Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Online assessment in a business department during COVID-19: Challenges and practices

Mahsa Madani Hosseini*, Gunawardena Egodawatte, Nursel Selver Ruzgar

Department of Global Management Studies, Ted Rogers School of Management, Ryerson University, 575 Bay Street, Toronto, M5G 2C5, Canada

ARTICLE INFO

Keywords:
Online assessment
Technical problems
Anxiety
COVID-19
Academic integrity

ABSTRACT

The sudden transition to online assessment due to COVID-19 brought unique challenges for both students and instructors. Indeed, the educational institutions were unprepared or did not have the capacity to deliver the courses online. The scarcity of literature addressing the challenges of the in-person to online migration was the main motivation for writing this paper. We first discuss the main challenges of online assessment that we experienced when migrating from an in-class to an online environment due to the COVID-19 outbreak, namely, academic integrity, adaptation to the new testing environment, technical problems and anxiety. We then elaborate on the practices we developed to minimize their impacts on both students’ and instructors’ performance. To maintain academic integrity, a combination of practices including awareness/communication, restricted test features and administrative proctoring were applied. The grade distributions of similar courses with in-class and online assessments were compared to evaluate the efficiency of the proposed practices in enhancing academic integrity. The efficacy of a pilot test in enhancing adaptation to a new testing environment is also discussed. The combination of a grace period, a pilot test and communication plans seems to be an effective practice to minimize complaints related to technical problems and students’ anxiety. Finally, we found that our coordination with the information technology department and implementing a pilot test helped instructors minimize their anxiety regarding working in the new environment.

1. Introduction

The outbreak of the COVID-19 pandemic has led to the migration of in-person classes to online classes. This has caused educational institutions to seek the best practices to deliver course content online, engage students and conduct assessments. The common challenge for this migration is to develop a reliable and effective online assessment system (Kumar et al., 2019; Mukhtar et al., 2020). According to Beck (2014), “Since its inception, online education has been maligned for a variety of reasons and one of the more prominent criticisms has been the issue of academic dishonesty in online, unmonitored testing” (p. 72). Note that many universities reported widespread cheating during the COVID-19 pandemic in Spring 2020 (Newton, 2020). The increase in cheating on online assessments during the pandemic could be due to the following reasons. First, students believe that cheating is easier on an online test since it is less likely to be caught. A survey of business students showed that 73.6% of the students had the perception that it is easier to cheat in an online versus a traditional course (King, Guyette Jr and Piotrowski, 2009). One reason can be the immediate access of students to Google and other search engines since the online exams in 2020 were not proctored (Bilen & Matros, 2021). This explains...
the rationale behind the findings. The surges of Google searches using keywords related to exam topics are perfectly correlated with the times of the examinations. Second, the stress of the pandemic has worsened the pressure on students, which has led to an increase in academic misconduct (Senoran, 2020). Third, the majority of instructors were unaware of tactics to minimize academic misconduct in an online assessment since they did not have experience conducting online assessments. It is important to note that the planned online learning experiences are meaningfully different from courses presented online as a response to the crisis (Adedoyin & Soykan, 2020, pp. 1–13), similar to what we have experienced during COVID-19.

In addition to academic integrity, the issues related to online assessments further include student and instructor anxiety, adaptation to a new testing environment and managing technical problems. A survey of 195 students indicated that 138 students (approximately 71%) experienced increased stress and anxiety due to the COVID-19 outbreak, and 82% had increased concerns about their academic performance (Son et al., 2020). Managing the new environment and technical problems of online assessments has increased both student and instructor anxiety. Technical problems such as technical glitches, slow loading times for questions, and difficulty logging into exams, to name a few, are inevitable in online assessments. Kuper (2020) reported on a medical school final exam in Canada plagued with technical issues after moving online due to COVID-19. This brought stress to students who were kicked out of the online test six times. The sudden transition to online assessment has also raised the concerns and stress of instructors regarding their capabilities to use existing technology. Weak computer competencies, a lack of online teaching experiences, and technical issues related to online platforms together increase the stress of instructors in handling online assessments.

The above discussion sheds light on the importance of designing effective practices during migration from in-person to online assessment, which is the main goal of this paper. Note that the body of literature addressing concerns related to (i) academic integrity during the sudden transition to online assessment during COVID-19 (Gamage et al. (2020) and the citations therein), (ii) the impact of the sudden online transition on students’ and instructors’ anxiety, and (iii) emerging technical issues during the COVID-19 outbreak (Alqabbani et al. (2020) and the citations therein) is scarce.

2. Research objectives and methodology

Addressing the concerns discussed in section 1, the main goals of this study are as follows:

i) to discuss the challenges of online assessment for both students and instructors specifically during COVID-19,

ii) to propose the best practices to overcome the challenges, and

iii) to evaluate the efficiency of practices to minimize their impacts on both students and instructors.

The COVID-19 outbreak has led to the transition of an in-class course titled “Applied Mathematics for Business” to an online course in Fall 2020. In this course, basic arithmetic and algebra are reviewed, and the functions that are most commonly used in business applications are introduced. This is a core course offered for first-year university students in the fall and winter semesters. Typically, more than 1800 students enrolled in this course in approximately 8 sections taught by 4 instructors in the fall. The evaluation of this course is based on 2 midterm tests, a final exam and 12 online assignments. The weights for tests 1 and 2 are 20% each, and the weight for the final exam (cumulative) is 38%. The tests and exam were held in a common course shell on the online course platform, called Desire2Learn (D2L), which was designed only for conducting tests and the final exam. The tests were scheduled on weekends to have a common test among all sections and to prevent overlapping with any other courses. The tests and final exam were open-book, and students were allowed to have unlimited access to their notes and paper-based textbooks.

The tests and final exam included a mixture of multiple choice and short answer questions. They were offered in a restricted time window. For example, we considered a 30-min window of availability to start the tests (e.g., the student could begin the test from 10:00 to 10:30 a.m.) with a 120-min test duration. Moreover, to obtain a fair estimation for the test duration, 4 instructors solved the test questions, and the time spent was recorded. We then assigned a test duration that was approximately 1.5 times the average time taken by all instructors. The distribution of the difficulty level of the test questions was 20% difficult, 60% medium, and 20% easy questions. Students had only one attempt, and one question per page was shown. We also prohibited backtracking (Budhai, 2020), meaning that students did not have the opportunity to change the answers and return to the questions already answered. Brand-new questions with 4 versions were designed. The order of questions and their answers were shuffled. We administered our tests using the LockDown Browser and Respondus Monitor, which were available on the D2L platform. For each test, a pilot test was designed with 10 questions to be answered in 30 min and was available two weeks before the actual tests. Students were informed that the pilot test resembled the test environment and was not comparable with their actual test in terms of difficulty level, number of questions or test duration.

The analysis was conducted in three main parts as follows:

To evaluate the efficiency of proposed practices in enhancing academic integrity, the grade distributions of a similar course with in-class (Fall 2019) and online assessments (Fall 2020) were compared.

To evaluate the efficiency of the practices to resolve the technical issues and students’ anxiety, the number of emails and complaints received (for all 4 instructors) and their content for each test and the final exam were reviewed. To verify every student’s claim regarding the technical issues, their attempt logs were assessed. The attempt log tracks detailed quiz attempt events such as quiz entry and re-entry times, response saving time, page movement time, and quiz confirmation screen/completion time per user.

To evaluate the impact of the pilot test on students’ adaptation to the new environment, a poll was conducted in the online class through Zoom (video teleconferencing software), and its results were assessed. Students were asked the following question. Was the pilot test helpful for you to be familiar with the online testing environment with proctoring? Yes. No.
3. Online assessment challenges and responses

It was important to have reliable and effective online assessments for this course since two midterm tests and final exams comprised 78% of the final grade. Therefore, in this section, we have discussed the outcomes of the practices applied to overcome the main challenges of online assessment, namely, academic integrity, the new online testing environment, technical issues and anxiety; and related them to the existing literature. Table 1 summarizes the main challenges in our online assessment, and how the practices impact both students and instructors. For example, referring to Table 1, the pilot test positively affected overcoming the challenge of technical issues for both students and instructors.

3.1. Academic integrity

Maintaining academic integrity in the online assessments of a math course is more challenging than in a writing-based course for the following reasons. First, the assessment of writing-based courses is based on students’ writing fingerprints. Therefore, an instructor can verify academic honesty by comparing a student’s submission with their other written or discussed pieces (Trenholm, 2007). This is not readily available in the assessment of an online math course with final solutions that are numbers. Second, there are many available online resources that students can use on their math tests without relying on their own math knowledge. One example is online calculator websites that factor or find the roots of polynomial equations (e.g., https://www.symbolab.com and https://www.mathpapa.com).

To address the above concerns, in the first step, we improved student awareness by familiarizing students with academic integrity policies. It has been reported that prevention and awareness are the two most important goals of any effort to address academic integrity issues (Michael & Williams, 2013). Among other things, certain aspects of student behavior, attitudes, perceptions and understandings deserve greater attention; and the effectiveness of institutional practices in helping students avoid academic misconduct is an important factor to consider (Jagger & Volkman, 2014; Perry, 2010). The former, i.e., prevention, begins with clearly defined academic integrity policies that guide students in a responsible manner. Academic integrity offices at universities are responsible for promoting cultures of integrity and educational excellence by informing, inspiring and educating the members of the community. Studies have shown that schools with academic integrity pledges reported fewer cheating behaviors during tests than schools without such pledges (Jones, 2007). The findings also show that the incidence of cheating may be reduced if cheating consequences have been advertised and are visible to students in multiple places (Sutton, 2019). To discourage students from cheating on their tests, we provided the academic integrity policy in the course outline to inform them of definitions of academic dishonesty and its consequences. For example, the following statement was added to the course outline to inform students of the consequences of academic misconduct: “Students who have committed academic misconduct for the first time will, at a minimum receive a “0” on the work, and the professor may assign an “F” in the course. The Academic Integrity Seminar will also be assigned and students will have the notation Disciplinary Notice (DN) placed on their academic record and official transcript. The notation shall remain until the students graduate, or for eight (8) years, whichever comes first”.

We also consistently and persistently discussed academic integrity in our virtual classes and posted multiple related announcements on our course platform.

In addition to using prevention and awareness to maintain academic integrity, there are many reported restricted test features to reduce the risk of cheating in online assessments. They include showing one question at a time, prohibiting backtracking, limiting the test duration, and randomizing questions and answers (Budhai, 2020; Shraim, 2019; Williamson, 2018). Therefore, in the next step, we considered different features in the online test to help minimize academic misconduct. Namely, we considered a strict time window, prohibited backtracking, designed a pool of questions, shuffled the questions, gave multiple versions of the same test, designed brand-new questions, and implemented proctoring. To minimize the ability of students to share information, the test was offered

| Practice Challenge | Restricted Test Features | Pilot Test | Recorded Proctoring | Awareness and Communication |
|--------------------|--------------------------|------------|---------------------|-----------------------------|
| Academic Integrity | Student + 2 | NA* | + | + |
| Instructor NA | NA | NA | NA |
| New Online Testing Environment | Student - 4 | + | - | + |
| Instructor - | + | - | + |
| Technical Problems | Student - / + | + | - | + |
| Instructor - / + | + | - | + |
| Anxiety | Student - | + | - | + |
| Instructor - | + | - | + |

*Indicates the practice positively affects the challenge.
Not Applicable.
Indicates the practice negatively affects the challenge.

a Restricted test features include a strict time window, no release of test score and showing questions after finishing the test, prohibiting of backtracking, designing a pool of questions, shuffling of questions, designing brand-new questions, and offering a grace period after the time limit.
within a strict time window with a limited completion time and backtracking was prohibited. Based on the average grades for all tests and final exams (Table 2 and Fig 1–3), we believe that the duration of the test was not long enough to violate academic integrity. It was also not short enough to receive student complaints regarding the test duration. Our records showed that the majority of students, approximately 92%, were able to finish the test within the allotted time. To minimize the probability of receiving the questions in the same order, 4 versions of each question were designed, and the order of the questions and the order of the answers were randomly shuffled.

As discussed earlier, one challenge of online tests is the immediate access of students to Google and other search engines. Students in online tests are indeed using the Internet to search for answers to specific questions through another computer or a cell phone, even in the presence of proctoring (Golden & Kohlbeck, 2020). Therefore, the risk of academic misconduct increases if the test questions come from a test bank since most of the test banks and solutions are available on the web (Madara et al., 2017). Our first step to address this concern was to design brand-new questions that result in the test contents not being searchable on the web. The second step was to apply proctoring tools. Note that the test takers occasionally violated unprotected Internet-based testing behavior agreements by receiving assistance from others, searching the Internet, and copying test content (Bloemers et al., 2016). Bloemers et al. (2016) found that cheaters frequently have someone else take the assessment or receive assistance during testing. It has been reported that students admitted to cheating on their online exams and tests regardless of prohibiting the use of notes, textbooks and electronic devices. An exploratory experimental study showed that remote proctoring did not directly affect test performance; however, it decreased cheating (Karim et al., 2014). Therefore, to minimize the ability of students to receive assistance on the tests, we administered our tests by using the LockDown Browser and Respondus Monitor as a recorded proctoring tool that was available on the D2L platform. This system reduces the likelihood of cheating in different ways. First, it prevents students from printing, copying, going to another URL, or accessing other applications during a test (Alessio et al., 2017; Hussein et al., 2020). Second, the identification of the student was verified to ensure that the person appearing for the test was the person who should be taking the test (Hussein et al., 2020). Third, student behavior was video-recorded, and any irregularities or suspiciousness were flagged. A red flag indicates that the recorded and flagged videos should be reviewed for further appropriate action (Dendir & Maxwell, 2020).

Besides all its benefits, applying the LockDown Browser and Respondus Monitor results in three main concerns. The first concern was the safeguarding of personal data and violating personal privacy (Karim et al., 2014; Weiner & Hurtz, 2017). However, we are allowed by our university’s privacy and security office to apply this proctoring tool as the only tool available for the faculty to use for virtual invigilation. The second concern was the heavy workload to review the recorded videos. To rectify this concern, we hired reliable graduate assistants to review all student records and report suspicious cases. The third concern was our adaptability and familiarity with using the LockDown Browser and Respondus Monitor and handling the technical issues related to administrating this tool during our tests. The applied practices to handle this concern will be discussed in sections 3.1.2 and 3.1.3.

As we discussed above, three main practices were applied to maintain academic integrity in our online assessments: (i) student awareness, (ii) restricted test features, and (iii) recorded proctoring (Table 1). To study the effect of proposed practices in enhancing academic integrity, the grade distributions of a similar in-class math course (Fall 2019) and our online math course (Fall 2020) were compared. The grade distributions for the two courses were as follows (Table 2).

The above results show that there is a reduction in the percentages of grades of “A” between the two semesters for both test 1 and test 2. An approximately 4% increase in grades of “F” is shown for test 2, and another 4% decrease in grades of “F” is shown for test 1. The final exam results are not directly comparable because in Fall 2019, the final exam was based on the materials that were not tested in test 1 and test 2 while the Fall 2020 final exam was cumulative. Still, with this change, the grade patterns are on par with those of other tests except for a sharp decline in grades of “A” on the final exam. This may have been caused by the difference in the material content tested in the two exams. Despite these changes, all the other percentages for both tests and the exam generally increased from the in-class test to the online test. This indicates that the measures taken by the instructors to maintain the same integrity level during the online tests as during the in-class tests had obtained considerably successful results. Given that students were selected for the course annually based on the same baseline test, the assumption here was that if academic integrity had been violated in online tests, the percentage increase of grades should be considerably higher than this. The following three figures show the graphical distributions of the marks for the two tests and the exam, respectively.

Comparing the line graphs for Figs. 1 and 2 shows that there are no extremely high or low points for the two graphs that are incomparable with each other. Both graphs follow similar patterns and remain close except for a few minor oscillations. A slightly different pattern emerged for the final exam because the same concepts were not tested in the two exams, as mentioned earlier. Therefore, it is further evident that the measures taken to maintain similar environments for in-class and online tests were successful. This further establishes our assumption that the academic integrity level was closely maintained in both environments. If academic

| Grade | Test 1 Fall (2019) | Test 1 Fall (2020) | Test 2 Fall (2019) | Test 2 Fall (2020) | Exam. Fall (2019) | Exam. Fall (2020) |
|-------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| A (80%-100%) | 19.48% | 14.93% | 29.27% | 13.00% | 34.59% | 5.36% |
| B (70%-79%) | 18.82% | 20.87% | 15.03% | 20.75% | 14.80% | 12.04% |
| C (60%-69%) | 18.36% | 19.92% | 15.95% | 16.58% | 13.64% | 16.33% |
| D (50%-59%) | 17.30% | 21.76% | 12.72% | 18.90% | 10.44% | 28.06% |
| F (0%-49%) | 26.04% | 22.52% | 27.03% | 30.77% | 26.53% | 38.21% |
integrity had been seriously violated during the online tests, one could expect a sharp increase in grades of “A”, “B”, “C”, and “D” and a sharp decrease in grades of “F” for the two tests.

3.2. Adaptation to a new testing environment

The next concern with the transition of in-class tests to online tests during the COVID-19 outbreak was students’ adaptation to a
new testing environment. A recent study by Besser et al. (2020) compared student reactions to online conditions versus face-to-face learning conditions. It has been shown that students had dominant negative reactions to online conditions during the COVID-19 pandemic because of their lack of adaptability to the new online environment. This is particularly stressful for a freshman who comes from high school with minimum experience in online evaluations. The majority of students enrolled in the “Applied Mathematics for Business” course were freshmen who were not used to responding to questions in a computer-based testing environment with proctoring and restricted features such as prohibited backtracking. To enhance students’ adaptability and reduce their stress to the new online assessment environment, a pilot test (a demo test) was offered two weeks before the actual test with unlimited attempts. Our experience with the pilot test, as a risk-free assessment, highlights two main advantages. First, students become familiarized with the new test environment, and it reduces student anxiety when taking a test in an online environment (St Clair, 2015). Because applying the proctoring tool requires the installation of specific software, a pilot test would allow students to download the virtual proctoring software in advance and to complete the authentication steps required to successfully proceed through the test start-up sequence (Kolski, 2020). Second, students could find and resolve any possible technical difficulties with proctoring that they might face in their actual test. Our records show that the majority of students took the pilot test and resolved any technical issues by contacting IT support, as well as their instructors, before their actual test. Later, we found that the majority of technical issues related to launching the proctoring software during the actual test were related to those students who did not take the pilot test. The results of a poll conducted in our online class showed that 95% of students (82 out of 87 students who participated in the poll) believed that the pilot test helped them become familiar with the new testing environment.

In addition to the pilot test seeking to help students become familiar with the new testing environment, we believe that our role as a bridge between the information technology (IT) department and students through multiple communications facilitated the smooth transition of students from in-person assessment to online assessment. We shared any updated information from the proctoring support team and guidelines regarding proctoring installation and technical requirements with our students.

Adaptation to a new testing environment is not only a challenge for students. It could be challenging for instructors with a low level of digital competence. Some faculty members are digital natives since they were born and raised during the digital period. However, a substantial number of faculty do not have the skills related to technology (Adedoyin & Soykan, 2020, pp. 1–13). Although online training supported by universities during the COVID-19 outbreak helped instructors adapt to the new environment, it brought stress to them for the following reasons. First, instructors were forced to participate in many online training sessions and learn many aspects of technology in a short period of time. For example, the sudden digital transformation of universities during COVID-19 has led to receiving more emails than before the pandemic and therefore increased faculty stress (Alqabbani et al., 2020, pp. 1–20). Second, instructors may face test features or a new situation in the setting of tests that are not covered in online training. Therefore, instructor mistakes in the setting of online assessments may cause the cancelation of an entire test and the redesign of another test. We were able to overcome this challenge by designing a pilot test and obtaining a dummy student account for instructors from the IT department. With the pilot test and the dummy student account, we were able to minimize the likelihood of making mistakes in administering, proctoring, and applying test features.

3.3. Technical problems

As reported by Song et al. (2004), technical issues are the greatest challenges in the online learning environment. The environment is stressful not only for students who face technical issues during the online assessment but also for instructors who need to handle student complaints. Technical issues become more challenging when remote proctoring software is used in the exam. It is important to note that the technical infrastructure of remote proctoring software has not been utilized on a large scale during the COVID-19 pandemic, even if the majority of in-person assessments migrated to online assessments. In addition to technical issues with proctoring, we were advised by our IT support team that the restricted features of the tests such as prohibiting backtracking may cause technical issues such as freezing.

The technical issues on the tests are problematic for the following reasons. First, supporting and resolving a technical problem remotely is difficult. Second, the instructor is not in the position to resolve technical problems resulting from hardware or software malfunctions (Guangul et al., 2020). Third, the technical problems are amplified in a large class. Berry (2009) showed that 10%–15% of students taking the exam experience some technical problems. This means that in a small class with 30 students, 3–4 had technical problems, and the small number became fairly easy for the instructor to resolve. However, in a large section of 150 students, this means that 15–20 students need to have their situations reviewed.

In our case, we minimized technical issues mainly in two ways. First, we considered a submission grace period feature (e.g., 10 min extra time) in the test that alerts the student to complete the test within the designated grace period. This alerted extra time was used to rectify the concerns related to potential Internet disruptions or technical glitches. Second, we prepared for technical issues by having a plan in advance and providing an overview of technical requirements of the tools (e.g., software) used during online assessment. It is important to inform students about any potential technical problems that they may face along with the ways to resolve them. Running a pilot test enabled us to identify such technical problems that students may face during their actual tests with proctoring. We then compiled the solutions corresponding to the technical issues by contacting the IT department and the proctoring software support team. For example, we heard about a technical problem called freezing/glitching during which the computer monitor may be frozen, requiring the student to logout and relaunch to continue the test. This problem may occur more than once in an online test, which may waste the time students have to complete the test. After consulting with the IT support team, we found that the students could minimize the occurrence of freezing issues by installing the latest version of either Google Chrome or Mozilla Firefox and clearing the cache of the browser before starting the exam. We also provided an instruction set in the case of freezing that required the affected student to...
immediately email their instructor with the details of the occurrence and screenshot as proof. We also reviewed students’ attempt log sessions to verify the honesty of students’ claims regarding technical issues. The attempt log of students with freezing issues showed that they had a problem moving to the next questions as their responses were saved several times.

Our experience with the two tests and final exams indicates that informing students about potential technical issues, along with their solutions, could significantly reduce students’ complaints. Namely, on our first midterm test, 10% of students had technical issues such as glitches, freezing and difficulty logging into the test. In our second midterm test and final exam, in which comprehensive technical problems and solutions were provided, the share of students with complaints was reduced to less than 5%. We found that the majority of complaints received (less than 5%) regarding technical issues were related to those students who had problems obtaining the authentication code to login to the D2L platform. Another main factor that contributed to most technical issues was the students’ slow/unreliable Wi-Fi connections. Since our tests and final exam were on weekends, the IT support team was not available to help them rectify their problems.

3.4. Anxiety

There are many sources of student anxiety and stress during an online proctored test. First, we found that students experienced stress regarding whether their own equipment would be adequate for matching the online proctoring technical requirements. We believe that a pilot test and communication with our students may address this concern. By participating in the pilot test, students were able to explore the proctoring software in advance of the actual test and to meet any technical requirements. Students were also informed about the technical requirements for proctoring and were given helpful troubleshooting links. We also communicated with our students by sharing the guidelines and any information from the proctoring support team. Second, students feared the intrusiveness of the proctoring software (Alexander & Poch, 2017). With all Internet-based transactions, individuals are concerned about the safeguarding of personal data (Langenfeld, 2020). To address this concern, we informed students that the proctoring tools, the LockDown browser and Respondus Monitor, has been approved by our university’s privacy and security office. Third, emails received from our students showed that they feared technical problems such as internet disruptions or glitches during an online test. To address this concern, we consulted with the IT department to provide a list of potential technical issues along with solutions. Moreover, we considered providing a makeup test to students who had verified technical issues when taking their actual tests. As reported by Kaup et al. (2020), being supportive, being sensitive to each other’s needs and being flexible would assist in creating a nonthreatening virtual classroom environment, facilitate learning and reduce student anxiety.

The stress and anxiety of online assessment was not limited to students. It also stressed instructors who were handling technical issues and the new testing environment. Due to the sudden transition to online assessment, universities did not have guidelines or rules to respond to the complaints of students who experienced technical issues during their tests. Therefore, the instructors were responsible for handling such complaints and verifying the honesty of students regarding their claims. This situation was amplified for our course with almost 1800 students enrolled and resulted in more than 150 student complaints (almost 10%) regarding technical issues during the first test. This presented us with a heavy workload to verify each student’s claim and to make a decision regarding offering a makeup test. To overcome this concern during our second test and final exam, we communicated with IT and a proctoring support team to find solutions for any type of technical issue. By releasing more information to students regarding how to handle technical issues, during the second midterm and final exam, the number of complaints was reduced to less than 5%. This reduced our level of stress since we received fewer complaints. In addition to technical issues, the new testing environment with proctoring was another challenge that caused stress for instructors. Any possible mistake in the setting of online tests is stressful for instructors who must handle such a situation. We were able to overcome this challenge in two ways. First, the pilot test and dummy account reduced the instructors’ stress by minimizing the probability of human error in the setting of our tests and predicting any issues that may occur during the actual tests. Second, our test setting was also reviewed by the D2L support team to identify any possible mistakes in the setting of our tests and final exam.

4. Conclusion and future research

The threat of COVID-19 has presented some unique challenges in the online delivery of courses for higher education institutions. This paper sheds light on the challenges of online assessment, which not only affects student performance but also increases instructors’ stress. We discussed the main challenges in online assessment during COVID-19, namely, maintaining academic integrity, adaptation to the new testing environment, technical issues and anxiety. We then suggested the following practices to address the above challenges: (i) restricted test features, (ii) designing a pilot test, (iii) administering tests with recorded proctoring, and (iv) awareness and communication. The comparison of the grade distributions between online and in-class assessments showed that students’ awareness, restricted test features, and recorded proctoring were effective in maintaining the academic integrity of online assessment. We find that awareness and communication are the key practices since they have positive impacts on all the mentioned challenges. Our results show that the pilot test is a highly recommended practice that can positively address the challenges of a new testing environment, technical issues and anxiety. The application of proctoring, as a practice to maintain academic integrity, worsens the challenges faced due to a new testing environment, technical issues and anxiety, but implementing a pilot test can help to rectify the negative impacts. This is true because a pilot test helps students become familiar with the new testing environment and resolve any possible technical issues. Consequently, the likelihood of technical issues during the actual tests is minimized, which reduces students’ anxiety. Finally, we believe that coordination between instructors and between instructors and the IT department is an important determinant of successful online assessment. The effectiveness of the above recommendations is proven by our course having no record
of student appeals.  

Our research can be extended in different directions. First, the results and discussion in this study were based on a quantitative course in a business school. An avenue for future research is to investigate the effectiveness of the recommended practices in a qualitative online course. Second, the results of this research were based on a mandatory course for freshman students. Similar studies can be done to recommend practices for elective courses as well as those for junior and senior students. Finally, a future research could consider conducting a student survey to (i) evaluate the impacts of communication, providing a pilot test and proctoring during tests on students’ anxiety, and (ii) verify the most problematic technical issues when writing an online test.

Author statement

Mahsa Madani Hosseini: conceptualization, Writing - Original draft preparation, Data Curation. Gunawardena Egodawatte: Software, Statistical analysis, Writing- Reviewing and Editing. Nurse server Ruzgar: Writing- Reviewing and Editing, Visualization.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of conflicting interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgements

We acknowledge the support of Dr. Boza Tasic, Dr. Clare Chua-Chow, and Dr. Michael Manjuris at the Ted Rogers School of Management at Ryerson University, in this project.

References

Adedoyin, O. B., & Soykan, E. (2020). ‘Covid-19 pandemic and online learning: The challenges and opportunities’, interactive learning environments. https://doi.org/10.1080/10494820.2020.1813180
Alessio, H. M., et al. (2017). Examining the effect of proctoring on online test scores. Online Learning, 21(1), 146–161.
Alexander, I. D., & Poch, R. K. (2017). Under the watchful eye of online proctoring. Minneapolis, MN: University of Minnesota Libraries Publishing.
Alqabbani, S., et al. (2020). Readiness towards emergency shifting to remote learning during COVID-19 pandemic among university instructors. E-Learning and Digital Media. https://doi.org/10.1077/204753020981651
Beck, V. (2014). ‘Testing a model to predict online cheating—much ado about nothing’. Active Learning in Higher Education, 15(1), 65–75.
Berry, R. W. (2009). Meeting the challenges of teaching large online classes: Shifting to a learner-focus. MERLOT Journal of Online Learning and Teaching, 5(1), 176–182.
Besser, A., Flett, G. L., & Zeigler-Hill, V. (2020). Adaptability to a sudden transition to online learning during the COVID-19 pandemic: Understanding the challenges for students. Scholarship of Teaching and Learning in Psychology, 1–21. https://psycnet.apa.org/doi/10.1037/stl0000198.
Bilen, E., & Matros, A. (2021). Online cheating amid COVID-19. Journal of Economic Behavior & Organization, 182, 196–211. https://doi.org/10.1016/j.jebo.2020.12.004
Bloomers, W., Oud, A., & Dam, K. van (2016). Cheating on unproctored internet intelligence tests: Strategies and effects. Personnel Assessment and Decisions, 21(1), 3.
Budhai, S. S. (2020). Cheating in online courses: Evidence from online proctoring. Computers in Human Behavior Reports, 2, 100033. https://doi.org/10.1016/j.chbr.2020.100033
Gamage, K. A., Silva, E. K. de, & Gunawardhana, N. (2020). Online delivery and assessment during COVID-19: Safeguarding academic integrity. Education Sciences, 10(11), 1–24. https://doi.org/10.3390/educsci10110301
Golden, J., & Kohlbeck, M. (2020). Addressing cheating when using test bank questions in online classes. Journal of Accounting Education, 52, 10671. https://doi.org/10.1016/j.jaccedu.2020.100671
Guangul, F. M., et al. (2020). Challenges of remote assessment in higher education in the context of COVID-19: A case study of Middle East college. Educational Assessment, Evaluation and Accountability, 32, 519–535.
Hussein, M. J., et al. (2020). An evaluation of online proctoring tools. Open Praxis, 12(4), 509–525.
Jagger, S., & Volkman, R. (2014). Helping students to see for themselves that ethics matters. International Journal of Management in Education, 12(2), 177–185.
Jones, I. M. (2007). Cyber-plagiarism: Different method-same song. In Schraiber, S., and G. Stricker, eds. Under the watchful eye of online proctoring. Minneapolis, MN: University of Minnesota Libraries Publishing.
Karim, M. N., Kaminsky, S. E., & Behrend, T. S. (2014). Cheating, reactions, and performance in remotely proctored testing: An exploratory experimental study. Journal of Business and Psychology, 29(4), 555–572.
Kaup, S., et al. (2020). Sustaining academics during COVID-19 pandemic: The role of online teaching-learning. Indian Journal of Ophthalmology, 68(6), 1220–1221. https://doi.org/10.4103/ijo.ijo_1241_20
King, C. G., Guyette, R. W., Jr., & Piotrowski, C. (2009). ‘Online exams and cheating: An empirical analysis of business students’ views.’. Journal of Educators Online, 6(1), 1–11.
Kolski, T. (2020). In , 4. Virtual proctoring and academic integrity. Central Michigan University (Learning in Digital Age.
Kumar, P., et al. (2019). Online business education research: Systematic analysis and a conceptual model. International Journal of Management in Education, 17(1), 26–35.
Kupfer, M. (2020). Canadian med school final exam plagued with technical issues after moving online | CBC News, CBC. Available at: https://www.cbc.ca/news/canada/ottawa/medical-mcc-exam-technical-issues-1.5619168, 17 February 2021.
Langenberg, T. (2020). Internet-based proctored assessment: Security and fairness issues. Educational Measurement: Issues and Practice. https://doi.org/10.1111/emp.12359
Madara, B., et al. (2017). ‘Nursing students’ access to test banks: Are your tests secure?’. Journal of Nursing Education, 56(5), 292–294.
Michael, T. B., & Williams, M. A. (2013). Student equity: Discouraging cheating in online courses. *Administrative Issues Journal, 3*(2). https://doi.org/10.5929/2013.3.2.8

Mukhtar, K., et al. (2020). Advantages, Limitations and Recommendations for online learning during COVID-19 pandemic era. *Pakistan Journal of Medical Sciences, 36*(COVID19-54). https://doi.org/10.12669/pjms.36.covid19-s4.2785

Newton, D. (2020). ‘Another problem with shifting education online: A rise in cheating’, *Washington Post*. Available at: https://www.washingtonpost.com/local/education/another-problem-with-shifting-education-online-a-rise-in-cheating/2020/08/07/1284c96d-7621-11ea-aff6-220dd3a14741_story.html. (Accessed 9 February 2021).

Perry, B. (2010). Exploring academic misconduct: Some insights into student behaviour. *Active Learning in Higher Education, 11*(2), 97–108.

Senoran, H. (2020). More students cheating during online classes, universities say | CTV News. Available at: https://kitchener.ctvnews.ca/more-students-cheating-during-online-classes-universities-say-1.5234890. (Accessed 12 February 2021).

Shraim, K. (2019). ‘Online examination practices in higher education institutions: Learners’ perspectives’. *The Turkish Online Journal of Distance Education, 20*(4), 185–196.

Son, C., et al. (2020). ‘Effects of COVID-19 on college students’ mental health in the United States: Interview survey study’. *Journal of Medical Internet Research, 22*(9). https://doi.org/10.2196/21279

Song, L., et al. (2004). Improving online learning: Student perceptions of useful and challenging characteristics. *Internet and Higher Education, 7*(1), 59–70.

St Clair, D. (2015). A simple suggestion for reducing first-time online student anxiety. *Journal of Online Learning and Teaching, 11*(1), 129–135.

Sutton, H. (2019). Minimize online cheating through proctoring, consequences. *Recruiting & Retaining Adult Learners, 21*(5), 1–5.

Trenholm, S. (2007). A review of cheating in fully asynchronous online courses: A math or fact-based course perspective. *Journal of Educational Technology Systems, 35*(3), 281–300.

Weiner, J. A., & Hurtz, G. M. (2017). A comparative study of online remote proctored versus onsite proctored high-stakes exams. *Journal of Applied Testing Technology, 18*(1), 13–20.

Williamson, M. H. (2018). Online exams: The need for best practices and overcoming challenges. *The Journal of Public and Professional Sociology, 10*(1).