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Online proctored exams and digital inequalities during the pandemic

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Abstract

Background: The emergence of the COVID-19 and the resulting global pandemic has ushered in far-reaching changes for countries across the world, not least of which are changes to their education systems. With traditional location-based exams no longer possible at universities, the uptake of online proctored exams (OPE) has occurred at a pace not seen prior to the pandemic. Students' experiences of online proctored exams during the pandemic are reasonably well-understood in terms of digital access and ease of use of the technology. However, less is known about students' perceptions of digital confidence and competence to complete an online exam, both of which are important digital equity considerations.

Objectives: This study investigates students' digital confidence and competence to undertake online proctored exams to determine whether issues of equity exist for students.

Methods: This study reports the results of a survey ($N = 761$) of one university's students' experiences of end-of-semester online proctored exams in New Zealand.

Results: Most students were positive about online exams, felt reasonably confident to complete an exam, and had the necessary digital access (i.e., devices, internet) and competence to succeed. However, digital inequalities were found between students' perceptions of digital competence based on ethnicity. While more time learning online equated to increasing self-reported digital competence for most ethnic groups, this was not the case for Pacific learners.

Takeaways: Perceptions of low digital competence can contribute to digital inequalities. Educators can support learners to develop positive perceptions of digital competence by teaching digital literacy skills.

KEYWORDS

COVID-19, digital access, digital competence, digital inequalities, higher education, online proctored exams

1 | INTRODUCTION

The emergence of the SARS-CoV-2 virus and the resulting global pandemic has ushered in far-reaching changes for countries across the world, not least of which are changes to their education systems. Globally, universities closed campuses and shifted to emergency remote teaching to ensure the continuation of their educational offer (OECD, 2020). Whilst online teaching and learning is not a new phenomenon (Hodges et al., 2020), lockdown requirements meant universities were faced with changes to teaching and assessment given that traditional location-based exams were no longer possible. This realization necessitated a shift towards alternative assessment approaches, including online proctored exams (OPE), in higher education institutions around the world at a speed not seen prior to the pandemic (Selwyn et al., 2021). OPE enable students to undertake examinations from a place of their choosing while being supervised via online technologies (D'Souza & Siegfeldt, 2017).

Pre-pandemic, OPE use in higher education was limited (Butler-Henderson & Crawford, 2020; Selwyn et al., 2021). The situation changed when university campuses closed as part of health measures introduced by governments to reduce the spread of the virus (Crawford et al., 2020). For some universities, the pandemic reignited the debate over the relative merits of summative examinations (St-Onge et al., 2021) and some used it as an opportunity to introduce alternatives to high-stakes summative examinations (Grande de Prado et al., 2020). However, the need to ensure academic integrity by universities and requirements to authenticate learning for outside accreditation bodies, saw the move to online, remote proctored exams by many (OECD, 2020; Selwyn et al., 2021). In practical terms, adopting OPE during the pandemic afforded a 'continuity in assessment design' (Dawson, 2021, p. 4) at a time when traditional face-to-face exams were not possible.

Since the start of the pandemic, a growing body of research has explored various topics associated with OPE. Of primary concern are questions related to exam integrity, identity authentication and instances of cheating (Butler-Henderson & Crawford, 2020; Comas-Forgas et al., 2021; Garg & Goel, 2022; Mate & Weidenhofer, 2021; Muzaffar et al., 2021). Other area of interest include institutional responses and staff experiences of implementing OPE in response to the crisis (Crawford et al., 2020; Selwyn et al., 2021; St-Onge et al., 2021). Students' perceptions and experiences of OPE have also been a further source of interest (Elsalem et al., 2021), though to a lesser degree than the aforementioned areas (Kharbat & Abu Daabes, 2021). Specific lines of inquiry include academic performance (Linden & Gonzalez, 2021), especially in relation to equivalence with face-to-face exam achievement (Finnegan, 2021), students' experiences of exam anxiety (Hosseini et al., 2021), technical problems during online exams (Butler-Henderson & Crawford, 2020; Montenegro-Rueda et al., 2021), and privacy concerns (Kharbat & Abu Daabes, 2021).

Advantages of online assessment identified by learners include greater flexibility regarding location and timing, greater accessibility, ease of use (e.g., editing question responses), timely feedback, and improved quality assurance (Elsalem et al., 2021; Raman et al., 2021). Several factors can enhance the success of online exams. Using an exam system that is familiar to learners can reduce anxiety and stress (Hosseini et al., 2021). Providing opportunities to use the system prior to an exam and offering technical support during an online exam is linked with positive student perceptions (Hosseini et al., 2021; Linden & Gonzalez, 2021). Recent research has also shown that students, who believe they have the requisite technical knowledge and skills, hold positive perceptions about online exams (ÇInar & Murat, 2022; Kharbat & Abu Daabes, 2021).

Notwithstanding these relative advantages, there are ongoing challenges for students (Linden & Gonzalez, 2021). These include the complexity (i.e., ease of use) of the exam system, technical difficulties along with insufficient training and support (Hosseini et al., 2021; Raman et al., 2021), reduced preference for online remote (i.e., at home) exams as a result of the pandemic (Elsalem et al., 2021), and equity issues (i.e., digital divide). Issues related to digital inequity tend to focus on appropriate access to devices, internet, and technical support (Alarcón López et al., 2021; Cahapay, 2021; Langenfeld, 2020). However, digital inequalities exist on many levels and encompass more than issues of digital access (Helsper, 2021). Inequalities of digital skills and capabilities have been labelled the second level divide (Helsper, 2021). Beyond access, students' perceptions of digital capabilities and confidence to undertake online exams are an essential consideration that few have addressed (Azionya & Nhedzi, 2021; Hosseini et al., 2021).

What is evident from this literature is that online proctored exam research is under-theorized. Most studies undertaken since the beginning of the pandemic have occurred without supporting theoretical or conceptual frameworks. However, studies are starting to emerge that have theoretical underpinnings. For example, Lee and Fanguy (2022) adopted Foucault's theory of disciplinary governmentality (where institutions exert power to surveil their members and individuals comply with such surveillance to the extent that they govern their own behaviour) to demonstrate that adopting online proctoring technologies has broad-reaching consequences beyond simply stopping instances of cheating. Raman et al. (2021) adopted diffusion of innovation theory (Rogers, 2003), a theory that attempts to explain the rate of adoption of an innovation, to identify factors that predict students' acceptance of OPE. Given the relative lack of theorisation, the current study adopted an exploratory approach to understand students' experiences of OPE. In doing so, it seeks to identify theories that may be applicable to future studies.

The research question informing this investigation was: What digital inequalities were experienced by students in online proctored exams during the pandemic that go beyond digital access? This study represents an important first step in identifying potential digital inequalities resulting from learners' perceptions of confidence and competence to complete an OPE. In doing so, it seeks to add to the limited research on digital inequalities experienced by university students during the pandemic (Lee & Fanguy, 2022).

2 | METHODOLOGY

2.1 | Research design

The research reported here is part of a broader research study exploring the impact of COVID-19 assessment changes on student and academic staff experiences with the aim of informing the University's assessment policy and practice. To investigate the experiences of changes to assessment, a convergent parallel mixed method research design was adopted for the main study (Creswell & Plano Clark, 2011). The design comprised three phases: an online survey of students studying courses where assessment was changed, an online survey of academic staff teaching courses where assessment was changed, and semi-structured focus group interviews of a purposive sample of university-level decision-makers, directly involved in the changes to assessment practices. While multiple groups of participants and alternative assessment approaches made up the wider study, the focus of this article is on the survey findings of the experiences of students whose paper-based exam was replaced by an OPE. Ethics approval was gained prior to the commencement of the research. OPE findings from the student survey are reported here.

2.2 | Context of the research

The University in which this research occurred is located within New Zealand and offers both on-campus and online study options. Figures from 2020 indicate that 52% of the student population were studying online with the remaining 48% of students located at one of the University's several campuses. Of the online students, 48% were located within New Zealand and the remaining 52% were located in 137 countries across the world. China, followed by the United Kingdom, India, and Australia had the highest numbers of students.

The unique circumstances brought about by the COVID-19 pandemic required the University to rethink assessments, particularly final examinations for Semester One, 2020 (i.e., February–June 2020), as it was not feasible to hold in-person proctored exams in multiple locations around the world. Students and lecturers were very quickly required to adapt their expectations and normal practices to new ways of learning and assessment. This was particularly true for end-of-course[1] final exams. A University-wide decision was made to adopt different approaches to assessment for different cohorts of students depending on the weighting of the final exam on the final grade. It was determined that taught courses with a final examination contributing 61% or more to the overall grade would have an OPE. Most exams that fell within this category were business courses where proctored exams were required for accreditation purposes. This equated to a total of 47 offerings,[2] or a net of 16 courses, and 1909 scheduled exam sittings within New Zealand and overseas. Courses whose final examination contributed 60% or less to the final grade chose alternative forms of assessment, namely a time constrained, open-book exam, or revised existing assignments so that no additional assessment was necessary.

Similar to other institutions (Montenegro-Rueda et al., 2021), for the OPE the University adopted a commercial cloud-based proctoring product that plugged into the University's learning management system (i.e., Moodle), meaning that learners were completing their exam using an online environment familiar to them. The live proctoring service (Raman et al., 2021) required students to authenticate their identity (using a valid form of photo ID) and connect their webcam and microphone so that the proctoring software recorded the desktop, webcam feed and audio feed during the exam period. Successfully completing authentication and technical processes was necessary prior to commencing the actual exam. Students were not allowed to leave the room during the exam period. Any handwritten notes made by the student during the exam were required to be scanned and uploaded at the end of the period. Recordings were reviewed by certified proctors, looking for violations that could compromise the integrity of the exam. Support staff from the University and proctoring company were available by phone so that students could call if problems arose.

Prior to the commencement of the exam period, students were given the opportunity to sit a practice OPE within the Moodle environment to gain familiarity with the process and to ensure the device they planned to use to complete their OPE could successfully do so (minimum technical requirements were published to students). Students could attempt the practice test multiple times if they wished, to familiarize themselves with sitting an OPE. Trouble-shooting information was provided online for common technical issues and University staff were available online to answer questions or address issues that arose during the practice period.

The types of exam questions varied widely depending on the course and included multiple choice questions, short answer questions, longer essay questions, and questions requiring calculations. Doing the exam typically involved downloading one or more files that included the exam questions and a place for students to add their answers. Files containing each student's responses needed to be uploaded before the end of the exam time.

2.3 | Survey measures

An online survey was developed for students to explore their experiences of undertaking an OPE. A range of demographic questions were included, in addition to questions in the following areas: digital competence, ease of use of the digital technology used as part of the assessment process, confidence to engage with the digital technology used as part of assessment, experiences of and attitudes towards assessment, assessment preferences, and support accessed. The survey drew on previously validated survey scales, adapted for the specific context of OPE. The section on assessment preferences was

[1]A course is a component of a programme of study; multiple courses aggregate to a qualification.

[2]An offering is a different instance of the same course delivered online and at one or more campuses.

newly developed for the survey by researchers with expertise in assessment and learning. Findings related to digital competence (DIGCOMP), confidence (CONF), perceived ease of use (PEU), and support accessed by OPE participants are the focus of this article. Results related to experiences and attitudes towards assessment and assessment preferences are reported elsewhere (forthcoming).

The survey consisted of several sections. The first section consisted of a series of demographic questions asking about participants' age, gender, ethnic groups, location, nature and location of study, online study experience, and internet and device accessibility. Next, questions about digital competence related to everyday experiences of problem solving and digital technologies were included in the survey. The Digital Competence framework (Al Khateeb, 2017; Ferrari, 2013), developed by the European Union, was adopted for this study. Specifically, four questions related to digital competence and problem-solving were included. Participants were asked to choose one of three statements that most accurately described their digital capability for each question. The three statements for each question equated to a three-point scale of basic, intermediate, and advanced levels of digital competence.

Subsequent sections of the survey asked respondents to focus on one specific course where changes to assessment had occurred when answering the remaining questions. Several statements related to the use of technology as part of the assessment process were included. A construct from the Technology Acceptance Model (TAM), namely perceptions of ease of use (Davis, 1989), was adopted. Perceptions of ease of use (PEU) is the belief that using the technology will be straightforward and effortless. Since its development, the TAM model has been used extensively to determine individuals' attitudes towards adopting various technologies (Selim, 2003). The researchers used the PEU scale from Selim (2003), who investigated university students' acceptance of course websites for learning. The original PEU scale comprised six statements. All statements were retained for this study with only slight changes to the wording of each statement to refer to the technology under consideration. One additional statement was also added (*I found the technology for the Online Proctored Exam flexible to interact with*). Participants were asked to respond to these statements using a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

The next section in the survey asked about respondents' confidence to complete the assessment given certain factors related to the technology being used. The statements within this section were developed with reference to the well-established computer self-efficacy scale created by Compeau and Higgins (1995). Participants were asked to respond to nine statements on a sliding scale ranging from 0 (not at all confident) to 100 (completely confident). A 'not applicable' option was also available. Finally, the survey included an open-ended question asking participants if they accessed support during the OPE and if so for what purpose. Participants could also choose to enter a prize draw for a voucher to the value of NZ $800.00 towards their future University fees, to recognize the value of their contributions and the time involved in completing the survey.

TABLE 1 Kolmogorov–Smirnov test results.

Scale	KS statistic (*D*)	df	Sig (*p*)
CONF	0.046	617	0.004
DIGCOMP	0.113	756	0.000
PEU	0.165	642	0.000

2.4 | Response rate

A purposive sampling approach was adopted where all students (both undergraduate and postgraduate) involved in courses where changes to assessment occurred because of COVID-19 were invited to take part in the anonymous surveys shortly after the finalization of grades for Semester One, 2020. An invitation to complete the student survey (containing a link to the online survey) was successfully sent to 13,584 unique email addresses at the beginning of July 2020. The survey was hosted in Qualtrics. The survey remained open for 1 month and a total of 4326 responses were received, representing a response rate of 32% of invited students. A total of 33,421 exam sittings were replaced with alternative assessments. Using the total exam sittings as the population, the response rate was 13%. Of those, 4134 were valid responses (i.e., they had completed more than the demographics section). Students could complete the survey more than once if they were studying multiple courses with assessment changes.

Of the valid responses, 761 were received from students who had completed an OPE from a maximum possible 1909 exam sittings, representing a 40% response rate.

2.5 | Data analysis

After the data were cleaned for invalid responses, descriptive statistics (frequency counts and percentages) were generated. Blank responses and 'not applicable' responses were excluded from the data analysis. Cronbach's Alpha (α) scores were calculated to investigate the internal consistency of each scale. The confidence scale (CONF) consisted of 9 items ($\alpha = 0.85$), the digital competence scale (DIGCOMP) consisted of 4 items ($\alpha = 0.7$), and the perceived ease of use scale consisted of 7 items ($\alpha = 0.95$). No items were removed from the scales and all results were considered acceptable (Tavakol & Dennick, 2011).

To determine the most appropriate inferential statistical tests for analysis, a series of one-sample Kolmogorov–Smirnov (KS) tests were conducted to examine the parametric nature of the data. For all measures, the KS test statistics were significant, indicating that the data were not normally distributed (see Table 1).

To investigate the strength of relationships between measures, two-tailed Spearman rho correlation coefficients were calculated. The following guidelines are commonly used to represent the strength of the relationship in social science research: weak positive correlations range from 0.1 to 0.3, moderate positive correlations range from 0.3 to 0.5, and strong positive correlations range from 0.5 to 1.0

TABLE 2 Demographics of OPE survey participants.

Variable	N	Categories	n	Percentage
Age[a]	761	25 years or less	329	43%
		26–40 years	295	39%
		41 years and above	137	18%
Gender[b]	759	Female	563	74%
		Male	191	25%
		Gender diverse	2	0.3%
		Prefer not to say	3	0.4%
Ethnicity[c,d]	733	Māori	67	9%
		Pacific Peoples	42	6%
		Asian	204	28%
		Other	68	9%
		New Zealand European	352	48%
Location[e]	760	New Zealand	681	90%
		Overseas	79	10%
Community type	761	City	506	66%
		Small town	129	17%
		Rural area	106	14%
		Other	20	3%
Study pattern[f]	750	Full-time	413	55%
		Part-time	337	45%
Mode of study prior to lockdown	761	On campus	257	34%
		NZ online	428	56%
		Overseas online	76	10%
Internet access	648	Broadband	563	87%
		Rural internet	75	12%
		Other	10	2%
Online learning experience	760	Inexperienced (<1 year)	399	53%
		Some experience (1–2 years)	207	27%
		Experienced (>2 years)	154	20%
Exam location	750	Where I normally live	645	86%
		A friend or family member's house	43	6%
		University campus	25	3%
		Other	37	5%
Type of device[g]		Laptop/notebook	694	91%
		Smart phone	277	36%
		Desktop	179	24%
		Tablet	105	14%

[a]University 2020 student population statistics report 57.5% were over 25 years of age.
[b]University 2019 student population statistics report 64% were female.
[c]University 2019 student population statistics report 11% Māori, 5% Pacific People, 20% Asian, and 56% New Zealand European. In the survey, respondents could select more than one ethnic group. These responses were prioritized according to Ministry of Education (2020) protocols, where Māori are first priority, followed by Pacific Peoples, Asian, Other, and New Zealand European, so that each individual was assigned to one ethnic group category for ease of statistical analysis.
[d]Māori (indigenous people of New Zealand) and Pacific People are identified as priority learners by the New Zealand Ministry of Education (2021).
[e]Overseas locations: China (29); Australia (15); UK (%); Cook Islands (3); Unites States (2); and 1 each in Fiji, Korea, Kuwait, Malaysia, Norway, Qatar, Singapore, Taiwan, and Uruguay.
[f]University 2020 student population statistics report 39% full-time and 61% part-time.
[g]A small number of participants (5) indicated that that the device they were using for assessment was borrowed, from the University (1), or was a library computer (2) or a work computer (2).

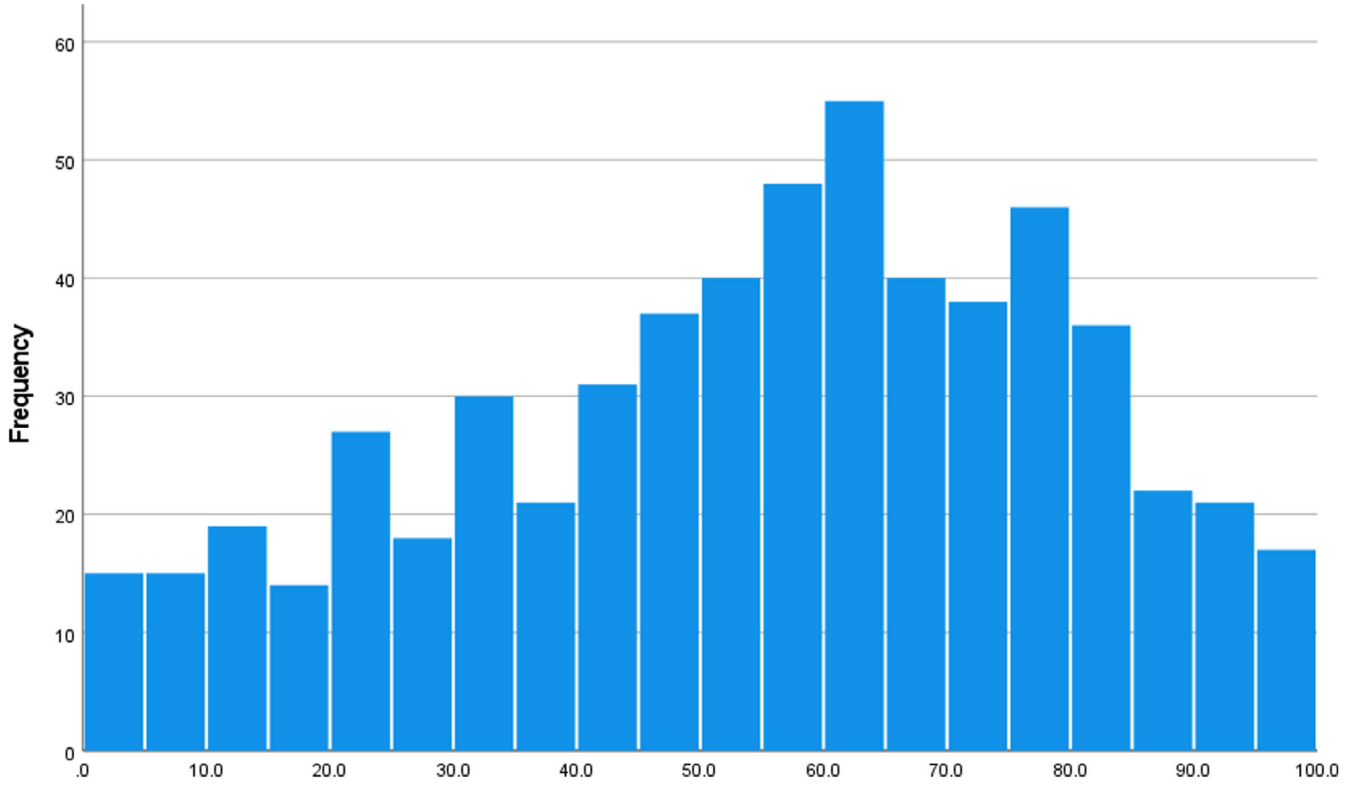

FIGURE 1 Confidence to complete an OPE.

(Cohen, 1988). To investigate differences in the various key measures between different groups of students, Kruskal–Wallis and Mann–Whitney *U* tests were calculated for the CONF scale, and chi square tests and cross-tabulations for the DIGCOMP and PEU scales. Cramér's *V* statistic was used to assess the strength of relationships (Field, 2018). Given that this was an exploratory study and multiple (35) comparisons were made across the data, a Bonferroni correction was applied to the critical *p* value of $p < 0.05$, adjusting it to $p < 0.001$ to avoid type I errors (Armstrong, 2014).

A thematic analysis (Braun & Clarke, 2006) of open-ended responses was undertaken using inductive and deductive coding. *NVivo 12* was used to facilitate and manage the iterative process of analysing the qualitative data. Responses to open-ended survey questions were analysed thematically and illustrative quotes have been used where appropriate.

3 | RESULTS

The focus here is on the perceptions of students who undertook an online invigilated exam which replaced their paper-based, place-based exam because of COVID lockdown restrictions. The experiences of students who undertook alternative forms of assessment, namely a time constrained, open-book exam, or revision of existing assignments so that no additional assessment was necessary, are reported elsewhere.

3.1 | Participant demographics

The demographics of OPE survey participants are summarized in Table 2. Overall, respondents were predominantly over 25 years old, female, of New Zealand European ethnicity, studying in New Zealand, studying full-time, had been studying online in New Zealand prior to start of the pandemic, lived in a city, had broadband internet access, were inexperienced online learners (i.e., less than 1 year of experience), and completed their online invigilated exam in the place where they normally lived. The most common device available to participants was a laptop/notebook (91%). The average number of devices per respondent was 1.65.

3.2 | Confidence (CONF)

Students were asked about their confidence to complete the assessment given certain factors related to the technology platform being used. Statements were measured on a sliding scale ranging from 0 (not at all confident) to 100 (completely confident). Confidence to complete the OPE ($M = 56.6$, $SD = 25.74$), shown in Figure 1, indicates that participants felt reasonably confident when taking an online invigilated exam.

Looking at the mean confidence (CONF) scores by quartile (see Figure 2), shows that almost two thirds of respondents rated their confidence to complete their OPE as reasonable (36%) or high (26%). Only 16% rated their confidence as minimal.

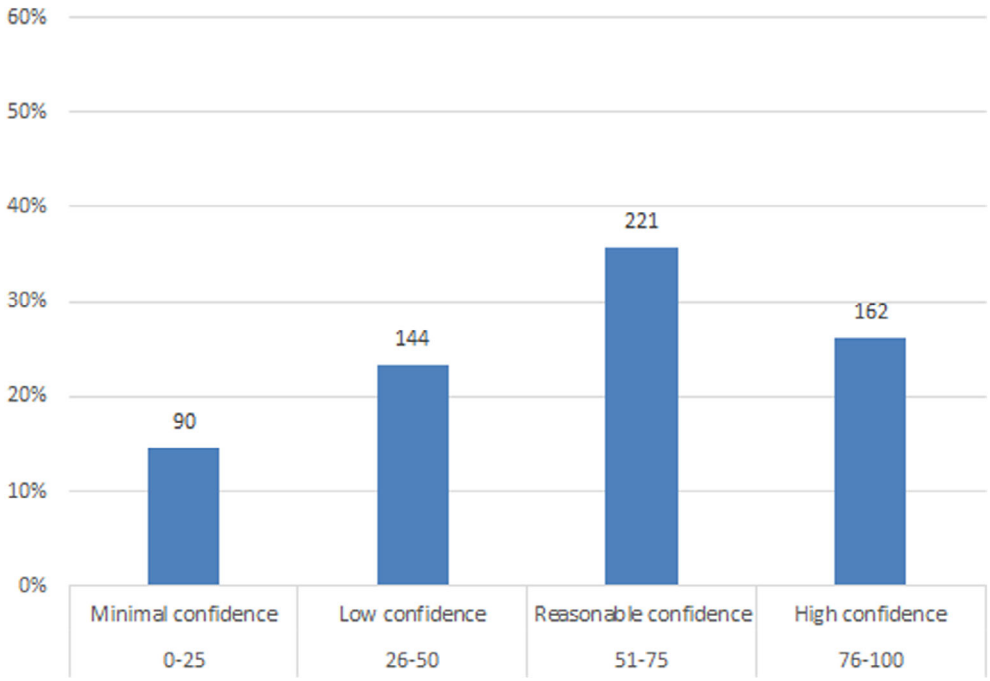

FIGURE 2 Students' mean confidence (CONF) for an OPE by quartile.

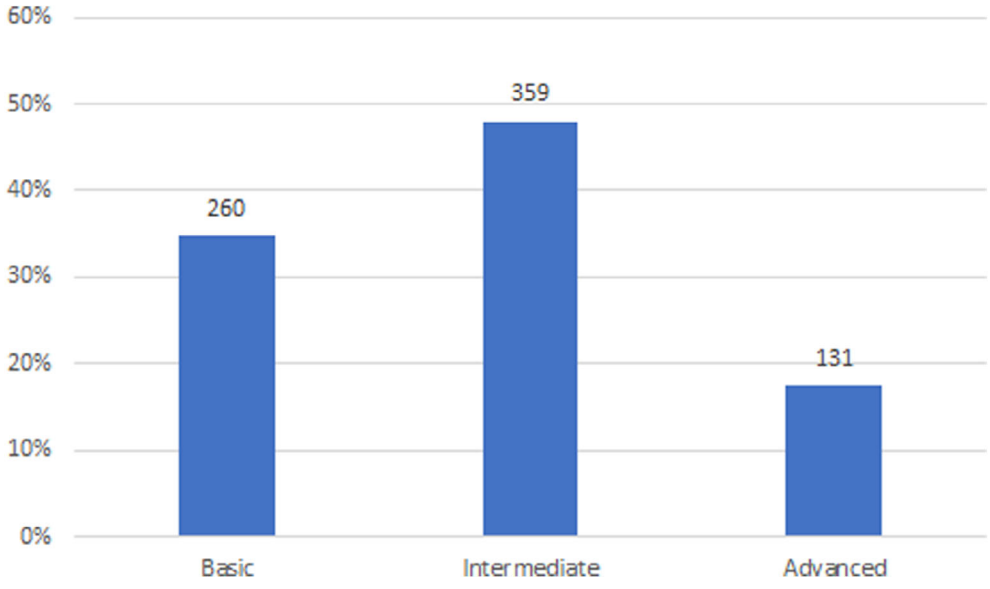

FIGURE 3 Digital competence.

3.3 | Digital competence (DIGCOMP)

Respondents were asked about their digital competence as it related to problem-solving (see Figure 3). Overall, the results indicate that across all problem-solving sub-categories, almost half of respondents rated their skills at an intermediate level (48%), followed by just over a third who rated their skills at a basic level (35%). Relatively few respondents (17%) rated their digital competence at an advanced level.

Looking at the sub-categories that comprise the digital competence problem-solving scale (see Figure 4), two thirds (66%) of student respondents were reasonably self-reliant (i.e., intermediate to advanced) when dealing with technical problems. Half (50%) of respondents indicated that they could solve most frequent technical problems that occur (i.e., intermediate). Only 16% indicated they had the ability to solve almost all technical problems (i.e., advanced). In terms of identifying needs and technical responses, just over two thirds (68%) indicated that they had intermediate to advanced skills. In terms of the actual use of digital technologies, 70% of respondents rated their skills as intermediate to advanced. The results for being able to accurately identify competence gaps were noticeably different. While 43% of respondents indicated that they were aware of the need to update their digital skills (i.e., basic), they were not necessarily doing so on a regular or frequent basis. A further 43% of students were aware of their digital limitations and regularly updated their digital skills (i.e., intermediate). Relatively few (14%) participants actively kept up to date with new digital tools and technological developments (i.e., advanced).

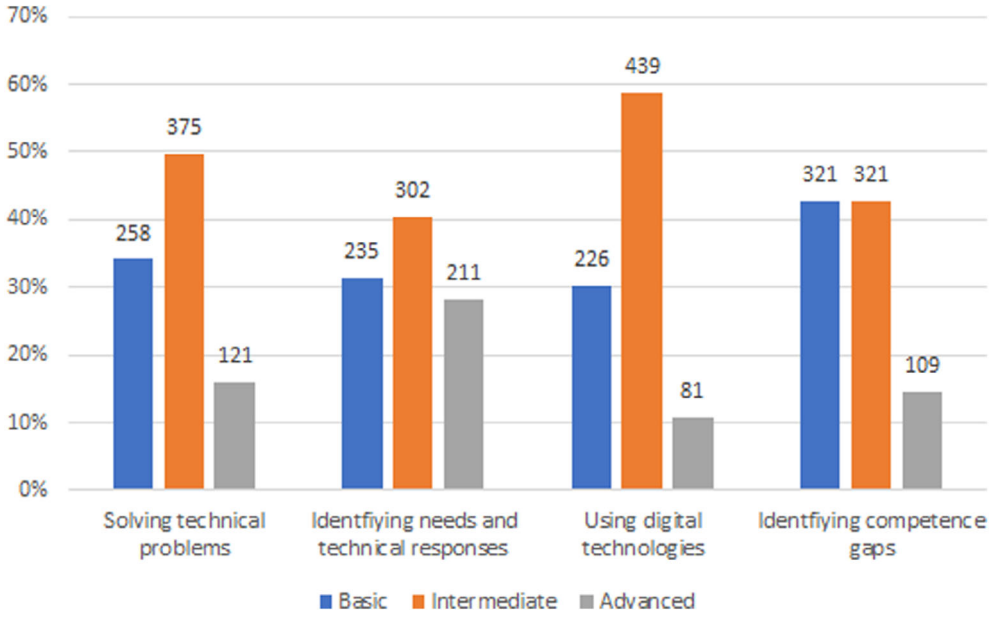

FIGURE 4 Digital competence by sub-category.

TABLE 3 PEU frequencies.

	Frequency	Percent
Strongly agree	56	8.7%
Agree	155	24%
Somewhat agree	150	23.4%
Neither agree nor disagree	143	21%
Disagree	48	7.5%
Somewhat disagree	75	11.7%
Strongly disagree	24	3.7%

TABLE 4 Correlations between CONF, DIGCOMP and PEU.

Correlation	Spearman's rho (r_S)	df	Sig (p)
PEU versus CONF	0.50	600	0.000
CONF versus DIGCOMP	0.23	611	0.000
DIGCOMP versus PEU	0.16	635	0.000

3.4 | Perceived ease of use (PEU)

Students' perceived ease of use (PEU) of the OPE technology indicate that more students agreed (56%) that the technology was easy to use, clear and understandable and convenient to access, compared with those who disagreed (23%) or were neutral (21%) (see Table 3).

3.5 | Relationships between digital competence, confidence, and perceived ease of use

Spearman's rho (ρ) correlation coefficients were calculated to investigate possible relationships between participants' confidence, digital competence, and perceived ease of use. Positive correlations were found between all variables (see Table 4). Results indicate a strong positive correlation between students' reported perceived ease of use of the OPE platform and their confidence to complete the OPE. In other words, participants who reported that the system was easy to use, also reported higher levels of confidence to complete the OPE. A moderate correlation was found between participants' self-reported confidence and digital competence. That is, students who reported higher levels of confidence also perceived themselves to be more digitally competent. Finally, a weak positive correlation was found between respondents' digital competence and their perceived ease of use of the OPE platform.

3.6 | Differences based on ethnicity

Further analysis of students' confidence, competence, and perceived ease of use were undertaken against various demographic variables including age, gender, ethnicity, location of study, community type, study pattern, mode of study, internet access, online learning experience, and exam location. Kruskal–Wallis and Mann–Whitney U tests of students' self-reported confidence (CONF) against the above demographic variables revealed no statistically significant differences. Examination of perceptions of students' perceived ease of use (PEU) via chi-square tests revealed no significant differences across all demographic variables.

An investigation of students' self-reported digital competence (DIGCOMP) revealed significant differences based on ethnicity and online learning experience (see Table 5). The chi-square value for digital competence based on ethnicity was significant, $\chi^2(8, n = 728) = 33.18$, $p < 0.001$. There were more Pacific learners than expected who rated their digital competence as basic and fewer who rated it as intermediate; there were also more Asian students than expected who rated their digital competence as basic and fewer who rated it as

TABLE 5 Cross-tabulation for ethnicity and online learning experience by digital competence.

		Digital competence		
		Basic	Intermediate	Advanced
		Frequency (percentage)		
Ethnicity	Māori	21 (31%)	38 (57%)	8 (12%)
	Pacific Peoples	27 (64%)	12 (29%)	3 (7%)
	New Zealand European	104 (30%)	188 (53%)	59 (17%)
	Asian	90 (45%)	92 (46%)	19 (9%)
	Other	18 (27%)	38 (57%)	11 (16%)
Online learning experience	Inexperienced (<1 year)	166 (42%)	188 (47%)	42 (11%)
	Some experience (1–2 years)	57 (28%)	121 (59%)	28 (13%)
	Experienced (>2 years)	48 (31.5%)	71 (46.5%)	34 (22%)

TABLE 6 Cross-tabulation for mode of study and online learning experience by ethnicity.

		Ethnicity				
		Māori	Pacific Peoples	NZ European	Asian	Other
		Frequency (percentage)				
Mode of Study	On-campus	16 (24%)	12 (29%)	97 (28%)	104 (51%)	21 (31%)
	New Zealand online	48 (71.5%)	22 (52%)	230 (65%)	66 (32%)	44 (65%)
	Overseas online	3 (4.5%)	8 (19%)[a]	25 (7%)	34 (17%)	3 (4%)
Online learning experience	Inexperienced (<1 year)	23 (34%)	19 (45%)	144 (41%)	163 (80%)	34 (50%)
	Some experience (1–2 years)	25 (37%)	13 (31%)	114 (32%)	27 (13%)	20 (29%)
	Experienced (>2 years)	19 (29%)	10 (24%)	94 (27%)	13 (7%)	14 (21%)

[a]Expected count less than 5.

intermediate or advanced; and fewer New Zealand Europeans than expected who rated their digital competence as basic and more who rated it as intermediate or advanced. The strength of the relationship indicates a medium association (Cramér's $V = 0.15$).

The chi-square value for digital competence based on online learning experience (i.e., length of time learning online) was also significant, $\chi^2(4, n = 728) = 23.58$, $p < 0.001$. More inexperienced online learners (i.e., less than 1 year) than expected rated their digital competence as basic and fewer rated their competence as intermediate or advanced; fewer students with some online learning experience (i.e., 1–2 years) than expected rated their digital competence as basic and more rated it as intermediate; and more experienced online learners (i.e., more than 2 years) than expected rated their digital competence as advanced. The strength of the relationship indicates a medium association (Cramér's $V = 0.13$). While the chi-square highlighted significant differences between groups based on digital competence, these results are not unexpected. They indicate that as online learning experience increased, digital competence also increased.

To further understand the differences between groups based on ethnicity, additional chi-square tests were undertaken based on mode of study and online learning experience (see Table 6).

The likelihood ratio chi-square value for ethnicity and mode of study was significant, LR(8, $n = 732$) = 93.05, $p < 0.001$. More Asian students than expected were located on campus and fewer than expected were studying online in New Zealand prior to the COVID-19 outbreak, while fewer New Zealand Europeans than expected were studying on campus, and more were studying online in New Zealand. The strength of the relationship indicates a large association (Cramér's $V = 0.22$).

The chi-square value for ethnicity and online learning experience was also significant, $\chi^2(8, n = 733) = 74.14$, $p < 0.000$. Fewer Māori students than expected reported having less than 1 year of online learning experience (i.e., inexperienced) and more Māori students had between 1 and 2 years of online learning experience (i.e., some experience). More Asian respondents than expected reported being inexperienced online learners and fewer reported having some experience, while fewer New Zealand Europeans than expected reported being inexperienced online learners and more reported either some experience or being experienced online learners. The strength of the relationship indicates a large association (Cramér's $V = 0.25$).

3.7 | Students' perceptions of university support for OPE

Students were asked an open-ended question related to whether they accessed support before or during their OPE and, if so, what sort of support they accessed and why. Table 7 outlines the key themes and

TABLE 7 Key themes and sub-themes associated with students' perceptions of university support for OPEs.

Theme	Sub-theme	Frequency
Type of support	Exam support	91
	Other support resources	18
	Proctoring software support	9
	Course administrator	6
Reason for seeking support	Time expired	45
	Clarify instructions or set up exam	40
	Submission process other than time expired	37
	Proctoring software problem	35
Satisfaction with support	Negative, or problem unresolved	35
	Positive, or problem resolved	32

sub-themes identified through the coding process and their frequency counts. Of the 117 students who identified the help they accessed, just over three quarters ($n = 91$) said they contacted the University via phone or email. Some students reported that they also accessed the protoring software support ($n = 9$) or contacted their course administrator ($n = 6$). Several students ($n = 18$) identified accessing other resources provided by the University.

Of the 201 respondents who gave reasons for seeking support, four significant areas were identified. Twenty-two percent ($n = 45$) identified problems with the expiration of the allocated time for the OPE, 20% ($n = 40$) made comments related to the clarity of instructions or the setting up of the exam, 18% ($n = 37$) talked about problems with submission of the exam not associated with expired time, and 17% ($n = 35$) reported problems with the proctoring software.

The most frequently occurring comments related to the exam timing out before students had uploaded their submission. Several students commented that they rang the support line to clarify whether they had to submit before the exam had concluded or were able to do it at the completion of the exam time. Problems submitting documents seemed to be a common student problem: '*I had to call the support line as I couldn't upload my answers as it kept telling me the program had timed out which was quite stressful*' (Student 255). Other students reported that the exam session timed out while the clock was still showing that they had time left. '*My exam exited 20 minutes before it was supposed to, so I had to call support to help me upload my files. I didn't get my time back*' (Student 367).

Students identified that they rang the helpline to clarify the instructions on how to undertake their OPE, or because they had problems using the software needed to complete their assessment. For several students, it took some time before they could start their OPE: '*phoned the University, emailed the University, email [the proctoring software company], couldn't log into Moodle, [the proctoring software] kept coming up with errors, very stressful and took over two hours to get the exam underway*' (Student 183). A loss of time due to problems either with the software or issues associated with the downloading of the necessary documents was common. Students had trouble with their courses not showing up in the Moodle environment, the file downloading in the wrong format, being unclear about the location of the exam download on their computer or having difficulty opening the exam. One student even rang the helpline because they had the wrong exam paper for their course. Students also needed help because they felt the instructions about setting up their computer to sit the OPE were not sufficient. '*Information on the University website and on the [proctoring software company] website are very vague*' (Student 375).

Associated with a lack of clarity of instructions was confusion over uploading the documents at the end of the OPE. For some, they rang the helpline to clarify the process of uploading the files. For others, their queries were about whether they had uploaded their answers successfully. This seemed to be the cause of anxiety as several students reported they had also experienced problems in other courses. In some instances, their exam answers had not uploaded correctly, or they had not uploaded important supplementary material.

Many students reported problems with the proctoring software freezing or logging out part way through the OPE. '*Both in the practice [proctoring software] set up and actual exam day, the software turned my laptop off. So, I had to restart my laptop, relog in prior to exam day and was late for my exam*' (Student 175). Commonly students sought help because the software failed multiple times during the OPE. '*I had to call the help line twice during the exam and email twice after the exam due to technical problems with the [proctoring] software stopping multiple times while trying to sit my exam*' (Student 58). Some students sought help with allowing the proctoring software to access their microphone, or camera. For a few students, their laptops would not accept the proctoring software, or the software slowed down their computers. One student, who normally used the cloud-based version of Microsoft Word, had problems with the proctoring software because it prevented the use of the online version. The student was required to download and install the software on their computer during their exam which significantly reduced the time available to complete the exam.

Sixty-eight respondents talked directly about their satisfaction with the support they received. Of those who did comment, approximately half reported a positive experience and half a negative experience. Those reporting a positive experience really appreciated the help they received during a time of great stress. '*Helpline was great, but the experience was not*' (Student 203). Respondents appreciated the speed with which their issues were resolved and the calmness of the support staff. '*The person I spoke to supported me and instructed me on what I needed to do, they reassured me everything would be fine*' (Student 264). In some instances, it was noted by the respondent that their issues took some time to resolve during the OPE. In many cases, additional time to complete the OPE was given but several students reported that extra time was not added on.

Those reporting negative experiences, reported problems accessing the support. Some reported that the line was busy or that no-one answered the phone. A number said they left messages but were not called back. Other respondents reported that the support person was not able to resolve their issue: '*phoned the number provided, my issue*

was unable to be resolved, emailed the University but didn't get a response until after my exam had finished' (Student 369).

4 | DISCUSSION

Despite some students experiencing challenges, particularly during the online exam as highlighted in the open-ended comments, results show that participants had access to appropriate digital technologies (i.e., devices and internet), felt reasonably confident to complete the exam and mostly agreed that the online proctoring system was easy to use, clear and understandable, and convenient to access. Reported confidence and perceived ease of use were consistent across the survey cohort with no significant differences found between groups across all demographics. The high percentage of participants with appropriate digital devices and internet connections are in line with those reported by Aguilera-Hermida (2020). The perceived ease of use results are similar to those reported by Raman et al. (2021) and Selwyn et al. (2021) who found that, despite some challenges, students were mostly satisfied with their experience. Perhaps unsurprisingly, a strong positive correlation was found between students' self-reported confidence and perceived ease of use. In other words, students who reported higher levels of confidence also agreed that the proctoring technology was easy to use.

Most respondents also rated their general digital competence at an intermediate level in terms of problem-solving, identifying technical needs, using digital technologies, and identifying competence gaps. In addition, online learning experience (i.e., time learning online) was found to relate to perceived digital competence across the respondent group. However, further analysis revealed a more nuanced picture based on ethnicity.

More Asian learners than expected rated their digital competence at a basic level and less at intermediate and advanced levels. This result reflects the fact that most international students, who travelled to New Zealand to study, were of Asian ethnicity and were typically on-campus students and therefore generally possessed less than 1 year of online learning experience, if they were new to New Zealand or in their first year of study, prior to the introduction of COVID restrictions. More New Zealand European learners than expected rated their digital competence at intermediate or advanced levels and reported being relatively experienced online learners. More Māori learners than expected also reported having more online learning experience (i.e., between 1 and 2 years). These results reflect the demographics of New Zealand-based learners at the institution in which this study was undertaken.

The most notable result was that more Pacific learners than expected rated their digital competence as basic, even though the number of Pacific learners with less than 1 year of online learning experience (i.e., inexperienced) was as expected. In other words, more time spent learning online did not translate to perceptions of greater digital competence for this group of learners unlike other ethnic groups. As priority learners identified by the New Zealand Ministry of Education, it is acknowledged that Pacific Peoples tend to experience more barriers to accessing tertiary education than other learners and are therefore provided more funding and resources because of systemic inequities (Ministry of Education, 2021). It is also known that Pacific Peoples tend to experience greater digital exclusion in wider New Zealand society (Citizens Advice Bureau, 2020; Department of Internal Affairs, 2020; Starkey et al., 2018). This finding highlights the importance of understanding and accommodating the diverse needs (i.e., digital capabilities) of students, as other researchers have highlighted (Azionya & Nhedzi, 2021; Dawson, 2021).

5 | CONCLUSIONS

As with all research, there are limitations associated with this project. Primary among them is that the findings have limited generalisability as the sample came from one university located in New Zealand. Furthermore, a self-reported measure of digital competence was used which may not be a true reflection of students' actual digital capabilities. Nevertheless, this study provides insight into the perceptions of students whose end-of-semester paper-based exams were replaced by online proctored exams because of COVID-19. In doing so, it adds to the growing body of knowledge about students' experiences of online exams during COVID times (Muzaffar et al., 2021). As the uptake of online proctored exams increased sharply during the pandemic, and is likely to continue post-pandemic (Selwyn et al., 2021), it is important for researchers, faculty, and university administrators to build a comprehensive understanding of the experiences of diverse groups of students and how they can be supported.

Results suggest that most participants of this study were positive about online exams, felt reasonably confident and had the necessary digital competence to succeed. The important contribution of this study was uncovering differences between students' perceptions of digital competence based on ethnicity. While more time learning online equated to increasing self-reported digital competence for most ethnic groups, this was not the case for Pacific learners. Pacific Peoples are identified as priority learners (along with Māori learners) in New Zealand (Ministry of Education, 2021) and are more likely to be digitally excluded than other groups (Department of Internal Affairs, 2020). These results highlight that digital inequality was experienced by a group of priority learners during high stakes online exams which was not related to issues of digital access (i.e., devices, internet access) that existing research has identified (Azionya & Nhedzi, 2021). Further research that uses a conceptual framework that addresses the complex explanations for and consequences of digital inequalities (Helsper, 2021), would help in this regard.

The following recommendations identify areas where institutions can further develop capacity and capability to meet future online assessment requirements. This is especially important for learners who are traditionally more likely to be digitally excluded. Primary among these recommendations is the need for targeted support and training for students whose perceived digital competence is insufficient to meet the requirements of undertaking online exams. Minimum technical requirement guidelines need to be clearly and simply communicated to students to reduce technical issues related to hardware, software, internet speed and wifi capacity. For students who

are unable to meet these minimum specifications, alternatives need to be provided to ensure they have equitable exam access (see Dawson, 2021). Any software used for online exam purposes needs to be thoroughly stress tested in exam-like conditions prior to its implementation to reduce the incidence of technical and procedural problems and student anxiety. In addition, high quality targeted support must be available to students before and during the online exam period to ensure they are not disadvantaged when issues arise.

This study adds to our understanding of learners' perceptions of online proctored exams but has also raised questions that need further investigation. Questions for future research include understanding why some groups of learners hold perceptions of digital competence equivalent to the length of time learning online and others do not, and whether perceptions of digital competence influence academic performance in online proctored exams.

AUTHOR CONTRIBUTIONS

Maggie Hartnett: Writing – original draft preparation; reviewing and editing; conceptualization; methodology; investigation; formal analysis; visualization; supervision; project administration; funding Acquisition. **Philippa Butler**: Writing – reviewing and editing; conceptualization; methodology; formal analysis; data curation. **Peter Rawlins**: Writing – reviewing; conceptualization; methodology; investigation; formal analysis; supervision; project administration; funding acquisition.

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DATA AVAILABILITY STATEMENT

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