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The Mixed-Bag Impact of Online Proctoring Software in Undergraduate Courses

RESEARCH ARTICLE

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ABSTRACT

This quantitative study is designed to help educational institutions and instructors make informed decisions regarding the use of online proctoring software. The researchers studied the impact of proctoring software in online courses by comparing the final grades of two groups of online, undergraduate students who took the same online course with the same professor who administered virtually the same content, with and without proctoring software. The overall sample included 252 students in six different undergraduate courses. When regressing all six courses together, the data did not show that the addition of proctoring software created a significantly lower course grade. The researchers then regressed the data of each individual undergraduate course, with the addition of independent variables, which had a mixed-bag of results. Interestingly, an undergraduate business course showed that the use of proctoring software reduced course grades while other courses produced interesting significant findings relative to gender and attendance status.

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INTRODUCTION

The rapid spread of the COVID-19 virus forced most educational institutions to move to online learning during the pandemic. The increased use of online instruction at the college level in recent years and especially during the worldwide pandemic prompted the need for controls to prevent or reduce cheating during online exams (Hosseini et al., 2021; Nigam et al., 2021). Many educational institutions contracted with providers of online proctoring software to boost the integrity of their programs (Lieberman, 2018; Nigam et al., 2021; Woldeab & Brothen, 2019). Unfortunately, academic dishonesty is a significant problem in online courses (Dendir & Maxwell, 2020; Oeding, 2022). Without sufficient controls in place, online testing opens the door for students to take exams with other students as well as refer to unauthorized materials during the examination (James, 2016; Oeding, 2022).

Most researchers recommend a human proctor or online proctoring software as a means of identifying and monitoring the test-taker (Bedford et al., 2011; Chiesl, 2007; Clesham, 2010; Foster, 2013; James, 2016; Khare & Lam, 2008; Nigam et al., 2021; Ricketts & Wilks, 2002; Stuber-McEwen et al., 2009; Watson & Sottile, 2010; Yates & Beaudrie, 2009). Historically, the proctoring of exams was performed through a person who would personally monitor the test-taker in a standard classroom or testing space. However, technology now permits humans to proctor exams virtually through a webcam while the proctor and test-taker are separated geographically (Atoum et al., 2017; Hylton et al., 2016; Selwyn, 2023; Nigam et al., 2021; Tromblay, 2020).

This article explores 'remote, online exam proctoring.' To fully understand this concept, the terms 'remote proctoring' and 'online proctoring' shall be examined. Remote proctoring involves human proctors who monitor the test-taker in a separate place during the exam or watch a video of the test-taker at a later date (Tromblay, 2020). 'Online proctoring' is a specific type of remote proctoring that involves the use of the 'Internet and automated processes to produce a secure solution in monitoring test-takers' (Foster, 2013, p. 2). 'Remote, online exam proctoring' encompasses the use of the Internet and technology to monitor testing outside of a standard, physical testing situation.

Universities have been using remote proctoring technology for over 20 years (Kinney, 2001). Early proctoring systems have come a long way as technology continues to improve and online learning becomes even more prominent. Current technology permits examinees to be proctored using a remote human proctor and/or proctoring software, which normally enables the proctor to see the examinee and his/her environment via webcam video, view the examinee's screen, and listen to the examinee and other sounds during the exam (Tromblay, 2020; Oeding, 2022). This study seeks to determine whether remote, online exam proctoring impacts course grades in undergraduate courses. This study is designed to help educational institutions and instructors make decisions regarding the use of online proctoring software.

LITERATURE REVIEW

A review of the literature regarding remote online exam administration reveals that the articles tend to be classified within one or more of the following three categories: 1) perceptions/reactions to online proctoring, 2) the prevention of cheating in online courses, and 3) the opportunity and likelihood of online cheating.

PERCEPTIONS/REACTIONS TO ONLINE PROCTORING

Several studies analyzed perceptions and/or reactions to taking online proctored exams by examinees. The reactions were positive and negative. Many students see the general advantages and benefits of taking exams online (Ilgaz & Afacan Adanir, 2020). For example, a representative of Western Governors University, a fully online institution, stated that 'more than 98% of the university's 90,000-plus students choose to have their exams proctored remotely' because the students believe the remote proctoring is easier (Lieberman, 2018, p. 4). In addition, Weiner and Hurtz (2017) found generally positive reactions to remote online proctoring from examinees for professional licensure.

Nigam et al. (2021) and Coghlan et al. (2020) listed security concerns, privacy concerns, and ethical concerns as major issues institutions should consider regarding artificial-intelligence-based proctoring systems. Nigam et al. (2021) stated, 'A robust, secure and easy-to-use' proctoring system is the 'need of the hour,' which ensure academic integrity and 'stringent security standards' (p. 6440). Proctoring software providers have a duty to have safeguards in place to protect the examinee's device and data as much as is possible (Ilgaz & Afacan Adanir, 2020). Coghlan et al. (2020) provided an ethical analysis of online proctoring technologies, weighing proctoring systems as an effective tool or 'Big Brother' watching the students (p. 10).

Karim et al. (2014) found negative test-taker reaction to online, remote proctoring due to the possibility of their Internet connection failing, the worry that they will not have enough time to complete the work in the allotted time slot (e.g., Clesham, 2010), and privacy concerns due to the video. Karim et al. recruited their subjects through Mechanical Turk rather than an educational setting, yet other studies found similar negative reactions in an educational setting. As to high stakes examinations, many students perceive significant challenges such as technical difficulties, unreliable connectivity, and insufficient support (James, 2016). Lee and Fanguy (2022) found online proctoring systems assume students are willing to cheat, which degrades the value of student engagement while creating distrust among students and teachers.

Woldeab and Brothen (2021) addressed exam anxiety as it relates to exam performance. The researchers studied 237 students from a Midwestern university. The researchers found that students are 'experiencing anxiety and fear of being wrongly flagged [for cheating] during online proctoring' (p. 1). However, the study found that the students' anxiety regarding online proctoring is related to the students' general anxiety level and the anxiety of being wrongly flagged did not harm test performance.

In order for online proctoring systems to work properly, the internet strength must be strong throughout the exam period (Ilgaz & Afacan Adanir, 2020; Nigam et al., 2021). A stable internet connection is key. If the proctoring software does not function properly, this may lead to or increase the examinee's anxiety level. Woldeab and Brothen (2019) looked at undergraduate students from a large university in the Midwest to compare 581 students who took their final exam in a computerized testing center versus 44 students who took the exam using ProctorU. The researchers found that an online proctored setting had a negative effect on students with high test anxiety. To overcome technical issues and lessen anxiety, Hosseini et al. (2021) recommended that instructors use a pilot exam to help online, proctored examinees adjust to the new testing environment.

THE PREVENTION OF CHEATING IN ONLINE COURSES

Several studies offer suggestions as to how to deter cheating in online courses. Instructors should be aware that today's students operate differently than prior generations without such readily available technology (Lieneck & Esparza, 2018). Modern students share their assignments, answers, grades, and notes from their current and former courses. Another difference from earlier generations of students is test banks and answer guides are published on the internet for all to view. To deter both of these issues, the researchers suggest changing assessments frequently, so students do not have the opportunity to readily copy assignment responses.

Some researchers recommend stern communication to students. Volpe et al. (2008) suggested that faculty communicate their academic integrity policy in their syllabus to attempt to deter cheating. Christie's (2003) approach to deterring cheating involved carefully designing all aspects of the online course including the syllabus, assessments, and other course content in addition to being intentional about developing a strong student-instructor relationship. Oeding (2022) recommends communicating to students that exam proctoring videos will be viewed and emphasizes to instructors the importance of watching the online exam proctoring videos to detect integrity violations and not assuming that student will not cheat just because they are being recorded. Oeding also suggests implementing comprehensive online exam rules, attempting to hinder a student's opportunity to cheat.

Some researchers made exam-focused recommendations to attempt to discourage cheating with online exams. Cluskey, Ehlen, and Raiborn (2011) recommended control procedures for online exams including offering the online exam during one short window of time, randomizing questions, presenting one question at a time rather than multiple questions, substantially limiting the duration of the exam, (Brothen & Peterson, 2012), employing a lockdown browser during the exam, and changing at least one-third of the test questions every semester. Brothen and Peterson (2012) suggest increasing the difficulty of questions, which would require the students to master the material in order to earn a high score.

With so many different risk factors associated with online classes, technological advances are working to solve these problems and allow for online testing integrity. Currently remote, online exam proctoring systems use artificial intelligence to identify the test-taker, restrict browsing capabilities, and monitor the test-taker's activities during the exam (Nigam et al., 2021; Slusky, 2020). The systems use a webcam to video the examinee's conduct and environment during the exam (Hylton et al., 2016). Different software options are available from various providers. The list of software functions is broad, depending on the company, and includes such capabilities as facial recognition, voice recognition, video and audio recording, keystroke and fingerprint analysis, behavior cues, browser lockdown functions, and gaze estimation (Atoum et al., 2017; Nigam et al., 2021; Slusky, 2020; Selwyn, 2023).

THE OPPORTUNITY AND LIKELIHOOD OF CHEATING IN ONLINE COURSES

Students admit that online learning gives them a greater opportunity to cheat (King et al., 2009; Watson & Sottile, 2010). Hobbs (2021) reported that universities are seeing enormous growth in claims of academic dishonesty. For example, at North Carolina State University the cases of academic misconduct more than doubled during the 2019–2020 school year, with the largest increase in claims after the students moved online due to the Covid-19 Pandemic. The University of Pennsylvania and Texas A&M University reported that cheating allegations surged at their universities by 71% and 50%, respectively.

Students' Perceived Opportunity to Cheat in Online Courses

Researchers have studied students' perceived opportunity to cheat in online courses versus face-to-face courses. King et al. (2009) found almost three-fourths of the 121 undergraduate students surveyed found it easier to cheat in an online course as opposed to a traditional face-to-face course. Watson and Sottile (2010) surveyed 635 undergraduate and graduate students who self-reported that they were more than four times likely to cheat in an online course as compared to a traditional seated course. However, not all studies found an uptick in cheating in online learning. Based on the students' self-reported behavior, Stuber-McEwen et al. (2009) found that students who took online courses were less likely to cheat than students enrolled in traditional, seated courses.

Comparing Exam Performance in Proctored and Unproctored Environments

Several researchers analyzed the performance of examinees in proctored and unproctored environments. Weiner and Hurtz (2017) compared online remote proctoring to onsite proctoring in high-stakes exams. The experiment involved three professional licensing exams, which were administered concurrently but at different testing sites. Some subjects were proctored onsite in testing centers, and other subjects were proctored in computer kiosks via Internet-connected video communication and surveillance. The researchers found that online, remotely proctored examinees scored comparably to the examinees who were situated in traditional onsite testing centers. This study shows the validity of remote online proctoring.

Several studies compared test performance (i.e. scores) in a proctored versus an unproctored testing environment. The results of the studies are mixed. Some studies found higher test scores in an unproctored environment, raising the inference of cheating. Karim et al. (2014) conducted a study outside of an educational context by recruiting participants from around the world through Amazon's Mechanical Turk to take a cognitive ability test online, while incentivizing the participants to do well on the exam by offering a bonus payment to the person with the highest score. The study indirectly determined the occurrence of cheating by comparing performance

of students taking exams through webcam proctoring verses using the 'honor code' and not being proctored. In a non-educational setting, Karim and his researchers concluded that remote proctoring may decrease cheating but does not affect test performance.

Studies comparing proctored and unproctored examinees have been completed in the educational context with a variety of results. Separating these educational studies between the type of student, graduate or undergraduate, is helpful. Several undergraduate studies found inflated exam scores with the unproctored exams, supporting the usage of proctoring software (Alessio et al., 2017; Alessio et al., 2018; Carstairs & Myors, 2009; Reisenwitz, 2020). Reisenwitz (2020) compared the exam scores from two different online sections of an introductory marketing course. The first online section had 40 students who completed unproctored exams, and the second section in a consecutive semester had 33 students who took proctored exams. Both sections had the same instructor, course content, and exams. Reisenwitz (2020) found the average exams scores to be significantly higher in the section with unproctored exams.

Alessio, et al. (2017) compared the proctored and unproctored test performance of 147 undergraduate students who took online tests in a health professions course, Medical Terminology, at a public university with approximately 17,000 students in Ohio. On average, the test-takers who were remotely proctored scored significantly lower than unproctored remote test-takers. In addition, the proctored test-takers spent significantly less time taking the test. Alessio and her researchers stated, 'Proctoring with video monitoring significantly negatively impacts online test grades, probably because it deters cheating, and its use is important to assure academic integrity through similar test taking conditions in similar courses when using online tests' (p. 13). The same researchers found video monitoring offered by proctoring software more impactful than lockdown software without video monitoring.

A similar study by Alessio et al. (2018) examined 97 undergraduate students who took Medical Terminology by Health Professionals. The later study was performed at the same Midwestern university and found the use of a remote proctoring software, which involved locking down the Internet browser and videoing the test-taker, resulted in lower quiz scores, less time in taking quizzes, and less disparity in quiz performance.

Other studies were contrary to Alessio's findings. When comparing proctored versus unproctored online exams, Hylton et al. (2016) studied undergraduate students at a private university in Jamaica who attended the same course with the same instructor and were given the same pool of questions for the exams, the researchers found no statistically significant difference on the scores of students in the same course who took online exams with and without a web-based proctor, although the unproctored group scored slightly higher. However, the proctored students used significantly less time to finish the exam. Based on the longer time unpoctored students took to take the exam and the fact the unproctored students had slightly higher scores, the researchers concluded that web-based proctoring deterred misconduct in online exams.

Beck (2014) compared midterm and final exam scores in three sections of an introductory undergraduate course. The exams were monitored in two of the sections and unmonitored in the third section. Beck developed a statistical model to predict academic dishonesty by taking into account a student's age, GPA, and class standing. Beck only found a slight difference between the monitored and unmonitored students. Interestingly, using the same regression method used by Beck (2014), Dendir and Maxwell (2020) came to the opposite conclusion in two undergraduate courses, finding a decrease in average performance of proctored exams. Dendir and Maxwell regressed 'test scores on measures of human capital (or ability) and other potentially relevant student characteristics (e.g., gender, age, class rank)' and found that 'academic dishonesty is a serious issue in online courses' (p. 6, 8). The researchers found that age was a significant predictor of performance in an unproctored environment; older students tend to perform better than younger students.

The projects that studied graduate students also produced varying results. Prince et al. (2009) found significant differences in average scores between graduate students who took online exams unproctored and exams proctored either online or with a live proctor. The researchers concluded their consistent results in different courses with different professors demonstrated the effectiveness of proctored exams. The authors concluded that students who take proctored exams will score lower as compared to non-proctored students. However, not all research at

the graduate level suggests that cheating is more prevalent in online courses as compared to traditional, face-to-face courses. Interestingly, at the graduate level, Ladyshewsky (2015) studied a total of 250 post-graduate students taking a management and leadership course and found no difference between unproctored on-line exams and face-to-face, proctored exams.

METHOD

To address our research question, we used regression analysis in our quantitative study, seeking to further the research by comparing the course grades from proctored and unproctored courses at the undergraduate level. Our regression analysis, similar to Beck (2014) and Dendir and Maxwell (2020), incorporated using human capital variables in addition to course grade. The researchers received permission to perform this study from the university's Internal Review Board. The instructors who taught the courses in this study also consented to have the course data analyzed for this project. The university's data department and information technology department aided the authors in collecting and organizing the de-identified demographic and assessment data used. The assessment data from the relevant courses included course grades and individual quiz and exam scores. The non-identifiable demographic data included age (i.e. under 24/25 and over), gender, race/ethnicity, in-state/out-of-state, living on/off-campus, first-generation college student, cumulative GPA, student classification (i.e. freshman, sophomore junior, senior), major, college classification, full- or part- time status, high school GPA, and SAT/ACT scores. Our research did not incorporate all of the human variables, but the data is available for further study.

Prior to the start of the study, the university offered faculty the option of using Proctorio, an online exam proctoring software that records the examinee's screen and uses a webcam to record the examinee's sounds and actions while taking the exam. A researcher within the study noticed that the exam scores seemed to be lower once the online exam proctoring software was added to the course. Thus, the authors developed the following research questions:

> Original Research Question: Does remote online proctoring software affect the overall letter grades for online courses?
>
> Additional Research Question: Does remote online proctoring software affect the overall letter grades for online *undergraduate* courses?

Our original research question combined data from both undergraduate and graduate courses. When the researchers completed the regression analysis, the combined group (both undergraduate and graduate) did not prove statistically significant. With this information, we decided to separate the analysis and regress the data for only the undergraduate courses in this paper. The sample for this study included students from six undergraduate courses from multiple disciplines (i.e. business, math, radiology, and engineering) that had data collected during pre-implementation and post-implementation of proctoring software. The overall sample included 252 registered students in the six different undergraduate courses (i.e. a 200-level business law course, two different 100-level math courses, a 400-level radiology course, a 200-level engineering course, and a 300-level engineering course) from Fall 2018 to Spring 2020. The researchers made the decision to include spring 2020 data, even though this ended up being the Covid semester. Our measurements were analyzed in the all-undergraduate courses group and then by each individual course.

The authors compared the final grades of two groups of online students who took the same online course with the same professor who administered the same content (i.e. lectures, exams, quizzes, written assignments, etc.), similar to Alessio et al., (2017), Allesio et al., (2018), Hylton et al., (2016), Reisenwitz (2020), using Blackboard, a learning management system. Virtually the only difference between the two groups of students was the use or nonuse of proctoring software. The 'pre-Proctorio' group of students took the course without the use of proctoring software, and the 'post-Proctorio' group of students was proctored using online exam proctoring software.

The 'post-Proctorio' students in the study were made aware of the necessity to take assessments within the course using the proctoring software. In order to use the software, students had to download the proctoring software prior to taking the first assessment in the

course. The course instructors activated exam proctoring within the post-Proctorio group as an automatic function of the online exam. Proctorio offers an array of functions that may be utilized by faculty to monitor students during the exam. When students started their exams, Proctorio began recording the students and saved the recording, which enabled the instructors to view the recordings later.

FINDINGS AND DISCUSSION

The current quantitative study uses the dependent variable of course grade; the researchers anticipated that the course grade would decrease with the implementation of online proctoring software. The authors used two different timeframes for the main independent variable of pre-Proctorio or post-Proctorio (Pre/Post) to measure against the course grade. In the analysis of the data, the researchers used regression of additional variables to find if there was statistical significance, similar to Beck (2014) and Dendir & Maxwell (2020). The findings showed the implementation of online proctoring software did not have a statistically significant impact on the students' course grade when the six undergraduate courses were regressed together as a group. This is consistent with Beck's findings for test scores being only slightly lower with the use of proctoring software and inconsistent with Dendir's et al. findings showing a decrease in test scores, under the same circumstances.

The researchers also added other independent variables into the regression along with Pre/Post and analyzed them after the addition of each. The second independent variable is a measure of female or male students in the courses. This variable did not prove statistically significant for the all-undergraduate courses group. The third independent variable is a measure of full-time or part-time status, and we had the same results for the all-undergraduate courses group of no statistical significance. The fourth independent variable, student cumulative GPA proved to be statistically significant in the measurement group. The R-squared was 10.8% for the all-undergraduate courses group, which gave some validity to the model. (See Table 1) Since this was found to be an important measurement, the researchers changed the regression model to make student cumulative GPA the primary independent variable. The model was re-analyzed, and student cumulative GPA was statistically significant for the all-undergraduate courses group and with the addition of each predefined variable. This should be expected and proved that the students with the higher GPA also earned a high course grade in their undergraduate courses. This analysis gave validation to the data.

	3 VARIABLES	4 VARIABLES
R Square	0.0382	0.1084
Significance F	* 0.021	** 0.000
X1 = Pre/Post	0.192	0.21
X2 = Fem/Male	0.341	0.3217
X3 = FT/PT	* 0.003	0.0274
X4 = Overall GPA	xxx	** 0.000

Table 1 Regression Results of All-Undergraduate Courses.

Grade = $b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \in$.

Statistically significant: * < .05 and ** < .001.

Even though the analysis did not prove statistically significant based on the research question that the addition of online proctoring would affect the students' course grade in the all-undergraduate courses group, the researchers regressed the data within each course separately to see if there were any interesting relationships. Unfortunately, each individual course did not prove statistically significant for the addition of the proctoring software affecting course grade, but some other variables had an impact within the courses. In two courses, a 200-level business law course and a 200-level technical engineering course, the cumulative GPA was statistically significant with an R-squared of 19% and 26%, respectively. Another course, a 100-level math course (i.e. College Algebra), using all of the variables, cumulative GPA and female/male both proved statistically significant with an R-squared of 38.9%, indicating that females had lower grades with proctoring software. (See Table 2) This was the first study in the online proctoring literature, about which the authors know, that indicates a gender-based result, suggesting that females were more likely to commit academic dishonesty in that course. This inference is

derived from the researchers who believe that lower course performance with online proctoring software is because the software deters cheating (Allesio et al., 2017; Allesio et al., 2018; Dendir & Maxwell, 2020; Hylton et al., 2016; Oeding, 2022; Prince et al., 2009).

Other undergraduate courses were regressed with the addition of human capital variables. In a 300-level engineering course, two variables proved statistically significant in full-time/part-time with an R-squared of 26.8% and with the addition of cumulative GPA, the R-squared rose to 39.5%. In this case, the full-time students had lower course grades with proctoring software. Based on the premise that online proctoring deters cheating (Alessio et al., 2017; Alessio et al., 2018; Hylton et al., 2016; Dendir & Maxwell, 2020; Prince et al., 2009), this result indicates that full-time students were more likely to commit academic dishonesty in this engineering course. (See Table 2) Two courses within the study, a 100-level math course for health professionals and a 400-level radiology course, had no statistical significance for any of the variable combinations.

Table 2 Regression Results of Individual UG Courses.

Grade = $b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \in$.

Statistically significant: * < .05 and ** < .001.

	200-LEVEL BUSINESS LAW	200-LEVEL TECH. ENGINEERING	100-LEVEL MATH	300-LEVEL ENGINEERING
Observations	84	46	32	49
R Square	0.19039	0.26025	0.38949	0.39507
Significance F	* 0.002	* 0.0131	* .008	** .0002
X1 = Pre/Post	0.0705	0.5466	0.769	0.058
X2 = Fem/Male	0.6822	0.5287	* .031	0.4606
X3 = FT/PT	0.885	0.589	0.114	* .0033
X4 = Overall GPA	** .0002	** 0.001	* .0077	* .004

The researchers experimented with the 200-level business law course by removing the measurements for Spring 2020, since this was the Covid semester to see if the perceived relationship would improve. Using regression, the model did not prove statistically significant with using only the Pre/Post variable, but with the addition of each variable along with the Pre/Post variable, then the researchers gained the results of the original question, which was the addition of proctoring software reduced course grades. The R-squared ranged from 11.5% to 19.3% after adding each variable, that helped to prove the researchers' model was moving in the right direction to explain the model. The only other variable that proved statistically significant was with the addition of cumulative GPA as the fourth variable in the model, which the researchers already have proven that significance. (See Table 3) This finding of lower course performance in the 200-level Business Law Course is similar to other studies by Allesio et al. (2017), Allesio et al. (2018), and Dendir and Maxwell (2020). These undergraduate studies found that online exam proctoring software led to lower scores on exams and quizzes than unproctored assessments.

Table 3 Regression Results of 200-Level Business Law Course.

Grade = $b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \in$.

Statistically significant: * < .05 and ** < .001.

OBSERVATIONS = 67			
R Square	0.115299	0.117986	0.193234
Significance F	* 0.0198	* 0.0466	* 0.00899
X1 = Pre/Post	* 0.0053	* 0.0063	* 0.0074
X2 = Fem/Male	0.766189	0.790386	0.750336
X3 = FT/PT	xxx	0.662842	0.883961
X4 = Overall GPA	xxx	xxx	* 0.0192

The results of this research project are consistent with current literature in the sense that the results are varied when researchers compare course performance data related to the use and nonuse of online proctoring software (Alessio et al., 2017; Alessio et al., 2018; Beck, 2014; Hylton et al., 2016, Dendir and Maxwell, 2020; Ladyshewsky, 2015; Reisenwitz, 2020). The results could be described as a mixed bag. Some studies find that online exam proctoring software lowers course performance and other studies come to the opposite conclusion. The current

study's results were mixed as well. Proctoring software impacts some courses but not others. According to prior studies, proctoring software has the potential to impact course grades, the duration of exams and quizzes, and scoring disparity in assessment performance (Alessio et al., 2017; Alessio et al., 2018; Hylton et al., 2016; Dendir & Maxwell, 2020; Reisenwitz, 2020).

This study adds to the literature in a couple of significant ways. First, females in a 100-level math course, when regressed with other independent variables (i.e. full/part-time status, GPA), had lower grades with the proctoring software, suggesting that females were more willing to commit academic dishonesty than males in this course. Second, full-time students had lower course grades than part-time students with proctoring software in an undergraduate engineering course, when the data was regressed with independent variables; this outcome implies that full-time students may be more willing to commit academic dishonesty than part-time students. No other studies have found such results.

CONCLUSION, IMPLICATIONS, AND SUGGESTIONS

When six undergraduate courses studied were analyzed together, the research project did not prove that the addition of proctoring software created a lower course grade. However, the independent variable of cumulative GPA, as expected, proved to be a significant indicator of overall course grade. Interestingly, one of the six courses studied, a 200-level business law course, did support the original research question by finding that students earned lower course grades with the use of proctoring software, but the significance was found only with the addition of the other independent variables (i.e. gender, full/part-time status, GPA).

An unexpected finding of significance was that females in a 100-level math course, when regressed with other independent variables (i.e. full/part-time status, GPA), had lower grades with the proctoring software. Another unexpected finding in a 300-level engineering course was that full-time students had lower course grades than part-time students with proctoring software, when the data was regressed with independent variables (i.e. gender, GPA). Other courses showed no statistical significance for any of the variable combinations.

In some ways this research project result is consistent with the current literature, which compares performance with and without online proctoring software, as the results are a mixed bag. Most studies find that online exam proctoring software lowers course performance (Alessio et al., 2017; Alessio et al., 2018; Carstairs & Myors, 2009; Reisenwitz, 2020) and other studies come to a different conclusion (Beck, 2014; Ladyshewsky, 2015). The current study's results were mixed as well. The researchers recommend that instructors implement proctoring software for their online exams and quizzes to see whether the software impacts the grades, the time it takes students to complete assessments, and the disparity of scores for assessments within the course.

A limitation for this project was the Covid Pandemic. In addition, the data collection was voluntary based on professor approval, so the sample could have been larger. Further research may be performed. Since the results did not prove our original research question, there is more investigation to see why some variables were statistically significant, while others were not. Researchers could perform more measures post-Covid to be compared against the pre-Proctorio measures to eliminate the potential effects of Covid on the course grades. Researchers could consider other independent variables such as first-generation college student, year in school, and race. Future researchers could also attempt to analyze which types of undergraduate courses proctoring software impacts the most. Lastly, based on our original research question, we collected data for graduate courses too. Another future research avenue would be to regress the data from the graduate courses to see what findings can be revealed that might differ from the undergraduate findings.

DATA ACCESSIBILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

ETHICS AND CONSENT

The researchers received the data used in this study from university administrators. Ethical approval was obtained by the University of Southern Indiana's Internal Review Board (IRB 1639356-1) to proceed with this study.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

Conceptualization, J.O. and J.S.; methodology, J.S. and T.G.; software, T.G.; formal analysis, T.G.; investigation, T.G. and J.S.; data curation, J.O and T.G.; writing—original draft preparation, J.O and T.G.; writing—review and editing, J.O., J.S., and T.G.; visualization, T.G.; supervision, J.O.; project administration, J.O.; All authors have read and agreed to the published version of the manuscript.

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