Online Assessment and COVID: Opportunities and Challenges

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ABSTRACT

As higher education moved abruptly online in response to COVID-19, it necessarily swept assessment along with it. Assessment has long been the subject of debate, particularly in the context of ensuring that the people being awarded the grades are those who actually did the work. While some universities have moved away from rigidly authenticated assessment, trusting the students to behave with integrity, others see value in ensuring that they assess the right people. This paper reports on interviews with a dozen leading computing educators in Australia, and finds that the move online brought by the pandemic has highlighted both of these positions. Some academics do indeed trust their students to behave with complete integrity and see no need to supervise or authenticate the students' submitted work. Others strive to ensure integrity as long as all assessment remains online and unsupervised, and are desperate to return to invigilated formal examinations. We endeavour to find common ground in these positions, and discuss the likelihood of a sustainable future for assessment in computing education.

CCS CONCEPTS

• **Social and professional topics** → **Computing education**; **Student assessment**.

KEYWORDS

academic integrity, computing education, online assessment, COVID-19

ACM Reference Format:
Simon, Meena Jha, Sander JJ Leemans, Regina Berretta, Ayse Aysin Bilgin, Lakmali Jayarathna, and Judy Sheard. 2022. Online Assessment and COVID: Opportunities and Challenges. In *Proceedings of ACE 2022: Australasian Computing Education Conference (ACE 2022).* ACM, New York, NY, USA, 9 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

ACE 2022, 14-18 February, 2022, Online

ACM ISBN 978-x-xxxx-xxxx-x/YY/MM…$15.00
https://doi.org/10.1145/nnnnnnn.nnnnnnn

1 INTRODUCTION

The outbreak of COVID-19, which we shall generally abbreviate to covid, has impacted higher education in many ways, the most obvious of which is a wholesale move to online learning and teaching. Online learning and teaching, now used to some extent by all higher education providers in Australia and worldwide, brings many advantages, such as the possibility to learn from anywhere, any time, synchronously or asynchronously, thus permitting students to learn as they desire [20]. However, there are also many disadvantages, such as technological difficulties with online connections and resource downloading, and the perception that online learning is tedious and disengaging [10].

One of the major issues faced by all universities worldwide during covid is assessing students in situations where face-to-face contact and physical exam sittings have suddenly become impossible. Assessments were modified to open-book exams, online exams, and take-home exams, which were insufficiently invigilated, giving rise to widespread cheating [9] and possibly harming the reputation of the Australian university sector. For computing education, the transition was possibly even more difficult because of the nature of assessments involved in computing.

In light of the move to online assessments sparked by covid, and to investigate the opportunities and challenges arising from this change, this study interviewed 12 key academics teaching in computing courses at Australian universities to determine how they have addressed the change to assessments to fit the online environment during covid. We focus on the following research question:

RQ: How, if at all, have assessment policies and practices, particularly those relating to academic integrity, changed in response to the move to online teaching due to covid?

In answering this question, we identify themes that appear to warrant the attention of providers of computing courses in higher education.

The rest of the paper is structured as follows. Section 2 provides some of the background, focusing on the legislation and regulations that Australian universities are required to comply with. Section 3 details our research method. Section 4 outlines the findings from the qualitative analysis of the interviews. Section 5 offers a brief summary and discussion of the findings, and section 6 concludes the paper, provides some recommendations, and outlines future work.

Different institutions use different terminology for their units of teaching. Throughout this paper, we will use the word 'course' to signify a discrete unit of teaching, typically lasting one semester, for which students are awarded a formal result after completing it.

2 BACKGROUND

Academic integrity – "acting with the values of honesty, trust, fairness, respect and responsibility in learning, teaching and research" [24] – is fundamental to learning and teaching at universities, is the basis of ethical academic practices, and is considered a top priority of Australian universities [24].

Australian universities are required to uphold academic integrity by three major pieces of legislation: The Tertiary Education Quality and Standards Agency Act 2011; The Higher Education Standards Framework 2021; and The Education Services for Overseas Students Act 2000 and the related National Code of Practice for Registration Authorities and Providers of Education and Training to Overseas Students 2007.

According to the Higher Education Standards Framework [22], methods of assessment should be considered in conjunction with the overall design of the course of study, and students' achievement of the course learning outcomes is to be credibly assessed by the education providers. With the move to online education, breaching academic integrity may be easier for students. According to TEQSA's Online Learning Good Practice [23], maintaining academic integrity is a concern in the higher education sector, and the change to online delivery of education has the potential to exacerbate the problem. Writing for TEQSA, Martin [12] suggests that:

- the higher education provider should review its academic integrity policies and procedures to ensure that they allow for additional challenges of academic misconduct that may be easier in the online environment;
- the current processes may require amendment and extra safeguards built into academic management and assessment; and
- steps should be taken to authenticate online assessment.

Concerns about academic misconduct require Australian universities to establish policies, practices, and procedures to enforce academic integrity, by providing education and training on what constitutes good practice, and to mitigate the risks to academic integrity [3, 21]. Policies typically require students and staff to uphold academic integrity principles and set out procedures to follow if these principles are breached [4]. There have been investigations into the development and implementation of academic integrity policies across Australia, and into their efficacy and effectiveness for non-text assessments such as computer programs [18].

There is a great deal of research into academic integrity at institutions of higher education, both in Australia and elsewhere. Investigating the attitudes to academic integrity of the students and academic staff at an Australian university, Busch and Bilgin [6] identified a mismatch between the perceptions of the two groups. Academics believe that most students do not understand what plagiarism is, while most students believe that they do know what it is. Citing the increased number of international students and their different cultural expectations, Busch and Bilgin [6] advise academics to be aware of unintentional plagiarism due to students' poor understanding of what constitutes plagiarism. A recent study by Curtis et al. [8] of 4098 students at six universities and six independent higher education providers in Australia concludes that eight percent of students have paid commercial sites to ghostwrite assignments for them, and 11% have submitted assignments written by other people. In another recent study, Reedy et al. [14] surveyed 308 students and 24 academics at three Australian universities. Some of their findings are that both academics and students are confused about what constitutes cheating in online examinations; that it is important to move to assessing higher-order thinking skills; and that students (but not academics) believe that cheating is harder in online exams than in face-to-face exams.

3 METHOD

This research was conducted between January and June 2021 to explore policies, procedures, and practices for academic integrity in Australian universities. It explored the practices adopted by computing educators in Australian universities for upholding academic integrity in light of the online move forced by covid, focusing on bachelors and coursework masters degrees rather than doctoral studies and other research.

The first phase of the research involved examining the public-facing web pages of all Australian universities, first to establish whether they offer computing degrees, and second to search their policies, if accessible, for mentions of online learning and assessment. The results of that phase have been reported in a separate publication [11].

The second phase entailed interviews, one of the most effective techniques for qualitative research [13]. Having identified 41 universities in Australia that offer computing programs, we searched the websites of those universities to identify appropriate academics, and sent them email requests to participate in interviews. Of the 41 academics who were invited, ten agreed to participate in interviews.

The research team developed 12 questions to investigate the research question by identifying the strengths and weaknesses of the procedures used during covid to address academic integrity for online assessments in computing courses. The interview questions are listed below:

(1) What types of assessment were conducted online or remotely in computing courses at your university before covid?
(2) What types of assessment were conducted online or remotely in computing courses in your university during covid?
(3) What is the normal support provided for designing, creating, and administering online assessment tasks? What are people expected to do?

(4) What were the challenges for moving to online assessments in such a short time? What kinds of difficulty did you face?
(5) Were there any changes in the support provided for designing, creating, and administering online assessment tasks during covid?
(6) What were your experiences with academic integrity with online or remote assessments before covid?
(7) What were your experiences with academic integrity for online or remote assessments during covid?
(8) Do your academic integrity policies and procedures explicitly address the current covid situation?
(9) Which policies and procedures for online assessments worked well and which did not work so well during covid? Did the pandemic bring to light any deficiencies in the policies and procedures?
(10) Was there any workload adjustment for the impact on stress and time?
(11) In your opinion, what should be done to ensure academic integrity in online or remote assessments?
(12) Do you have any suggestions for dealing with academic integrity in online or remote assessments?

Pilot interviews were conducted with two members of the research team to ensure the reliability and quality of the questions, to confirm the estimated interview time, and to check the functionality of the interviewing, recording, and transcribing process. As these interviews did not lead to any changes in the questions, they were included with the ten subsequent interviews, giving a total of 12 transcripts for analysis.

All interviews were conducted using Zoom, and were recorded with the permission of the interviewees. Transcription began with the automatic transcripts provided by the Zoom software, and continued with substantial editing of those transcripts to correct errors. Each transcript was checked and edited by three members of the team, after which it was agreed that the transcripts were reliable renditions of the interviews. During this editing process, the researchers highlighted passages of interest and annotated them with possible themes, and one member of the team copied these annotations to NVivo for further analysis.

We chose thematic analysis as the method to identify the ideas and concepts from the interviews. This involved following six distinct phases [7]:

(1) transcribing and editing the Zoom interview data, and reading and re-reading the transcripts;
(2) generating the initial codes related to online assessments;
(3) combining the codes to develop themes;
(4) examining the themes and data to see the patterns so that an accurate analysis can be conducted;
(5) developing a comprehensive analysis around the themes and generated patterns;
(6) reporting on the themes that make meaningful contributions to the examination of academic integrity before and during covid.

As described above, the transcription and editing were partitioned, with three team members taking responsibility for each transcript. The subsequent steps of the analysis were carried out by most or all of the team working together in a series of Zoom meetings, with any initial disagreements resolved by discussion.

4 RESULTS

In this section we report the principal findings from the interviews, supported where appropriate by quotations from the transcripts. Interviewees are identified by the codes I1 to I12.

A university's assessment practices are a reflection of its values [2]. All Australian Universities have a responsibility to teach the curriculum and then to assess students on the basis of that curriculum. The basic purpose of teaching students in a classroom is to assess and evaluate them to ensure that a successful student meets the learning outcomes of the course and the graduate attributes of the degree. The award of a degree should attest that the graduate has achieved the graduate outcomes of the degree and the learning outcomes of its courses.

As in many other disciplines, assessment in computing courses can include group work, presentations, quizzes, and exams. However, it can also entail assessment in computer labs, which it shares with fewer disciplines; and many of its assessments involve types of activity that are highly specific to computing, such as programming, database design and implementation, and so on. Practical and computer lab assessments are often conducted face-to-face, but have been forced by social distancing rules to move online. The pandemic also forced the conversion of written exams to other forms of assessment such as online proctored exams, open-book exams, take-home exams, and presentations. All of these forms of assessment were conducted online following the imposition of social distancing rules, with the computer-based technological platform serving as the communication channel and middle layer between students and academics. All of the assessment themes resulting from our analysis are wrapped around online delivery.

4.1 Group Project Work

According to the Accreditation Manual of the Australian Computer Society [1], accreditation of computer courses requires the inclusion of team-based projects or other teamwork. In computing courses, teamwork is achieved by designing group projects on which students will work for one or two semesters. Even though some groups find ways of partitioning the work so that each member takes responsibility for a distinct component, the project nevertheless requires a minimum level of cooperation, and a higher time commitment from the students and academics than with other kinds of assessment such as exams.

Before covid, group assignments typically required students to spend substantial time in face-to-face communication. Being of the technologically advanced generation, students were also using online communication tools such as WhatsApp, Facebook Messenger, and Discourse. Ideally, students are given some guidance about the benefits and issues of working in teams to help them achieve the best outcomes and equip them to deal with problems such as dysfunctional teams. Assessments of this sort need a lot of time, and are generally completed by students outside the class and unsupervised: "every assignment that they get, they have time to do it, and they'll probably do it at home" (I11).

Moving group projects fully online due to covid brought challenges to the facilitation of group work. It was no longer possible to allocate class time for the group work in which students could work on their projects while academic staff moved around the classroom helping students. It involved additional and sometimes innovative work, including adoption of technology-based group tools that required time and resources for academics to learn for themselves. "We didn't have ample time to look thoroughly at designing assessments, and particularly group work assessments" (I3). Moving online after the start of semester was especially challenging for group work since students had already started their work in a face-to-face mode. Over time, with experience in technology "to allow people to select projects, to select group members" (I10), although still harder than face to face, "once you do it frequently, then it becomes easier" (I10). Nevertheless, "making the students work together in the online setting is very much a challenge compared to the face-to-face challenge" (I10).

Students found it hard to adapt their group work to online study. They were not used to managing their own time since project meetings had typically taken place during their time on campus, either in or outside class. "They don't come to the meeting, or they don't collaborate with their peers, although they're in the same project" (I10). Academics also found it hard, especially when they could not find policies in place to support the change to online education, and some of them were not adequately supported by learning and teaching teams.

Due to accreditation, computing courses involve group work which has normally been conducted in class. The move to online education meant that planned or started group activities now had to be facilitated in the online context. Technological solutions that enable students to choose their projects and their group members were of some help in subsequent semesters, but not in that first semester when the work had already begun. Some academics reported that prior to covid there had been no requirement for students to adopt a cloud-based tool to facilitate group work since they could meet face to face and work together on their project. But with the new restrictions, use of cloud-based tools became a requirement for group-work assessments. Academics reported the adoption of different online collaboration platforms such as Slack and JIRA boards, which had the potential to track and identify individual student contributions. These online interactions also became incorporated into the assessment since they can be observed, whereas it is not so easy to observe and assess face-to-face student meetings.

There were challenges and unexpected issues because of moving to fully online learning, teaching, and assessment within a very limited time. Some academic staff required professional development on how to do certain things online and how to use new technologies: "I think there was a little bit of support ... but by and large, we were left to our own devices to work out what that might look like" (I7). Some academics found the newly designed assessments to be good and easier to mark. Some also believed that their students found it much better to use computers for the assessments since students would normally use computers for their work: "Normally, you know, people work on a computer. So some people certainly decided that their experience with the online exams was so good that they wanted to retain that" (I2).

4.2 Exams

Most interviewees talked of having face-to-face invigilated final exams in their courses. Some also mentioned in-class tests (I11) that were invigilated (I2). One or two discussed examination arrangements in their existing online courses, in which they employed the services of commercial proctoring agencies. Some interviewees indicated that invigilated final exams are a requirement of degree accreditation by the Australian Computer Society. This might well be the case in practice, but the society's accreditation manual notes only that "There will be mechanisms to address identity management in a virtual environment" [1, p17].

Formal examinations underwent immense changes when the pandemic struck. It was a uniform perception that moving exams online meant moving them from supervised to unsupervised. Even those institutions that had been using proctoring agencies for specific online courses were unable to expand that use to cover all of their courses; and had they been able, it is not clear that the agencies would have been adequately resourced to cope with the influx.

Unsupervised exams are necessarily open-book exams, with students able to use whatever resources they can access. Many academics recognised that this rendered certain types of question unsuitable. For example, if a question asks students what output a certain piece of program code will produce, the student can simply execute that code and copy the answer. "Question types that might have been suitable for a face-to-face exam were no longer suitable" (I3); "What we tried to change is the style of questions that were asked, because of the acknowledgement that it was an open-book exam" (I7); "Some kinds of question are more appropriate if you're doing online as opposed to offline" (I10); "We had to throw away a number of useful question types, and replace them with a more limited range of question types" (I11). While none of the interviewees explicitly said so, this would seem to be an opportunity to assess higher levels of learning according to Bloom's taxonomy.

I12 describes in great detail the effort devoted to devising questions that could not be answered by reference to lecture notes or by online searching, only to discover after the exam that many students simply collaborated and answered the questions jointly.

Beyond the need to change question types, I11 pointed out a workload implication of online exams. In the past, it had generally been possible to reuse some questions from one exam in another. But "when an exam is online, we must assume that there are copies of that exam out there among the students." As a consequence, every exam needs to be completely new – and if a course has multiple offerings, perhaps on different campuses, that can mean the creation of a large number of completely distinct exams.

A number of interviewees reported an increase in academic misconduct when their exams moved online. "The biggest concern was how to ensure the integrity of the assessment when you don't have the student in the room" (I8). "There was a lot more cheating, both plagiarism and collusion ... students are cheating in way that they were not able to cheat with paper, supervised exams" (I11). A number mentioned specific websites that can be used for cheating: "there are some websites where you can post a question and you get an answer; or you can even have online helpers, who can help you with a project or exam or something like that" (I10). I7 notes

that "we would release the exam at 8am ... and about 20 minutes later the questions were appearing on the contract cheating sites ... we couldn't do anything in that context to try and prosecute or trace things ... we reported these to the university, which was very surprised"; and "we did think of limiting the time they had available to do the exam, but clearly, the internet moves faster than we do" (I7).

A number of interviewees reported the introduction of vivas, post-exam interviews to help establish whether the exam was completed by the student working alone. Students were informed before the exam that they might subsequently be required to attend a viva. Students might be selected randomly for a viva, or might be chosen because of suspicions raised by their online exam answers. This practice entailed an entirely new set of procedures and kept academic staff on their toes during the examination and marking processes, increasing their workload without compensation. After explaining the concept of a viva, one interviewee remarked: "This is one measure that the university brought in to try to discourage collusion during exams, and it doesn't work ... the thought of a viva didn't stop them cheating" (I11).

There was clear appreciation that exam timing can be an issue for students, especially those in disparate time zones, and that the students do not always have ideal exam conditions. "Some students will have a good room to sit, a good chair, good desk, good internet connections; some students will be needing to sit somewhere like in a car, using a phone with poor reception" (I1). "A lot of our students were at home, and therefore might have their children at home with them or whatever, so we gave them a lot longer" (I2). I7's university required academics to adopt one of two options: a two- or three-hour exam repeated, to accommodate students' problems with technology or timetabling, or a six-hour window in which students could do the exam. "In the end the department came down to using the six-hour window and essentially just allowing any time; so effectively a six-hour exam for pretty much all the exams in semester one, which turned out to be allowing the students at least twice as long as they would normally have for the exam" (I7). At another institution, I2 reports that all exams were replaced with 24-hour take-home exams.

Some interviewees extended their appreciation of the student perspective to the increase in cheating, which was "partly because of accessibility of information and the lack of invigilation; but also, there's a very big panic by students, because it was something new to them as well" (I8). And "stressed students will take advantage of opportunities to improve their mark if they can" (I7).

A number of interviewees showed evidence of trust in their students. "If you know your students, you will know whether they are cheating" (I2). "One student said to me 'You know we're going to cheat, don't you?' I said 'No, I have faith that you won't cheat,' and he said 'Well, I have faith that we will cheat' " (I4). One interviewee presented a particularly interesting perspective. As the head of school, every time a student was found to have plagiarised he invited the student for a chat, where he explained some of the consequences of plagiarism, with high-profile examples. "All these students say, I had no idea; that was just this big mistake. I say that's fine. You come to school for a reason; it's a place for you to learn. And then we move on. None of those students committed plagiarism again; none of them." (I1)

Almost without exception, the interviewees saw no need for academic integrity policies to change during covid. "I don't believe that any of our policies and procedures for assessment make explicit mention of online assessment. Our policies and procedures are at a higher level than that, and they are written in a way where you wouldn't expect them to cover that level of detail" (I11). "The policies, essentially, were the same. The difficulty is in the identification, the evidencing, actually confirming the allegations. The policies themselves, though, didn't relate specifically to covid" (I8). I7 elaborated: "All of those policies are fine and they worked. The policies themselves are all about what constitutes academic honesty and that's not really changed. It wasn't the longer term policies that were the problem, it was the short term solutions that were the problems that we faced."

One interviewee did see a disparity between policy and practice, but appears to have been given the freedom to override the former: "I would say that we didn't have good policies in place to support this change to moving online. But the university supported us by saying, do what you need to do, and ask permission to make the changes after you've made the changes. So really, we just had to document what we'd done" (I4).

There was also one suggestion of an actual change of policy. I12 describes the introduction of an 'academic safety net' whereby students who had passed a course, but with a lower grade than they were used to, could elect to have the course 'satisfied' without contributing to their average grade. "This was introduced in semester 1 2020 and continued on for the next semester and continued on again this year. So that was a new policy introduced for handling the covid situation " (I12).

Considering the future, the interviewees expressed a number of thoughts and aspirations with regard to exams. I2 notes "there were certainly some staff who found that the outcomes from running alternatives to the formal exams they found were good, they actually found that it made marking easier"; but the same interviewee would like to replace final exams with multiple smaller assessments, suggesting that these are more difficult for students to outsource. I7 says that "We haven't come up with an answer as to how to do assured assessment online ... all of the solutions that we've tried for online invigilation have problems of one kind or another," and I11 is a little more forceful: "you cannot ensure academic integrity in online assessment." I9 suggests that if online exams must be continued, there must be online proctoring that adequately supports that form of assessment; but in fact prefers the idea of changing to a continuous assessment regime with assignments released every two weeks or so. I12 advocates the early resumption of face-to-face invigilated exams, while acknowledging the difficulty that this will pose for students who remain overseas.

4.3 Assignments

A typical form of assessment in computing programs is an assignment where students work on a project individually or in a group over a period of time, mainly outside of class time. Often the work is submitted electronically through a learning management system. In these regards, assignments can already be considered a remote form of assessment.

Assignments were not greatly impacted by covid, according to the interviewees. During covid, the students were given a specification, as was done pre-covid, for which they produced a solution and submitted it online. The assignments were marked and feedback given either online or during an interactive class session, rather than in person.

One interviewee, however, found that during covid the assessment of assignments was more challenging. Before covid, they used interviews as a means of verifying that the programming assignment submitted was the work of the student. During covid, as they could not conduct interviews in person, the interviews were held via Zoom sessions.

> We had a few challenges with this, because we insisted that students would identify themselves and turn their cameras on to show their face ... and some were reluctant to do this. Some students said, I haven't got a camera. So we gave them plenty of warning and told them you have to make sure you have audio and video turned on on your computer. I think we had one case where a student used their phone ... they said their camera wasn't working on the computer. So we did it that way. And we insisted that otherwise we wouldn't assess them. (I12)

The interviewee further mentioned that there were academic integrity issues with the interviews:

> Some students, when they were asked a question, they would sort of look away from the screen, and then look back and answer the question. The student would look like they were talking to someone else in the room. (I12)

4.4 Practical Assessments / Lab Work

In computing courses, classes are often held in computer labs where students may work on tasks that are to be assessed. Some interviewees mentioned that conducting this form of assessment was problematic during covid. The main issue raised was invigilation. When students are assessed in labs they are under the observation of their instructor. During covid, however, students were often allowed to do these lab classes in a non-invigilated setting. Sometimes students completed the tasks during an online video session which simulated a lab class, where students could be observed while they worked, but often the students would complete the tasks in their own time and submit them online.

The interviewees did not express many concerns about these assessments. As one interviewee explained, "they actually don't have too much weighting, like 10%, 5% ... It's not much but it actually helps them to be motivated and engaged with the unit" (I5).

4.5 Quizzes

Before covid, many assessment regimes included quizzes. According to our interviewees, these were always administered online through a learning management system. They were occasionally held during class, in which case they could be monitored (I9); but in most cases they were unsupervised, raising concerns about academic integrity: "It's just multiple choice and stuff. How do you check that? It could be somebody else has done it, or they have done it in a group of 10 people" (I5).

When education moved online in early 2020, quizzes were for the most part unaffected. Some interviewees spoke of introducing more quizzes, as small low-stakes assessment items. I9, whose quizzes were formerly monitored, noted seeing an increase in integrity issues due to students working together, accessing the internet, or working from prepared materials of a type that they were not permitted to use in supervised quizzes.

Presenting a strong position, I5 remarked that "We have to stop having quizzes. The Australian Computer Society, our accreditation body, says that you cannot have the quiz as a main assessment. Some units have a 100-question quiz as their final exam. There is no way you can have that kind of assessment."

4.6 Presentations

Oral presentations are a type of assessment that allows students to answer questions directly and in person, demonstrating evidence of their understanding of the concepts leading to the intended learning outcomes.

Before covid, oral presentations were usually conducted face to face in a classroom setting rather than online; however, some required the submission of presentation slides or videos, submitted online by means of the learning management system. When covid struck, all in-class face-to-face presentations were replaced by online presentations on platforms such as Collaborate or Zoom. The move from face-to-face to online presentations was not always smooth, and academic staff and students encountered many technological issues making presentations difficult to conduct.

Although in the context of a meeting, I1 spoke of "a real digital divide. I had a meeting with a student, and I could see two bedrooms behind him. He was sitting in a very uncomfortable position in one of the beds with this small improvised table where his old laptop was sitting. And the microphone was not working well. I could see that was just not working for him." Students faced with these circumstances in a meeting are undoubtedly faced with the same circumstances when required to make an oral presentation.

Some academics had difficulties getting students to turn on their cameras, something some students were reluctant to do. Academics wanted to be sure that the right students were presenting, and were not hiding their faces behind the technological glitches. Academics would ask the students to check their audio and video before the presentation, but this was not always done satisfactorily. Some students used their phones for the presentations, and academics were sending them continual reminders to turn on their cameras during the presentation. I3 mentioned that some students had the option of "submitting a video instead of attending an in person presentation", and suggested that students are more comfortable sending recorded presentations than presenting in person online. I3 continued: "there was an additional flip to more of the online presentation, particularly where a group might present the results of a project as part of their assessment".

Presentations were also sometimes introduced as a new form of examination, or, like a viva, to supplement online assessment. Unlike vivas, they appear to have been required of all students. According to I9, "an oral exam or some sort of a presentation that

you have to give somewhere at the end would be a replacement for assessments", to ensure that academic integrity is met. Also, "with regard to those who are doing the quizzes, the discussion is to add an oral assessment to prevent it from academic integrity breaches" (I9).

We did not identify any major changes to academic integrity policies reflecting the practices discussed above.

5 DISCUSSION

5.1 Interpretation of Results

Assessment is a vital component of learning and teaching, aiming to measure the students' knowledge of the material acquired during a course. It is also essential for creating feedback for students, allowing them to improve their learning. An essential aspect of assessment is to help ensure academic integrity, making sure that the work submitted by students is their own. The increased issues of academic integrity in online assessment settings – more opportunities, more cases, more difficult detection, more difficult gathering of evidence – seem to be widely recognised by academics involved in computing education.

With the advent of covid in 2020, universities had to quickly move all their teaching, including assessment, to an online environment using learning management systems and other online tools. The challenges were numerous. Exams, typically conducted face-to-face before covid, all moved to an online setting during covid. After the initial changeover problems, the main remaining concern was academic integrity. Some universities adopted proctoring for online exams, but due to the practicalities of adopting this solution on a large scale, most universities moved to non-invigilated online exams, perhaps followed by vivas for a small number of selected students. However, the wholesale change to online exams also brought opportunities. The knowledge and innovation generated by moving so many exams to an online setting and trying to assure academic integrity have increased interest in designing higher-level assignments, and are leading some universities to consider moving entirely to online exams.

Group work brought different challenges and opportunities. Before covid, group work was conducted partially face to face, and students would typically exchange information using online platforms. However, with covid, students had to complete the entire group work online. One of the main challenges was time management by students. Also, academics were required to quickly learn specific online tools to support and manage group work, which was very time-consuming. However, all the knowledge learnt created opportunities to manage group work in more efficient ways in the future.

Policy and procedural changes are not following at the same pace as practices. An earlier analysis of the publicly accessible policy documents of all 41 Australian universities that offer computing degrees [11] showed that few of these policies explicitly consider online assessment types. Most interviewees supported this view, confirming that their universities have no explicit policies on online assessment, even though the interviewees agree that the academic integrity issues and challenges are well known and widespread. A straightforward recommendation is that universities produce clear procedures and policies based on the knowledge, experiences, and innovation generated by the massive online teaching and learning move. Another approach might be to amend the overarching accreditation guidelines for Australian computing degrees, which could prove a catalyst in the struggle against online cheating. While the accreditation manual currently only mentions that "There will be mechanisms to address identity management in a virtual environment" [1, p17], the guidelines might be extended to incorporate minimal requirements for misconduct prevention and detection. Overall, we expect university policies to catch up sooner rather than later; and we are aware that some universities have already begun the process of updating their policies to reflect the new reality.

The sudden move online has also provided new opportunities, such as a move to higher Bloom levels of assignments and open-book quizzes that might better correspond to the types of task performed by computing graduates in industry.

5.2 A Sustainable Way Forward?

Even before covid, many educators have expressed concerns about academic integrity in computing courses [19]. The move to online assessment has clearly amplified these concerns among most of our interview participants, and while some hope that a return to face-to-face assessment will bring about some reduction, the concerns will presumably still remain. Is there, then, any way to assure academic integrity in computing courses?

Many researchers have proposed specific changes that can be seen to have some impact, whether it be positive or negative. From a national study of first-year computing programs, Sheard et al. [17] found found 21 different types of strategy used by computing academics to discourage or prevent their students from cheating. These were classified into five themes: education; discouraging cheating; reducing the benefits of cheating; making cheating difficult; and empowerment. We have found in the literature that academics often employ strategies across all of these themes. Bridson and Fleming [5] replaced 'normal' graded homework with frequent, timed coding tests, but the impact is perhaps not what they were hoping for. Students disliked the change, many students withdrew during the semester, and the approach highlighted that identifying students who are struggling is by no means the same as helping them to overcome their struggles. Rusak and Yan [16] prepared a distinct exam for each student in a probability course, essentially by populating the same question skeletons with different numerical parameters selected from a sufficiently long list. While they do include a code-tracing question among their examples, they acknowledge that their approach is best suited to short-answer computational problems, which are rather more prevalent in probability than in most areas of computing. With regard to programming questions, they acknowledge that examiners might have to fall back on 'traditional plagiarism detectors or manual inspection by graders' to detect academic misconduct. Ribaux et al. [15] report a drop in detected cases of academic misconduct when they incorporate hard milestones, with brief video reports from students, throughout the lifetime of a long software project. They conclude that this approach might lead to a reduction in reliance on a final exam for measuring learning outcomes. However, most computing courses do not assess by way of a long and substantial project, and therefore would not be amenable to the approach.

These and many other approaches all offer the prospect of some impact around the edges of academic integrity in computing education, but none of them holds the promise of overcoming all of the concerns. If there is an approach that might do that, it appears that it is yet to be discovered.

5.3 Limitations

Some threats to validity and limitations of our study include the fact that of the 41 Australian universities that offer computing education we interviewed only 12 academics from 11 different universities. Furthermore, we focused on computing education, thus the results might not generalise to other fields of academic tertiary education, or to other levels of education, such as TAFE and high schools. While it is unlikely that the interviews would have included each and every issue encountered during covid, the recurrence in the interviews of the overall themes provides some confidence in their validity, completeness, and generalisability.

There might have been selection bias introduced by potential interviewees being more likely to participate if they had themselves encountered more negative consequences of teaching during covid. However, due to the omnipresence of teaching during covid and the broad range of issues with respect to academic integrity mentioned, we conjecture that this selection bias is likely to be small.

6 CONCLUSION

This paper reports the impact of the COVID-19 pandemic in assessment in computing courses at Australian universities due to the rapid transition of learning and teaching from face-to-face to online. The study's main aim was to investigate whether assessment policies and practices, with particular regard to academic integrity, changed in response to the move to online teaching due to covid. We interviewed 12 key academics, performed a thematic analysis, and identified several challenges and opportunities.

While the main challenge was academic integrity in many types of assessment, the knowledge and innovation generated by the transition to an online setting while trying to maintain academic integrity have increased interest in designing higher-level assessment items, and have led some universities to consider moving entirely to online exams. However, assessment policies have not changed, which suggests that universities need to review their assessment procedures and policies based on the knowledge, experiences, and innovation generated by the massive switch to online education.

The next step for this project is to conduct a survey of Australian computing academics to gather quantitative data on the questions that have arisen from this qualitative analysis. With the survey we expect to identify current practices and how effective they are, and to discover what is done to prevent misconduct at the level of individual courses.

The findings of this study might carry forward only partially, just as teaching might return partially to pre-covid styles as society opens up. Nevertheless, we expect that universities and students might surrender to the temptations of reducing on-campus teaching and its associated costs and annoyances in favour of online delivery models, thus yielding future relevance for our findings.

ACKNOWLEDGMENTS

This project is funded by a grant from the Australian Council of Deans of ICT.

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