Exam Proctoring in Online Business Education: Empirical Insights and Strategic Recommendations

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This study examines the impact of exam proctoring on student performance in online MBA courses. Following the literature, this topic remains relatively understudied in graduate-level online business courses, particularly those focusing on economics. Using data from two sections of an online MBA economics course – one with proctored exams and one without – the study identifies a significant performance gap, with students in the proctored setting achieving lower scores. The findings further suggest that proctoring methods and students' comfort with proctoring technology can influence performance. Based on these results, strategic recommendations for improving exam practices in online MBA programs are provided.

Keywords: business education, online MBA, proctored exams, student performance, remote proctoring

INTRODUCTION

In recent years, online education has seen steady growth and has become an increasingly vital component of the higher education landscape (Allen & Seaman, 2006; Kim & Bonk, 2006; Palvia et al., 2018). This trend is particularly prominent in the U.S. In an article published by Inside Higher Ed, Smalley (2021) reports data from the U.S. Department of Education, showing that more than half of college students, roughly 52%, participated in at least one online course during the academic year 2019-20. This number has already excluded courses temporarily shifted from in-person to online due to the COVID-19 pandemic and its related restrictions. Despite the continuing popularity of online education, many faculty members and campus administrators across U.S. higher education institutions remain apprehensive about the quality of student learning in online courses and question whether it is relatively comparable to that of face-to-face courses. In particular, academic integrity in online education is considered one of the most pressing concerns.

Most research concerning academic integrity in online education consistently argues that the prevalence of academic dishonesty and misconduct among students is comparatively higher in online courses than in face-to-face courses (e.g., Lanier, 2006; Haney & Clarke, 2007; Moten et al., 2013). This phenomenon is largely attributed to the nature and administration of exams in online courses, which often lack a proctor and present opportunities for students to cheat online (Stack, 2015; Wachenheim, 2009). When online exams are non-proctored, students can generally seize upon a range of items and resources that are

prohibited during online exams, such as textbooks, written notes, external websites, cell phones, and consultations with other students. However, online exam cheating may also take other forms. Rowe (2004) suggests that some students may wait to take their online exams after obtaining exam answers and unauthorized assistance from their fellow students. Daffin and Jones (2018) have documented interesting evidence that numerous third-party websites publicly share textbook test banks, enabling students to quickly search for answers to their online exam questions. The study further highlights that some students may outsource to companies that are willing to take online courses on their behalf and offer a money-back guarantee for satisfactory and passing grades.

Several requirements have been put in place in response to concerns surrounding the proper maintenance of academic integrity in online exams. One of the most prevalent requirements is proctored exams, which have been widely adopted by many colleges and universities offering online degree programs. The primary purpose of proctored exams is to ensure that students adhere to ethical and honest behavior when taking online exams, thereby safeguarding academic integrity in online learning environments. More generally, proctored exams involve the use of technology to monitor students during online exams, or the requirement that students must take online exams within testing centers under the supervision of test administrators. Following the literature, the potential advantages of proctored exams in online courses have been well-documented. Such advantages include the prevention of cheating behavior (Alessio et al., 2017), the promotion of academic integrity and honesty (Cluskey et al., 2011), the enhancement of online assessment quality (Rovai, 2000), the protection of institutional reputation (Khalil et al., 2022), and the improvement of student online learning skills (Adanir, 2022).

Based on the literature review, it is apparent that the use of proctored exams in online courses is a well-explored topic that has witnessed continuous advancements over time (e.g., Carstairs & Myors, 2009; Daffin & Jones, 2018; Harmon and Lambrinos, 2008; Hylon et al., 2016; Karim et al., 2014; Richardson & North, 2013; Stack, 2015; Wachenheim, 2009; Wellman & Marcinkiewicz, 2004). However, there are still noteworthy limitations within the current body of literature that warrant careful consideration. First, there is relatively little research on proctored exams in the field of business, despite this topic being extensively studied across various academic disciplines. As business is widely considered an academic program that increasingly offers students a wide range of online courses and degrees, further investigation is essential to provide business schools with managerial implications for maintaining academic integrity in online settings. Second, prior research on this topic has predominantly focused on the impact of proctored exams in undergraduate-level courses. A comprehensive understanding of proctored exams and their consequences at the graduate level, particularly for MBA courses, remains largely undiscovered and unexplored in the literature. Given the distinctive characteristics and attributes of graduate students, it is of great interest to thoroughly examine how they perform on proctored and non-proctored exams in online courses. The outcomes may deviate from what has been observed with undergraduate students, which thereby can help extend the existing literature in a meaningful direction.

The current study aims to fill the abovementioned literature gaps by empirically examining graduate students' performance on proctored and non-proctored exams in online MBA courses. In this study, we collect data on student exam scores from two sections of the same online MBA course taught by a single instructor, where a comprehensive final exam is administered online. One section requires students to take the final exam in a proctored setting, while the other allows students to take the exam in a non-proctored setting. Then, various empirical tests are employed to explore and address the following research questions: 1) is there a significant difference in student performance between proctored and non-proctored exams, and to what extent?, and 2) if such a difference exists between the two exam environments, what are the potential factors that influence student exam performance? Subsequently, the findings are utilized to provide a set of managerial implications for online examination practices, aiming to assist business schools that offer online MBA programs in maintaining academic integrity, promoting online teaching and learning, and enhancing the assessment of student learning outcomes.

This study contributes to the literature in several ways. First, the study provides the community of business scholars with additional insights into the issue of student performance on proctored versus non-proctored exams, which has yet to receive much attention in the field of business. Second, unlike other

studies, the current study not only compares differences in student performance between proctored and non-proctored exams, but also delves into exploring potential factors that may influence student performance during online exams. These factors encompass test proctoring locations, proctoring procedures, students' familiarity with the test, stress and anxiety, and class performance. Thus, the findings of this study should enable the scholarly community to obtain a more profound understanding of the use of proctored exams in online business courses. Third, it is worth mentioning that the unique aspect of this study lies in its exclusive focus on student exam performance in an online business course at the graduate level. As described earlier, this is a crucial research area that has received little attention in the existing literature. Moreover, our empirical analysis is grounded in online MBA courses, and we leverage the findings to offer managerial implications for business schools to promote academic integrity in online settings and strengthen their online MBA programs. Considering the growing popularity of online MBA degrees among professionals seeking to advance their careers, this study is particularly pertinent and timely, and it should extend the existing literature in a meaningful direction.

The remainder of this paper is organized as follows. The next section provides a literature review. The third section explains the methodology and details the data collection process. The fourth section provides additional insights into the empirical strategy employed in this study. The fifth section summarizes the results. The sixth section concludes the study, and the final section offers managerial implications for academic institutions offering online MBA programs.

LITERATURE REVIEW

Significant efforts in the literature have been devoted to exploring student performance on proctored exams across various academic disciplines, as evidenced by the works of Andrade et al. (2020), Carstairs & Myors (2009), Daffin and Jones (2018), Goedl and Malla (2020), Hollister and Berenson (2009), Richardson and North (2013), Stack (2015), Wachenheim (2009), and Wellman and Marcinkiewicz (2004). These studies commonly employ a comparative analysis, where students' exam performance in proctored environments is evaluated against that of their counterparts in non-proctored environments. Among them, several studies report that proctored and non-proctored exams have differential effects on student exam performance, in which students tend to perform better on non-proctored exams than on proctored exams. For instance, Wellman and Marcinkiewicz (2004) conduct a study with 120 students, who are randomly assigned into three different groups: 1) an online group with online proctored quizzes, 2) an online group with non-proctored quizzes, and 3) a textbook-based group with proctored quizzes. The study finds that students in the online, non-proctored group achieve the highest average quiz score. Carstairs and Myors (2009) analyze a sample of 300 undergraduate students using a cognitive achievement test, and report that students taking the test in a non-proctored environment tend to perform better than those in a proctored environment. However, the study further notes no difference in student test scores whether the exam is non-proctored online or administered in a paper-based format. Similarly, Richardson and North (2013) empirically examine a smaller sample of 65 students drawn from various courses and report a similar pattern of relatively higher test scores among students in the non-proctored environment.

Following the literature, the reasons behind the significant difference in student test scores between proctored and non-proctored exams have also been extensively investigated. One plausible explanation is attributed to cheating behavior exhibited by students who are not proctored. In their seminal work, Harmon and Lambrinos (2008) analyze two sections of an undergraduate-level economics course, where one session requires a proctored exam while the other does not. Consistent with prior research, higher exam scores are observed in the non-proctored section. The study interprets these findings as an indicative signal of cheating, as variables related to human capital examined, including students' GPA, class standing, and age, are less effective in explaining variation in student test scores, especially in the non-proctored section. Similarly, Hylon et al. (2016) further delve into this topic by investigating the effectiveness of webcam-based proctoring in deterring misconduct in online exams. The study reports that non-proctored students tend to perceive greater levels of opportunity to engage in misconduct, thereby achieving higher exam scores than those monitored by a webcam-based proctor.

The research findings previously discussed are consistent with the work of Karim et al. (2014), which empirically investigates cheating behavior in online testing. The study randomly assigns students into two groups, with one group being monitored by a webcam proctor and the other following an honor code without additional supervision. Both groups must complete cognitive ability tests, and discrepancies in test scores are analyzed to identify the incidence of cheating. The main findings indicate that cheating among students is less likely to occur when the tests are proctored. Additionally, it is worth emphasizing one aspect of the study by Hylton et al. (2016), which analyzes cheating behavior alternatively through the time students spend finishing online exams. The findings provide compelling evidence that non-proctored students invest significantly more time on the online exam and tend to earn significantly higher exam scores, compared to their proctored counterparts. The study explains that these differences could be attributed to the incidence of cheating during online exams.

The literature has also presented an alternative viewpoint, proposing that test-taking anxiety exhibited by students in proctored exam settings may contribute to the observed difference in student test scores between proctored and non-proctored exams. In particular, this research stream argues that proctored exams can potentially elevate levels of test-taking anxiety and stress, leading to a decrease in student exam performance (Kolski & Weible, 2018; Prakasha et al., 2021; Woldeab & Brothen, 2019, 2021). For instance, Woldeab and Brothen (2019) conduct a study with 631 students, and report that test-taking anxiety significantly diminishes student exam scores. This relationship is much more pronounced when students take online exams within a proctored setting. Woldeab and Brothen (2021) also conduct a follow-up study involving 237 undergraduate students, and provide additional insights that students in an online proctored setting frequently experience anxiety and fear of being wrongly flagged by webcam-based exam proctoring. Along the same lines, Prakasha et al. (2021) conduct a comparable study with students in STEM disciplines, and report an inverse relationship between test-taking anxiety and student performance on online proctored exams, with first- and final-year students displaying significant variation in their levels of anxiety and exam scores.

From the aforementioned literature review, it is reasonable to conclude that proctored exams in online courses have been studied extensively and experienced continuous advancements over time. However, some notable gaps in the existing literature warrant attention. First, within the field of business, there is a dearth of research that explores and compares student performance on proctored and non-proctored exams, despite the widespread popularity of online business courses. Additional research in this domain is essential to offer meaningful insights and implications for business schools in effectively maintaining academic integrity and managing online learning environments. Second, the existing literature has been limited mainly to the impact of proctored exams in undergraduate courses, leaving the implications at the graduate level largely unknown and unexplored. Therefore, exploring how graduate students perform in proctored and non-proctored exams can yield additional insights and contribute meaningfully to advancing existing literature.

In the present study, we endeavor to fill these gaps in the literature by undertaking an in-depth empirical analysis of how graduate students perform on proctored and non-proctored exams in online MBA courses. Furthermore, our study seeks to identify potential factors that influence student performance in online exams and provide managerial implications, which academic institutions with online MBA programs can adopt to further enhance student success and maintain academic integrity in online education.

DATA AND METHODOLOGY

Design

Our research design comprises three main phases to address previously stated research questions. The first phase involves gathering student data from two sections of an online MBA course. This is a core course in the online MBA program offered by a public university in the U.S., which all MBA students must complete before progressing to their specialized MBA concentrations. Both sections are delivered online via the Moodle e-learning platform over a 7-week semester and taught by the same instructor. As part of the course requirements, all students must take a comprehensive final exam during the last week of the

course, from which our data on student exam performance will be sourced. Further information regarding the structure and organization of this course, along with details about the available options of exam proctoring for students, will be discussed later in the following subsection.

In addition to the data on exam scores, our study gathers data on student learning performance from all the class activities, including weekly quizzes and online discussion forums, along with relevant information on student characteristics, such as gender, MBA concentrations, and cumulative GPA. To gain further insight into factors that may contribute to student performance on proctored exams, we also administer an online survey through the Moodle e-learning platform. This survey mainly aims to elicit information on students' exam proctoring details, including the proctoring method, test location, exam date and time, and any concerns students may have with the proctored exam.

Discussing the experimental design employed for the two sections of the online MBA course utilized in this study is pertinent. One section requires the final exam to be taken online in a proctored environment, which we refer to as the treatment condition. The other section allows the final exam to be taken online at any non-proctored locations, which we consider the control condition. Essentially, students in the section without the proctored exam requirement belong to the control condition, while those in the section with the proctored exam requirement are considered part of the treatment condition. It is noteworthy that the exam questions are identical for both conditions. Table 1 summarizes the design of these two conditions.

TABLE 1
EXPERIMENTAL DESIGN – CONTROL CONDITION VS. TREATMENT CONDITION

Items	Control	Treatment
Quizzes	Yes	Yes
Online discussions	Yes	Yes
Comprehensive final exam	Yes	Yes
Proctored exam requirement	No	Yes
Online survey for proctoring information	No	Yes

Notes: Additional information regarding on quizzes, online discussions, and the procedure of exam proctoring will be discussed in the Data Source section.

To examine whether students perform differently between proctored and non-proctored exams, we compare the results obtained from the control condition against that of the treatment condition using statistical analysis. In particular, our statistical analysis involves a series of regression models. These statistical techniques allow us to accurately identify and differentiate the impact of the two exam environments on student exam scores, while also controlling for other influential factors that may affect student exam performance.

The second phase of this study will delve deeper into the potential factors that may influence the scores students attain for their proctored exams. Our primary focus here will be on the treatment condition, where a proctored exam is mandatory. Specifically, we will undertake a second set of regression models using a subsample from the treatment condition. In this regression analysis, we will use the student exam scores as the dependent variable and consider various explanatory variables, such as student learning performance (e.g., weekly quizzes, discussion forums, cumulative GPA), student characteristics (e.g., gender, MBA concentrations), and the student's exam proctoring information (e.g., proctoring format, test location, and other concerns related to the proctored exam).

Finally, in the third phase, we carefully review our findings with existing literature to formulate managerial implications for academic institutions offering an online MBA program. These implications intend to guide academic institutions to better understand the impact of test proctoring on graduate student performance, and suggest appropriate test proctoring procedures and effective online assessments that can help enhance the quality of online teaching and learning.

Data Source and Class Structure

This section provides a detailed overview of the structure and organization of the online MBA course, which serves as the primary data source for our study. The course, focusing on economics, is offered over a 7-week semester at a public university in the U.S. As a mandatory core course in the online MBA program, students are required to complete it during their initial semesters and must achieve a grade of B or higher to be eligible for advancement to specialized MBA concentrations. The course is delivered entirely online via the Moodle e-learning platform, providing students with access to a wide range of learning resources, including class presentations, readings, lecture videos, assignments, and other relevant materials. For this study, data are collected from two course sections, both taught by the same instructor: one during Fall 2023 (control condition) and the other during Spring 2024 (treatment condition).

This 7-week course is organized as follows: In Week 1, students are introduced to the course with an overview of the syllabus and a foundational exploration of key economic principles. There are no assignments during the first week. Weeks 2 and 3 focus on essential microeconomic concepts, such as supply and demand, elasticity, market structures, consumer and firm behavior, and theories of economic welfare. From Weeks 4 to 6, the course shifts to macroeconomics, covering topics like national income, inflation, unemployment, financial markets and institutions, banking systems, monetary policy, the quantity theory of money, and the relationship between aggregate demand and aggregate supply, along with policies to stabilize economic fluctuations. During these weeks, students will complete weekly assignments, including discussion questions (worth 5% each) and quizzes (10% each), designed to assess their understanding of the material and foster active engagement. In Week 7, students will take a proctored final exam (worth 25% of the total course grade), covering all the previous weeks' material. The grading distribution for this course is provided in Table 2.

TABLE 2
GRADING DISTRIBUTION

Assessment	Percentage
Weekly Quizzes (5 quizzes @ 10% each)	50%
Weekly Discussion Questions (5 questions @ 5% each)	25%
Proctored Final Exam	25%
Total	**100%**

Note: Percentages indicate the weight of each assignment.

Upon completing the course, students are expected to demonstrate the following learning outcomes: 1) the ability to apply economic reasoning to critically analyze real-world economic scenarios; 2) the capacity to articulate and apply fundamental microeconomic theories and principles – such as supply and demand, market structures, elasticity, firm behavior, and consumer decision-making – to solve more complex economic and business problems; 3) the proficiency to examine macroeconomic indicators, including gross domestic product (GDP), inflation, unemployment, interest rates, savings, investment, money supply, and the dynamics of economic expansion and contraction; and 4) the competence to assess the intent and consequences of monetary policy, fiscal policy, and other government interventions designed to stabilize the economy.

Exam Proctoring Procedures

This section provides a detailed description of the final exam and its available proctoring methods for students enrolled in the Spring 2024 course (treatment condition), where a proctored exam is mandatory. The final exam is administered online through the Moodle e-learning platform in the seventh week of the course. Access to the exam requires a password managed exclusively by test proctoring services. Students are responsible for scheduling their exams with the proctoring services, with two available options. The first option involves on-site proctoring, where students must take the exam at authorized educational

institutions or testing centers. The second option is remote proctoring, offered by ProctorU, a company specializing in live and automated online proctoring services for academic institutions.

If students opt for on-site proctoring services, they will take the final exam using a computer provided by the testing center. On the exam day, students will need to present a valid photo ID, and their identities will be verified by the test administrators at the respective proctoring centers. Once verified, students can log into the Moodle e-learning platform, and the test administrator will enter the exam password to initiate the exam. The exam duration is restricted to 2 hours, during which textbooks, notes, or electronic devices are prohibited. Only scrap paper and calculators are allowed. Additionally, printing or copying the exam is strictly forbidden.

If students opt for remote proctoring services, the process differs slightly. Remote proctoring provides greater flexibility, allowing students to take the final exam from any location using their personal computer. This method requires a computer with a webcam and microphone for real-time monitoring and communication with the test administrator. Additionally, students must install screen-sharing software, which securely connects their computer screen to the proctoring service. This setup enables the test administrator to monitor the student's screen and prevent access to external websites during the exam.

To use remote proctoring services, students need to first create an account on the ProctorU website and schedule their exam date and time. On the exam day, students should log into ProctorU approximately 20-30 minutes before their scheduled start time. This allows the test administrator to verify their identity and ensure that all necessary technology is functioning properly. After this verification process, students can access the final exam through the Moodle e-learning platform, where the test administrator will enter the exam password to start the test. Similar to on-site proctoring, students have 2 hours to complete the exam. Textbooks, notes, and electronic devices are not allowed during the exam. Only scrap paper and calculators are permitted; copying the exam is strictly prohibited. It is important to note that the exam questions are the same for both on-site and remote proctoring.

Lastly, students in the Spring 2024 semester must complete an online survey on the Moodle e-learning platform, regardless of the proctoring method used. The survey will ask students to provide details such as the proctoring method, test location, exam date and time, and any other relevant information. This survey aims to help us better understand the factors influencing student performance on proctored exams. Table 3 summarizes the main characteristics and differences between on-site and remote proctoring services.

TABLE 3
ON-SITE VS. REMOTE PROCTORING

Items	On-Site Proctoring	Remote Proctoring
Exam Format	• 2 hour exam. • Exam is administered online via Moodle. • Textbooks, notes, and electronic devices are not allowed. • Calculator and scratch paper are allowed.	• 2 hour exam. • Exam is administered online via Moodle. • Textbooks, notes, and electronic devices are not allowed. • Calculator and scratch paper are allowed.
Exam Access Code	• Password is required. • Test administrator will enter the password.	• Password is required. • ProctorU will enter the password.
Test location	• Testing centers.	• Remotely from a personal computer.
Identify Verification	• Valid photo ID is required.	• Valid photo ID is required.

Technology Requirements	• Computer equipment is provided by testing centers.	• Personal computer equipped with a webcam, microphone, and screen-sharing software
Access to Other Websites	• Not allowed. • Test administrator will monitor the student's computer screen.	• Not allowed. • ProctorU will monitor and record the student's computer screen via screen-sharing software, and the recording will be sent to the course instructor once the exam is complete.

Source: Table created by authors

EMPIRICAL STRATEGY

To empirically examine the difference in student performance between proctored and non-proctored exams, we closely follow the literature (Daffin and Jones, 2018; Harmon and Lambrinos, 2008; Stack, 2015), and then estimate the following regression model:

$$Exam_i = \beta_0 + \beta_1 Treatment_i + \sum \delta(Controls)_i + \varepsilon_i \quad (1)$$

where $Exam_i$ is the exam score for student i = 1…n; $Treatment_i$ is a dummy variable taking a value of 1 if student i is in the treatment condition, where a proctored exam is required, and 0 otherwise; $Controls$ represents a vector of control variables, including student i's average homework score, average score on weekly discussion forums, cumulative GPA at the beginning of the course, areas of study, and gender; and ε_i is the error term.

The regression model in condition (1) allows us to examine whether the exam performance of students taking the final exam in a proctored environment is comparable to those taking the final exam in a non-proctored setting. In particular, if there is a significant difference in student exam scores between the two settings, the coefficient $\beta_1$on $Treatment_i$ is expected to display either a positive or negative sign that is statistically different from zero. A positive sign would indicate that students achieve higher exam scores when the exam is proctored, while a negative sign suggests that students score higher when the exam is non-proctored. This can provide valuable insights into the impact of proctored exams on student performance.

Subsequently, we delve into our second research question: What factors affect student exam performance in a proctored environment? To accurately identify these potential factors, we limit our empirical analysis to the treatment group, where students must take the final exam in a proctored environment, and then estimate the following regression model:

$$Exam_i = \alpha + \sum \beta(LP)_i + \sum \gamma(SC)_i + \sum \theta(PP)_i + \varepsilon_i \quad (2)$$

where $Exam_i$ is the exam score earned by student i in the proctored environment. LP represents a set of variables that can potentially describe student i's learning performance in the class, including his or her average homework score, average discussion score, and cumulative GPA at the beginning of the course. SC is a set of variables that capture student i's other characteristics, such as gender (male vs. female) and MBA concentration (e.g., Accounting, Business Analytics, Marketing, Health Administration, General Management, and Human Resources Management). PP is a set of variables related to the proctoring procedures, such as the proctoring method chosen by student i (on-site vs. remote proctoring) and whether the student has prior experience with the remote proctoring method. ε_i is the error term.

It is important to recognize that, due to the nature of cross-sectional data used in this study, our regression analysis may suffer from the presence of heteroskedasticity, wherein the variance of the residuals

is unequal over a range of measured values. This issue can potentially violate the ordinary least squares (OLS) assumption, leading to inefficient regression estimators. To address this issue, we employ the regression with robust standard errors, in addition to the OLS regression with conventional standard errors, when estimating conditions (1) and (2). This method is widely acknowledged as an appropriate econometric approach to account for and address heteroskedasticity. The results obtained are expected to bolster the reliability and robustness of our findings.

RESULTS

Proctored vs. Non-Proctored Exams

We first perform descriptive statistics to examine and compare whether there is a significant difference in student scores between proctored exams (treatment condition) and non-proctored exams (control condition). The sample size is nearly identical for both exam environments, with 59 students taking proctored exams and 65 students taking non-proctored exams, and the average exam score across the two exam environments is around 82%. However, the results suggest that the average exam score for the non-proctored environment (M = 88.81, SD = 6.81) is significantly higher than that of the proctored environment (M = 76.23, SD = 13.79). The two-sample t-test provides confirmation that this difference is statistically significant ($p < 0.01$). In essence, this implies that the average exam score among students taking non-proctored exams is approximately 12% higher than those taking proctored exams. These results are summarized in Table 4 and graphically presented in Figure 1. Furthermore, Figure 2 displays the frequency distribution of student exam scores for both proctored and non-proctored exams.

Upon careful examination of other variables, including students' homework scores, scores earned on weekly discussion forums, and cumulative grade point average (GPA) before the class, the two-sample t-test indicates no statistically significant difference between the proctored and non-proctored exam environments. This implies student learning performance throughout the course is comparable across both exam settings. However, we are aware that these factors may, to some extent, contribute to student performance on the final exam and need to be taken into consideration when comparing student scores between proctored and non-proctored exams. Therefore, an in-depth empirical investigation is needed, and we proceed to estimate the regression model as outlined in condition (1).

Table 5 summarizes the regression results obtained from estimating 4 different condition versions (1). Specifically, Model 1 is the baseline model, where only $Treatment_i$ is included to determine the difference in student exam scores between the proctored and non-proctored environments. Model 2 extends Model 1 by incorporating control variables to account for student learning performance. These include student i's average homework score, average discussion score, and cumulative GPA, respectively. Model 3 further expands Model 2 by controlling for student characteristics, including student i's gender and MBA concentration (e.g., Accounting, Business Analytics, Marketing, Health Administration, General Management, and Human Resources Management). Finally, Model 4 ensures the robustness of our findings by re-estimating Model 3 through the regression with robust standard errors. As described earlier, the estimation method employed in Model 4 aims to handle the issue of heteroskedasticity, which may possibly arise due to the nature of our cross-sectional data. The results should add credence to the validity and reliability of our findings.

The regression results robustly indicate that the coefficient $\beta_1$on $Treatment_i$ is negative and statistically significant ($p < 0.01$) across all the model specifications. These results confirm that the average exam score among students in the proctored environment is significantly lower than that of their counterparts in the non-proctored environment. Specifically, students taking proctored exams earn around 12% lower than those taking non-proctored exams. It is worth noting that the R-squared is about 55% in Models 3 and 4, where other influential variables are all controlled. This implies that our regression models can explain substantial variation in student exam performance. Other control variables, if significant, appear to display an expected sign. For instance, the coefficient on GPA is positive and statistically significant across all the model specifications, indicating that GPA is a strong predictor for student exam performance.

In other words, student exam scores generally reflect students' academic abilities, for which GPA is a measure of knowledge and skills that students have obtained and accumulated through schooling.

TABLE 4
DESCRIPTIVE STATISTICS

Section	Exam (%)	Homework (%)	Discussion (%)	GPA
Control (non-proctored)				
Mean	88.81	89.97	97.80	3.67
SD	6.81	4.95	5.04	0.28
Min.	62.50	75.20	68.00	3.05
Max.	97.50	98.40	100.00	3.99
N	59	59	59	59
Treatment (proctored)				
Mean	76.23	88.10	97.42	3.68
SD	13.79	8.70	3.14	0.30
Min.	42.00	42.00	85.00	3.00
Max.	100.00	100.00	100.00	4.00
N	65	65	65	65
Full Sample				
Mean	82.22	88.99	97.60	3.67
SD	12.68	7.20	4.14	0.29
Min.	42.00	42.00	68.00	3.00
Max.	100.00	100.00	100.00	4.00
N	124	124	124	124

Notes: 1) Exam score is measured in %, with a total of 100%; 2) Homework is the average score that students earn across 5 homework assignments, measured in %; 3) Discussion is the average score students earn from 6 weekly discussion forums, measured in %; and 4) GPA is measured on a 4-point scale.
Source: Table created by authors

FIGURE 1
THE AVERAGE SCORES OBTAINED IN PROCTORED VS. NON-PROCTORED EXAMS

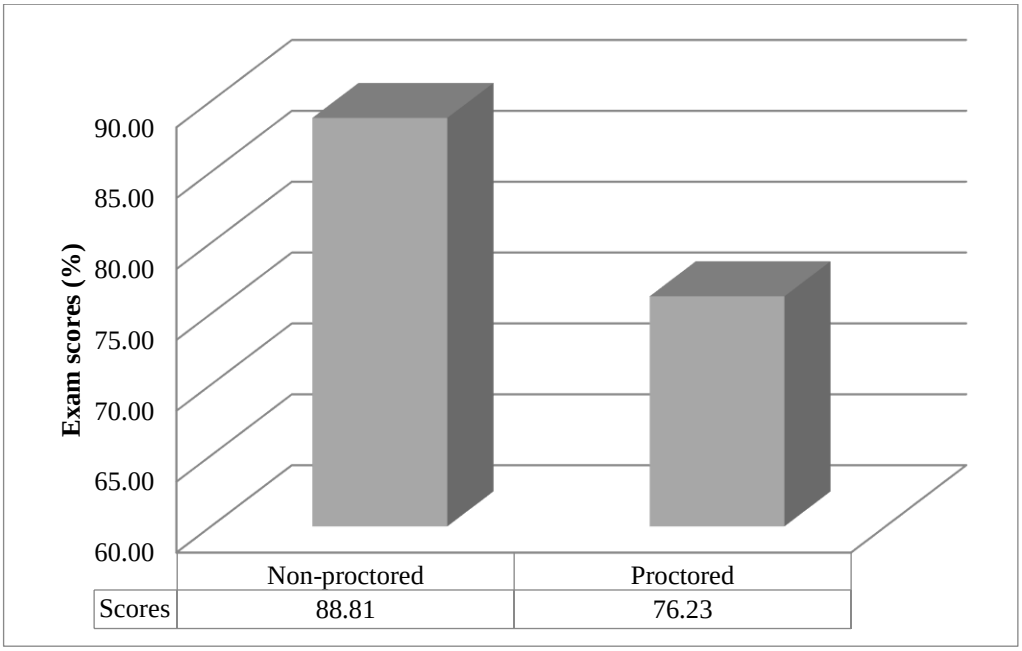


FIGURE 2
FREQUENCY DISTRIBUTIONS – PROCTORED VS. NON-PROCTORED EXAMS

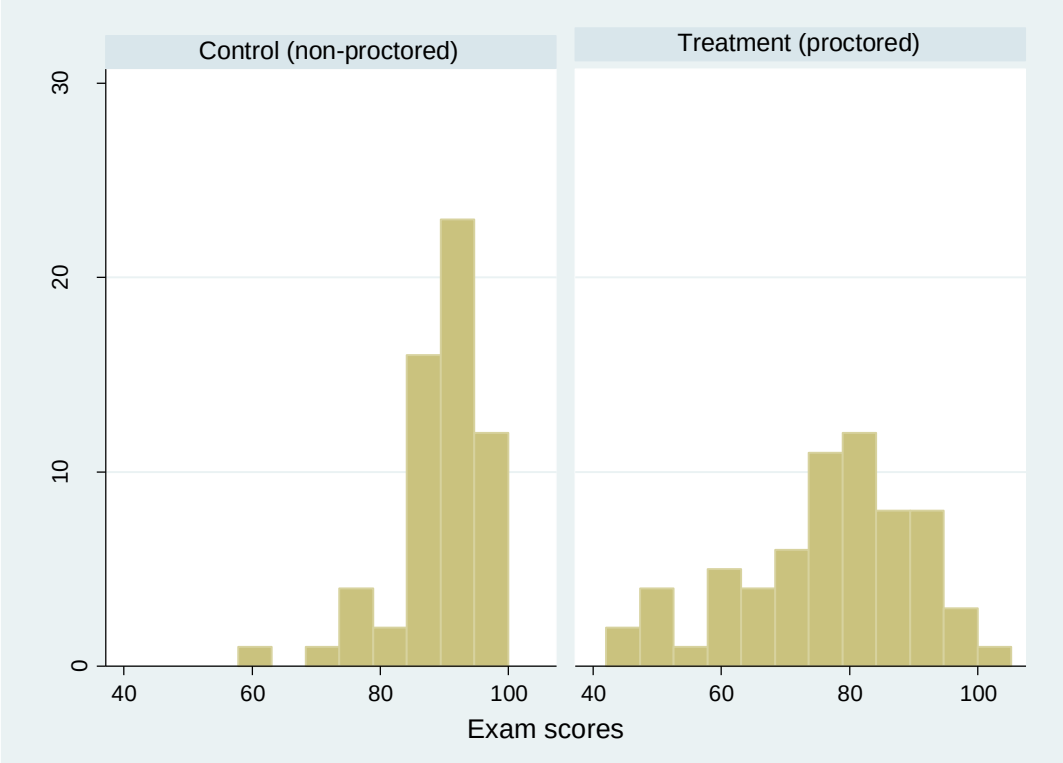


TABLE 5
REGRESSION RESULTS – PROCTORED VS. NON-PROCTORED EXAMS

Variable	Model 1	Model 2	Model 3	Model 4
Treatment (proctored exam)	-12.58***	-12.39***	-12.33***	-12.33***
	(1.99)	(1.61)	(1.67)	1.69
Student Learning Performance				
Homework		0.21	0.19	0.19
		(0.14)	(0.14)	(0.14)
Discussion		0.13	0.17	0.17
		(0.21)	(0.22)	(0.25)
GPA		19.39***	19.33***	19.33***
		(3.52)	(3.68)	(4.75)
Student Characteristics				
Accounting			-0.14	-0.14
			(5.82)	(7.02)
Business Analytics			-0.98	-0.98
			(5.57)	(6.74)
Marketing			-2.42	-2.42
			(5.79)	(6.90)
Healthcare Administration			-2.41	-2.41
			(5.48)	(6.72)
General Management			-2.32	-2.32
			(6.76)	(6.72)
Female			-1.08	-1.08
			(1.68)	(1.70)
Intercept	88.81***	-13.68	-13.54	-13.54
	(1.44)	(19.40)	(20.50)	(22.31)
F-statistic	40.18***	33.66***	13.14***	13.71***
R^2	0.25	0.53	0.54	0.54
N	124	124	124	124

Notes: 1) Standard errors/robust standard errors are reported in parentheses; 2) ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively; 3) For Models 3 and 4, an MBA concentration in Human Resources is excluded, for which the average exam score can be measured through the intercept.
Source: Table created by authors

Our results demonstrate a significant discrepancy in student performance between proctored and non-proctored exams. Specifically, students taking proctored exams tend to achieve lower scores than their counterparts taking non-proctored exams, with the difference estimated at approximately 12%. These results address our first research question, which inquires whether a significant difference exists in student performance between proctored and non-proctored exams, and to what extent. Furthermore, it is worth highlighting that our results are strongly robust across a range of model specifications and consistently in line with several prior studies on this topic (Daffin & Jones, 2018; Richardson & North, 2013; Stack, 2015; Wellman & Marcinkiewicz, 2004).

Nevertheless, these results prompt another interesting question regarding the underlying reasons for the observed difference in student performance between the two exam environments. As discussed in our literature review, one plausible explanation pertains to cheating behavior, which is more prevalent among students taking non-proctored exams. Specifically, students in the non-proctored environment may take advantage of not being monitored by using various resources, such as class notes, textbooks, lecture videos, internet sources, and consultation with classmates, which are unavailable to those taking proctored exams. Another potential explanation is test anxiety experienced by students in the proctored environment. Previous research suggests that proctored exams generally increase the level of test anxiety and stress among students, resulting in a decline in exam performance and contributing to the performance gap among students between the two exam settings (Kolski & Weible, 2018; Prakasha et al., 2021; Woldeab & Brothen, 2019, 2021).

Potential Influences Within Proctored Testing

This section summarizes the regression results obtained from estimating the regression model in condition (2). This model primarily addresses our second research question concerning the potential factors influencing student performance on proctored exams. To ensure the validity and reliability of our findings, we estimate the regression model in condition (2) across 4 different versions. Model 1 is a regression model that exclusively involves a set of variables characterizing student learning performance (LP). This model aims to illustrate the extent to which student exam scores are attributed to their learning performance throughout the course. Model 2 extends Model 1 by incrementally adding another set of variables related to student characteristics (SC) to evaluate the impact of these characteristics on exam scores. Model 3 further expands Model 2 by incorporating variables related to test proctoring procedures (PP) to examine whether exam scores can be explained by the student's selected proctoring method. Lastly, Model 4 re-estimates Model 3 using the regression with robust standard errors to ensure the robustness of our findings.

As shown in Table 6, Model 1 suggests that the coefficient on GPA is positive and statistically significant ($p < 0.01$), indicating its crucial role as a predictor of student exam scores in the proctored environment. Specifically, this result suggests that students with higher GPAs tend to perform better on proctored exams than those with lower GPAs. It is noteworthy that this result is consistently observed across all model specifications. On the other hand, Model 2 reveals that the coefficients on gender and different MBA concentrations are statistically indistinguishable from zero, meaning these variables apparently have no impact on student exam performance within the proctored environment. This result is also consistent across all model specifications.

TABLE 6
FACTORS INFLUENCING PERFORMANCE ON PROCTORED EXAMS

Variable	Model 1	Model 2	Model 3	Model 4
Student Learning Performance (*LP*)				
Homework	0.15	0.16	0.12	0.12
	(0.19)	(0.21)	(0.20)	(0.19)
Discussion	0.08	0.09	0.06	0.06
	(0.45)	(0.49)	(0.47)	(0.49)
GPA	27.96***	27.46***	26.27***	26.27***
	(5.64)	(6.41)	(6.17)	(9.28)
Student Characteristics (*SC*)				
Accounting		5.36	4.50	4.50
		(12.67)	(12.45)	(7.96)
Business Analytics		3.18	3.25	3.25

Variable	Model 1	Model 2	Model 3	Model 4
		(12.44)	(12.44)	(8.52)
Marketing		4.26	3.61	3.61
		(12.53)	(12.27)	(6.53)
Healthcare Administration		-1.21	0.12	0.12
		(16.59)	(16.60)	(8.81)
General Management		2.90	3.36	3.36
		(12.22)	(12.11)	(6.99)
Female		-0.03	1.11	1.11
		(2.87)	(2.80)	(2.73)
Proctoring Procedures (*PP*)				
On-Site Proctoring			5.25*	5.25*
			(2.80)	(2.92)
Inexperienced with Remote			-5.53*	-5.53**
			(3.31)	(2.33)
Intercept	-47.43	-50.73	-42.48	-42.48
	(41.05)	(46.76)	(45.37)	(42.11)
F-statistic	16.00***	4.94***	5.02***	5.02***
R^2	0.44	0.45	0.51	0.51
N	65	65	65	65

Notes: 1) Conventional Standard errors and robust standard errors are reported in parentheses; 2) ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively; 3) For Models 3 and 4, an MBA concentration in Human Resources is excluded, for which the average exam score can be measured through the intercept.

FIGURE 3
ON-SITE VS. ONLINE REMOTE PROCTORING

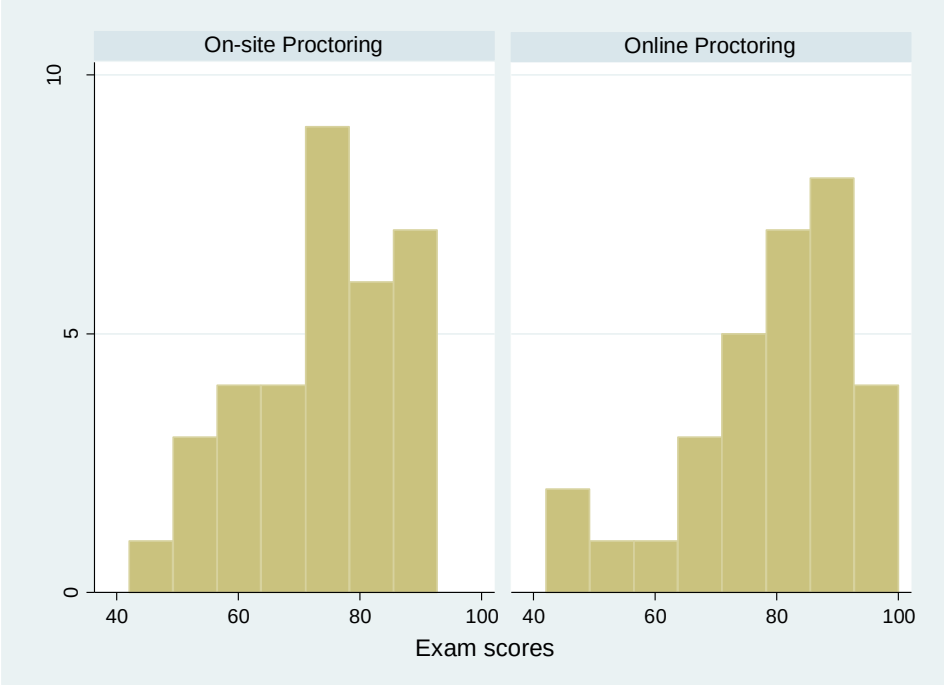
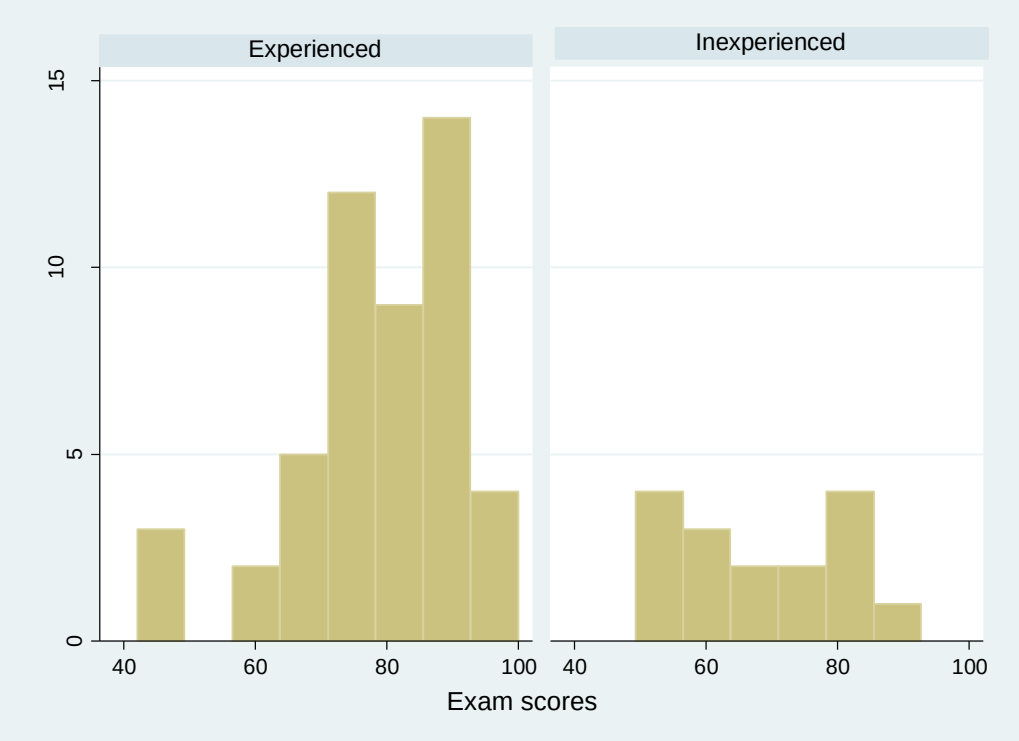


FIGURE 4
EXPERIENCED VS. INEXPERIENCED WITH PROCTORED EXAMS



Model 3 offers additional insights into the impact of the proctoring method on student exam performance. Specifically, the regression results indicate that the coefficient on $Onsite\ Proctoring$ is positive and statistically significant ($p < 0.1$). This provides meaningful evidence that students who opt to take their proctored exams onsite at testing centers tend to earn exam scores about 5% higher, compared to those using the remote proctoring service. The difference is more pronounced for students who are less familiar with remote proctoring, as evidenced in Model 3 by the negative and statistically significant coefficient on $Inexperienced\ with\ Remote$ ($p < 0.1$). This result indicates that students without experience in remote proctoring tend to score approximately 5% lower than those familiar with this method. These findings are highly robust and remain unchanged even when performing the regression with robust standard errors in Model 4. Therefore, it is reasonable to conclude that student exam scores are generally lower in remote proctoring settings, in which relative inexperience and unfamiliarity with the remote proctoring method can negatively affect student exam performance even further. For a comparison of exam score distributions, refer to Figure 3, which contrasts on-site and online remote proctoring methods, and Figure 4, which differentiates between students with prior proctoring experience and those without.

Our empirical analysis reveals that GPA is a vital predictor of student performance on proctored exams. Furthermore, the method of exam proctoring and students' familiarity with it can also significantly impact their exam results. This may be attributed to the stress and anxiety that students usually experience when taking proctored exams and being monitored remotely by the test administrator. When students are unfamiliar with the proctoring method and its procedures, their stress and anxiety levels can increase, which could ultimately lower their exam performance.

CONCLUSION

In conclusion, this study provides an empirical analysis of student performance on proctored versus non-proctored exams within the context of online MBA courses. Our findings yield several significant insights. First, we observe that students perform better on non-proctored exams than their proctored counterparts. While this result aligns with existing research, it is particularly significant in the context of graduate-level online education, which has received limited attention in the current literature. Second, our analysis shows that the methods of exam proctoring – particularly remote proctoring – combined with students' familiarity with the relevant procedures and requirements, significantly affect performance on proctored exams. This finding advances the literature in this area by highlighting the importance of how varying proctoring methods affect student learning outcomes and emphasizing the need for institutions to provide adequate support to help students navigate proctored assessments.

Overall, this study provides valuable insights into the body of knowledge surrounding online education, particularly in business, by illuminating effective practices associated with online examinations. Additionally, it suggests promising avenues for future research in online business education. However, it is essential to acknowledge that this study is limited to two sections of an online MBA course, which may somewhat restrict the generalizability of our findings. Future research should aim to expand this investigation to include a broader array of online MBA courses. Such investigations could yield additional insights into the impact of proctored exams and the various factors that influence student performance across diverse online educational contexts.

IMPLICATIONS AND RECOMMENDATIONS

The findings of this study carry significant implications for academic institutions offering online MBA programs and for the instructors teaching these courses. Our study indicates that students tend to perform considerably worse on proctored exams compared to non-proctored ones. This raises concerns that, while proctored exams aim to deter cheating and uphold academic integrity, they may inadvertently hinder student learning outcomes. This highlights the need for proctored exam policies to be implemented with caution, ensuring that they do not compromise educational effectiveness. In light of these findings, it is advisable for institutions, together with instructors, to explore alternative assessment methods that accurately assess students' knowledge and understanding of course material without relying exclusively on proctored exams. rSuch alternative assessments protect academic integrity and create a more supportive learning environment that enhances student achievement.

One viable alternative is to conduct online exams in non-proctored settings while incorporating a range of assessment formats, such as essay questions, problem-solving tasks, or case studies, which require students to demonstrate their analytical and critical thinking skills to succeed. Additionally, integrating project-based assessments can further enhance the learning experience, as these assignments prompt students to apply theoretical knowledge to real-world scenarios. For instance, a project might involve analyzing a contemporary economic issue or developing a comprehensive business strategy. This approach not only evaluates students' understanding but also cultivates practical skills that are essential for their professional careers. If these alternative assessments are not feasible, instructors might consider utilizing secure browser technology that restricts students' access to external websites when administering online exams. Setting time limits for answering each exam question can also deter students from searching for answers online, reducing the likelihood of cheating in non-proctored settings. Moreover, creating a diverse pool of exam questions and randomizing their presentation can ensure that each student receives a unique set of questions, thereby minimizing academic dishonesty opportunities. Together, these strategies can maintain the academic integrity of online learning environments while promoting a fair assessment atmosphere.

In addition to the notable disparities in student performance between proctored and non-proctored exams, our findings suggest that remote proctoring may adversely impact the performance of MBA students, particularly those who lack familiarity with the procedures and requirements related to this

technology. This highlights the critical need for students to become well-acquainted with remote proctoring technology and the importance of effective communication between instructors and students regarding relevant policies and procedures. Moreover, implementing supportive training programs is also essential for enhancing students' comfort and competence with remote proctoring technology. To address these challenges effectively, instructors should utilize the course syllabus to clearly outline the specific requirements and expectations of remote proctoring technology. Additionally, incorporating supplementary instructional videos can further support students' understanding of the relevant policies and procedures. Academic institutions should also consider developing training programs specifically focused on the use of remote proctoring for online MBA students. To enhance the effectiveness of these initiatives, institutions could produce and disseminate instructional videos that provide strategies and tips for success in remote proctored exams. These resources need to be easily accessible on the online learning platform to support student engagement and comprehension. By cohesively implementing these measures, academic institutions and course instructors can ensure that students develop a comprehensive understanding of the policies and procedures governing remote proctoring. This, in turn, will enhance students' comfort and confidence with the process, ultimately improving their chances of success on proctored exams.

Another important recommendation for academic institutions offering online MBA programs is the establishment of an in-house proctoring system integrated into their online learning platforms, such as Moodle, Canvas, and D2L Brightspace. This initiative would enhance student flexibility in taking exams remotely and reduce reliance on third-party proctoring services. However, institutions must prioritize the security and reliability of their in-house proctoring systems. Implementing robust measures such as multi-factor authentication, biometric identification, and video monitoring is essential for preventing fraud and ensuring academic integrity during online exams. In addition, institutions should provide students with clear and comprehensive guidelines regarding the remote proctoring process. This includes specifying allowable materials during exams, such as notes, textbooks, and other resources, as well as offering detailed instructions on troubleshooting potential technical issues. Common issues may include connectivity problems, software malfunctions, or difficulties with audio and video settings, and students should have access to resources that address these concerns effectively.

Lastly, our study strongly advocates for institutions to offer practice tests in a remote setting. This would allow students to schedule trial appointments with test administrators and undergo the necessary checks required for remote proctored exams, including ID verification, webcam and microphone checks, internet connection assessments, screen sharing, and recording software evaluations. These practice sessions would enable students to familiarize themselves with the remote proctoring technology, better prepare for their actual exams, and ultimately enhance their overall performance. Implementing these measures is expected to enrich the online learning experience for students, foster greater confidence and competence as they navigate remote proctoring technology, and contribute to their overall success in academic pursuits.

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