

The impact of the Covid-19 pandemic on on-line examination: challenges and opportunities

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ABSTRACT: The latest Covid-19 pandemic changed the workflow of different sectors, mainly education. Academic institutions and external examination providers responded differently to the lockdown enforced by the pandemic. The widespread pandemic meant that schools and universities could not operate as they used to. Educators and learners were forced to teach and learn from their homes. In addition to the logistical complexity of such a solution, the examination is another challenge. Examinations were usually held in a monitored environment, with results generally deciding students' qualifications for university admission. Various institutions dealt differently with on-line examinations and faced challenges on all levels. Some institutions came up with opportunities for others to learn from their experiences. However, considering the recency of the Covid-19 pandemic, only limited published academic literature reviewed the impact of the pandemic on on-line assessment. In this article, the authors review and summarise research examining the impact of the pandemic on on-line examination globally, as well as highlight challenges and opportunities for policymakers, educators, researchers and higher education decision-makers regarding on-line examinations in this new environment.

Keywords: E-assessment, on-line examination, academic misconduct, academic dishonesty, e-proctoring

INTRODUCTION

According to the 2018 National Center for Education Statistics report, post-secondary enrolment fell by about 90,000 students or roughly 0.5%, from fall 2016 to fall 2017. Students who were entirely enrolled on-line, on the other hand, increased by 0.7%, from 14.7% to 15.4% of all students. The percentage of students who took at least one on-line course rose to 33.1%. As a result, over a third of all post-secondary students learn on-line. As on-line education has become more widespread, numerous researchers have pushed for new pedagogies appropriate for on-line learning and the needs of the tech-savvy generation [1].

With the Covid-19 pandemic, the world has been immensely disrupted and challenged. This pandemic has impacted all sectors of society, mainly education, altering students' learning environments, perceptions and skills. Governments worldwide had to legislate for the closure of in-person teaching in schools and universities, thus making them switch to on-line delivery forms. Because of the fast shift to on-line learning, educators and institutions must develop more innovative teaching approaches to help students cope with these rapid changes, especially when it comes to on-line assessment [2].

Assessment is essential at all stages of education, primarily for higher education, where university admission criteria become competitive and demanding. Even though assessment is defined differently for different goals, it is self-evident that the new approaches to evaluation have a significant impact on learning [3]. According to previously limited research during the pandemic, the abrupt switch from a traditional to an on-line method of instruction had a substantial impact on student assessment and evaluation processes. When compared to regular examinations, students found on-line tests to be challenging. Instructors and institutions must use safe, dependable, valid and fair assessment techniques [4].

On-line assessment proved to be controversial among scholars. Some scholars believe that e-assessment is beneficial, positively impacting continuous and real-time feedback. In contrast, others prefer the traditional examination mode, where there is less room for misconduct, among other challenges. In this sense, educators need to address challenges and explore opportunities arising from the pandemic's impact on on-line assessments and their future implementations. Information and communication technology (ICT) implementation of varied approaches in the learning environment has become one of the most critical aspects of the teaching and learning process, and the concern of many researchers. The use of information technology tools in classroom learning and teaching methods aids in improving educational quality in schools, universities and institutions [5]. There are many purported benefits and uses of on-line learning.

Some of the most important topics of research include its efficiency in educating students, use as professional development, cost-effectiveness in combating rising post-secondary education costs, postgraduate education and the ability to provide world-class education. With the growing popularity of on-line learning, an efficient instructional design paradigm to develop and deliver on-line learning environments is urgently needed [5].

In today's educational systems, there is a movement toward standardisation. Assessment is seen as a critical component of that system to improve academic quality while also facilitating student mobility. *Students should be examined using documented criteria, norms, and processes implemented consistently.* Assessment and evaluation seem to be an ever-present activity facing significant variations and changes in higher education, especially after critical periods like the pandemic. Higher education has seen an upsurge in ICT in recent years.

E-learning and technology-enhanced learning (TEL) have become essential features in higher education, giving new opportunities and approaches to teaching, learning and assessment [6]. E-assessment in higher education is riddled with difficulties, which may explain why institutions have resisted incorporating technology into their assessment methods. Because of unreliable and unpredictable challenges regarding technology integration, it could be identified that technology itself could be a barrier to assessment and evaluation in an on-line context [7].

A limited number of review papers discuss e-assessment before, during and after the pandemic. This review aims to synthesise current literature about the impact of the Covid-19 pandemic on e-assessment. This review article begins with an introduction to the development of e-assessment based on previous research, followed by the terminology and definition section. The methodology section presents the selection criteria, papers cited in chronological order and a description of the findings. Next comes a discussion section reviewing and identifying gaps in the literature related to e-assessment, challenges, opportunities, perspectives and attitudes. The article ends with a conclusion and recommendation section for future research.

TERMINOLOGY AND DEFINITIONS

The modern international economy is undergoing a new (fourth) information revolution, with digital technology gaining widespread acceptance, modernising an increasing number of economic phenomena and processes, and spreading to a growing number of industrial markets. The worldwide digitisation trend in education demands a new generation competent in the knowledge economy. The pandemic has impacted all sectors and countries, leaving the education industry a fast-paced need for quick decision-making and adaptation. To examine the impact of the pandemic on on-line examination, it is necessary to explore emerging terms related to on-line assessments. As mentioned above, first are presented emerging terminologies and definitions discussed in previous research. Table 1 includes some terminologies that need to be explained before being used in the rest of the article.

Table 1: Terminologies used throughout the article.

Terminology	Definition
Remote education	This approach to education is applied when students can choose their individualised education schedule at any time and place that is convenient for them [8].
On-line learning	Many definitions address the ambiguity and disagreement among scholars around the exact meaning of on-line learning. Among the many definitions, on-line learning can be defined as learning in an asynchronous classroom using the Internet/on-line computers/devices. Learners engage with instructors and other students, and are not restricted by their physical location [9].
Learning management system (LMS)	LMS is software that allows the development, management, organisation and delivery of on-line learning materials to learners [10].
E-assessment	E-assessment refers to ICT-assisted assessment, which encompasses the complete assessment process, from developing assignments to storing results [6].
E-proctoring	E-proctoring is a system established by electronic instruments that permits monitoring remote evaluative processes through telematic resources to make the outcomes reliable [11].
On-line assessment	On-line assessment includes assessing students in an on-line context and creating distributing feedback and analysis of various types of on-line assessment/examinations. An entire e-system is required for on-line assessment, including an e-administrator, e-support personnel, e-learners and e-teachers [12].
Computer adaptive testing (CAT)	CAT is distinguished by the fact that it selects questions for the test taker as they proceed, based on their performance on previous questions. This way, the test taker can be given a set of questions tailored to their abilities [13].
Computer-based assessment (CBA)	CBA is an assessment type administered and graded entirely by computers. This separates it from computer assisted assessment (CAA), which only uses the computer for part of the assessment procedure [14].
General Certificate of Secondary Education (GCSE)	GCSE eventually led to Cambridge International General Certificate of Secondary Education (IGCSE) certification for students. Cambridge IGCSE is an internationally recognised curriculum for pupils aged 14 to 16 [15].
SAT (formerly Scholastic Aptitude Test)	SAT stood for the Scholastic Aptitude Test until it was renamed the Scholastic Assessment Test in the 1990s, and it is now known as SAP. Many higher education institutions use it as an admission examination. The college board administers and oversees this multiple-choice,

	paper-based examination. The SAT determines whether a high school student is ready to begin a college or university major [15].
Advanced Placement (AP)	AP examinations are standardised tests that assess how well a learner understands the content and skills of a particular AP course. Most AP courses feature an end-of-year paper-and-pencil examination, but some have different ways of evaluation [15].
Test of English as a Foreign Language (TOEFL)	TOEFL is a test of English for people who do not speak English as a native language [16].
Graduate Record Examination (GRE)	GRE is an examination that must be passed to be admitted to a university as a graduate student [17].
Graduate Management Aptitude Test (GMAT)	This test is given to business school applicants in the United States to assess their analytical reading, writing, presentation, etc skills. [17].
Academic dishonesty/academic misconduct	Academic dishonesty, including cheating, plagiarism and falsifying data or citations, is a pervasive and challenging problem in higher education [18].

METHODS

Due to the newness of the topic, a limited number of databases were identified to extract relevant papers on the impact of on-line assessments during the Covid-19 pandemic. This article includes 30 studies reviewing on-line assessment methods used in higher education before, during and after the pandemic, and the impact of on-line examination with the challenges, opportunities and a recommendation section. Table 2, Table 3 and Table 4 show a summary of papers that discuss the educational situation before, during and after the pandemic.

Table 2: Papers cited related to assessments before the pandemic.

Study	Year	Method	Sample	Findings
Online formative assessment in higher education: a review of the literature [19]	2011	Literature review	18 out of 91	Fundamental issues of assessment: - Validity - Reliability - Dishonesty - Engagement with critical learning processes - Promoting equitable education
On the design of online synchronous assessments in a synchronous cyber classroom [20]	2012	Review	N/A	- The extent of monitoring and cheating - Lack of suitable software tools specifically for supporting on-line synchronous assessments - The need for various on-line synchronous assessment methods for the different subject matter - Some possible solutions were identified, such as a short time limit for answering questions and a well-analysed need for a software tool to address all the issues
E-examinations from student's perspective - the future of knowledge evaluation [21]	2013	Qualitative	292	- On-line assessment's popularity - Positive impact with new educational possibilities
Classroom versus online assessment [22]	2014	Quantitative	174	- Students' effort and performance did not significantly differ
Postgraduate students' perceptions towards online assessment: the case of the faculty education, Umm Al-Qura University [23]	2014	Mixed methods	34	- High positive perceptions of on-line assessment - Gender and ICTs familiarity significantly affect postgraduate students' responses in most areas studied
Overview of open book-open web exam over Blackboard under e-learning system [24]	2015	International conference IEEE	---	- It can be concluded that open book-open Web (OBOW) examinations are better in accessing the student's ability to understand the subject and utilise the knowledge learned
Medical students' acceptance of online assessment systems [25]	2016	Quantitative	240 students	- Preference for on-line assessment - The on-line multiple-choice question (MCQ) test as an assessment technique had a high level of acceptance among the participants - MCQ examinations are more objective and better for evaluating knowledge
Proposed bio-authentication system for question bank in	2017	Proposed mode	N/A	- On-line assessments should be authentic and put forward credibility to the quality of distance learning - Biometrics as technology enhances the security of

learning management systems [26]				question banks - Authentication processes in on-line assessment improve security and quality assurance standards
Comparative analysis of online and printed form of testing in scientific reasoning and metacognitive monitoring [27]	2018	International symposium IEEE	N/A	- The results revealed no statistically significant changes in scores between the on-line and printed versions of the test - Some primary school teachers believe that e-learning has the slightest promise specifically for primary school students
An application of online exam in a discrete mathematics course [28]	2018	Conference proceeding	N/A	- Modern information technology in on-line examinations improves the efficiency and reliability of data collecting and storage - Using test data mining collects insight into educational deficiencies and challenges - Assessment piques students' interest in, and enthusiasm for, learning - On-line testing and data are objective evaluation approaches that permit teachers to evaluate students' learning accurately - E-assessment provides teachers with individualised feedback and helps students grasp knowledge
E-exams in engineering education - online testing of engineering competencies: experiences and lessons learned [29]	2018	Report qualitative	N/A	- Remote examination/e-examinations are challenging to be applied - Instructors need to take into consideration legal recollections, the lecturer's acceptance and willingness, and the learner's attitude towards e-assessment
Development of continuous authentication system on android-based online exam application [30]	2018	Conference proceedings	N/A	- Authentication system is needed to minimise possible fraud/examination misconduct and make on-line assessment more effective
Online assessments: exploring perspectives of university students [31]	2018	Qualitative	41 students	Critical perspectives by learners: - Students show a degree of worry during on-line tests - Concerns related to technology and technological expertise - Concerns among students regarding unreliable technological infrastructure - Teachers lacked experience with on-line assessment methods - Problems with assessment design, cheating and topic discipline - Rather than solely relying on multiple-choice questions, students preferred a range of question forms - Concerns about grading and instant feedback

Table 3: Papers cited related to assessment during the pandemic.

Study	Year	Method	Sample	Findings
On-line learning on information security-based on critical thinking andragogy [32]	2020	Proposed framework	N/A	- The proposed model allows instructors and learners to use on-line learning better and enhance necessary thinking skills in an on-line environment
Impact of technology, digital devices and test timing on score comparability [33]	2020	Book chapter	N/A	- Task design, test scheduling, tool and feature selection, test delivery, answer type, scoring and the sorts of the information reported having benefited from technological advancements - Variations in examinee experience, timing, input type, response device, screen size, interface, resolution and other testing criteria might result in device malfunction - New tools and programs require new approaches to e-assessment

The longer-term impact of COVID-19 on K-12 student learning and assessment [34]	2020	Report	N/A	<ul style="list-style-type: none"> - Gap year identified challenges in assessing and comparing students' achievement and performance - Without an approach like hierarchical linear modelling (HLM), the enormous heterogeneity within any school will be overlooked, affecting the reliability and validity of any study - The necessary response to the pandemic impacted instruction for nearly three months during the 2019–2020 academic year with the potential to continue into the 2020–2021 academic year, including quickly transitioning schools and universities to on-line instruction with little time for training and standardised procedures - Disparity in classroom instruction during the final quarter of the academic year will influence standardised test scores
The effects of delivering personalized course recommendations at scale on advanced placement participation and performance [35]	2020	Experimental/ intervention design	160,269 students	<ul style="list-style-type: none"> - Access to demanding courses, such as AP has progressively increased - In the United States, socio-economic differences remain considerable, especially when it comes to underrepresented groups - Many students who are qualified to thrive in AP courses may be unaware of their academic capabilities and might benefit from individualised course recommendations - According to AP coordinators, barely a third of high schools assess students' AP potential when advising others on which courses to enrol in

Table 4: Papers cited related to assessment after the pandemic.

Study	Year	Method	Sample	Findings
Remote assessment in higher education during COVID-19 pandemic [36]	2021	Mixed methods	486 students from 61 universities	<ul style="list-style-type: none"> - Assignments are the most used tools for on-line assessment - Students' satisfaction level is a critical matter with the quality of the assessment practices - Formative assessment and feedback in remote assessment are critically important - Instant evaluation and feedback were not sufficient for effective learning experiences - Distinctiveness of test scores impact the quality of assessment processes in a negative manner - Learners encouraged the employment of traditional examinations rather than remote assessment and evaluation
Remote e-exams during Covid-19 pandemic: a cross-sectional study of students' preferences and academic dishonesty in faculties of medical sciences [37]	2021	Quantitative	730 students	<ul style="list-style-type: none"> - Examinations and quizzes were the most preferred method of assessment submission of reports while short written assignments were the least preferred ones - Examination dishonesty/misconduct is identified as a continuous challenge - There is less preference for remote e-examinations among students at medical faculties
E-proctored exams during the COVID-19 pandemic: a close understanding [38]	2021	Qualitative	106 students	<ul style="list-style-type: none"> - Educational institutions were required to adapt to the pandemic's demands to strike a balance between instructional quality and the ongoing educational processes, including assessment and evaluation - Learners identified several challenges related to technical, environmental, psychological, cultural and privacy/security issues while taking on-line examination - Despite the challenges, most students scored high while taking on-line examinations - Most students would not choose on-line examination if they had the choice

An approach to reinforce active learning in higher education for IT students [39]	2021	Quantitative	120 students	<ul style="list-style-type: none"> - ICT encourages students' learning and engagement - Since the Nearpod tool can be used with Zoom, it made on-line learning possible and faster during the pandemic
Full-time online assessment during COVID-19 lockdown: EFL teachers' perceptions [40]	2021	Mixed methods	26 instructors	<ul style="list-style-type: none"> - The descriptive statistics revealed that EFL teachers have a modest attitude toward the electronic assessment - The majority of responses linked to instructors' impressions of on-line assessment techniques/methods with a positive reflection - Teachers had significant difficulties in assessing pupils on-line - No significant differences were found in teacher views of the four characteristics studied between male and female teachers
Impact of COVID-19 pandemic on education: moving towards e-learning paradigm [41]	2021	Qualitative	50	<ul style="list-style-type: none"> - Tight protocols imposed by various governments in response to the Covid-19 epidemic have had a significant impact on learning - The outbreak has revealed various flaws and disparities in the educational system - Despite the efforts of the educational community to ensure learning progression during the epidemic, learners have had to rely more on their resources to continue studying
Zoom invigilated exams: a protocol for rapid adoption to remote examinations [42]	2021	Quantitative	1,728	<ul style="list-style-type: none"> - E-examinations were found to be more student-friendly than traditional ones - There was a slight difference among traditional and on-line examination modules in average test scores, the distribution of examination scores or the distribution of cumulative test scores
Adoption of online proctored examinations by university students during COVID-19: innovation diffusion study [43]	2021	Diffusion study	N.A.	<ul style="list-style-type: none"> - Diffusion of innovation theory operationalised in this study was successful in predicting the adoption of on-line proctored examinations by students - 55% of students favour on-line proctoring with rapid adaptive behaviour for on-line tools - On-line proctored examinations are user friendly
The impact of rapid adoption of online assessment on students' performance and perceptions: evidence from a distance learning university [44]	2022	Quantitative	725 students	<ul style="list-style-type: none"> - Students' academic performance has increased across all metrics and Bachelor's degrees, with a positive view of the on-line system - Students believe that on-line assessment and evaluation are complex, with low-quality metrics - Learners witnessed increased chances of achievement rate with on-line examination
Educational data mining techniques for student performance prediction: method review and comparison analysis [45]	2022	Quantitative	7,897 students	<ul style="list-style-type: none"> - Aptitude examinations should be included as an additional entrance criterion because they have been shown to affect university performance outputs negatively if the aptitude is poor - The existing input parameters should be given less weight, and the suggested aptitude tests should be given more attention in university entry requirements - High school diploma was revealed to be the strongest predictor of overall GPA, explained by statistically significant disparities in diploma performance among graduating students, implying that earning 90% on an I.B. certificate would likely result in a higher output GPA than scoring 90% on an American diploma certificate
Why did students report lower test anxiety during the COVID-19 pandemic? [46]	2022	Quantitative	417 students	<ul style="list-style-type: none"> - Effective science instruction, regardless of the learning setting, builds subject knowledge and develops the metacognitive learning skills - While students reported less anxiety in the on-line environment and saw on-line learning as generally positive in terms of flexibility and accessibility, they also found it challenging to interact with the content and create meaning

Challenges and possibilities for board exams in the Covid-19 era: experience from the fellowship Committee of the European Board of Nuclear Medicine [47]	2022	Editorial	N/A	- A remote on-line examination can provide a flexible and trustworthy alternative with easy access and low cost for board examinations - Pandemic scenario has compelled board members, educators and examiners to collaborate and exchange cutting-edge information, experiences and skills that will reshape medical education and proficiency knowledge evaluation methods for the future generation of nuclear medicine physicians
Supporting students during the transition to university in COVID-19: five key considerations and recommendations for educators [48]	2022	Review	N/A	- The study uses the <i>five sense of student success</i> paradigm to highlight five essential evidence-based, psychology-informed aspects that higher education educators should keep in mind as they plan for the coming academic year or assessment post-pandemic

DISCUSSION

Interactive technology in learning has increased student engagement by supporting constructivist approaches to creating an active learning environment. In a study, student evaluation indicates that technology integration improves student comprehension and retention of learning material while also increasing student motivation for learning. Furthermore, the Covid-19 pandemic compelled all educational institutions to go on-line. This change necessitated adapting instructional tactics to the new virtual setting. The teacher must go above and beyond to attract and retain students in the on-line class. As a result, new on-line tools are being sought [39]. On-line learning serves tech-savvy learners with on-demand life skills. Developing an on-line learning model to improve critical thinking skills in an on-line environment is complex. The new teaching approaches must satisfy the needs of the 21st Century learner, whose abilities go beyond basic capabilities. There is a demand to move away from traditional pedagogy and toward andragogy to develop self-directed learners who can compete in a global market for higher education graduates [32].

When tackling the issue of e-assessment post-pandemic, some considerations need to be highlighted and explored to get the best out of e-assessment. In a study on supporting learners during the transition to the university during Covid-19 five critical considerations with corresponding essential recommendations were discussed that could be taken as a road map for educators, learners and policymakers [48]. These considerations began with the reacclimatising to studying, imposter syndrome and sense of belonging, mental health consequences of Covid-19, increasingly unattainable hidden curriculum, and ended with accountability for (in)equality of experiences [48].

In the comparative analysis of on-line and printed form of testing in scientific reasoning and metacognitive monitoring, the results showed no statistically significant scores between the on-line and printed versions of the test [27]. Scholars have shown considerable interest in comparing on-line and off-line learning modes, precisely after the emergence of the pandemic in 2020.

In a study exploring how on-line testing affects students' study efforts and performance compared to regular paper-and-pencil classroom testing, the findings revealed that the testing process did not influence study efforts or course performance. However, the authors did discover a clear positive association between students' effort and their course performance. In other words, no significant differences in the administration of both modes were found [22].

Digital learning assessment systems have improved education due to their flexibility and capacity to adapt to specific student conditions. In the case of the National Distance Education University (UNED), Madrid, Spain, the academic difficulties that influenced the on-line evaluation were focused on the Covid-19-induced introduction of change [44]. In addition, the rate of change determined the sort of technology and the assessment technique in each situation. The data show that an increase in performance indicators corresponds to a high degree of student enthusiasm for on-line assessment; nevertheless, when the system shifted from face-to-face to on-line, a tiny number of students were discouraged from completing assessments. The results show that students' academic performance has improved across all measures and Bachelor's degrees. The majority of students who responded to the poll thought the on-line system were helpful [44].

Through on-line learning, students can virtually go outside of their countries and communicate with students they might not otherwise have met, which is because of on-line proctoring. According to Kubiato, automated proctoring allows an on-line examination to be completed at the examinee's leisure while still being monitored [49]. Automated proctoring is gaining traction because it saves time, is very scalable, aids in individual examinee monitoring, and generates reports of possible examinee fraud or malpractice [43].

FUNDAMENTAL ISSUES OF ASSESSMENT: VALIDITY, RELIABILITY AND DISHONESTY

In short, enabling a diversity of meaningful assessment activities that support contextual, inquiry-based learning and multidimensional views is what validity in the on-line assessment context is all about. Validity also has to do with the effectiveness of formative feedback in terms of adequacy, immediacy, creating meaningful interactions and

providing enough learner support. In the e-context, reliability implies the ability to document and track learning over time, which informs the feedback process. Reliability also refers to providing sufficient possibilities for multiple sources of learning evidence. The degree of intrinsic validity and dependability affects the issue of dishonesty in on-line formative assessment, which relates to students owning their work. To enable desirable qualities and overcome associated dangers, significant considerations must be made throughout the design and integration of formative assessment in on-line contexts; and on-line feedback serves that purpose. In other words, feedback should not be viewed as a goal in and of itself; instead, it should be used to foster shared meaning, ongoing learner support and learning to scaffold. Individual learning styles and study strategies are also considered in on-line learning. Integrating on-line formative assessment while maintaining the highlighted features will surely change perceptions of validity and reliability, allowing on-line formative assessment to serve as an innovative instructional technique in a knowledge-based society [19].

CHALLENGES OF E-ASSESSMENT

Technological Infrastructure and Resources

Students believed that on-line assessments were restricted to specific majors, mainly science courses. Concerns about students' and teachers' technological incompetence, as well as scepticism about the digital infrastructure, were raised in several previous studies. Most educational institutions were not fully equipped to provide all their courses on-line. Inadequacies in technology, a lack of professional on-line tools, and instructors' and students' lack of expertise with distant education have surfaced as essential difficulties that institutions must deal with during turbulent times. Other issues students faced were related to the fact that most students are unaware of the proper browser to use before taking the on-line test, the correct browser settings and clearing the browser history. All of these account for sensitive security issues. The main culprit in computer systems that use Internet service is the simultaneous execution of large background programs, which obstruct the user's computer's smooth operation.

While allowing a coordination server to assume control of all learners' computers during taking on-line synchronous assessments could be a viable option, it poses numerous ethical and privacy concerns. It does not address the issue of learners using other computers or non-computing resources. In the study of e-examinations in engineering education, the findings demonstrate that developing *e-exams from home* as a type of actual e-examination that may be passed at home or far away from the study location without proctoring the students is not easy [29]. The rapid technological advancements of recent years have made it possible to implement simple technical solutions for conducting e-examinations: a computer and a secure and stable Internet connection. But the major problems are dealing with a plethora of legal rules and lecturers' approval and desire to devote a significant amount of time to meticulously preparing e-examinations. The authors are confident and optimistic that the initial hurdles will be solved, paving the way for a more straightforward and more comfortable method of competency testing in the future [30].

Many colleges in the USA and in other countries have begun to offer on-line courses, and on-line examinations are becoming more common. Despite its widespread use in on-line education, on-line examinations are a standalone tool for assessing students' knowledge in traditional lectures. Teachers only understand students' learning situations by observing, asking questions and correcting homework. They usually apply subjective and one-sided opinions to their performance because it is impossible to schedule regular tests in traditional classes. This gives on-line examinations a place in traditional classrooms. When using an on-line examination system, teachers create a test question library first, from which the examination system will automatically select questions to start test sheets based on a strategy. Students sign up for the design and take the examination after receiving a link from the teacher; that is how LMS facilitates learning and evaluation [29].

Security Concerns

Most educational institutions that use traditional, open and distant learning are heavily invested in the digital world, notably using virtual learning environments (VLEs) to offer e-content to students and assess their performance. Continuous course assessments (CCAs) are a critical aspect of any educational system, but they are essential in open and distance learning institutions that use e-learning platforms. E-learning platforms, such as Moodle, Canvas and Blackboard frequently incorporate on-line assessments, such as tutor marking assignments (TMAs) and on-line examinations. As a result, on-line examinations necessitate a high level of collaboration and organisation from all parties involved in the higher education institution. Before that creating a question bank was critical and vital since it is both financially and logistically demanding, resulting in fierce competition among educational institutions in the effective use of their e-learning platforms. These systems are presented in a comprehensive report on learning management and e-learning products with vendors highlighting important structure and features of desired e-learning products [50]. According to the report, *e-learning has become a way of life for many businesses*, as many corporations and universities have built their proprietary systems and made them available only in limited ways, if at all. The most common LMSs used in the education sector are Blackboard, Brightspace, Moodle and Instructor Canvas; these have internal course material management and the capacity to create examinations and assessments [50].

Verifying the candidate's identification is one of the most significant aspects of remote assessment. This should be considered a precautionary measure at registration and on the examination day. Furthermore, a set number of applicants

for the on-line oral test should be established to ensure the examination's quality. In this sense, distant on-line examinations for board examinations have the potential to provide a flexible and dependable alternative that is both convenient and inexpensive. Despite the inherent constraints of a virtual examination, a remote oral examination can be conducted using readily available video conferencing technologies while meeting the specialised needs of the medical field if well planned [47].

Aside from the user's computer's technical issues, the Internet service provider in the location where examinations were held is often identified as underdeveloped. This results in slow Web page load and creates a malware attack during specific scenarios. An antivirus program detects the appearance of harmonised Web pages one after the other from the same site like a virus. Thus, the antivirus program prevents the display of different pages from the Web site. As a result, many students had their examinations terminated. This study casts doubt on the question of bank security, which is regarded as the backbone of on-line examinations' defence against malicious behaviour. A study describing a collaborative design of a bio-authentication technique based on the authorised person's fingerprint as a nested internal security level for accessing the question bank could alleviate the security concerns during an on-line assessment [26]. Even though certain negative connotations still exist among scholars, yet there is a probability that such feedback will decrease once instructors are given enough training about the selected criteria for preparing such type of assessment [51].

On-line examination applications with android-based continuous authentication that represent authentication modules and Web-based applications in the form of admin dashboard pages to validate test participants were developed due to system development, a critical concern to the reliability and validity of e-assessment. The authentication module is for people who are participating in a test. The supervision module is designed for users in charge of supervising examinations. On-line examination activities can be carried out remotely with these two modules, and administrators can still validate and oversee participants during the examination. Prototype development aims to create authentication that may be used in on-line examinations. This enables test participants to be taken during the examination. According to the results of the tests, the on-line examination application can provide image data during the 20-minute examination without disrupting the work on the question. The information gathered from snapping images during the examination can be used to determine whether or not there was any fraud. The administrator can use the supervision module to verify the examinee [30].

Academic Dishonesty and Misconduct

Examination dishonesty and misconduct appear to be among the most significant issues with e-assessment. Although, in most cases, students were instructed to activate the display of their video image via Webcams so that the instructor could observe them, it did not give the instructor any information about what the learners' settings were. A learner may theoretically arrange for a helper to sit nearby but out of the Web camera's range [20].

Maintaining academic integrity in an on-line setting can be a near-impossible effort. On-line proctored tests may be the answer, providing assessment security, student authentication, and making cheating more complex, less likely and detectable. However, no assessment method is entirely free of cheating. According to research, on-line tests provide some protection against cheating and may discourage and identify opportunistic efforts at cheating, but they cannot wholly eliminate cheating. As a result, an on-line examination working group was formed to ensure that the student-centred culture continues to support on-line tests in the future. While there is a strong push inside universities (and the higher education landscape in general) to move away from invigilated examinations, there is still a case for them in some disciplines and certification contexts. As a result, on-line examinations must stay pedagogically sound and deliver a positive student experience. The group actively engaged with one another, conversed and solved problems using collaborative on-line communication technologies. The whole-of-institution strategy provided for a quick response if something went wrong with an on-line invigilated examination: if necessary, the Division of Student Services sent bulk text messages to students; the Division of Learning and Teaching created and shared a GoogleDoc, if an image in the examination was not visible to students; subject coordinators and discipline leaders clarified and communicated discipline-specific tests [42].

E-ASSESSMENT OPPORTUNITIES

The examination system and the transition from traditional paper examinations to electronic examinations have resulted in a degree of resistance among higher educators. E-assessment is gaining more and more popularity. In this sense, e-learning offers new educational possibilities for different groups of people. These possibilities are developed through new mobile technologies, enhancing students' mobility [21]. Entrance requirements to universities are essential markers for evaluating applications. A study examining aptitude examinations measuring engineering knowledge and spatial vision rather than general cognitive ability assessments like inductive and verbal capacities can negatively correlate to university performance outputs.

According to previous studies, several authors have shown that on-line settings can provide interactivity that may exceed interactions in face-to-face settings, particularly in terms of opportunities for providing and reviewing feedback close performance gaps. This is expected to promote transferrable learning and help learners build self-regulated learning practices, a critical skill in on-line environments [19].

According to the overall picture offered in the examined publications, e-assessment works quite well for formative and summative evaluation - the potential to save educational resources and measure traditionally difficult to test skills and competencies. Using technology in the assessment process is nothing new. Still, the possibilities that come with it can improve assessment procedures and generate discussion about how to think about assessments in higher education [19].

In the study of on-line synchronous assessments in a synchronous cyber classroom, once the learners were asked whether they preferred a physical paper-pencil examination or an on-line synchronous examination, 19 out of 25 (76%) said they chose the on-line synchronous examination over the paper-pencil examination. Others said typing on a computer is more efficient because it allows changes and editing. These choices could be made because most of these students were working adults conversant with ICT and preferred a practical examination style. This data backs up the claim that on-line synchronous assessments meet a specific need in the learning community [20]. In a comparative study of open book-open Web (OBOW) examinations and invigilated closed book-pen and paper (ICBPP), the number of students receiving higher grades on the OBOW examination compared to the invigilated one did not differ significantly. Essential factors in favour of OBOW are the examination's flexibility in terms of location, a structure relevant to a wide range of majors, appropriate to students' learning styles, quality of learning results and an intellectually challenging approach [24].

On-line formative assessment can help students perform better in summative assessments if they check feedback frequently to improve their understanding. When learning resources, procedures and products can be shared concurrently across on-line participants, the convergence of formative assessment with on-line affordances invariably provides scalability and significant flexibility. Students also emphasised constructive, timely and customised feedback as added value benefits. Before students consent to the move to on-line assessment, they must be convinced of its value. Hence, students value active, one-on-one interaction with professors. Overall, the learners appeared to be pleased with their on-line assessment experience. Another benefit was that e-assessment reduces the distance barrier for attending on-campus examinations [20].

The appropriateness of synchronous oral evaluations and synchronous practice assessments for evaluating various on-line courses across different subjects is another benefit of e-assessment. As already mentioned, some even stated that typing on a computer was more efficient because it was much easier to make changes and edits. The employment of modern information technology in on-line examinations improves the efficiency and reliability of data collecting and storage by using test data mining to gain insight into educational deficiencies and challenges. This assessment piques students' interest in learning and enthusiasm for learning.

In a study examining the impact of implementing Nearpod as an active ICT tool in higher education, the study demonstrated the need for higher education to adapt its teaching approaches to be more interactive and boost student participation in the classroom. Because its multiple features enable instructional discussions, student feedback and formative exercises, Nearpod was an effective tool. With the current trend of moving face-to-face education to virtual mode, particularly during the Covid-19 period, Nearpod can ensure that students participate in the lecture by using the reporting function to check their response rates [39][48].

ATTITUDES AND PERSPECTIVES

Education includes a component of knowledge evaluation. Students' knowledge, abilities and behaviour are evaluated through testing and assessment. Their primary goal is to provide feedback to students, teachers and those in charge of the learning process. The success of the educational process can be judged by comparing obtained results to objectives. Its purpose is to encourage students to work systematically. Considering the knowledge level of a particular group or individual, the instructor can frequently tailor didactical methods and forms to the current circumstance, resulting in improved learning results. According to one definition, assessment expresses thoughts using degrees or descriptive comments. It can be done once in a while or regularly, during or after the activity [21].

E-learning is gaining traction as an innovative and viable pedagogical tool, especially for subjects requiring multimedia, collaboration tools (for example, wikis, blogs, course-management systems) and on-demand learning. The traditional model of assessment, as stated before, does not simply vanish. This is an anachronism in and of itself. However, as an evaluation tool, a closed book, invigilated test - still the most often used in institutions today - is at odds with modern learning theory. An OBOW examination can be a special assessment and evaluation tool in various ways. Significantly, cheating opportunities are thought to be nearly equal. As a result, the study suggests that the best option is to choose the assessment instrument that produces the best learning outcomes without a perfect answer [24].

ICT is critical to learning and, more precisely, to assessment and evaluation processes. Then, incorporating ICT into the learning environment provides and supports the relationship between education, teaching and assessment, particularly considering the current broad availability of computer systems, quicker Internet connectivity and increased system stability [23]. There is a knowledge gap about how people feel about utilising e-proctoring during e-assessment. Students show less worry and anxiety during on-line assessments. Yet, their fears rotate around their privacy and other environmental and psychological concerns, including technical, environmental, psychological, cultural, and privacy problems and other academic challenges. When discussing e-proctoring, traditional in-person proctoring cannot be ignored. Consequently, these on-line techniques can be employed as a backup plan or a short-term alternative for schools during critical times [11].

Combining tests and quizzes was the most popular assessment and evaluation tool favoured by learners, while submitting reports or short written tasks was the least popular. Examination cheating/misconduct appears to be one of the most severe problems with on-line examinations when it comes to challenges. Students requested that alternative types of examination evaluation be replaced, that new examination forms be adopted, that on-line proctoring solutions be used, and that enforced pass/fail grades to be considered effective strategies to combat examination dishonesty. There is a need to improve remote teaching methods, restructure assessment options, adapt the academic curriculum to current circumstances, and adopt specific protections to avoid examination cheating and maintain academic integrity, to mention only a few examples [37].

Even among learners with the potential and access to succeed in advanced high school coursework, disparities in socio-economic position and location exist in the USA. The study's findings suggest that tailored course recommendations can improve advanced high school course enrolment fairness [35].

Differences in socio-economic status existed before the pandemic, yet the pandemic widened this gap. Inadequate self-perceptions and a lack of information about course availability may contribute to the continuation of these disparities [34].

As the use of computers in education grows, so do computerised examinations, particularly Web-based assessment systems. Students prefer on-line assessment to other kinds of evaluation and find them more objective. Attitudes regarding cheating may also put pressure on students to cheat - if other students are known to cheat, highly ethical students may feel forced to cheat to avoid being disadvantaged. Teacher/educator reactions to reports of cheating are also likely to influence student attitudes. What was evident is that students' attitudes and rationalisations about academic dishonesty were highly complex. One needs to do more to foster a literary integrity culture among students and faculty, which demands more profound research. More concerns arise from students, including their primary worries about privacy and other environmental and psychological elements. Their concerns included also technical, psychological, cultural and other academic challenges. When it comes to instructors, preparing for an e-examination necessitates more effort. Developing different questions with the same testing quality level is not easy. To understand students' perspectives towards on-line assessment, areas targeting their feelings, faith in the outcomes, the kind of assistance they require if technical equipment fails during the home examination, the history of written examinations with pencil and paper, computer literacy, technical infrastructure and security were of high priority to several researchers and continue to be [29].

From a learner's perspective, knowledge assessment is one of the most significant aspects of the educational process. In a study on medical students' acceptance of on-line assessment systems, learners showed positive interest and acceptance for on-line examinations, especially with multiple-choice questions [25].

In a study looking into EFL teachers' perceptions of on-line assessment during Covid-19, four factors were examined: 1) EFL teachers' perceptions of e-learning assessment; 2) types of on-line assessment methods used; 3) challenges that teachers face while assessing students on-line; and 4) if there were any significant differences between female and male teachers' perceptions of e-assessment [40]. The vast majority of EFL teachers, according to the findings, have a moderate attitude toward e-assessment. They also expressed appreciation for the methodologies and tactics used in on-line testing. The bulk of them, however, experienced significant issues with on-line examinations [40]. Finally, the Covid-19 pandemic has exposed numerous flaws and inequities in education systems worldwide, ranging from a lack of computers and broadband for on-line learning to the supportive nature of environments required to focus on the learning process to the degree of misalignment between needs and available resources.

Lockdowns implemented in reaction to Covid-19 have disrupted the usual educational process, resulting in school closures worldwide. Even though the academic community has made tremendous efforts to guarantee that learning continues during this epidemic, students and learners have increasingly relied on their means of education, such as the Internet, radio and television. Teachers' acceptance of pedagogical approaches has also been hampered because they must design new ways to instruct students using appropriate Internet platforms. In particular, learners from underprivileged groups have been left behind because they lack access to crucial digital learning resources or the drive and determination to learn independently [40].

POST-PANDEMIC E-ASSESSMENT

For its June series across all states, Cambridge International Examinations (CIE) had to put its Cambridge O Level education, Cambridge International AS and A Level, Cambridge Advanced International Certificate of Education (AICE) Diploma, Cambridge IGCSE, and Cambridge Pre-U examinations on hold. The already scheduled international Baccalaureate examinations were also cancelled in June because of the rapid spread of Covid-19 cases in various parts of the world. The Covid-19 pandemic has wreaked havoc on the global education system. Except for candidate classes in unusual instances, most schools are closed owing to lockdown and movement restrictions. Masks, hand sanitisation, regular hand washing, constant temperature checks for both staff and students, and ultimately, a change in sitting arrangements since students must maintain a social distance of at least 1.5 meters are still the most prevalent school reactions to Covid-19.

Furthermore, many educational institutions have invested in cutting-edge technology that enables on-line learning. Schools, for example, are looking into suitable choices like using Zoom to conduct classes, but not all pupils can afford it [52].

Accessibility, cost, flexibility, learning methodology, lifelong learning and educational policy are all recognised as challenges with e-learning. Many countries struggle to maintain a stable Internet connection and gain access to digital devices. In contrast, many economically disadvantaged students in underdeveloped nations cannot afford on-line learning gadgets and other tools. As a result, off-line activities and self-exploratory learning have become increasingly important for learners. Learners faced the issue of parental guidance, where the challenge was attributed to the fact that, in most cases, both parents work. For this, the lack of parental direction is another issue. These disruptions resulted in many uncertainties for instructors, learners and parents being driven into trial and error, doubt and confusion [52]. When it came to confidence in steering the child's learning at home, more than 75% of parents with a postgraduate degree and slightly over 60% of parents with an undergraduate degree said they were confident. However, less than half of the parents had an A level or GCSE level qualifications as their highest-level qualifications. Since then, the lockdown has increased parental involvement in the learner's education, and the distinction between home and school environments has blurred, especially for elementary school students [53].

The method used to conduct on-line examinations differed depending on the educators' convenience and expertise, and the learners' compatibility and affordability. Due to the enormous number of learners, many schools and institutions have yet to implement appropriate plagiarism-checking mechanisms. Internal evaluations and tests for primary public credentials, such as GCSE have been halted, and A levels have been cancelled for the entire cohort in the United Kingdom. The ongoing situation has significantly impacted the educational system in schools, colleges and universities across countries with varying percentages [52].

The current pandemic will undoubtedly have a long-term impact on peoples' habits in various ways. It is not easy to forecast how it will affect admissions and testing. First and foremost, the influence on undergraduate admissions processes may be immediate. While 12-17% of all four-year colleges and universities do not recommend or need admissions tests, accounting for around 1% of all freshmen in the USA, one over 150 colleges have chosen a test-optional policy for 2021 or beyond given Covid-19. Due to the coronavirus, the GRE general test, TOEFL Internet-based test, GMAT, and the Law School Admissions Test (LSAT) have all been suspended in-person and switched to remote proctoring. During the pandemic, each organisation described slightly different methods of remote proctoring to allow students to complete their examinations at home.

Challenges arise at home with e-assessment for college board examinations. Tablets and mobile devices are not permitted in the GRE, TOEFL, GMAT or LSAT at-home testing options, and administration is limited to desktops and laptops. Windows and Mac computers are both allowed. However, Macs have additional requirements that may limit their use. Although most applications allow for a Wi-Fi connection, some expressly prohibit tethering to a mobile hotspot [54].

The GMAC used the Pearson OnVue proctoring system to implement a similar human remote-proctoring solution. The GMAT on-line examination is identical to the test centre version but lacks the analytical writing assessment section. However, the quantitative, verbal and integrated reasoning sections remain unchanged (same number of questions and testing time), and the scoring algorithm and scale are the same [54]. The AP administrative model for 2020 was likely the only feasible alternative that could be developed, tested and implemented within 90 days, given its administrative requirements. Many colleges and universities understood the limitations associated with AP scores in 2020 and were sympathetic to the effort, given that about 60% indicated they would confer credit as usual. An estimated 2.9 million students was supposed to take over 5 million AP examinations in 2020 [54].

Assessment is essential for developing learning outcomes and skills in an on-line learning environment. It has been demonstrated that using forum submissions and attending on-line lectures positively impact student achievement. Analytical tools can help determine and enhance training and learning in an on-line context. Learning analytics can be valuable for tracking learners' progress and demonstrating improvements in self-regulated learning and time management abilities. This strategy allows the instructor to assess the learning process based on software functionality while also devising new ways to increase learning in a virtual learning environment. The motivation assumption is used here because evaluation provides the learner with feedback on their performance and helps them to track their progress toward monitoring the achievement of their goals [32].

The theory of reasoned action describes how action and attitudes are linked. People's actions change once their beliefs do, whereas subjective social standards and individual judgments shape attitudes. The technology acceptance model (TAM) focuses on perceived utility and ease of use as predictors of willingness to employ technology systems. A study reveals that learners are unaware of the benefits of switching to on-line examinations. Traditional assessment methods were the norm for students, and they needed to be persuaded of the value of the move to on-line evaluation before they happily accepted it. The participants did not find the on-line assessment method to be a convenient means of obtaining information [31].

RECOMMENDATIONS

In a discussion of tips during the migration to on-line teaching during the early stages of the Covid-19 pandemic, for example, Pownall et al highlighted the need for organisation-level change and support for staff and learners during this

time [48]. Indeed, it is essential to note that individual action and institutional strategies are critical to implementing these recommendations. Some proposals could be more readily implemented in the classroom with students and require relatively little change in policy, culture or structure. In contrast, others may need a more top-down implementation and approach restructure. The extent to which recommendations can be implemented locally, departmentally or institutionally is likely to differ depending on the local context and culture.

According to the review of literature presented in this article, many significant recommendations were addressed to be adopted for the improvement of e-assessment:

- The most favoured mode of the evaluation was combining examinations and quizzes, whereas submission of reports or short written tasks was the least preferred.
- Improvements to distant teaching approaches, reorganisation of assessment alternatives, adaptation of the academic curriculum to the current circumstances, and the implementation of particular safeguards to prevent examination dishonesty and maintain academic integrity are only a few examples.
- E-proctoring cannot wholly replace traditional in-person proctoring. As a result, these on-line solutions can be employed as a backup, short-term option for schools in emergency and spread new learning and education horizons.
- The transition should be gradual, beginning with technical training for students and faculty on low-stakes tests. It is evident from this study that for students to accept on-line assessments, the contact between teachers must remain individualised, dynamic and meaningful.
- Question bank security solution: question banks, which are necessary for on-line tests, can be taken as part of the course while developing on-line assessment. The use of biometrics in remote education is a novel notion. Its explanation stems from the belief that assessments should be authentic and provide credibility to the on-line learning quality.
- University is a place where learners develop communication skills with one another in a group setting. The pandemic has proved to be a unique contributor to bringing instructors and learners from all over the world into one virtual classroom [55]. This critical role of technology in e-learning settings transcends learning development and acquisition to impact assessment and evaluation processes which are integral parts of a learner's growth.
- Because of the pandemic more user-friendly and less advanced learning platforms than Moodle began to emerge in the learning environments. According to a study, the three instruction styles based on MS Teams, Moodle and a combination of these two platforms have no effect on students' academic achievement [56]. This reveals that investing diversified tools in an on-line setting has been actually tested during the pandemic which proved to be a facilitator for assessing and evaluating learning.
- The established MOOC system is regarded as a valuable instrument for promoting self-directed learning using digital technology. The MOOC system with self-directed learning (SDL) can assist learners in acquiring the digital literacy skills required in the 21st Century workforce. Users of the system are satisfied with this type of learning and can make the best use of the available technology. In digital universities, this approach to education could lead to the creation of a learning society that serves the knowledge economy [57].
- When used effectively, technology can become a learning enabler. However, to some extent, its success is contingent on individuals' willingness to adopt SDL. Implementing on-line examinations is one technique to employ technology in higher education and to determine if students are engaging in SDL [58].

CONCLUSIONS

To sum up, the Covid-19 outbreak has significantly disrupted the educational system worldwide. Educators, policymakers, learners and researchers have a distance to cover as they are not yet over the pandemic's long-lasting impacts. On-line assessment and evaluation became an essential requirement, not an option. This article reviewed 30 previous research studies on e-assessment influence, challenges and opportunities with a deeper outlook on standardised examinations, mainly college board tests. When one tackles an e-assessment, it is crucial to consider the infrastructure, security concerns, approaches, perspectives, tools, ethics and misconduct issues, among other challenges presented in the study.

It is hoped that this article creates a firm foundation for other scholars interested in researching on-line examinations, allowing other educators and policymakers to widen their knowledge of on-line examination systems based on their current e-learning infrastructure and general socio-economic circumstances. This research can be expanded in many ways in the future. One suggested approach is to deep dive into the learner and instructor's perspectives. This allows a cutting-edge challenge to create a national e-assessment system that takes current world-wide e-assessment practices and variables in consideration to serve the new digital generation better.

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