Online examinations: Factors that impact student experience and perceptions of academic performance

Michael Henderson
Monash University, Australia

Rebecca Awdry
Deakin University, Australia

Jennifer Chung
Deakin University, Australia

Mike Bryant
Charles Sturt University, Australia

Sweta Vijaykumar Patel
Royal Melbourne Institute of Technology, Australia

Alice Shihua Yu
Monash University, Australia

Matthew Mundy
Torrens University, Australia

Kris Ryan
The University of Queensland, Australia

Cliff Ashford
Monash University, Australia

Online examinations are an increasingly common feature of higher education. Research in this area often focuses on academic integrity without exploring student experience in online examinations more broadly. With increasing use of online examinations and associated security measures, there is a plausible risk that the platform, examination conditions and measures to achieve assessment security may have a negative impact on student experience, well-being and performance. This paper reports on a large-scale survey conducted in 2021 and 2022 at a large metropolitan university in Australia. Analysis of 13,751 completed surveys revealed that the majority of students perceived their overall online exam experience positively. However, a thematic analysis of 5,213 optional open-ended responses provided a more detailed understanding of the range of positive and negative influencing factors and their consequences. Many of the issues negatively impacting student experience were related to the assessment design, rather than the assessment platform or exam security. The findings also revealed implications relating to platform functionality, personal technology and exam conditions, including location of exam, and preparation and support.

Implications for practice or policy:

- Academics need to consider the quality and appropriateness of assessment design, as these affect the extent to which students experience online exams positively and are largely independent of the exam and security systems.
- Institutions can reduce the wide range of negative impacts through improved communication and in-exam support.

- System developers can iteratively ameliorate negative impacts through investigating student experience and involvement of students in the co-design of assessment platforms.

Keywords: online examinations, student experience, assessment security, digital exams, proctoring, thematic analysis

Introduction

Online examinations have become more common since the global pandemic in 2020 in which institutions around the world had to rapidly shift from face-to-face and paper-based assessments with online and remote examinations, particularly for large numbers of students in higher education. Online examinations require students to complete an examination via a computer using an active Internet connection. They may be conducted on campus or off campus and may involve different kinds of security measures including remote proctoring. Although there has been considerable interest in online examinations in relation to topics such as design, feedback and student integrity, less attention has been paid to the overall impact of such examination environments on student comfort, stress and performance (Butler-Henderson & Crawford, 2020; Osabutey et al., 2022).

Examinations are often a stressful experience for many students. The introduction of new platforms, processes, technology requirements and security measures could be an opportunity to explore how we might alleviate stress and positively impact student experience. However, it is perhaps more plausible that the additional layers of complexity, especially those related to security, are more likely to exacerbate negative experiences. Indeed, some researchers have already noted students' concerns about infringement of privacy, impact on equity, the cognitive effects of being surveilled and a generally heightened sense of discomfort and stress in online examinations (Eaton & Turner, 2020; Elsalem et al., 2021; Selwyn et al., 2021).

In light of the increasing use of online examinations, this paper sets out to identify the factors impacting on student experience, in particular, their well-being and perceived academic performance. Such findings may provide useful insights for institutions planning to use online examinations.

Online examinations and student experience

In conjunction with the increased use of online examinations, and in response to threats to integrity, there has been a growth in the development of assessment security measures, including online proctoring. Assessment security often includes multiple measures, for example, mechanisms to verify the user sitting the exam (such as via photo ID); detection of authorised materials (through browser control and head pose monitoring); and detection of unauthorised help (through use of webcams and microphones to monitor the examination environment). These proctoring tools and platforms have been shown to support academic integrity; however, scholars have questioned the manner of surveillance and the implications for student experience as well as privacy (Coghlan et al., 2021; Selwyn et al., 2021).

Online examinations are not only continuing to be more common in higher education but are often associated with high stakes end-of-semester assessment. The literature (described below) reveals that online exams can both negatively and positively impact student experience and outcomes.

Negative experiences

Research describes a variety of negative experiences arising from online exam conditions, security and platforms. The technology requirements alone have been criticised for potentially increasing inequities due to differing access to high-speed Internet and reliable technology (e.g., computers, laptops and other hardware) (Selwyn et al., 2021). Studies have noted that more stress and anxiety are reported by students under certain exam conditions, such as closed-book examinations compared with open-book (Gharib et

al., 2012; Şenel & Şenel, 2021) and those experiencing security measures such as remote proctoring tools (Eaton & Turner, 2020; Elsalem et al., 2020). This in turn has been shown to influence their academic performance (Dendir & Maxwell, 2020). However, not all research supports this negative stance, such as some scholars who reported students being less anxious in online examinations compared to those conducted in-person (Harley et al., 2021; Jaap et al., 2021). In addition, Butler-Henderson and Crawford (2020) observed students' anxiety decreased once they became familiar with the online examination platform, whilst Blondeel et al. (2024) reported reduced test anxiety and increased self-efficacy for those students who had used a formative online test environment in preparation for the final examinations. While this is promising, it does highlight a negative consequence as noted by other research, that students need to invest extra time into their preparation in order to become familiar with the examination platforms (Slack & Priestley, 2022).

The issue of time has also been raised in relation to students being concerned about Internet or technology failures impacting upon their completion of their examination (Butler-Henderson & Crawford, 2020; Jaap et al., 2021). A study by Milone et al. (2017) reported that 20% of students had said that their supervisor was late to their proctored online examination, leaving them waiting to start. Dikmen (2023) found that technological anxiety was described by students separately to other forms of anxiety in online exams, manifested through physiological or psychological indicators. Similarly, Marano et al. (2024) found that many studies reported students' negative experience in online exams due to various technological issues or concerns, such as connection problems, software issues, poor technology support and a lack of the required technologies). Online platforms have also been viewed negatively by students reporting being slow typers or worrying about disturbances in their home environments whilst completing examinations (Jaap et al., 2021), which added to their anxiety (Butler-Henderson & Crawford, 2020).

Positive experiences

In recent studies, students have expressed satisfaction with online examinations, particularly noting the advantages of remote and open-book formats. Butler-Henderson and Crawford (2020) identified several benefits in their literature review, including speed in typing, ability to edit responses, flexibility in completion (in open-book assessments) and greater authenticity in assessment experiences in different types of examinations (practical or open-book, for example). Indeed, open-book exams, in comparison to their closed-book counterparts, have been favoured by students for facilitating higher performance levels, reducing student anxiety and offering learning experiences more closely resembling study and workplace practices (Gharib et al., 2012; Green et al., 2016; Şenel & Şenel, 2021). Osabutey et al. (2022) found that students not only reported higher perceived performance in their online exams but their actual academic performance improved in online exams compared to like paper-based exams.

The comfort of familiar environments, such as the home, has also been a significant factor in student preference for online exams (Jaap et al., 2021; Marano et al., 2024). Harley et al. (2021) found that students reported decreased anxiety in their online examinations due to their environment being less negatively emotive in comparison with traditional examinations in which large numbers of students are completing exams in the same space. Moreover, not needing to travel to exam centres, thereby saving time and reducing logistical stress, has been highlighted as a notable advantage (Tam, 2022).

The flexibility offered by online, open-book exams in scheduling and completing assessments allows students to better manage their time and reduce pressure, particularly in the face of potential technology issues (Şenel & Şenel, 2021; Slack & Priestley, 2022). This flexibility, alongside the more inclusive environment for students with disabilities or access issues, underscores the broader appeal of online exams (Slack & Priestley, 2022).

The above studies have largely focused on specific exam conditions (such as open-book) or issues such as academic integrity. There is a need for a large-scale and broader exploration of student experience of online examinations, particularly in terms of the factors leading to the positive and negative experiences, as well as the impact of those experiences.

Method

This study used a cross-sectional survey to explore students' experiences, attitudes and perceptions of the online examination, including the examination conditions, platform and security. This method supports the exploration of hypotheses around interindividual differences, such as demographic groups and experiential conditions (Robinson et al., 2005; Spector, 2019). In the conduct of this study, we recognise there are a number of limitations, such as the ability to make a claim of causality (Robinson et al., 2005); however, this study is exploratory in nature, with the goal of describing patterns in the self-reported student experiences between groups.

The study was conducted at Monash University, which has approximately 85,000 students with most of those students enrolled at the Victorian campuses in and around Melbourne, Australia. The survey was released during the formal examination period at the end of Semester 1 2021 and Semester 1 2022. The survey was open for 3.5 weeks, from the first examination to the week after the final examination. The survey was anonymous and no identifiable information was collected. Monash University Human Research Ethics Committee approval (#28807) was granted before conducting this study.

Survey

The 57-question (121-item) survey took approximately 20–25 minutes to complete. The construction of the survey, including validity and reliability testing, is reported elsewhere (Henderson et al., 2023). This paper draws on a selection of items that provide an overview of student experience of the online platform, security and conditions. However, the main focus of this paper is on the final open-ended question(s). In 2021, students were invited to provide "any other comment" in relation to their exam experience, while in 2022, students were asked two questions: what positively and negatively impacted on their exam experience.

Participants

Participation in this study was voluntary and anonymous. All students who sat an examination during the examination periods were invited. Table 1 details the participant response rate.

Table 1
Participant response rate

	Sem. 1 2021	**Sem. 1 2022**	**Total**
Students sitting exams	39,308	41,169	80,477
Exams being offered in the exam period (3 weeks)	577	611	1,188
Sittings of exams by students	85,332	88,521	173,853
Fully completed surveys[a]	7,839	5,912	13,751
Response rate (completed surveys/total students sitting exams)	19.9%	14.4%	17.1%
Students who completed the optional open-ended question(s)	2,300	2,913	5,213

[a] It is possible students may have completed the survey more than once.

There was a variation in the number of respondents across disciplines but this was in proportional alignment with the fact that some faculties had more students sitting examinations than others. More responses were received from students enrolled in science, technology, engineering and mathematics disciplines (37.4%); business and commerce (27.6%); medicine, nursing and health sciences (including psychology) (18.8%) than the other disciplines. A total of 83.2% were enrolled in undergraduate courses, which is almost 10% more than the university average, but which is consistent with the fact that more exams are used in undergraduate studies. A total of 61.4% of respondents were domestic students, which is similar to the university average when taken into account that the majority of exams were in undergraduate classes. In terms of exam conditions, 43.7% had some form of open-book exam and 79.1%

had online proctoring (monitored through their computer's webcam, microphone and screen recording). Further demographic and exam condition details can be found at Appendix A (https://doi.org/10.26180/25366312).

The main difference between the 2021 and 2022 time periods was that, in 2021, almost all students sat their examination online at their home or other off campus location due to COVID-19 lockdown restrictions. This was reflected in the survey with 97.4% of the responses completed by students who sat their exam off campus, such as at home. In contrast, in 2022, approximately half of the exams were set on campus, resulting in 40.5% of the survey responses from students who sat their examination off campus. Regardless of location, all examinations were online, that is, each student used an Internet-enabled computer to connect to the exam platform and security measures.

Methods of analysis

The Likert scale items are reported using descriptive statistics, with the intent of providing a general overview of the student experience of the exam platform and security. However, the main focus of the paper is on the open-ended responses, which were analysed using an adaptation of thematic analysis (Braun & Clarke, 2006).

Out of the 13,751 fully completed surveys, 38% (n = 5213) included a response to the optional open-ended item(s). A total of 5% (n = 730) were not usable (e.g., single word, unclear or unrelated to their exam experience). This resulted in 33% (n = 4,483) of the surveys containing usable responses. This totalled 231,683 words with an average of 52 words in length per response (the longest entry length was 972 words).

The initial 33 codes were developed by four of the authors, using a grounded approach across three iterations. The coding structure was conceptualised as factor-valence-impact in order to better explore the interaction of factors and impact.

Three of the authors and two research assistants coded all 5,213 responses. Inter-coder reliability checks were undertaken (at 50, 300, 500) for both data sets. One of the authors then reviewed all of the coding as a final reliability check and as a holistic sense-making exercise to see if broader themes or issues arose. Through the process of iterative development, using a constant comparative method, the initial 33 codes were refined and expanded, resulting in 46 final codes. These included 35 factors (e.g., exam conditions) grouped into four themes and 18 sub-themes, two valence codes (e.g., positive), eight impact codes (e.g., academic performance) and a final code for unusable responses. The full coding structure and descriptions can be found in Appendix B (https://doi.org/10.26180/25366312).

Semantic coding (Braun & Clarke, 2006) was utilised in order to describe the explicit or surface meanings of the data. Such an approach was considered to be most appropriate given the broad nature of the comments and the recognised complications of coding latent meanings from short open-ended survey responses (LaDonna et al., 2018).

Results

The quantitative data revealed that the majority of students reported an overall positive experience of the exam system and security (see Table 2). Approximately two thirds of the students reported the exam system and security to be easy to use and half of the students reported the exam system to be helpful. This is perhaps explained by the fact that the exam system was developed by the university in collaboration with educators and students and included features such as bookmarking questions so that the student can quickly return to them. In relation to the security, the university had also developed its own software to enable remote proctoring as well as functions for students to interact with their proctors if they needed help. Approximately 60% of the students agreed that the security measures were

reasonable and appropriate. This item aimed to gauge students' degree of acceptance of the security measures, which included remote proctoring.

Table 2
Responses to survey items

Question		Year	Negative (1–2)	Neutral (3)	Positive (4–5)	*M*	*SD*
Overall, I felt the computer-based exam **system and functionality** was	easy to use [a]	2021	13.8%	20.9%	65.3%	3.74	1.06
		2022	14.4%	19.0%	66.6%	3.75	1.10
	Helpful [a]	2021	17.1%	29.4%	53.5%	3.51	1.09
		2022	20.0%	26.3%	53.7%	3.48	1.14
Overall, I felt the computer-based exam **security** (check-in process, lockdown browser, invigilation, etc.)	easy to use [a]	2021	11.0%	23.2%	65.8%	3.81	1.05
		2022	11.6%	21.2%	67.1%	3.81	1.07
	reasonable and appropriate [a]	2021	12.0%	26.9%	61.1%	3.72	1.08
		2022	17.6%	23.5%	58.9%	3.60	1.18
Overall, the experience of the computer-based exam system and security was [b]		2021	13.9%	26.5%	59.6%	3.64	1.05
		2022	18.1%	25.4%	56.5%	3.54	1.13
How was your **academic performance** impacted by the computer-based exam system and security? [b]		2021	23.1%	42.4%	34.5%	3.17	1.03
		2022	19.0%	40.8%	40.1%	3.32	1.06

[a] 1 = *not at all*, 5 = *extremely*. [b] 1 = *strongly negative*, 5 = *strongly positive*.

Across the items, there was a trend of a small increase in negative experience between 2021 and 2022. The factors leading to these negative experiences (explored further below) are partially explained by the shift back to campus for a large proportion of students, which was accompanied by an increase in stress, particularly in relation to additional layers of complexity relating to exam conditions and technology.

Students were asked if they felt the exam system and security had an impact on their academic performance. We assumed that students would not report a positive impact since the technology ultimately provided an additional layer of mediation in the students' responses to the exam questions. However, over a third of the students felt the system and security had a positive impact on their academic performance. Qualitative data suggests that students appreciated the functionality of the system (such as flagging items that they skipped) but also appreciated the convenience of sitting exams at home, which was afforded by the remote proctoring and other security measures. Indeed, across all items reported in Table 2, analysis of the Semester 1 2022 data reveals statistically significant differences between exam location. Students who sat exams on campus were more likely to report a more negative experience than students who sat their exam off campus (for statistical analysis, see Appendix C, https://doi.org/10.26180/25366312).

Overall, the quantitative data reveals that the online exam experience was positive for most students. When comparing across time points, there was an increase in negative experiences linked with the shift back to sitting exams on campus. The qualitative analysis in the next section helps to further reveal the issues which students felt impacted on their well-being and performance.

Impact on student online exam experience

The students' comments were analysed to reveal which factors had a positive or negative impact on their experience. In total, there were 8,562 comments referring to a factor and valence, with 57.7% (*n* = 4,943) also indicating the perceived impact – or consequence – of the experience (e.g., increased stress). With regards to valence, 70.7% (*n* = 6,054) were negative comments and 29.3% (*n* = 2,508) were positive comments.

Table 3 reports the perceived impact of the online exam experience. Almost a quarter of the comments (22.3%) indicated that the exam experience had a negative impact on students' psychological states, such as increased stress, anxiety and confusion. A further 4.6% of the comments reported a negative impact on academic performance and 7.1% on reduced productivity (e.g., wasting time due to technology issues).

Table 3
Student reported impact, by valence

Impact	Description	Year	Negative	Positive	Total
Stress/Comfort (psychological)	Comments that reveal impact on psychological states: stress, comfort, anxiety, concern, worry, confidence, confusion, etc.	2021	975 (38.1%)	184 (7.2%)	1,159 (45.3%)
		2022	932 (15.5%)	345 (5.7%)	1,277 (21.3%)
		Total	1,907 (22.3%)	529 (6.2%)	2,436 (28.5%)
Stress/Comfort (physical/ ergonomic)	Comments that reveal the student was experiencing physical or ergonomic stress or dis/comfort.	2021	11 (0.4%)	1 (0.1%)	12 (0.5%)
		2022	128 (2.1%)	126 (2.1%)	254 (4.2%)
		Total	139 (1.6%)	127 (1.5%)	266 (3.1%)
Academic performance	Comments that reveal an impact on academic performance: grades, getting answers correct, answering all the questions.	2021	219 (8.6%)	16 (0.6%)	235 (9.2%)
		2022	173 (2.9%)	117 (1.9%)	290 (4.8%)
		Total	392 (4.6%)	133 (1.6%)	525 (6.1%)
Productivity	Comments about speed, being able to achieve things efficiently, "wastes time", etc. (but do not explicitly refer to academic performance or other)	2021	316 (12.4%)	7 (0.3%)	323 (12.6%)
		2022	291 (4.8%)	93 (1.5%)	384 (6.4%)
		Total	607 (7.1%)	100 (1.2%)	707 (8.3%)
Academic integrity	Comments related to something impacting on academic integrity, such as opportunity to cheat, temptation to cheat, etc.	2021	71 (2.8%)	27 (1.1%)	98 (3.8%)
		2022	75 (1.2%)	39 (0.6%)	114 (1.9%)
		Total	146 (1.7%)	66 (0.8%)	212 (2.5%)
Assessment reliability	Comments about something impacting on the validity or reliability of the exam itself. E.g., comments made by student that multiple-choice questions do not effectively measure learning.	2021	40 (1.6%)	5 (0.2%)	45 (1.8%)
		2022	37 (0.6%)	19 (0.3%)	56 (0.9%)
		Total	77 (0.9%)	24 (0.3%)	101 (1.2%)
Distraction	Comments about distraction during the exam, but without any clearer details	2021	57 (2.2%)	12 (0.5%)	69 (2.7%)
		2022	497 (8.3%)	130 (2.2%)	627 (10.4%)
		Total	554 (6.5%)	142 (1.7%)	696 (8.1%)

	about the consequences of the distraction.				
Not stated or unclear	No explicit/clear statement of what was impacted. E.g., "exam at home are good".	2021	534 (20.9%)	81 (3.2%)	615 (24.1%)
		2022	1,698 (28.3%)	1,306 (21.7%)	3,004 (50%)
		Total	2,232 (26.1%)	1,387 (16.2%)	3,619 (42.3%)
Total		2021	2,223 (87.0%)	333 (13.0%)	2,556 (100.0%)
		2022	3,831 (63.8%)	2,175 (36.2%)	6,006 (100.0%)
		Total	6,054 (70.7%)	2,508 (29.3%)	8,562 (100.0%)

Note. 2021 *n* = 2,556; 2022 *n* = 6006; Total *N* = 8,562. Data is percentage of total comments for the year or total.

When comparing across years, there are some noticeable differences in the frequency of impacts. The most notable difference is the reduced frequency of reported stress (from 38.1% to 15.5%). The full data breakdown reveals that the higher level of reported stress in 2021 was influenced by greater concerns around exam platform functionality (e.g., cannot see all of the question at a glance), authentication problems (e.g., the system to take images of one's room did not work as expected), invigilator response time and confusion resulting from central communications (Appendix D, https://doi.org/10.26180/25366312). This is explained by the fact that 2021 was the first year in which the university mandated all exams to be fully online. In 2022, the platform, authentication systems, invigilation technologies and supports, including central communications, had been significantly improved.

Another impact that increased across the years was that of distraction (57 comments in 2021 to 497 comments in 2022). This code relates to comments in which students identified that a factor caused them to be more or less distracted. This increased distraction was being reported by students who were sitting their exam on campus. They reported the distraction of other students, invigilators or the room itself (e.g., cold). Interestingly, in 2022, there was also an increase in positive comments about being less distracted (from 12 comments in 2021 to 130 comments in 2022). The vast number of these comments were from students who were sitting their exam off campus and who were reflecting that they felt less distracted due to the quieter and more controlled environment of their off-campus setting.

Factors that impacted on student online exam experience

The analysis identified 35 factors that were reported by students to have caused negative or positive experiences of the online examination. These factors were organised into four themes and 18 sub-themes. Table 4 reports on the four themes and valence (positive or negative). The full breakdown of all 35 factors, themes and sub-themes, along with the associated valence and impact, can be found in Appendix D (https://doi.org/10.26180/25366312).

Table 4
Themes influencing experience, by valence

Factor themes	Explanation	Year	Negative	Positive	Total
Assessment design	This theme relates to issues arising from the design of the assessment. Arguably, these decisions are independent of the technology and reside primarily with the academic. This includes decisions around the length of the examination, the complexity of the questions, and the conditions such as whether the exam was open or closed.	2021	704 (27.5%)	122 (4.8%)	826 (32.3%)
		2022	685 (11.4%)	309 (5.1%)	994 (16.6%)
		Total	1389 (16.2%)	431 (5.0%)	1820 (21.3%)
Technology	This theme relates to positive and negative issues attributable to digital technologies, including: the exam platform; security systems such as invigilation and authentication processes; and personal technologies.	2021	1097 (42.9%)	71 (2.8%)	1168 (45.7%)
		2022	1238 (20.6%)	439 (7.3%)	1677 (27.9%)
		Total	2335 (27.3%)	510 (6.0%)	2845 (33.2%)
Environment	This theme relates to the issues arising from the exam environment which includes two sub-themes: comments about the on or off campus location of the exam; and comments about the implications arising from the exam room, including other students in the room.	2021	84 (3.3%)	84 (3.3%)	168 (6.6%)
		2022	1485 (24.7%)	824 (13.7%)	2309 (38.4%)
		Total	1569 (18.3%)	908 (10.6%)	2477 (28.9%)
Preparation and support	This theme relates to the issues arising from preparation prior to the exam, and support during the exam. Preparation sub-themes include the instructions provided to students by the central university communications team as well as their teaching teams. Support sub-themes include the interactions with the invigilators, technology helpdesk and teaching staff during the exam.	2021	338 (13.2%)	56 (2.2%)	394 (15.4%)
		2022	423 (7.0%)	603 (10.0%)	1026 (17.1%)
		Total	761 (8.9%)	659 (7.7%)	1420 (16.6%)
Total		2021	2223 (87.0%)	333 (13.0%)	2556 (100%)
		2022	3831 (63.8%)	2175 (36.2%)	6006 (100%)
		Total	6054 (70.7%)	2508 (29.3%)	8562 (100%)

Note. 2021 *n* = 2556; 2022 *n* = 6006; Total *N* = 8,562.

Assessment design

Assessment design was a key theme and refers to the decisions, primarily made by the academics, about the content and conditions of the assessment. Notably 32.3% of the comments in 2021 were related to assessment design issues, compared with 16.6% in 2022. Within this theme, the most prominent sub-themes were that of exam conditions and question design (for full breakdown, see Appendix D, https://doi.org/10.26180/25366312).

The most frequent comments within assessment design related to the sub-theme of examination conditions and, in particular, the issue of time constraints. In total, 290 comments pointed out that there

were too many questions to complete in the allotted time. Some students went on to explain that they felt these time constraints were inauthentic and a poor design to measure learning, for example:

> Time pressure to get an examination done quickly just creates unnecessary stress and I don't think has much real-world relevance. I have been in industry for 15 years and just can't see how time-based examinations will remain relevant in the future.

Students repeatedly noted that they felt time restrictions impacted their ability to think or respond effectively and thereby not accurately demonstrate what they know or can do.

In addition to issues of time and volume of questions, a large number of students (*n* = 320) commented negatively about the question design. Arguably, it may be unsurprising that a proportion of these refer to complaints around the level of difficulty. However, many of the comments spoke about the inappropriate type of question (e.g., multiple choices), poor expression, structure or overall presentation of the question. For example, a number of students commented on the issue of dealing with overly long questions and related tasks on a single screen, such as, "I had a case which 3 questions referred to … I had to go back and forth between the case and the exam tab which wasn't ideal".

The proportion of these negative comments about exam conditions and question design more broadly decreased over the 2 years, possibly reflecting improved design by academics as they became more proficient and possibly increased student comfort or acceptance of the new format.

Technology

This theme accounts for almost a third (33.2%) of all comments. The theme relates to issues or concerns around the digital systems, including the exam platform, security systems such as remote proctoring, authentication procedures, Internet connectivity and personal technologies (for full breakdown, see Appendix D, https://doi.org/10.26180/25366312).

Although the quantitative results revealed that a majority of students felt positive about the exam platform and security systems, the qualitative data provides insight on those areas still causing problems or where improvements could be made. Despite a startling number of negative comments (*n* = 2,335), there were also a considerable number of positive comments (*n* = 510).

The largest number of comments were coded against the sub-theme of examination system, which included (a) issues of functionality, where a feature of the software was not working or could work better and (b) issues arising from input difficulties such as creating formulas or uploading handwritten notes. Most of these comments were in relation to impacts on psychological well-being (stress or comfort) and productivity (efficiency).

Student experience in the platform varied between disciplines. Disciplines requiring more technical or complex content, such as computer science and engineering, were more likely to report frustration with inputting formula, navigating tables and uploading handwritten notes. Students, such as those in law, also reported frustration with lengthy and multi-part instructions and scenarios which could not be seen easily on the screen at a glance or required a lot of moving back and forth.

Although most comments had a negative valence, they were often framed in terms of how the system could be improved. For example, this student commented on the timer function: "One thing that would really help is that if you could put the timer in the corner of the screen ... when the countdown is going in the middle of screen it's very distracting and adds significant stress to the situation". Although a visible timer in the examination platform was designed as way to help students keep track of time, some students experienced it as a distraction, which added to their stress. This highlights the potential value of ongoing iterative development in partnership with students.

In the context of this project, the exam platform was developed in-house, and as such, there was a keen interest in using student experience to improve the system. This appeared to be a successful strategy. In 2021, students commented on a number of problems or limited functions with regards to uploading handwritten notes, inputting formula, text editing such as copy/paste, and note-taking. In 2022, there was a decrease in these specific complaints and a notable increase in positive comments indicating students valued these improvements to the system (a more detailed list of key system functions that were seen to be challenging or desirable can be found in Appendix E, https://doi.org/10.26180/25366312).

In addition to exam platform functionality, students also noted the negative impact of the additional steps created by the technology-based invigilation (e.g., remote proctoring) and authentication (e.g., verifying identify, taking photos of room). A number of students also indicated concerns about privacy. Almost all students who discussed check-in processes remarked on it causing psychological stress, and many felt that it was a violation of their privacy. Similarly, students also referred to anxiety arising from camera surveillance: "being watched is intimidating. [I'm] scared that actions that are normal would be interpreted incorrectly".

The sub-theme of personal technology was also prominent in the comments. Indeed, it was the only sub-theme to increase in volume of comments from 2021 to 2022. In 2021, comments included concerns around unreliable web camera and microphone, but most of the comments focused on issues of Internet connectivity while conducting their exam from home: "my computer disconnected from [the] supervisor 6 times within the 1 examination. Each time, I panicked and spent the next 5 minutes trying to restore connection". In 2022, the data indicated a significant rise in negative feedback, highlighting concerns related to campus Internet connectivity issues, two-factor authentication issues, ongoing difficulties in battery life and charging of personal laptops and challenges associated with the use of microphones and headphones.

Environment

The theme of environment included the two sub-themes of location of sitting (remote, on campus, and the logistics of coming to campus) and environmental conditions (the room, other students). In 2021, these sub-themes comprised a total of 84 negative and 84 positive comments. In 2022, this rose to 1,485 negative comments and 824 positive comments. This increase is explained by the shift back to on-campus exams for many students (59.5% of responses in 2022 were from those who sat on-campus exams). Those students who were required to sit their exam on campus indicated the negative impact on stress, physical comfort, productivity (efficiency) and distraction. Factors included the complications and tension about getting to their exam room, the tension over equipment and distractions from other students. The increase in positive comments was largely due to the increased number of comments from students who sat exams off campus and who relayed the benefits of this situation.

Preparation and support

This theme includes issues relevant to the preparation prior to the exam and support during the exam. Preparation included two sub-themes: instructions prior to exams from central communications as well as teaching teams; and students' own preparations. Support included sub-themes relating to interactions during the exam with invigilators, helpdesk technology support staff, and the teaching team. The most frequently reported factors that impacted negatively on students' experiences were the quality and timeliness of the instructions from the university, and the interactions with the invigilators.

Student comments about central communications frequently noted stress and confusion resulting from what they felt was inadequate instructions relating to the system use and check-in requirements. Although this seemed to improve between the years, there continued to be concerns about understanding the implications of the online systems, for example, this student indicated that they were uncertain how suspicious behaviour is managed: "there was no information … about how suspicious behaviour is handled (e.g., being told/alerted during the examination when suspected)".

The role of invigilators and other support staff is clearly impactful in both adding to stress as well as comfort of students. For example, delays in response from invigilators left some students feeling deserted:

> I was not able to scan a QR code in order to scan my room for the supervised examination. It took over half an hour to get in touch with a supervisor which was extremely stressful in the examination, and I felt as though I had been left to my own devices to complete the examination.

Delays in connecting to supervisors resulted in anxiety and confusion, particularly when students wanted a response to a query during the examination.

However, we also noted many positive comments from students about interactions with invigilators. This was particularly the case in 2022, when the technology and processes had been improved to speed up response time and improve communications: "It went very well. It was very easy to talk to the supervisor when necessary, which was good since it was my first examination and I wanted to confirm that I was doing things right".

Discussion

Overall, a majority of students felt positive about their online exam experience, reporting that the online exam environment had a positive impact on their academic performance. However, there was still a large number of students who had a neutral or negative experience. Consequently, the qualitative data was analysed with the purpose of revealing the breadth of factors impacting student experience and thereby potentially provide insight into what may be given more attention. Four key themes emerged: assessment design, technology, environment and support.

Even though a defining feature of online examinations is that the technologies (exam platform, security, personal computer and connectivity) mediate the exam experience – only a third of the comments related to this theme. This is a useful reminder to not solely focus on technological issues when developing an online examination strategy.

Technology issues were more frequently reported in terms of negative experience, and particularly in relation to the negative impact on students' psychological stress and productivity. A large proportion of these comments focused on issues which could be resolved through improved functionality, simplicity and reliability. This includes features such as improved screen-viewing options through to easier and more robust check-in processes. Interestingly, when looking across the years, there was a marked reduction in negative comments and a small increase in positive comments in relation to these factors, reflecting the system improvements made over that year. It was noted that to note that although there were many comments describing both negative and positive experiences in relation to the exam platform and security, they often also included explicit suggestions for improvements and new features. We take this as encouragement to meaningfully co-design with students, who have diverse and valuable insights.

There were a large number of comments arising from frustration around typing speed, coding, entering formulas and using tables in the online exam environment. This is not surprising since research has shown that interface design has been found to be an inhibitor to positive student experiences in their examinations (see Butler-Henderson & Crawford, 2020). However, it does suggest that discipline-specific input requirements need to be carefully catered for, and that students need to be exposed to, and proficient in, using the system before the exam itself (see Blondeel et al., 2024).

Despite privacy in online examination proctoring systems being suggested to be a major concern for students (Coghlan et al., 2021; Selwyn et al., 2021), there were relatively few comments referring to this, compared to other sub-themes. These responses, however, did confirm that, for some students at least, the perception of being monitored via web camera and microphone and the need to take photos of their

home location (e.g., bedroom) felt invasive, added to stress and at times was distracting. Gudiño Paredes et al. (2021) similarly found students reported increased anxiety when being monitored through online proctoring technologies. However, the research on examination security, including remote proctoring, seems to have only been explored from a perspective of reducing cheating and promoting integrity (Butler-Henderson & Crawford, 2020; Dawson, 2020; Noorbehbahani et al., 2022). Further research into the impact of the security measures on issues of well-being and academic performance is likely to be useful when considering the merits of security strategies and assessment designs.

A noteworthy issue which increased in frequency of reporting was that of the problems surrounding the reliability of personal technologies (e.g., laptop, web camera) and reliability of connectivity with the Internet and/or the exam system (see Marano et al., 2024). Research has already highlighted the potential inequities of online examinations due to differing personal financial situations of students, with some having no webcam and slow or outdated devices, which may result in unjust outcomes (Coghlan et al., 2021). Dikmen (2023) found that students' anxiety could be directly related to technological stress, which students described differently to psychological and physiological factors. However, research has reported that students believe online assessment can also support equitable access for students with different needs (Slack & Priestley, 2022). Our own data affirms that issues with personal technologies and connectivity need to be considered for those who sit exams on campus and off campus. Although it may be assumed that students off campus may suffer from less reliable connectivity, our data also shows that different problems arise on campus, including insufficient battery life and frustration from lack of peripherals such as an external keyboard.

Assessment design issues were found to have a particular impact on stress and perceived academic performance. Arguably, these decisions are independent of the technology and reside primarily with the academic. This includes decisions around the length of the examination, the complexity of the questions and the conditions, such as whether the exam was open or closed.

Students were critical of the appropriateness of examinations as a form of assessment and, in particular, that of closed-book exams. They felt that such assessment did not effectively allow them to demonstrate their learning and was irrelevant to the workplace. This mirrors the findings of Gudiño Paredes et al. (2021), who reported that students wanted pedagogical factors taken into consideration more than technological issues such as the technology and security settings around the examinations. In general, research has recognised a range of pedagogical issues with high-stakes examinations, including those of reliability, validity, relevance to the workplace and limited ability to access critical thinking, as well as its impact on stress (Mulder & French, 2023). Clearly, the choice of examination as a mode of assessment, and the design of the online examination itself, needs to be a careful pedagogical decision, and one that should be clearly communicated with students, particularly in relation to the types of restrictions placed on them, such as the information they are allowed to access and the tools they can use (Dawson et al., 2023).

Students also commented on issues around the question construction within the exam, as well as the sheer number of questions or inadequate exam length. This fits with Selwyn et al.'s (2021) observation that the rapid move online for many assessments during the pandemic resulted in poor pedagogical decisions, such as question design. However, student experiences need to also be balanced by research such as that of Stadler et al. (2021), which encourages the careful use of time restrictions in examinations.

The **Environment** theme related to issues arising from the location of the exam (on campus, off campus), the exam room (whether it was at university or at home) and the impact of the presence of other students. In 2021, there were only 84 negative comments, compared with 1,485 negative comments in 2022. Analysis of the comments clearly revealed that coming back to campus for exams in 2022 was creating additional stress, physical discomfort and distraction. In contrast, the students who sat exams off campus frequently reported relief at not having to deal with other students, the logistics of getting to the exam room, or managing technologies outside of their home environment. It should be noted that in this study, students had experienced a long period of lockdown and there had been no on-campus exams in the

previous year. This may have contributed to the strong responses. Nevertheless, others also found that students appreciated the convenience of online remote examinations (Butler-Henderson & Crawford, 2020; Gudiño Paredes et al., 2021; Marano et al., 2024). The findings in this study highlight that if exams are hosted on campus, then students' experience, and ultimately performance, will be negatively impacted unless accompanied by additional planning around supporting the student, including their logistics, comfort and reduced distraction from other students.

The **Preparation and support** theme confirmed the importance of clear and consistent communications about the exams, from both central and teaching teams. However, it is perhaps more interesting to note that our data also revealed both the negative and positive impact of interactions with examination staff, especially invigilators and technical support. This reminds us that while the primary purpose of invigilators is to supplement assessment security, they also can positively and negatively impact student performance, productivity, and psychological well-being. Students positively referred to how invigilators and other staff could make them feel calmer, confident that they were in the right place and secure in knowing that they could reach out for help if they were confused.

Interestingly, respondents often commented that they expected a speedier response during the examination from technical support and clarifications from their teachers. Disruptions caused by invigilators were also reported. For example, invigilators suddenly talking or asking questions disrupted student focus, for some time after the event. Although various studies have discussed invigilators in relation to academic integrity (e.g., Harper et al., 2021; Pleasants et al., 2022), no literature was found on the impact that invigilators can have on the student experience unless it was related to issues of privacy.

Two key implications become evident with respect to the theme of preparation and support: first, that systems need to be in place to support timely response, and secondly, that invigilators and other staff need to be trained to not only be experts in their tasks but also to provide positive and affirming interactions with students.

Limitations

The survey was anonymous and voluntary. The open-ended questions in the survey were also optional and were broad in focus. In addition, there was a variety of exam conditions (such as length, location and security). Therefore, the reported themes cannot be taken to be representative of the population. Nevertheless, the scale of qualitative data is considered to support an exploratory study seeking to provide insight into the potential range of issues impacting student experience.

Conclusion

The quantitative data revealed that the majority of students felt positively about the exam system and were positive about its impact in relation to their academic performance. Although these overall measures of perceived usefulness and impact are promising, there is room for improvement. Analysis of the qualitative data provided insight into the factors that positively and negatively impacted on students' experience and offers possible avenues for future refinements in platform development as well as broader issues of examination delivery and assessment design.

A key finding is that while technology (platform and personal) was frequently noted by students as having an impact on their experience, they also clearly identified many concerns around the assessment design itself. This suggests that online examinations, like all examinations, need to be carefully designed according to sound pedagogical reasoning and, arguably, that reasoning be conveyed to students. This highlights that higher education educators may be specialists in their fields but may not have depth of knowledge around assessment design. Institutions implementing online examinations need to maintain a strong focus on staff development.

With regards to the exam platform and assessment security, such as remote proctoring, our data supports the potential value of co-design with students who, in our study, have provided valuable experiential data and explicit recommendations for improvement.

Author contributions

Author 1: Conceptualisation, Method, Investigation, Analysis, Writing; **Author 2:** Analysis, Writing. **Authors 3–5:** Investigation, Analysis, Writing – review and editing. **Authors 6–9:** Conceptualisation, Writing – review and editing.

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Corresponding author: Michael Henderson, michael.henderson@monash.edu

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