in a way that may encourage deep learning via editing and restructuring of responses? Can e-exams assist in mediating student assessment anxiety?

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<sup>80</sup> See, eg, Barrett et al, *Technology in Note Taking and Assessment* (n 9).