



Challenges of E-Examination Adoption and the Role of Block chain in Enhancing Security and Trust: A Field Study at the Faculty of Science, Gharyan– Libya

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تحديات تبني الاختبارات الإلكترونية ودور تقنية البلوك تشين في تعزيز الأمان والثقة:
دراسة ميدانية بكلية العلوم غريان – ليبيا

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Abstract:

In recent years, higher education has witnessed a significant shift toward digital environments, with e-exams becoming an essential tool for academic assessment due to their speed, efficiency, and reduced administrative burdens. However, the adoption of e-exams in Libyan educational institutions, particularly at the Faculty of Science in Gharyan, still faces challenges stemming from technical, organizational, and human factors. This study aimed to explore the main challenges hindering the implementation of e-exams and analyze the potential role of blockchain technology in enhancing security and reliability. A descriptive methodology was employed, with data collected through a questionnaire distributed to faculty members. Results revealed that the most significant barriers included weak ICT infrastructure, a lack of administrative and technical support, and the absence of reliable and user-friendly e-exam systems. Additional challenges included unclear policies, a lack of awareness of the benefits of e-exams, and concerns about cheating and technical glitches. On the other hand, individual factors, such as resistance to change and the difficulty of designing e-exams, showed a relatively smaller impact. The findings highlight the need for stronger infrastructure, ongoing training, and clear institutional policies as prerequisites for the successful adoption of e-exams. Furthermore, the integration of blockchain technology offers a promising solution by ensuring consistent exam records, secure student identity verification, and transparent assessment processes. The study concludes that developing more reliable and effective e-assessment systems in Libya requires collaboration between technical and Libyan educational institutions, with blockchain technology considered a strategic option for enhancing trust and security in higher education.

Keywords: E-exams, Blockchain Technology, E-learning.

المخلص

في السنوات الأخيرة، شهد التعليم العالي تحولاً ملحوظاً نحو البيئات الرقمية، حيث أصبحت الاختبارات الإلكترونية أداة أساسية في التقويم الأكاديمي نظراً لسرعتها وكفاءتها وتقليلها للأعباء الإدارية. ومع ذلك، ما يزال تبني الاختبارات الإلكترونية في المؤسسات التعليمية الليبية، وخاصة في كلية العلوم بجامعة غريان، يواجه تحديات ناجمة عن عوامل تقنية وتنظيمية وبشرية. هدفت هذه الدراسة إلى استكشاف أبرز التحديات التي تعيق تنفيذ الاختبارات الإلكترونية وتحليل الدور المحتمل لتقنية البلوك تشين في تعزيز الأمان والموثوقية. وقد تم اعتماد المنهج الوصفي، حيث جمعت البيانات من خلال استبيان وزّع على أعضاء هيئة التدريس. وأظهرت النتائج أن أبرز المعوقات تمثلت في ضعف البنية التحتية لتقنية المعلومات والاتصالات، ونقص الدعم الإداري والفني، وغياب أنظمة اختبارات إلكترونية موثوقة وسهلة الاستخدام. كما شملت التحديات الأخرى غياب السياسات الواضحة، وضعف الوعي بمزايا الاختبارات الإلكترونية، والقلق من الغش والأعطال التقنية. في المقابل،

كان للعوامل الفردية مثل مقاومة التغيير وصعوبة تصميم الاختبارات الإلكترونية تأثير أقل نسبيًا. وتبرز النتائج الحاجة إلى تعزيز البنية التحتية، وتوفير التدريب المستمر، واعتماد سياسات مؤسسية واضحة كمتطلبات أساسية لنجاح تبني الاختبارات الإلكترونية. علاوة على ذلك، تقدم تقنية البلوك تشين حلاً واعدًا من خلال ضمان سجلات امتحانات آمنة، والتحقق من هوية الطلبة بشكل موثوق، وتوفير عمليات تقييم شفافة. وتخلص الدراسة إلى أن تطوير نظم تقييم إلكترونية أكثر موثوقية وفاعلية في ليبيا يتطلب تعاونًا بين المؤسسات التقنية والتعليمية، مع اعتبار تقنية البلوك تشين خيارًا استراتيجيًا لتعزيز الثقة والأمان في التعليم العالي.

الكلمات المفتاحية: الاختبارات الإلكترونية، تقنية البلوك تشين، التعليم الإلكتروني.

Introduction

In recent years, higher education has undergone a profound transformation driven by rapid technological advancements, with digital environments becoming an integral part of the academic process. Within this context, electronic examinations have emerged as a modern assessment tool that surpasses traditional methods in terms of efficiency, grading speed, and administrative relief. These systems also provide immediate feedback, enabling students to track their academic progress and encouraging institutions to adopt them as a strategic component of university evaluation frameworks [1,19]. This trend accelerated significantly during the COVID-19 pandemic, which posed unprecedented challenges to conventional education and compelled universities worldwide to embrace digital solutions as a necessary alternative [21]. Despite the numerous advantages of electronic examinations, their implementation faces significant challenges related to security, integrity, and credibility of results, raising concerns among faculty and administrators and affecting the acceptance of such systems [2,9,17,18]. To address these challenges, Blockchain Technology emerges as an innovative solution to enhance trust and security in digital assessment systems, thanks to its unique features such as decentralization, transparency, and resistance to tampering[4]. Accordingly, this study analyzes the challenges hindering the adoption of electronic examinations at the Faculty of Science, Gharyan University, and explores the integration of blockchain technology to develop a secure and sustainable evaluation model aligned with global standards.

Accordingly, the research problem can be identified through the following two main questions:

- What are the key obstacles that hinder the adoption of electronic examinations at the Faculty of Science – Gharyan (Libya)?
- To what extent can blockchain technology contribute to enhancing security and reliability within these electronic examination systems?

This study is significant for several reasons:

- It highlights the challenges hindering the implementation of electronic testing at the Faculty of Science in Gharyan.
- It introduces a potential solution through the use of blockchain technology—a modern approach that remains underexplored in the local context.
- It aims to inform and inspire decision-makers and academics to embrace innovative technologies that can elevate the quality of electronic assessment.

Literature Review

Several empirical studies have explored the implementation of electronic examination systems across different educational contexts, revealing both their potential benefits and the challenges they entail.

Benefits and Challenges of Adopting Electronic Examinations

A field study demonstrated the effectiveness of implementing the E-Exam system in evaluating e-learning outcomes, as it supported teachers in preparing questions, supervising exams, and analyzing results, while providing students with an experience that enhanced their digital skills and motivation. Moreover, the availability of infrastructure support contributed to improving the efficiency and effectiveness of the school's assessment system [12]. In the Arab context, a study conducted at Minia University revealed that the experience of managing electronic examinations contributed to the development of a revised and continuously updated question bank, facilitated the preparation of diverse exams, and enabled automated grading and immediate feedback. Despite

these advantages, one-third of faculty members indicated that multiple-choice questions alone are insufficient for evaluating analytical and problem-solving skills, highlighting the need to diversify assessment tools to include case-based and practical evaluations. The findings also emphasized the importance of institutional support and the provision of resources to ensure the effectiveness of e-examinations [13]. At Palestine Technical University, a field study examined the reality of electronic examinations from the students' perspective, highlighting their advantages over traditional paper-based exams in terms of efficiency, time reduction, effort, and costs, as well as increased reliability of assessment. Conversely, key challenges emerged concerning fairness, validity, and security. The findings emphasized that the success of e-examinations requires a flexible and reliable design, in addition to institutional support that includes improving infrastructure, providing financial resources, and building faculty capacities. The study further recommended integrating e-examinations into universities' strategic planning to ensure the sustainability of education [14]. Another study examined the reality of implementing electronic examinations in universities in South-South Nigeria, indicating that the success of these systems is influenced by a set of factors, some related to institutions (such as infrastructure, administrative support, and technical services) and others related to students (digital literacy, attitudes toward technology, and self-efficacy). The findings confirmed that strengthening both institutional and individual factors directly contributes to the successful implementation of electronic assessment systems.[15]

Security and Trust Concerns

Despite the numerous advantages offered by electronic examinations, their adoption is not without fundamental challenges that hinder the full realization of their benefits and directly affect their credibility and acceptance. Foremost among these challenges are concerns related to security and integrity, as issues such as electronic cheating, system hacking, question leakage, and result manipulation raise serious concerns for both faculty members and administrators, on the fairness and transparency of assessment processes [3,8,9,16,18]. Furthermore, trust is considered a critical factor in the acceptance of any assessment system, as all stakeholders must be assured that the system is secure, impartial, and tamper-proof to ensure the credibility of academic credentials [8, 19]. The study presented by Bervell et al. [23] focused on a systematic review of 159 studies on electronic examinations in higher education institutions in sub-Saharan Africa during the period (2013–2024). The results showed that the most prominent challenges were weak technical infrastructure, unstable internet services, and widespread online cheating, in addition to the heavy reliance on multiple-choice questions as the primary assessment tool. Although this review highlights the obstacles to adoption, it does not address innovative technical solutions in-depth, particularly regarding the use of technologies such as blockchain to enhance security and transparency. Hence, the importance of the current study lies in its aim to bridge this gap by analyzing the reality of electronic examinations in the Libyan context and exploring the possibility of integrating blockchain as a strategic option to enhance the reliability of assessment systems.

Blockchain Applications in Education

In addressing these challenges, Blockchain is a digital technology used to store data and transactions securely and transparently. The concept is based on linking data into sequential blocks, where each block contains an encrypted record of the previous block, along with a timestamp and transaction data. Due to its decentralized and distributed nature, it is extremely difficult to alter any block without affecting the entire chain, making this technology reliable and effective in protecting information and enhancing transparency [5, 10]. Blockchain technology represents a revolutionary innovation with wide-ranging applications across multiple fields, including education, due to its decentralized, secure, and transparent nature. Studies have shown that integrating blockchain into educational systems can enhance efficiency, strengthen security, and ensure the credibility of the learning process by creating secure platforms to document and track students' achievements, thereby facilitating the presentation of their skills to potential employers. Despite these benefits, several challenges hinder its practical implementation in education, such as adoption issues, technical knowledge, regulatory frameworks, costs, data protection, and scalability. Some research also suggests that blockchain can contribute to supporting education for sustainability by promoting transparency and verifying related activities. Although its use in education is still in the early stages, existing evidence highlights its significant potential to drive a fundamental transformation in educational systems and achieve greater efficiency and reliability [6, 4, 10, 11, 22].

Many universities worldwide have integrated blockchain technology into different dimensions of their educational systems. The following Table 1 highlights institutions that have adopted blockchain applications in education [4].

Table 1 : The most recent universities utilize blockchain technology in education [4].

<i>University</i>	<i>Country</i>	<i>Use Case</i>	<i>Blockchain Technology</i>	<i>Benefits</i>
<i>Arizona State University</i>	USA	Credentialing	Ethereum	Enables secure and tamper-proof storage of academic records, reducing administrative burden and increasing transparency for students and employers.
<i>University of Nicosia</i>	Cyprus	Payment Processing	Bitcoin	Allows for fast and cost-effective international payments for tuition and other expenses, bypassing traditional banking intermediaries.
<i>University of Malta</i>	Malta	Research Collaboration	IOTA	Facilitates secure and decentralized sharing of research data and collaborations with other universities and institutions.
<i>Imperial College London</i>	UK	Supply Chain Management	VeChain	Improves transparency and traceability of the university's supply chain, ensuring ethical and sustainable sourcing of goods and services.
<i>Swiss Federal Institute of Technology Zurich (ETH Zurich)</i>	Switzerland	Decentralized Autonomous Organizations (DAOs)	Tezos	Facilitates decentralized decision-making and governance, enabling greater participation and transparency for stakeholders within the university community.

Recent literature indicates that integrating blockchain technology into educational systems can contribute to enhancing reliability, ensuring the integrity of assessments, and improving the efficiency of exam management.

A systematic review on blockchain applications in higher education [20], which analyzed 37 studies, revealed that blockchain plays a vital role in verifying certificates and academic records, preventing forgery, and enhancing transparency. However, the review also identified major challenges, such as high implementation costs, limited institutional awareness, and legal restrictions, underscoring the necessity of establishing appropriate technological and regulatory frameworks to enable its effective adoption within universities.

Several practical models have been proposed to explore the integration of blockchain into electronic examination systems:

The work presented by Abdelsalam et al. [9] models that integrates blockchain technology with the Learning Management System (LMS) and automated grading systems, with the aim of enhancing the security, reliability, and efficiency of e-exams. The proposed model leverages the immutability and transparency features of blockchain to address challenges associated with centralized examination systems, thereby providing a secure and trustworthy solution for conducting online assessments.

Haque et al. [21] emphasized that while IoT-based e-learning systems became essential during the COVID-19 pandemic due to their flexibility and efficiency, they still face major challenges related to privacy and security. To overcome these issues, the authors proposed an architecture integrating IoT with blockchain, ensuring data confidentiality, user identity protection, and system reliability. Their findings confirmed that this integration improves the quality and sustainability of distance learning while enriching students' experiences and academic productivity.

Experimental Applications of blockchain in education:

Kadam et al. [7] developed a blockchain-based electronic examination platform utilizing technologies such as Ethereum and IPFS. The platform was experimentally applied to a limited sample of students and demonstrated effectiveness in securing exams, reducing administrative errors, and facilitating the assessment process. However, the experiment was restricted to small-scale tests (objective and multiple-choice questions) and did not address broader issues such as cost, scalability, and legal compliance.

In Kazakhstan, Sakhipov et al. [8] implemented an intelligent monitoring system to safeguard academic integrity in electronic assessments. The system was deployed on the BlockchainStudy.kz platform, which delivers online courses with blockchain-based certificates. It relied on technologies such as facial recognition, user activity tracking, and browser behavior analysis, which contributed to reducing cheating incidents and enhancing the credibility of examinations as well as the perception of fairness among students and faculty members.

Although numerous studies have examined the adoption of electronic examinations in different contexts, most have focused on general challenges such as infrastructure, institutional support, or student readiness. Other research has explored the potential of blockchain technology in enhancing transparency and security in education. However, the integration of blockchain into electronic examination systems in the Libyan higher education context has not been sufficiently investigated. In particular, there is a lack of empirical studies that analyze the specific challenges facing Libyan institutions and assess how blockchain could practically enhance the security, reliability of e-exams. This gap highlights the need for the present study.

Conceptual Framework

A conceptual framework that illustrates the relationship between the key challenges hindering the adoption of electronic examinations and the potential role of blockchain technology in enhancing their effectiveness.

The framework consists of three main categories of challenges:

- **Technical challenges**, such as weak infrastructure, insufficient devices, and system failures.
- **Organizational challenges**, including the absence of clear policies, weak administrative and technical support, and limited institutional planning.
- **Human challenges**, which refer to resistance to change, low awareness of the benefits of e-exams, and a lack of training for faculty and students.

These challenges collectively influence the dependent variable, namely the effective adoption of electronic examinations in terms of reliability, fairness, and sustainability. To mitigate these obstacles, the framework introduces blockchain technology as an enabling factor that enhances security, transparency, and trust in e-exam systems.

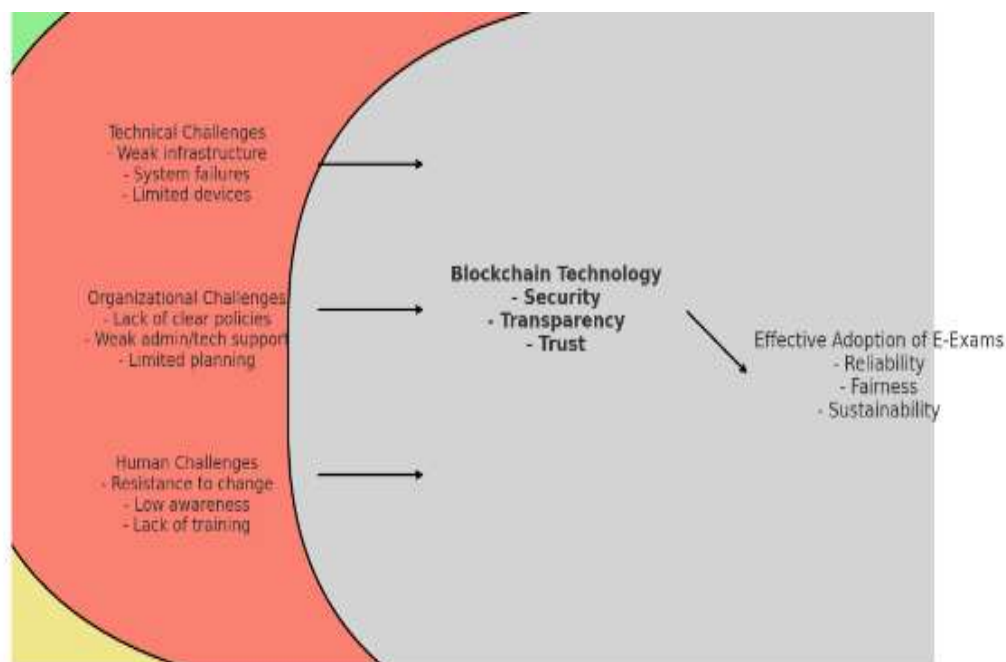


Figure 1: Conceptual Framework of the Study

This framework provides the foundation for the present study by linking the identified challenges to the adoption of electronic examinations and positioning blockchain as a potential strategic solution to strengthen security and trust within higher education assessment systems

The Methodology

Given the nature of this study, the descriptive method was employed. This approach is most appropriate as it links the research problem to a specific phenomenon, examining its reality and diagnosing it. The descriptive method relies on studying the phenomenon as it exists. A questionnaire was used as the primary tool for data collection.

The Study Population

The study population consists of faculty members at the Faculty of Science – Gharyan, whose roles vary between academic, administrative, and leadership responsibilities.

The total number of faculty members at the Faculty of Science – Gharyan is 113. However, this figure includes members who are currently on study leave or academic sabbaticals. Therefore, the actual number of faculty members actively engaged in teaching and administrative duties is 93, which was adopted as the effective population of the study. Accordingly, the target sample size was set at 75 participants, in line with scientific standards to ensure proper representation of the research population, with a margin of error of 5%, a confidence level of 1.96, and a coefficient of variation of 0.5. The questionnaire was distributed to the target sample, and 66 completed responses were received, representing a response rate of 88.0%, which is considered excellent in field studies and enhances the reliability of the statistical findings.

Study Limitations:

Scientific Boundaries: This study focuses on identifying the obstacles to implementing electronic examinations in the educational context by analyzing the technical, administrative, and human factors that may hinder their effective application within the Faculty of Science – Gharyan.

Spatial Boundaries: The study was conducted at the Faculty of Science – Gharyan, Libya, as an academic environment that represents a model for the application of electronic examinations in higher education.

Temporal Boundaries: The study covers the year 2025, during which the data were collected and analyzed in order to assess the current state of implementation within this timeframe.

Human Boundaries: The study was limited to faculty members at the Faculty of Science – Gharyan, given their direct role in designing, implementing, and evaluating electronic examinations, as well as their contribution to identifying the obstacles.

Sample Characteristics:

The sample consisted of a group of faculty members from the Faculty of Science – Gharyan. They were described according to a set of demographic and professional characteristics that contribute to understanding the participants' backgrounds and their relevance to the subject of the study. The main characteristics are presented as follows:

Academic Qualification: The academic qualifications of the study participants varied between master's and doctoral degrees, with master's degree holders representing the majority of the sample. This reflects a diversity in academic backgrounds and levels of expertise. The results showed that 71.2% of participants held a master's degree, while 28.8% held a doctoral degree. This disparity indicates a difference in academic orientations—between those who focus on the direct practical application of the educational process and those who pursue a strategic path related to institutional policy-making.

Scientific Department: The study sample was distributed across various academic departments within the college, such as Computer Science, Mathematics, Physics, and others, reflecting a multidisciplinary representation that enriches the diversity of perspectives on the study topic. The distribution results revealed that the Computer Science department accounted for the largest proportion of participants (30.3%), followed by Chemistry (16.7%) and Mathematics (15.2%). The remaining participants were spread across departments such as Zoology (12.1%), Environmental and Natural Resources (7.6%), Statistics and Physics (6.1% each), Botany (4.5%), and finally Geology with a modest share of 1.5%. This distribution highlights the dominance of departments closely linked to digital and experimental technologies—particularly Computer Science—within the study sample, which may indicate a higher level of awareness regarding the technical and security challenges associated with electronic examinations. Moreover, the balanced representation between theoretical and applied departments enhances the credibility of the findings, as it allows for the exploration of differing viewpoints on the obstacles to implementing such types of assessments.

Years of Experience: The participants' professional experience varied across three time-based categories: less than two years, between two and five years, and more than five years. This diversity allows for a multifaceted understanding of the challenges associated with implementing electronic examinations, grounded in both practical and experimental expertise. Analysis results revealed that the vast majority of faculty members participating in the study had more than five years of experience, accounting for 84.8% of the sample. In contrast, only 9.1% had between two and five years of experience, while those with less than two years represented the smallest proportion

at 6.1%. These findings suggest that most of the sample possesses sufficient academic experience to provide an objective assessment of the reality of electronic examinations, thereby enhancing the credibility and robustness of the study's outcomes.

Results and Discussion

The study was based on a set of research questions designed to obtain scientific answers that explain the results of the phenomenon under investigation. A five-point Likert scale was used to measure participants' responses, offering flexibility in expressing levels of agreement or disagreement with the questionnaire items. Statistical analysis of the data was conducted using JASP version 0.19.3.0, through which key quantitative indicators—such as means and standard deviations—were extracted to support the interpretation and discussion of results in light of the study's objectives.

Ten questions were posed to shed light on the topic, as presented in Table 2. The means and standard deviations of the participants' views were described regarding the main challenges hindering the implementation of electronic examinations at the Faculty of Science in Gharyan.

Table 2: Questions of Theme.

SN.	Inquiry	Mean	SD
1	Weakness in technical infrastructure (unstable internet connection, insufficient devices)	4.318	0.862
2	Lack of reliable and user-friendly electronic testing systems and software	4.242	0.681
3	Insufficient training and preparation of faculty members and students in using electronic examinations	4.045	0.773
4	Insufficient administrative and technical support for implementing electronic examinations at the college	4.333	0.641
5	Resistance to change by some faculty members	2.985	1.222
6	Lack of a clear policy or implementation plan for electronic examinations at the college	4.227	0.697
7	Concerns about student cheating during electronic examinations	4.030	1.037
8	Difficulty in designing electronic exam questions suitable for all academic subjects	2.848	1.070
9	Concerns about technical issues during the examination that may affect student assessment	4.030	0.911
10	Lack of awareness about the importance and benefits of electronic examinations	4.076	0.730

Statistical analysis results revealed that one of the most significant challenges facing the implementation of electronic examinations at the Faculty of Science in Gharyan is the lack of sufficient administrative and technical support. This was reflected in a high mean score of 4.333 with a standard deviation of 0.641, indicating a strong level of agreement among participants that the absence of adequate administrative and technical backing constitutes a major obstacle to activating the electronic examination system.

The results also indicated that weak technical infrastructure had a mean score of 4.318 with a standard deviation of 0.862, reflecting a high level of agreement among participants that inadequate infrastructure represents a fundamental challenge to the adoption of electronic examinations.

Additionally, the absence of reliable and easy-to-use electronic systems recorded a mean score of 4.242 with a standard deviation of 0.681, indicating a high level of agreement among participants that the absence of these systems constitutes a major obstacle. This result confirms that the absence of reliable and easy-to-use electronic testing platforms is one of the most prominent challenges facing the Faculty of Science, Gharyan.

The results also showed that the absence of clear policies or implementation plans recorded a mean score of 4.227 with a standard deviation of 0.697. This indicates that the lack of a clear plan is among the most prominent institutional barriers affecting the successful implementation of electronic examinations.

The lack of awareness regarding the importance and benefits of electronic examinations, with a mean score of 4.076 and a standard deviation of 0.730, represents a significant barrier that limits the effectiveness of this system. In other words, a limited understanding of the advantages of electronic testing hinders its potential for widespread adoption and success.

The results also revealed that concerns about electronic cheating, with a mean score of 4.030 and a standard deviation of 1.037, along with worries about technical malfunctions during exams, with a mean score of 4.030 and a standard deviation of 0.911, are among the key challenges affecting the acceptance and integrity of these systems. Participants believe that electronic cheating poses a fundamental obstacle that raises concerns for educational institutions and weakens the credibility of assessment outcomes. Likewise, they consider that technical failures and unexpected disruptions during electronic examinations represent a significant concern for faculty members.

In contrast, individual-related challenges—such as resistance to change by some faculty members recorded a mean score of 2.985 with a standard deviation of 1.222, indicating a noticeable variation in opinions among the sample participants. The difficulty of designing electronic exam questions suitable for all academic subjects, with a mean score of 2.848 and a standard deviation of 1.070, ranked lower compared to institutional and technical challenges. This suggests that resistance to change is not among the most prominent challenges, although it remains an influential factor for a specific segment of faculty members. Moreover, the difficulty of preparing exam questions is not considered a major challenge in the current study environment, especially when compared to more pressing issues such as weak infrastructure, lack of institutional support, or concerns about cheating.

The study results revealed that the most significant challenges hindering the adoption of e-exams at the Faculty of Science at Gharyan University are institutional and technical. The most influential factors were weak ICT infrastructure, a lack of administrative and technical support, and the absence of reliable and user-friendly e-exam platforms. These findings are consistent with previous studies in Egypt and Palestine [13, 14], which confirmed that limited infrastructure and institutional support constitute a major obstacle to the transition to e-assessment. However, what distinguishes the Libyan context is the severity of these challenges, due to weak investments in digital infrastructure and the absence of clear institutional policies, placing it in a more fragile position compared to other contexts.

Network infrastructure, hardware requirements, implementation complexity, and training needs are fundamental factors in the successful adoption of electronic examinations. Strengthening these elements provides a solid foundation for global adoption, with the potential to develop future systems that predict the readiness of educational institutions based on their technical capabilities and economic conditions [16].

The results also showed that individual factors—such as resistance to change or difficulty in preparing e-exams—were relatively less influential. This suggests that the problem lies not in the preparedness of faculty or students as much as it lies in the unsupportive institutional and technical environment. Therefore, any reform strategies must begin with improving institutional capacity and providing ongoing training that enables individuals to fully utilize technological capabilities.

Another important aspect is concerns related to security and reliability, such as online cheating and hacking attempts, which were clearly expressed by respondents. These concerns reflect a recurring crisis of trust in most previous studies [8, 16], but in the Libyan case, they are doubly important due to the absence of officially approved secure platforms. This is where the added value of this study emerges, presenting blockchain as a strategic option that can enhance trust by ensuring tamper-proof records, verifying student identities, and providing greater transparency in the assessment process.

Compared to the global literature, the use of blockchain in online examinations remains limited and often within small pilots [7, 9]. This means that its application in the Libyan context could represent a qualitative addition not only at the local level but also to the international literature by providing a new field case in a developing educational environment.

Thus, it can be said that the results of this study not only confirm the existence of globally recognized challenges, but also reveal dimensions specific to the Libyan context that make it necessary to view the digital transformation of assessment as an institutional and strategic issue rather than a merely technical one.

Recommendations:

Based on the analysis of this study's findings, a set of recommendations has been developed to enhance the likelihood of successfully implementing electronic examinations at the Faculty of Science in Gharyan in the future. These recommendations can be structured around several key areas that the college administration is expected to adopt and implement to ensure the effectiveness and sustainability of this system.

- Enhance technical infrastructure by improving internet quality and providing appropriate devices within the college.
- Ensure continuous administrative and technical support to promptly address technical issues during examinations.
- Develop clear policies and implementation plans to organize the electronic examination process and standardize procedures.

- Train faculty members and students on using electronic examination systems to improve efficiency and readiness.
- Adopt advanced security systems to reduce cheating attempts and ensure data protection, with consideration of integrating technologies like blockchain to enhance transparency and prevent result manipulation.
- Raise awareness about the importance of electronic examinations through orientation programs and workshops that highlight their benefits and role in improving education quality.
- Encourage diversity in electronic assessment tools, moving beyond objective questions to include analytical and applied questions that reflect higher-order thinking skills among students.

Conclusion

This study concluded that implementing e-exams in Libyan higher education institutions, particularly at the Faculty of Science in Gharyan, represents a strategic choice driven by technological advancements and the requirements of modern education. The results revealed that the main challenges include weak technical infrastructure, a lack of administrative and technical support, and the absence of clear policies, in addition to concerns about cheating and technical failures. Conversely, individual barriers, such as resistance to change and the difficulty of designing e-questions, were found to rank second to institutional barriers.

The results clearly indicate that a successful transition to e-exams requires integrated efforts, including strengthening technical infrastructure, ensuring ongoing administrative and technical support, training faculty members on the use of digital systems, and adopting clear policies that ensure fairness and transparency. The study also highlighted that blockchain technology offers a promising opportunity to address security challenges and enhance confidence in assessment processes, thanks to its transparency and tamper-resistance. Based on these findings, the study recommends integrating e-exams into institutional strategies for higher education in Libya, while exploring the potential of employing blockchain technology as a future solution to ensure the security and reliability of assessment systems. This approach will contribute to improving the quality of the educational process and achieving fairness and objectivity in assessment and evaluation, in line with global trends toward digital transformation in education.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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