

Cite as:

Hillier, M. & Lyon, N. (2018), Student experiences with a bring your own laptop e-Exam system in pre-university college (refereed conference paper). Presented at Open Conference on Computers in Education, 25-28th June, IFIP TC3. Linz, Austria. <http://occe.2018.ocg.at/>

Student experiences with a bring your own laptop e-Exam system in pre-university college

Mathew Hillier^{1[0000-0001-9990-0479]} and Nathaniel Lyon²

¹Monash University, Australia, Mathew.Hillier@monash.edu

²Monash College, Australia, Nathaniel.Lyon@monashcollege.edu.au

Abstract. This study investigated student's perceptions of a bring-your-own (BYO) laptop based e-Exam system used in trials conducted at an Australian Pre-University college in 2016 and 2017. The trials were conducted in two different subjects, in Geography and Globalisation. Data was gathered using pre-post surveys (n = 128) that comprised qualitative comments and Likert items. Student's perceptions were gathered relating to the ease of use of the e-Exam system, technical reliability, suitability of the assessment task to computerisation and the logistical aspects of the exam process. Many of the typists were taking a computerised supervised test for the first time. A divergence of opinions between those that typed and those that hand-wrote regarding student's future use intentions became more prominent following the exam event.

Keywords. e-Exam system, assessment, student perceptions, acceptance.

1 Introduction and Background

In this study we characterise an e-Exam (e-exam) as a “timed, supervised, summative assessment conducted using each candidate’s own computer running a standardised operating system” [1]. We would add that the use of authentic software applications as part of the examination environment is an important element of our approach. As such, we distinguish our approach to computerised exams from 'online assessments' that are limited to the test or quiz functionality of a learning content management system (Moodle, Blackboard) or specialised testing software (TCEExam, QuestionMark Perception, ExamSoft) that may or may not be directly supervised by human invigilators.

This study is part of a wider project [2, 3, 4] investigating authentic approaches to supervised high stakes assessment typically carried out in exam halls and classrooms suited to the Australian higher education context. In this respect our paper takes a departure from other trials we have conducted in that we focus here on e-exam use in a pre-tertiary pathway college context.

In this paper we explore the literature related to e-exams including matters relating to student choice and acceptance of the e-exam approach. Data was collected on the student's impressions of the process as expressed through written comments and selected response items in a pre and post assessment surveys.

2 Literature

Computerised exams have been increasingly gaining attention in the last decade. Whilst one of the first reported uses of computers for assessment was in 1965 [5], little movement away from pen-on-paper exams has occurred in the higher education or school systems around the world. Only recently has attention shifted to modernising the exam room. Examples of efforts underway in higher education and other sectors were reviewed by [6 and 1]. The 'Dublin declaration' developed at the International Federation of Information Processing Technical Committee Three for Education conference sets a future direction for computers in assessment [7] (pp xvii – xviii):

"To see computers used effectively in education, it is necessary to develop fair, reliable and resilient computer-based assessment methods. Assessment methods must go far beyond imitating paper-based assessment, and prioritise the pedagogical affordances of computers over administrative convenience. The use of computers in timed, supervised assessments offers the chance to transform curricula in the light of computational thinking".

In particular the declaration recommends that e-Examinations must be:

"authentic assessment that matches modern workplace practices and many student learning experiences". ([7], p xviii)

We particularly find resonance with the idea of promoting authentic assessment [8] in high stakes exams. One way to enable such assessment is to provide a rich array of software tools of the trade to candidates in the exam room. Doing so opens up the possibility of designing complex constructed assessment tasks to be done under supervised conditions. This enables assessment designers to push into the Modification and Redefinition stages of the SAMR model [9, 10] or to target 'higher order thinking' of Bloom's taxonomy [11] with respect to pedagogical efficacy. Systems such as 'Secure Exam Environment' and the work described in [4] place authentic assessment at the heart of the project. The e-Exam platform [4] used for this study uses a bring-your-own laptop approach and provides the same full operating system and application suite that includes an office suite, multimedia tools and optional discipline specific applications (e.g. maths, CAD, chemistry, accounting). In this instance we used the fully functional word processor as the question presentation and response environment thus providing an authentic tool typically used to produce essays and reports.

The perceptions and attitudes of users with respect to ease of use and usefulness (being fit for purpose) have been found to be important factors in people accepting new computer technology [12, 13], but not the only factors at play [14]. This particularly applies to the students as the people most directly impacted by e-exam systems, although they often do not have a strong voice when it comes to selecting software deployed in education institutions. Therefore it is important to ensure their views are heard if we desire smooth acceptance and operation of a high-stakes e-exam system. A survey of students [15] at the University of Bradford in the UK, following their use of QuestionMark Perception included a range of topics. Other studies

include the use of Examsoft in pharmacy courses in Canada [16] and an institution wide survey [17] capturing student's hopes and fears prior to the trailing of e-Exams at The University of Queensland in Australia. e-Exam trials followed the latter study, exploring the student's experience of the process [18]. These studies on student's perceptions of the e-exam process informed our construction of the survey tools used in this study.

Another characteristic is how each system architect treats the idea of technology reliability. Where an e-Exam solution has a heavy reliance on a network during the exam, the risk of a 'single-point of failure' impacting on a whole cohort of students is increased and so the need to ensure extra redundancy measures is heightened. The study [17] reported that the fear of technology failure is a major barrier to the adoption and intention to use e-Exams by students. A recently publicised case of failure during a national high stakes Medical board e-exam event in Australia [19, 20] highlights the critical need to ensure a robust system and to void 'single point of failure' designs. Earlier online assessment systems tended to stop working the moment the network dropped out. Advances in web technologies now mean that some systems may handle or mitigate network outages of a short duration (e.g. auto save for Moodle quiz) but extended outages will result in an unscheduled end to the session. Only a small number of e-exam systems are able to continue to operate and successfully complete the e-exam session without a network connection. This includes the commercial product 'Examsoft' [21] and the e-Exam platform [2, 4] used in this study. Avoiding system-wide failures means that any technical issues that do occur are likely to be isolated to a single student. Therefore an issue can be managed according to existing exam protocols with respect to individual interruptions, breaks and extra time.

This review of prior work has outlined several areas of concern that will serve as a focus for our evaluation in this study. These are summarised in Table 1.

Table 1: Areas for investigation

Area	Example research questions
Intention and attitude	Were candidates in favour of the e-Exam system? Would they recommend it to others or use it again? Did they have any concerns about undertaking an e-exam? If they typed their exam, was their attitude changed or any concerns lessened following the event?
Ease of use	Were the students able to use the system with relative ease? Did they have any issues related to the e-exam processes?
Technical reliability	Did any technical issues or interruptions arise? If so, did such issues interfere with the exam or result in lost work?

2 Study Context

In Australia, the lead author is conducting a nation-wide project investigating the scalable provision of authentic assessment in the examination room using BYO laptops [2, 4]. The study reported in this paper investigates if prior work carried out in the higher education sector would work successfully in the pre-university context. The study was undertaken at Monash College, Australia within the 'Foundation Year'

[22] program. This program is at the equivalent level as an Australian year 12 high school leaving certificate or the International Baccalaureate. The study was run in conjunction with the second author who is a unit coordinator and teacher in the two units in which trials were conducted. The trials were carried out using in-class supervised written assessments. These took the form of a couple of mini cases that included photos, charts and data tables each with one or several questions requiring a short text or essay style response.

3 Method and Approach

This study examined involved two live trials of the e-Exam system and approach in two separate units at the College involving 128 students. The units selected were Geography (Geo) in semester 1, 2016 and Globalisation (Glo) in semester 2 2017. The process used to run each trial is represented in Table 2 below.

Table 2: e-Exam trial process

Stage	Activities
1. Call for interest.	Students indicate interest in either typing or handwriting their exam and complete research study consent forms.
2. Practice session done two weeks prior to exam.	Preview the exam process and practice following provided instructions for starting up their laptop from an e-Exam USB stick. Students complete the practice questions. Data collected about hardware compatibility via hardware logging, observation of use and student impressions via pre-exam survey. Following the session, data analysis of the surveys was carried out to detect any concerns.
3. Real exam for both typists and hand-writers.	Individual desks were set up with a paper copy of the 'e-Exam quick start guide' and post-exam survey. A power socket was provided for each typist. Hand-writers were given a paper copy of the exam questions and response booklets. These were available to typists upon request. Both typists and hand-writers sat in the same room. <ol style="list-style-type: none"> 1. Students enter the room and were seated at a suitable desk. 2. Typists were given an e-Exam USB stick containing the questions. 3. Students start their computer with a USB stick progressing to the e-Exam desktop. A desktop background image provides a visual check that all have booted from the correct USB. 4. Invigilator announces the start of the exam. Students enter their student ID and name into the starter screen. The system then opens the exam document. Auto-save occurs every two minutes. 5. At the end of the exam, the student saves their work one last time and shuts down the computer. 6. Students return the USB sticks containing their responses. 7. Students complete the post-exam survey before leaving the room.
4. Grading.	In the following week the teacher did the grading. Students were given grades and feedback comments. Surveys results were analysed.

The formative un-graded practice session was run in-class time with all students participating. Students were free to choose typing or handwriting for the real exam.

Selected response survey questions as shown in Tables 3 to 5 were analysed using SPSS v24 using alpha level of .05. Likert data pertaining to student's opinions were treated as non-parametric [23]. Another study [15] did the same when analysing students' perceptions of their experience with an e-Assessment system. Mann & Whitney's U test [24] was used to test the variance between groups (typists v hand-writers) on Likert items. When comparing paired pre-post Likert items, a Wilcoxon Signed Ranks Test [25] was used with the requirement of a normal distribution of differences met. Chi-square was also used to test if experiencing a technical issue impacted in the decision to type the exam.

It is important to note the participants were not randomly assigned to the typing or hand-writing groups so results are only descriptive of this group. As per [15], we take the stance that statistical tests serve as a tool to summarise the body of student's opinions rather than to be representative of an objective truth.

4 Findings

The trials involved 128 pre-tertiary students, 65% were female and 35% were male. We examined the student's opinions regarding their first encounter with the e-Exam system in terms of differences between those that went on to type the exam and those that handwrote the exam using a Mann-Whitney U test. Table 3 displays the results from Likert items (strongly agree 5, neutral 3 and strongly disagree 1) collected on the pre-exam survey (done at the practice session). The strongest difference was for "I would like to use a computer for exams in the future" ($U = 842.5$, $p < .001$). Means and standard deviations are provided in the tables for clarity.

Table 3: Pre-exam survey responses by text production mode

Question	Type			Hand write			MW		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	diff	<i>U</i>	<i>p</i>
Pre survey (Practice run)									
Written instructions were easy to follow	55	4.1	0.7	55	4.0	1.0	0.2	1466	0.759
It was easy to learn the necessary technical steps	55	4.2	0.7	56	3.9	1.1	0.3	1307	0.128
It was easy to start my computer using the e-Exam USB stick	55	4.0	1.0	56	3.7	1.2	0.3	1333	0.194
I feel confident I will be able to do these steps in a real exam	55	3.9	1.0	56	3.3	1.2	0.6	1093	0.006
The software within the e-Exam System was easy to use	54	4.0	0.8	56	3.8	1.0	0.2	1439.5	0.642
I now feel relaxed about using the e-Exam system for my exam	54	3.8	1.0	56	3.3	1.1	0.5	1171.5	0.034
I would like to use a computer for exams in the future	55	4.0	1.0	56	3.0	1.2	1.0	842.5	<.001

Following the exam, typists (52%) were asked to reflect on the e-Exam system itself with regard to suitability, usability and reliability (See Table 4 and Figure 1).

The majority of items received positive agreement, most with mean agreement ratings of 4 or above out of 5. The sentiment within the group was relatively uniform as evidenced by the small standard deviations (Table 4) and boxplots in Figure 1.

Table 4: Post-exam survey responses regarding the e-exam system

Question	<i>n</i>	<i>M</i>	<i>SD</i>
I felt this particular exam suited the use of computers	63	4.2	0.7
I liked the fact I could use my own computer	57	4.5	0.7
I felt the e-exam system was easy to use	63	4.2	0.8
I felt the e-exam system was reliable against technical failures	62	4.0	0.8
I felt the e-exam system was secure against cheating	63	4.2	0.9
I would recommend the e-exam system to others	63	4.0	0.9

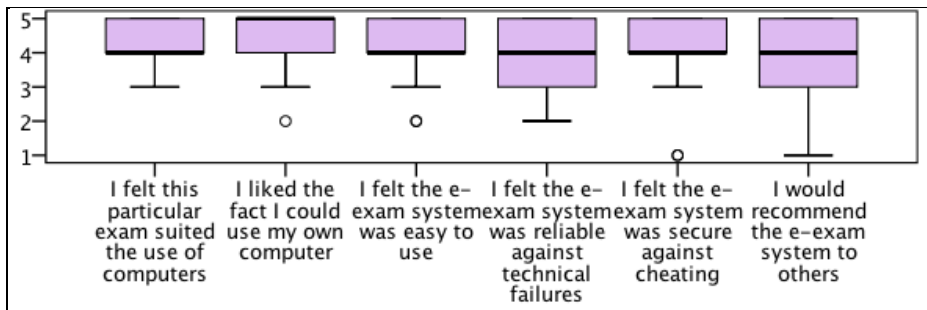


Figure 1: Opinions of the e-exam system

Typists were asked "Did you experience any technical difficulties during this exam?" Responses yes (n=17, 24%) and no (n=53, 76%) were gathered via a comment box and a list covering usability, technology and logistics. It should be noted that all those who typed successfully completed and submitted their work. A comparison of problems encountered in the pre and post sessions is shown in Figure 2. A Chi-square test indicated that there was no statistically significant relationship between encountering a problem in the practice session and electing to type or handwrite the exam ($\chi^2(1) = 0.003, p = 0.956$). This could indicate that the practice session did its job in preventing serious problems from reaching the exam room, or that problems were considered to be minor by those that encountered them.

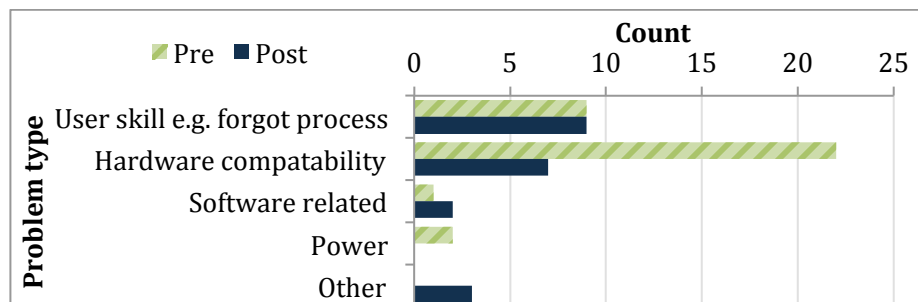


Figure 2: Reported issues

A comparison between typist's and hand-writer's intentions to use a computer for future exams following the exam event (see Table 5) showed a significant Mann-Whitney U test result ($U=160.5, p<.001$).

Table 5: Post-exam survey future intention to use

Question	Type			Hand write			diff	MW	
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>		<i>U</i>	<i>p</i>
I would like to use a computer for exams in the future	61	4.2	0.7	53	2.1	1.0	2.1	160.5	<.001

Finally we examined if student's declared future use intentions may have changed between pre exam and post exam surveys for typists and hand-writers using the question "I would like to use a computer for exams in the future". Those that typed the exam were in slightly stronger agreement following the exam ($n=61, M=4.2, SD=0.7$) than prior ($n=55, M=4.0, SD=1.0$). However the difference was not significant when tested with a Wilcoxon Signed-Ranks test, $Z = -1.763, p = 0.078$. Both pre and post median agreement was 4. Those that handwrote the exam became more negative following the exam to a significant extent ($Z -3.757, p=>.001$), with the median agreement 3 prior and 2 following the exam. For clarity, mean agreement for hand-writers pre was $M=3.0 (SD= 1.2, n= 56)$ and post $M = 2.1 (SD = 1.0, n = 53)$.

5 Discussion

In the practice session most students were able to successfully undertake the steps required for doing the e-exam using their laptop, although some did require assistance. This includes starting up their laptop from the USB stick and using the software (see Table 3). The Chi-square result shows that encountering a problem in the practice session did not impact the decision to type or handwrite. The practice session appeared to resolve most serious problems (see Figure 2) before they reached the exam itself as seen by the reduced number of issues reported between the pre and post sessions. Most problems that remained related to user familiarity with the software or process (i.e. forgetting the boot key, not realising that short-cut keys behaved like 'Windows' rather than Apple OSX) or minor hardware incompatibility (i.e. their laptop touch pad being too sensitive; although a wired mouse would have solved the issue). However the persistence of these issues indicates that further opportunities for practice and increased awareness of the option to bring a wired mouse were needed.

Those that went on to type the exam not surprisingly expressed stronger agreement in being able to undertake the practical steps of the e-exam process but the differences in opinions with hand-writers were not statistically significant. However, the items reflective of confidence "I feel confident I will be able to do these steps in a real exam", "I now feel relaxed about using the e-Exam system for my exam" and future intentions "I would like to use a computer for exams in the future" did show a significant difference between the groups. This gap between their perceptions of process and the their expressed levels of confidence or intentions could be indicative that other matters beyond those surveyed play a role in student's decision making.

Additional findings related to student's preferences with respect to writing styles, behaviours and proficiency, where a link to their selected text production mode was found to be stronger are reported separately [26].

Following the exam event, the results in Table 4 and Figure 1 showed that a large majority of students who typed the exam were satisfied that the assessment task was suited to computerisation, they appreciated being able to use their own computer, and that the system was easy to use, reliable and secure against cheating. Most also agreed that they would recommend the e-exam system to others. This was consistent with prior work in the university sector [18].

A moderate, but not statistically significant divergence of opinion between hand-writers and typists emerged across most items in the pre-exam survey. Overall it would appear that people tended to reaffirm their choice to type or handwrite in terms of their future intentions following the exam. This divergence can be seen when looking at future intentions stated prior to the exam with difference in agreement of 1 widening to 2.1 in the post-exam survey. It would appear that student's opinions 'hardened' once the real exam was over in that typists became more positive about their future intentions to type an exam and hand-writers more negative.

Finally the decision to allow students to self-select typing or handwriting served to lessen the stress for students but it also limited the degree of task sophistication that was possible (i.e. keeping to the lower levels of SAMR). However this can only ever be a temporary state of affairs if we want to progress up the SAMR ladder to include re-designed, higher order assessment tasks that assume sophisticated tools will be available. To take advantage of the affordances of modern software means all students must ultimately use a computer in the exam. Our work on e-Exams is also about providing a strategy [4] for moving from paper-equivalent e-exams to sophisticated post-paper e-exams where all must type. This phased strategy, along with associated support, will be important in helping staff and students to make this transition.

6 Conclusion

We have successfully completed two trials of e-exams centred on the use of a fully featured word processor in two different units within a pre-university context. From this point of view we broadly achieved what we set out to do in that the e-Exam technology and BYO laptop centric processes were shown to have worked in this context. We have also seen that most students were satisfied with the approach to doing e-Exams within a classroom setting. The strength of opinions regarding the process and technology between those that typed the exam and those that elected to hand-write were not significantly different, although there was a general trend towards typists holding more positive opinions. Their levels of confidence did differ significantly and this likely played a role in their choices. The results are not at all surprising given the self-selecting nature of the groups who went on to type the exam. However it does reinforce the need to ensure adequate support is available to students who are not all equally prepared for the computerisation of high-stakes exams.

Future work will involve comparisons with similarly run exams in the university system and within different discipline contexts. The next phase will be to trial e-Exams using post-paper, higher-order tasks where all members of the class will type.

Further technical work on the e-Exam system is progressing that will see integration with the Moodle quiz tool alongside the ability to use authentic software tools in a manner that is robust against network outages.

Acknowledgments. The authors would like to thank the Australian Government Office of Learning and Teaching for financial support and the students at Monash College for being willing to 'give it a go'.

References

1. Fluck, A., & Hillier, M. (2017). eExams: Strength in Diversity. In A. Tatnall & M. Webb (Eds.), *Tomorrow's Learning: Involving Everyone*. Learning with and about Technologies and Computing (Vol. 515, pp. 409–417). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-74310-3_42
2. TEAA (2015) Transforming exams across Australia, Australian Government Office for Learning and Teaching, Grant, ID15-4747 <http://transformingexams.com>
3. Fluck, A., & Hillier, M. (2016). Innovative assessment with eExams. In Australian Council for Computers in Education Conference. Brisbane, Australia. <http://conference.acce.edu.au/index.php/acce/acce2016/paper/view/34/27>
4. Hillier, M. & Fluck, A. (2017). Transforming Exams - How IT works for BYOD e-Exams. Australasian Society for Computers in Learning in Tertiary Education conference (pp. 100-105). Toowoomba, 4-6 December. <http://2017conference.ascilite.org/wp-content/uploads/2017/11/Concise-HILLIER.pdf>
5. Swets, J. A. & Feurzeig, W. (1965). Computer-Aided Instruction. *Science*, 150(3696), 572–576. <http://doi.org/10.1126/science.150.3696.572>
6. Fluck, A., Pálsson, H., Coleman, M., Hillier, M., Schneider, D., Frankl, G., & Uolia, K. (2017). eExam symposium: design decisions and implementation experience. Presented at the IFIP World Conference on Computers in Education, 3-6 July, Dublin, Ireland. http://transformingexams.com/files/Fluck_etal_2017.pdf
7. Tatnall, A., & Webb, M. (eds) (2017). *Tomorrow's Learning: Involving Everyone*. Learning with and about Technologies and Computing: 11th IFIP TC 3 World Conference on Computers in Education, Dublin, Ireland, 3-6 July, Revised Selected Papers. Springer
8. Crisp, G. (2009). Towards Authentic e-Assessment Tasks (Vol. 2009, pp. 1585–1590). Presented at the EdMedia: World Conference on Educational Media and Technology, Honolulu, HI, USA. Retrieved from <http://www.editlib.org/p/31689/>
9. Puentedura, R. R. (2003). A Matrix Model for Designing and Assessing Network-Enhanced Courses, Hippasus. Retrieved 26 February, 2018, <http://hippasus.com/resources/matrixmodel/index.html>
10. Puentedura, R. R. (2006). Transformation, Technology, and Education, Hippasus. Retrieved February 26, 2018, from <http://hippasus.com/resources/tte/>
11. Krathwohl, D. R. (2002). A Revision of Bloom's Taxonomy: An Overview. *Theory Into Practice*, 41(4), 212–218. https://doi.org/10.1207/s15430421tip4104_2
12. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, 13 (3): 319–340, doi:10.2307/249008
13. Farzin, S. (2017). Attitude of Students Towards E-Examination System: an Application of E-Learning. *Science Journal of Education*, 4(6), 222. DOI: 10.11648/j.sjedu.20160406.19
14. Lunceford, Brett. (2009). Reconsidering Technology Adoption and Resistance: Observations of a Semi-Luddite. *Explorations in Media Ecology*, 8(1), 29-47
15. Dermo, J. (2009) E-assessment and the student learning experience: A survey of student perceptions of e-assessment. *British Journal of Educational Technology*, 40, 203–214

16. Bussi eres, J., M etras, M. & Leclerc, G. (2012) Use of Moodle, ExamSoft, and Twitter in a First-Year Pharmacy Course. *American Journal of Pharmaceutical Education* 76(5) Atl 94
17. Hillier, M. (2014) "The Very Idea of e-Exams: Student (Pre)conceptions", 31st Australasian Society for Computers in Learning in Tertiary Education, 24-26 November, Dunedin. <http://ascilite.org/conferences/dunedin2014/files/fullpapers/91-Hillier.pdf>
18. Hillier, M. (2015) "e-Exams with student owned devices: Student voices" Proceedings of the International Mobile Learning Festival: Mobile Learning, MOOCs and 21st Century learning, 22-23 May, Hong Kong SAR China
http://transformingexams.com/files/Hillier_IMLF2015_full_paper_formatting_fixed.pdf
19. Aubusson, K., & Noyes, J. (2018, February 20). Burnt-out doctors deeply distressed by botched high-stakes exam. *The Sydney Morning Herald*.
<https://www.smh.com.au/national/nsw/burnt-out-doctors-deeply-distressed-by-botched-high-stakes-exam-20180220-p4z117.html>
20. Aubusson, J., & Noyes, K. (2018, February 21). Company behind botched medical exam has track record of failure. *The Sydney Morning Herald*. Retrieved from
<https://www.smh.com.au/national/company-behind-botched-medical-exam-has-track-record-of-failure-20180221-p4z15a.html>
21. ExamSoft, Examsoft Worldwide Inc, <http://www.examssoft.com>
22. Foundation Year (2016), Monash College, Australia,
<https://web.archive.org/web/20160402024339/http://www.monashcollege.edu.au:80/courses/foundation-year>
23. Jamieson, S. (2004). Likert scales: how to (ab)use them. *Medical Education*, 38(12), 1217–1218. <https://doi.org/10.1111/j.1365-2929.2004.02012.x>
24. Mann, H. B., & Whitney, D. R. (1947). On a Test of Whether one of Two Random Variables is Stochastically Larger than the Other. *The Annals of Mathematical Statistics*, 18(1), 50–60. <https://doi.org/10.1214/aoms/1177730491>
25. Wilcoxon, F. (1945). Individual comparisons by ranking methods. *Biometrics Bulletin*, 1(6): 80–83. doi:10.2307/3001968
26. Hillier, M., & Lyon, N. (2018) Writing e-Exams in pre-university college, Same volume.