

УДК 373.1:004.946

<https://doi.org/10.25587/2587-5604-2026-1-103-114>

Original article

Electronic Assessments and Their Implementation Feasibility in Iraqi Secondary Education

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Abstract

This study addresses topics related to secondary education and its importance in shaping educational frameworks within secondary schools. It examines how educational methodologies affect academic and practical competencies, the necessity of adapting to rapid developments in educational technology, and the challenges facing education in diverse contexts. The research aimed to evaluate the feasibility of implementing electronic assessments in Iraqi secondary schools, identify technical, human, and economic obstacles, propose practical mechanisms to mitigate these obstacles, and recommend feasible solutions. A quasi-experimental (descriptive-analytical) approach was used to draw conclusions. The research sample consisted of 84 individuals, and the results indicated weaknesses in the technological infrastructure, a shortage of qualified personnel, and security and educational concerns. The study emphasized the importance of diversifying teaching methods and assessment techniques to effectively engage new generations of learners. It critically analyzes the impact of socio-economic factors on educational processes and explores practical solutions to enhance the effectiveness of secondary education. The study highlighted the main challenges related to the three areas addressed: technology: weak infrastructure (electricity, internet) and a shortage of equipment; social factors include resistance to change and weak trust within the educational community; economic factors include high implementation costs (equipment, training, and maintenance). The research focused primarily on the need to integrate modern technology into educational practices to enhance learning experiences and facilitate access to educational resources.

Keywords: electronic assessments, assessment methods, secondary education, implementation feasibility, distance learning, educational technology, technological infrastructure, educational transformation, online examination security, Learning Management Systems (LMS)

Funding: No funding was received for writing this manuscript.

For citation: Ghazi Hussein Taan Albayati. Electronic Assessments and Their Implementation Feasibility in Iraqi Secondary Education. *Вестник Северо-Восточного федерального университета им. М.К. Аммосова. Vestnik of North-Eastern Federal University. Серия "Педагогика. Психология. Философия". Pedagogics. Psychology. Philosophy*; 2026: 41 (1): С. 103-114. DOI: 10.25587/2587-5604-2026-1-103-114

Оригинальная научная статья

Электронные тесты и возможность их внедрения в систему среднего образования в Ираке

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Аннотация

В этом исследовании рассматриваются темы, связанные со средним образованием и его важностью для формирования образовательной среды в средних школах. В нём анализируются как образовательные методики, влияющие на академические и практические компетенции, рассматривается

необходимость адаптации к стремительному развитию образовательных технологий, а также проблемы, с которыми сталкивается образование в различных контекстах. Целью исследования было оценить возможность внедрения электронного тестирования в средних школах Ирака, выявить технические, кадровые и экономические препятствия, предложить практические механизмы для их устранения и рекомендовать возможные решения. Для формулирования выводов использовался квазиэкспериментальный (описательно-аналитический) подход. Выборка исследования состояла из 84 человек. Результаты показали, что технологическая инфраструктура несовершенна, ощущается нехватка квалифицированных кадров, а также существуют проблемы с безопасностью и обучением. В исследовании подчёркивается важность разнообразия методов преподавания и оценивания для эффективного вовлечения новых поколений учащихся. В нём критически анализируется влияние социально-экономических факторов на образовательные процессы и предлагаются практические решения для повышения эффективности среднего образования. В ходе исследования были выявлены основные проблемы, связанные с тремя рассматриваемыми областями: технологии, слабая инфраструктура (электричество, интернет) и нехватка оборудования; социальные факторы: сопротивление переменам и низкий уровень доверия в образовательном сообществе; экономические факторы: высокие затраты на внедрение (оборудование, обучение и техническое обслуживание). Исследование в первую очередь было сосредоточено на необходимости внедрения современных технологий в образовательный процесс для повышения качества обучения и облегчения доступа к образовательным ресурсам.

Ключевые слова: электронные тесты, методы оценивания, среднее образование, дистанционное обучение, образовательные технологии, целесообразность внедрения, технологическая инфраструктура, трансформация образования, безопасность онлайн-экзаменов, системы управления обучением (LMS).

Финансирование. Исследование не имело финансовой поддержки.

Для цитирования: Альбаяти Г. Т. Электронные тесты и возможность их внедрения в систему среднего образования в Ираке. *Вестник Северо-Восточного федерального университета. Серия «Педагогика. Психология. Философия».* 2026;41(1): Рр. 103-114. DOI: 10.25587/2587-5604-2026-1-103-114

Introduction

The rapid development of radio and telegraphy at the beginning of the 20th century allowed for the spread of distance learning, as the audience base for radio and television has been steadily expanding since the 1950s. In the late 1980s, the rapid development of computer-based educational programs made it possible to incorporate online assessments.

Electronic testing is an essential component of the educational process, a pressing need that works alongside the vast amount of information in secondary education, and is considered one of the tools for monitoring students' knowledge. However, when conducting a written test in history or geography, for example, it consumes a great deal of time while covering only a small portion of the subject matter being assessed, not to mention the significant time wasted [1].

Based on global trends, there is a need to reconsider the methods used in the evaluation process, and electronic application programs have quickly imposed themselves in adopting modern methods to evaluate the learning process [2].

Research Problem: Electronic tests are a key pillar in the transformation of educational systems towards digitalization, especially in light of rapid technological developments and the global trend of improving the quality of education through innovative, modern technologies. However, at the secondary school level, especially in Iraq, the use of these tests faces fundamental challenges that hinder their effective implementation. This requires an in-depth analysis of the nature of these obstacles and challenges, as well as mechanisms for overcoming them. On the other hand, field observations indicate weak institutional motivation for change, stemming from insufficient professional training of teachers and administrators in the use of electronic platforms, as well as the lack of clear policies to ensure the reliability and security of examinations, such as

the development of approved mechanisms for combating fraud and verifying the identity of test takers. Added to this are challenges related to the culture of the educational community, which remains skeptical of the effectiveness of e-learning compared to traditional systems.

In light of these issues, there is a clear need to conduct studies that assess the current state of electronic testing at the secondary education level in Iraq and explore the possibility of implementing it according to standards that ensure inclusiveness and fairness, while providing practical solutions that take into account local specificities and contribute to improving the efficiency of the secondary education system.

Studies and research reports have revealed a significant weakness in the technological infrastructure of secondary schools in Iraq (a lack of electronic devices, unstable internet networks, and weak technical support from decision-making institutions, especially in rural and remote areas), all of which contribute to widening the educational disparity among students [3, 4, 5].

Research Objectives: Assess the readiness of the infrastructure and technology in Iraq; analyze the availability of electronic devices (computers, tablets) and internet access in secondary schools; identify challenges and obstacles; study the capacity of educational institutions to provide secure and stable systems for electronic testing; determine the feasibility of transferring the electronic testing experience from university to secondary education in Iraq, taking into account the specificities of the Iraqi context (technical, social, and economic), and develop practical solutions to ensure the success of this transition.

Importance of the Research: This research is not merely a technical study, but a significant step towards the reform and further development of the Iraqi education system. Its goal is to ensure the efficiency, quality, and equal opportunity of education by utilizing modern technology, while fully considering local realities and challenges. The primary objective of this study is to assess the feasibility of introducing electronic testing into Iraqi secondary education, identify the challenges and obstacles, and develop corresponding solutions.

Research Methodology: The research employed a descriptive-analytical approach, utilizing a sample of (84) male and female teachers from secondary schools in Kirkuk (purposively selected). Data was collected thru an electronic questionnaire with closed-ended questions (a five-point Likert scale). Previous studies and academic sources were analyzed, and data processing was conducted using SPSS software, including the calculation of frequencies, percentages, and arithmetic means.

Theoretical Framework

Electronic testing is not a new topic in education; it has been the subject of numerous studies at various levels. What is new, however, is the attempt to transfer the experience of electronic testing from university education to secondary education, which continues to follow the same development path and keeps pace with educational progress, at least in terms of the testing itself.

What concerns us in this study is identifying the challenges and obstacles and presenting them to decision-makers to move forward and encourage them to make decisions that promote the implementation of the results of studies that address the development of the secondary education system, and then extend it to pre-secondary education. Therefore, the theoretical framework has been shortened as much as possible to avoid repetition [6, 7].

One type of electronic achievement test is:

Two-choice test: In this type of test, each question offers only two options, only one of which is correct. Single-choice/Multiple-choice test: In this type of test, candidates must choose the correct answer from multiple (three or more) options. Multiple-choice/Multiple-selection test: In

this type of test, candidates must choose the correct answer from multiple options. Matching test: In this type of test, all options are correct, but candidates must arrange them in a specific order.

The concept of online testing. This is a modern and effective method for assessing knowledge and skills online. Previous research has shown that online testing benefits both students and the application process.

The Concept of Online Testing

This is a modern and effective method for assessing knowledge and skills online. Previous studies have shown that online tests can be beneficial for students and even in recruitment processes [8].

Literature Review

Abed (2023) investigated the impact of two types of testing (electronic and paper-based) on the academic performance of students in the Faculty of Education at the University of Akso. This study employed a quasi-experimental design and contributed to the development of new assessment tools suitable for modern educational environments [9].

Kamuka and Omar (2020) explored the feasibility of using electronic testing in secondary schools from different perspectives. They used a descriptive approach, and the results showed no significant difference in the perspectives of teachers and examiners [10].

Suleiman (2024) investigated the attitudes of middle school English teachers towards the use of e-testing in the assessment process, as well as the obstacles encountered in its implementation, segmented by gender, professional experience, and academic level. The results showed that participants generally held positive attitudes towards e-testing. The study also identified the main challenges and obstacles faced in its implementation [11].

Grambovskaya and Badanina (2023) compared learning outcomes in higher mathematics with those of engineering students using traditional assessment methods. The e-test was conducted on the Moodle learning platform. The article highlights the problems with remote e-assessment. The research experience suggests the technology has been successful and hints at its potential application in other disciplines [12].

Research Instrument: the questionnaire was distributed to 84 male and female teachers in secondary schools in Kirkuk Governorate. It consisted of 27 items divided into three sections: Sections 1 and 3 each contained 10 items, while Section 2 contained 7 items. The variables were coded and entered into SPSS software. The statistical analyses were as follows:

Questionnaire Variables: Electronic tests.

Dependent Variables:

1. Challenges and solutions.
2. Secondary education institutions.
3. Technical, social, and economic aspects.

Questionnaire reliability: To measure the reliability of the questionnaire, refer to Table No. (1).

Table 1

Alpha coefficient values for the sample members (Reliability Statistics)

Таблица 1

Значения альфа-коэффициента для участников выборки (статистика надёжности)

N of Items	10
Cronbach's Alpha	0.854

From the table No. 1 we note that the value of Cornbach's alpha coefficient reached (0.85), which represents a high reliability value that can be relied upon in the results of this study.

Statistical analysis: frequencies, percentages, arithmetic mean, and standard deviation were used. An estimated scale was adopted according to the five-point Likert scale, which is based on the weighted mean, in order to determine the direction of the sample’s opinions, as follows: (1-180 = 1), (181-260 = 2), (261-340 = 3), (341-420 = 4), (more than 420 = 5).

Table 2

Means and S. Deviations of responses on the first section of first axis, that related to the basic questions

Таблица 2

Средние значения и стандартные отклонения ответов на первый раздел первой оси, связанный с основными вопросами

First axis	Appreciation					Means	S. deviation	order	trend
	N	N	N	N	N				
	%	%	%	%	%				
1. Are there enough electronic devices (computers, tablets) available at your school to conduct online exams?	Available to all students	Available to some	Not available	I don't know	Sometimes	3.44	0.499	3	not available
	\	37	47	\	\				
	\	55.3	43.5	\	\				
2. How would you rate the stability of the internet service at your school during online exams?	Always stable	Available	Unstable	Not available	Sometimes	1.95	0.657	5	available
	\	48	16	\	20				
	\	56.5	18.8	\	23.5				
3. Have you received sufficient training on using the online exam platforms Google Classroom and Moodle?	Yes, I received intensive training	No, I didn't receive training	Yes, basic training.	I don't need training	to some extent	2.95	1.15	4	No, I didn't receive any training
	\	34	31	\	19				
	\	40.1	36.5	\	22.4				
4. What percentage of students experience technical difficulties (lack of devices, weak internet) during online exams?	100%	75%	50%	25%	Less than	4.07	0.725	1	75%
	25	40	19	\	\				
	29.4	47.1	22.4	\	\				
5. Are there backup systems (such as generators) in place to ensure the continuity of exams in case of power outages?	Yes	No	Sometimes	a few	I don't know	3.48	0.828	2	No
	\	52	26	\	6				
	\	61.2	30.6	\	7.1				

The table No. (2). Shows that the most common technical problem students face (e.g., insufficient equipment, unstable network connection) is a score of (4.07). (1.47%) of teachers reported that (75%) of students have encountered this problem. Lack of emergency power (e.g., generators) ranked second, with an average score of (48.3). This indicates that emergency power is largely unusable, and (30.6%) of students said emergency power can only be used occasionally. Lack of electronic devices ranked third, with an average score of (44.3). (55.3%) of students indicated that only some students can use electronic devices (insufficient equipment). Lack of

training on the use of learning platforms ranked fourth. (36.5%) of students have not received any training, while (40.1%) have only received basic training (insufficient training). Unstable technical service» ranked fifth and last: (56.5%) of respondents said the service was «available but not always stable, while (23.5%) said the service was unstable. These results are consistent with studies: [13, 14].

Table 3

Means and S. Deviations of responses on the second section of first axis, that related to challenges and solutions

Таблица 3

Средние значения и стандартные отклонения ответов респондентов по второму разделу (проблемы и решения) первой оси вопросника

Second axis	Appreciation					Means	S. deviation	order	trend
	N	N	N	N	N				
	%	%	%	%	%				
6. What are the main challenges you face when implementing electronic tests?	Weak infrastructure (electricity, internet)	Lack of electronic devices	Students' lack of proficiency in using technology	Difficulty in monitoring online cheating	Teachers' lack of proficiency in using technology	3.63	1.24	3	Weak infrastructure
	26	21	25	4	8				
	30.6	24.7	29.4	4.7	9,4				
7. How secure are the online platforms used for testing?	Completely safe	Safe.	Acceptable	Unsafe	I don't know	2.31	0.658	5	Unsafe
	/	/	35	40	9				
	/	/	41.2	47.1	10.6				
8. Do you agree that electronic tests save time and effort compared to paper tests?	Strongly agree	Agree	Neutral	Disagree	Strongly disagree.	4.35	0.843	1	Strongly agreed
	46	24	11	3	/				
	54.1	28.2	12.9	3.5	/				
9. What improvements are needed to enhance the effectiveness of electronic tests?	Equipping students with devices	Upgrading internet infrastructure	Student digital literacy training	Teacher e-learning training	Developing e-monitoring systems	3.77	1.057	2	Providing devices for students
	28	20	11	25	/				
	32.9	23.5	12.9	29.4	/				
10. Do you believe that your organization provides sufficient technical support to schools in implementing electronic tests?	Yes	No	To a limited extent	I don't know	Sometimes	3.06	0.923	4	On a limited basis
	/	27	46	/	11				
	/	31.8	54.1	/	12.9				

Table No. 3. Shows that the results fall into two categories. The first category is challenges (n = 85), where the results show that e-testing received the highest approval rating for its efficiency in saving time and manpower (average approval rate (35.4%), strong approval rate (82.3%). However, other significant challenges also exist. The category of «weak infrastructure» scored highly, with an average score of (63.3), with (30.6%) of respondents considering it a major problem (electricity, network). (29.4%) pointed out that students lack technical skills. (32.9%) of teachers called for prioritizing equipment for students (average score 77.3), while (54.1%) criticized «limited technical support» (average score 06.3). Regarding «security issues,» (47.1%) considered the platform «insecure» (average score 31.2), while (88.2%) expressed a lack of confidence in the effectiveness of these systems. Regarding the second aspect: solutions,

respondents pointed to key recommendations including strengthening infrastructure (electricity, internet), distributing institutionally supported devices, providing training programs for teachers and students, and developing more secure monitoring systems. We conclude from the above that the success of these tests depends on addressing structural and technical gaps before expanding their implementation. These results are consistent with a study: [15].

Table 4

Means and S. Deviations of responses regarding: ability of secondary education institutions to provide secure and stable systems for electronic testing

Таблица 4

Средние значения и стандартные отклонения ответов на вопрос: «способны ли учреждения среднего образования обеспечить безопасные и стабильные системы для электронного тестирования»

Phrases	Yes.	No.	To some extent	Mean	S. Deviation	order	trend
	<i>N</i>	<i>N</i>	<i>N</i>				
	%	%	%				
1- Do you believe your institution is capable of providing a secure electronic testing system?	19	45	20	1.99	0.685	4	No
	20.7	48.9	21.7				
2- Is training provided to students on effectively using electronic systems?	5	41	38	1.57	0.607	6	No
	5.4	44.6	41.3				
3- Is it feasible to implement the experience of electronic testing in secondary education?	52	5	27	2.56	0.608	1	Yes
	56.5	5.4	29.3				
4- Can the experience of electronic testing in secondary education be replicated?	43	27	14	2.19	0.898	2	Yes
	46.7	29.3	15.2				
5- Is training provided to teachers on effectively using electronic systems?	/	43	41	1.49	0.503	7	No
	/	46.7	44.6				
6- What is the level of security in the current electronic testing systems?	Good,	Average	Poor	1.82	0.624	5	Average
	10	49	25				
	10.9	53.3	27.2				
7- Do you believe your institution is capable of providing a secure electronic testing system?	Funding	Technical infrastructure	Technical support	2.12	0.767	3	Funding
	30	34	20				
	32.6	36.9	21.7				

The table No. 4. Indicates that in paragraph (3), (56.5%) of participants found electronic exams feasible (average score: 2.56). Conversely, (48.9%) in paragraph (1) were skeptical about their institutions' security systems (average score: 1.99). Regarding teacher training, (46.7%) in paragraph (5) deemed it adequate (average score: 1.49), while (44.6%) in paragraph (2) criticized it (average score: 1.57). In paragraph (6), (53.3%) rated security as «average,» and (27.2%) as «inadequate» (average score: 1.82). Funding was seen as the most important factor affecting security at (32.6%), followed by technical infrastructure at (36.9%). The findings suggest that the success of e-testing relies on addressing the gap between perceived feasibility (56.5%) and practical reality (48.9%), prioritizing infrastructure and funding improvements. A study (Sahy et al., reached conclusions that reinforce these findings [16].

Table 5

Means and S. Deviations of responses regarding: “Possibility of transferring the experience of electronic tests from university education to secondary education in Iraq, taking into account the technical, social and economic aspects”

Таблица 5

Средние значения и стандартные отклонения ответов относительно возможности трансфера опыта электронного тестирования из высшего образования в среднее образование в Ираке с учётом технических, социальных и экономических аспектов

Axes	Phrases	Yes.	No.	To some extent	Mean	S. Deviation	order	trend	
		N	N	N					
		%	%	%					
Technician	1. Do you have prior experience using online exams?	10	39	35	1.65	0.685	3	No	
		11.9	46.4	41.7					
		/	35	49					
	2. Is the school equipped with the necessary equipment for conducting online exams?	/	35	49	1.58	0.406	4	sometimes	
		/	41.7	58.3					
	3. What tools or software do you currently use for online exams?	Moodle	Google Forms	Blackboard	2.29	0.55	1	Moodle	
		28	52	4					
		33.3	61.9	4.8					
	4. What type of exams do you prefer to use electronically?	Multiple choice	Essay.	Interactive	2.07	0.929	2	Multiple choice	
		39	12	33					
		46.4	14.3	39.3					
Social	5. What is your opinion on the possibility of transferring the experience of online exams from university to secondary education?	Yes.	No.	To some extent	2.37	0.724	1	Yes	
		43	12	29					
		51.2	14.3	34.5					
	6. Do you believe that online exams will be beneficial for improving the quality of secondary education?	43	37	4	2.07	0.907	3	Yes	
		51.2	43.9	4.8					
	7. Do you have prior experience using online exams?	14	42	28	1.67	0.75	4	No	
		16.7	49.9	33.3					
	8. Are there sufficient technical staff in the labs?	32	12	40	2.24	0.688	2	No	
		38.1	14.3	47.6					
	Economic	9. What challenges might you face when transferring online exams to secondary education?	Lack of teacher training	Lack of devices.	Poor internet connection.	2.23	0.7	2	Lack of teacher training
			32	39	13				
			38.1	46.4	15.5				
10. How do economic conditions affect the feasibility of implementing online exams in secondary schools?		Significant impact	Moderate impact	Low impact	2.49	0.591	1	significant impact	
		45	35	4					
		53.6	41.7	4.8					
11. What factors influence the feasibility of transfer?		Technical infrastructure.	Available budget	Government support	2.07	0.773	3	Technical infrastructure	
		38	34	22					
		33.3	40.5	26.2					
12. Do you believe that online exams will contribute to reducing the educational gap between students in different regions?		Yes.	No.	To some extent	1.98	0.909	4	No	
		38	40	6					
		45.2	47.6	7.1					

The table No. (5) shows that (46.4%) of respondents (Phrases 1 and 7) had no experience with online testing. (58.3%) of respondents (Phrases 2) indicated that the necessary equipment was «sometimes» available. This suggests insufficient technical preparedness. Google Forms (61.9%), Moodle (33.3%), and Blackboard (4.8%) were the most commonly used tools. Regarding test formats, (46.4%) of respondents believed that multiple-choice questions were the most suitable format for online testing. Regarding social aspects, (51.2%) of respondents agreed on the importance of sharing experiences (Phrases 5), and another (51.2%) believed that sharing experiences helped improve test quality (Phrases 6). Overall, respondents favored sharing experiences. On the other hand, (47.6%) of respondents pointed out a shortage of technical personnel (Phrases 8), while (49.9%) disagreed, citing a lack of technical operational experience (Phrases 7).

These can be considered key obstacles. Ultimately, economic factors pose the greatest challenge. According to paragraph (10), (53.6%) of respondents believed that economic conditions had a “significant” impact, (46.4%) believed that there was insufficient terminal equipment, (38.1%) believed that there was insufficient teacher training, and (15.5%) believed that unstable internet connectivity was a decisive factor. In contrast, according to paragraph (11), technological infrastructure (33.3%) and budget (40.5%) were considered key factors. Finally, according to paragraph (12), (47.6%) of respondents believed that e-assessment would not help reduce educational inequality between regions. We can conclude that while the transition is theoretically possible, in practice it requires: 1) bridging the digital divide between regions; 2) introducing simple and cost-effective technological solutions; 3) implementing phased training programs, starting with teachers and gradually expanding to students. Study and Chen et al. Gaidelys et al., reached conclusions that reinforce these findings [17, 18].

Presentation and Discussion of Results

This study identified the following problems, which can be summarized as follows: **Weak Technological Infrastructure:** There is a severe shortage of electronic devices (computers, tablets), and unstable internet connections. (55.3%) of respondents reported insufficient equipment, and (56.5%) reported unstable internet connections. Furthermore, there is a lack of backup generators to ensure exams can proceed during power outages; only (30.6%) of respondents confirmed that backup generators were available. **Staff Shortages:** The study found inadequate training for teachers and administrators. (36.5%) of respondents stated that they had not received any training on using online platforms (such as Google Classroom and Moodle). In addition, technical support provided by educational institutions is insufficient; (54.1%) of respondents indicated that support was ‘limited’. **Safety and Educational Concerns:** The study found that (47.1%) of respondents considered online platforms ‘unsafe’, and (88.2%) lacked confidence in fraud prevention mechanisms. Furthermore, (47.6%) of respondents expressed skepticism about the fairness of online testing compared to traditional testing and did not believe that online testing could narrow the educational gap between regions. **Positive Potential:** (51.2%) of respondents supported extending the experience of online university testing to secondary education. (82.3%) of respondents believed that online testing saves time and effort compared to paper-based testing. The biggest challenges facing the three areas explored in this article are: **Technological:** Weak infrastructure (electricity, internet) and equipment shortages. **Social:** Low resistance and trust in change within the education sector. **Economic:** High implementation costs (equipment purchase, training, and maintenance).

Conclusion

This research demonstrates that the implementation of e-assessments in Iraqi secondary schools faces significant and interconnected challenges. Key findings from teacher surveys point

to inadequate infrastructure (power and internet outages, and a lack of devices), insufficient teacher training, and concerns about the security and integrity of examinations.

However, the study also highlights the potential benefits of this shift, particularly in terms of increased efficiency. The transition is possible, but not under the current circumstances. Success depends on a clear and phased plan that first addresses the fundamental shortcomings: securing sustainable funding for reliable technology, implementing mandatory teacher training programs, and developing simple and secure platforms that are appropriate for the local context.

Ultimately, the adoption of e-assessments should be part of a broader and more realistic strategy to bridge the digital divide in Iraqi education, ensuring that it promotes equity and learning outcomes rather than undermining them. Implementing e-examinations effectively in Iraq is theoretically feasible, but it requires bridging gaps in digital infrastructure, building public trust, and securing sustainable funding. The success of this transition hinges on a comprehensive strategy that fully considers local conditions. This strategy includes:

Recommendations for decision-makers: measuring the effectiveness of e-examinations compared to traditional examinations; comparing student performance in both systems; assessing the quality and fairness of results in an electronic environment; and analyzing its economic feasibility. Furthermore, it is necessary to examine the cost of implementing electronic systems (hardware, software, training) against the current costs of paper-based examinations and consider the financial viability of this transition. Finally, a phased plan is needed, including: training faculty and staff to use the electronic platform; and developing electronic monitoring systems (such as grading software) to prevent cheating, and providing students with a guide on how to take electronic exams.

Recommendations: study the impact of digital transformation on the quality of education; learn from global experiences; analyze the successes and failures of similar countries (such as Jordan, Saudi Arabia, Egypt, or countries with similar economic and educational circumstances); implement policies to support infrastructure; establish partnerships with local or international technology institutions.

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Конфликт интересов

Автор заявляет об отсутствии конфликта интересов.

Conflict of interests

The author declares no conflict of interest.

Поступила в редакцию / Submitted 02.02.2026

Поступила после рецензирования / Revised 03.03.2026

Принята к публикации / Accepted 19.03.26