Exploring the Efficacy of Online Proctoring in Online Examinations: A Comprehensive Review

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Abstract. **With the rapid growth of online education, ensuring academic integrity in online examinations has become a significant concern. Online proctoring has emerged as a solution to monitor students remotely during exams, aiming to deter cheating and maintain assessment credibility. This scientific article thoroughly reviews the literature to investigate the effectiveness, challenges, and implications of using online proctoring in online examination settings.**

A systematic review was conducted by searching electronic databases, including popular scientific databases such as Web of Science, Ebsco, Scopus, and Google Scholar, for relevant articles published between 2018 and 2023. Keywords such as "online proctoring ", "remote invigilation ", "academic integrity "and "online examination "were used to identify pertinent studies. Various research designs, including experimental studies, case analyses, and qualitative assessments, were considered to capture diverse perspectives.

The review synthesized findings from existing literature to elucidate the multifaceted aspects of online proctoring in online examinations. Studies highlighted the potential of online proctoring to mitigate cheating behaviors through real-time monitoring, identity verification, and surveillance mechanisms. Proponents of online proctoring argue that it offers a scalable solution to uphold academic standards in online learning environments. Furthermore, some research indicated that students perceive online proctoring as a fair method to ensure equal treatment and transparency during assessments.

However, challenges such as privacy concerns, technological issues, and the potential for bias in proctoring algorithms were identified as significant drawbacks. Additionally, the implementation of online proctoring may exacerbate disparities in access to resources and exacerbate test anxiety among students.

In conclusion, integrating online proctoring in online examinations presents opportunities and challenges for academic institutions. While online proctoring offers a means to enhance exam security and maintain academic integrity in remote learning environments, its implementation requires careful consideration of ethical, technical, and pedagogical implications. Adopting online proctoring should be balanced with the need to uphold academic standards while ensuring equitable access and promoting student well-being in online education.

Keywords: dishonesty, effectiveness, online proctoring, online exams.

I. INTRODUCTION

The rapid evolution of technology and the unforeseen circumstances brought about by the COVID-19 pandemic have significantly accelerated the transition to online education and assessment methods. This shift has necessitated the adoption of online proctoring systems to maintain academic integrity and fairness in examinations conducted remotely. Online proctoring, which employs various technologies to monitor examinees during tests to prevent academic dishonesty, has become a crucial component of online education. This comprehensive review explores the efficacy of online proctoring in online examinations, examining its impact on academic integrity, student experience, and challenges.

There are several basic types of proctoring - Live, recorded, and automated proctoring. [1].

The transition to online education has posed significant challenges and opportunities in maintaining the integrity of examinations. Traditional in-person proctoring methods, which play a critical role in deterring academic dishonesty, are not feasible in remote settings, leading to the adoption of online proctoring solutions. These solutions range from automated systems using artificial intelligence (AI) for suspicious activity detection [2] to live proctoring by individuals through videoconferencing platforms [3]. The effectiveness of these systems in detecting and deterring academic dishonesty has been a topic of extensive research, with studies showing varying levels of success [4], [5].

Moreover, the impact of online proctoring on the educational experience cannot be overlooked. While some studies suggest that online proctoring can enhance the credibility and reliability of online assessments [6], others

raise concerns about the potential for increased anxiety among students and the feeling of being surveilled, which could negatively affect their performance [7]. The ethical considerations surrounding privacy and the psychological impact of surveillance are critical issues that need to be addressed [8].

The adoption of online proctoring technologies has also been influenced by the need for scalable and efficient methods to conduct examinations remotely. Innovations in AI and machine learning have led to the development of sophisticated proctoring solutions capable of identifying suspicious behaviors with high accuracy [9 – 10]. However, the effectiveness of these systems in different contexts and their acceptance among academic communities remain areas of ongoing research.

The literature on online proctoring needs to be critically evaluated, with attention to its effectiveness in preventing cheating, its impact on the student experience, and its ethical and legal challenges. By examining a wide range of research and perspectives, this review aims to provide a comprehensive understanding of the current state of online proctoring and offer insights into future directions for research and practice in this area.

II. METHODOLOGY

This review synthesizes data from various scientific articles focusing on online proctoring systems. The methodology involved a systematic review of literature published between 2018 and 2023, identifying studies that assess the effectiveness, challenges, and perceptions of online proctoring in higher education. Keyword searches included terms such as "Online proctoring", "Online exam", "remote examination," "academic integrity", and "e-assessment". 445 results were found, from which we selected 27 scientific articles after a thorough review based on the inclusion criteria. Both qualitative and quantitative studies provided a comprehensive understanding of the subject. Additionally, this review examined technological advancements in proctoring software, including AI-driven monitoring, biometric identification, and behavioral analysis, to evaluate their contributions to academic integrity.

Following the study's main objective, i.e., to investigate the efficacy of online proctoring systems, we provided inclusion and exclusion criteria for the articles in this study.

A. Inclusion criteria

1. An online exam proctoring environment was examined, and the tests included researched participants.

2. Explored the opinion of surveyed participants about their experience during online testing.

3. An overview study on online exam proctoring has been done.

4. Analysis (including comparative analysis) of different online proctoring systems.

B. Exclusion criteria

1. An article that presents only the technical description and parameters of an online proctoring system.

After thoroughly applying the criteria, 22 articles were selected as eligible to be included in the review article. Some of them research the opinions and results of participants in an online exam with a different proctoring product, and a few prepare essay articles on the topic. Five articles address the exclusion criterion.

Although the research team is part of a university institution with a sports focus, we chose not to limit the study to this topic because, despite their focus, the exams are mainly theoretical and do not differ radically in approach from those in, for example, geography, mathematics or agricultural sciences. Students at the National Sports Academy " Vassil Levski" are not tested entirely in physical achievements as athletes but in theoretical ones - as future coaches, teachers of physical education and sport, and also physiotherapists.

III. RESULTS AND DISCUSSION

Several issues were identified from the detailed analysis of the articles that are of utmost importance concerning "Online Proctoring" and conducting examinations in an electronic environment.

In general, the articles report a relatively positive effect in their study of the application of the online proctoring method.

M. Bernardo and E. Bontà [11] found that it turns out that using an e-proctoring tool alone is not entirely satisfactory from a timing viewpoint while resorting to video surveillance alone is even risky as it provides no systematic feedback about what is happening on students' computers. They strongly believe that using an online proctoring system is essential, but on the other hand, they find that teachers are not fully prepared for this type of testing. On the other hand, Chan and Ahn [12] conclude that online exams, even when unproctored, are a viable assessment tool.

An interesting study is presented by Nurpeisova et al. [13], who consider not only the technical characteristics and features of different systems but also the actual applied experience of the learners. They find that a considerable percentage of students (85%) manage to take the tests in an online environment using an exam proctoring system. For this reason and overall, a positive effect is reported. However, this effect would not have been reported as such if it were not for the relatively good internet speed provided for the exams. In conducting the study on the system, it was found that the lighting of the exam location is of great importance as it can give wrong information on the eye position, and the system can report it as an error.

An interesting result was shared by the authors Hussein et al. [14] in their paper, such as the fact that learners were satisfied not only with the use of the mock-proctored test system but also since they could take the exam in a wider time-frame window. Another positive element is that such a system reduces travel and accommodation costs, which in turn justifies the cost of paying for the system. The only negative aspect that emerges in the study is the discomfort of some students being recorded all the time. This, in turn, is a solvable problem, as an automated system is used, and there is no human behind it to supervise, and the recordings are only available for review when necessary.

In the study by Cramp et al. [15], the importance of communication with students and preparation in advance of exams to reduce cognitive load is acknowledged.

Students' own prepractice for the exam and familiarising faculty with the details and instructions to clarify specific information for students is a mandatory element.

Similar to the experience described above, Griffiths [16] also concludes that it is crucial for students to read the instructions before taking the exam. Another interesting approach is to reconfirm the knowledge of some of the students scoring very high on their test two days after the exam by answering two additional questions. As the author mentions, although the students' opinions were not specifically sought, the challenge was to set up the webcam in a way that matched the instructions sent to the students.

In the study by Purpura et al. [17], no serious problems were reported with the use of a proctoring system, but it was reported as a problem that not all learners were proficient enough in English, and when technical assistance was needed from the system's help desk, a communication problem was reported. In this case, the problem was solved with assistance from the training institution, who were available when a problem arose. Despite the difficulties in adapting and switching to online testing, the authors of the study report an overall positive effect and that the implementation of such a system is for the better.

Oeding [18] describes in detail the possible case studies that can most often be described as rule violations in online testing when using a proctoring system. The author suggests paying utmost attention to examining the video recordings of those with the highest rank for suspicious behavior, especially in reporting the examinee's eye movements on the screen.

As shortcomings in proctoring systems are reported in the study of Arno et al. [19], a more specific problem appears to be the system's lack of precision in detecting irregularities. In conclusion, they outline the need to limit the number of learners who appear for an exam, as this increases the complexity of monitoring and the fact that pre-preparation of an exam conducted in an electronic environment supported by a proctoring system is mandatory.

The so-called "hidden labor" of maintaining an "automated" system is one of the critical remarks in the Selwyn et al. study [20]. Also, the article examines the adoption of online proctoring in universities as a short-term solution during a crisis, suggesting it might become a long-term fixture. It highlights the benefits from an institutional perspective, such as catering to remote learners through data-driven examination methods. However, it also raises significant concerns about privacy, ethics, and the commercialization of education by normalizing automated monitoring and outsourcing educational functions. The piece suggests that these practices may fundamentally alter the nature of university education and emphasizes the need to rethink online proctoring in alignment with educational values that respect users and promote quality education.

The ethicality of the process is also addressed in the article by Coghlan et al. [21], as they consider the use of online proctoring software to be rather unethical in terms of using facial recognition and data without the fully informed consent of examinees. We believe that this is rather a manageable problem, but the need for clarification and the provision of additional information is mandatory.

In their article, Kharbat and Abu Daabes [22] raise essential questions about online proctoring technologies. Interesting feedback was received from research subjects who reported anxiety during exams about not being able to control sounds coming from family members or other external objects or from the fact that due to certain cultural or other beliefs, the family disagreed with the use of such technology to conduct exams. The study has shown that students' overall satisfaction with e-proctoring was below their expectations.

From the analysis conducted in the study by Chen et al. [23], they believe that "*if students are willing to cheat in an academic context, it seems probable that they would also cheat as an employee if given sufficient opportunity*". They conclude that "*proctoring online exams is important in maintaining exam integrity and for the reputation of an academic program or university*".

The study by Lee and Fanguy [24] addresses the view that it is necessary to foster a more positive and democratic future in online higher education post-pandemic. There is a need to support innovative assessment practices that emphasize trust and formative assessment over surveillance. Similar to the practice of using books during examination or project-based assessments, the article suggests that educational technology and higher education institutions should support and collaborate with teachers who engage in innovative assessment practices.

The system considered in the article by Guney et al. [10] has been reported to be capable of producing false positive or false negative test results. In conclusion, they theorize that in the near future, it is expected that exam-based proctoring environments of this kind will be used outside of educational environments, namely for hiring employees for various companies and fields.

Evidence of exam anxiety is also discussed in the article by Conijn et al. [7]. In this study, it was found that factors such as lack of study space, lack of reliable technology, or financial issues were found to increase test anxiety.

Barrio [25] makes a general discussion on online proctoring technologies and identifies significant concerns regarding privacy, equity, and pedagogical integrity. The legal aspects of the problem and the specificity of GDPR legislation are discussed. He considers that the "lawfulness of the processing is highly disputable, taking into account the existence of assessment methods that, in addition to having a better education value, do not infringe students' rights. "

An interesting study on the value of a proctored versus non-proctored testing environment for online class exams was prepared by Reisenwitz [26]. He considers that there may be fewer or no opportunities for academic dishonesty due to the implementation of proctored online exams, but also that the students may be attracted to online classes because of the increased opportunity for academic dishonesty in the case of instructors who do not proctor their exams. And the results of his research lead directly to the conclusion that exams need to be proctored.

In their study, Tweissi et al. [5] compare exam results conducted through an online proctoring system with embedded artificial intelligence, and the same is analyzed

through human decisions about misconduct during the exam. After testing and analysis, the conclusion drawn was that online proctoring becomes more accurate when the system is automated with less human intervention. It is also found that there are misconduct cases that human proctors cannot easily identify during the examination, especially in the case of large numbers of students.

Having conducted their research, Dendir and Stockton Maxwell [4] conclude that the use of online proctoring technology is effective, and although it is not a perfect tool, its use is important to be encouraged.

In the exams compared and experiments done, Vazquez et al. [27] found that students who were not subject to proctoring scored, on average, 11% higher compared to those who were required to use a proctor. Although their research is more about the unfair methods used in testing (in-person and online), it can be said that collaboration as an approach is the most prevalent method in online testing, using their notes, books, or the internet.

IV. CONCLUSIONS

We found that some of the articles did not have as positive a view towards proctoring solutions for exam integrity, but at the same time, could not be sorted into those with an entirely positive effect, a mixed effect, or an entirely negative effect of using these forms of exam proctoring in an online environment.

We could formulate some conclusions and lines for future research from the analysis of the presented articles.

Challenges emerge in the use of proctoring systems for online examinations in distance form by students with different types of disabilities, but on the other hand, facilitation for students with physical disabilities or (temporary) injuries. Also, students with insufficient computer experience and who type more slowly or look at the keyboard when typing would find it a real challenge to use this kind of system.

The lack of a stable internet could also be identified as a significant challenge in conducting online examinations through a proctoring system.

The development of an automated AI-based proctoring system demonstrated high accuracy in detecting suspicious activities, thus enhancing the integrity of online exams. As artificial intelligence evolves, it will be interesting to track from a scientific perspective whether systems for detecting unfair practices in online environments will become more sophisticated or more challenging in terms of AI's popularity among learners.

According to student satisfaction, studies revealed mixed effects on student satisfaction and performance, with some students reporting satisfaction with online proctoring services while others faced performance issues. Conversely, some research indicates that the stress associated with being monitored can negatively impact performance, particularly for test-takers with anxiety disorders. Perceptions of online proctoring among students and faculty are varied. Many students appreciate the flexibility and convenience of online examinations but express concerns about privacy and the invasiveness of proctoring software. Faculty members recognize the necessity of online proctoring for maintaining academic

standards but highlight challenges in implementing these systems, including technical issues and the need for extensive training.

As a general conclusion, it could be said that online systems can be used as a supplementary, short-term option for schools or universities during sudden, critical situations. They are an effective and practical solution, although not ideal in terms of accuracy, but could detect suspicious behavior during an exam to a very high level. However, the effectiveness varies depending on the proctoring method (live, recorded, or automated) and the robustness of the technology used. Flexibility in the decisions of educational institutions would be rather positive for them, as it would not restrict their learners and, at the same time, ensure the fairest possible approach to taking an exam in an electronic environment.

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