Learning Under Fire: Technological Vigilance and Exam Performance Amid Gaza's War Crisis

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Abstract
In war-affected Gaza, where traditional education infrastructure has collapsed, students have turned to digital platforms for continued learning. This study examines the effects of technical, economic, psychological, and academic challenges on students' performance and technological vigilance during electronic examinations. Drawing from a sample of 3349 undergraduate students and employing a descriptive-correlational design, findings indicate that severe infrastructural limitations, financial hardship, and psychological distress significantly hinder students' exam experiences. Nevertheless, students exhibit notable adaptive behaviors, including contingency planning and digital resilience. These results reveal a dual narrative of adversity and innovation and highlight the urgent need for structural, psychological, and pedagogical support in conflict-based digital education.
Keywords: Gaza Education Crisis, War and Digital Learning, Technological Vigilance, Electronic Exams, Educational Resilience, Conflict-Affected Students, Online Assessment Challenges

Introduction
The ongoing conflict in Gaza has inflicted profound disruptions across all facets of daily life, with the education sector among the hardest hit. Escalating violence, recurrent airstrikes, infrastructure collapse, and widespread displacement have created an environment where access to consistent, quality education has become increasingly precarious. According to the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA, 2023), over 90% of schools in Gaza have been affected by military operations, either through direct damage or their use as emergency shelters. These conditions severely undermine educational continuity and present unique challenges for students and educators alike.

In this unstable environment, the transition to electronic examinations—a shift accelerated globally by the COVID-19 pandemic—has introduced additional layers of complexity for students in Gaza. While e-assessments offer flexibility and scalability, their effectiveness hinges on reliable electricity, stable internet connections, adequate digital infrastructure, and students' technological preparedness. In Gaza, however, electricity outages often last more than 12 hours per day (Al Jazeera, 2023), and internet access remains inconsistent due to damaged infrastructure and limited access to updated technology (Gisha – Legal Center for Freedom of Movement, 2022). These war-induced technical barriers significantly hinder students' ability to effectively engage with online learning and assessments.

Beyond logistical constraints, the psychosocial toll of war—manifested in heightened anxiety, trauma, and the absence of stable learning environments—poses severe threats to students' concentration, performance, and overall academic well-being. Studies have shown that conflict exposure negatively impacts students' cognitive functioning, motivation, and mental health (Sirin & Rogers-Sirin, 2015), all of which are critical for navigating digital platforms under high-stakes conditions such as examinations. Moreover, economic hardship, exacerbated by the blockade and recurring hostilities, prevents many families from affording modern digital tools or internet services necessary for effective participation in online exams (UNICEF, 2022).

Within this fragile context, the concept of *technological vigilance*—students' ability to anticipate, adapt to, and manage digital disruptions—emerges as a vital competency. Technological vigilance becomes not just a technical skill, but a survival strategy for students confronting war-induced educational uncertainty. This study aims to investigate how various war-related challenges (technical, economic, psychological, and academic) affect students' performance and foster or hinder the development of technological vigilance during electronic exams in Gaza. By exploring these dynamics, this research contributes to the growing literature on crisis-affected education and provides actionable insights for educators, policymakers, and humanitarian organizations striving to uphold educational equity amid conflict. In light of the educational challenges posed by prolonged conflict in Gaza, this study seeks to explore how war-driven crises affect students' ability to engage with electronic examinations. To achieve this, the research is structured around a set of clear objectives and corresponding research questions that examine the technical, economic, psychological, and academic barriers students face, and how these challenges influence their technological vigilance and academic performance.

Research Objectives
1. This study seeks to investigate the multifaceted impact of war-driven crises on university students' ability to participate in and perform electronic examinations within the Gaza Strip. Specifically, the study aims to:
2. Identify the technical, economic, psychological, and academic challenges that students face during electronic exams amidst the ongoing conflict.
3. Examine the influence of these challenges on students' performance in online assessments.
4. Assess students' level of technological vigilance, defined as their preparedness, adaptability, and awareness of digital disruptions during exams.

5. Explore how repeated exposure to crisis-induced educational obstacles shapes students' ability to manage technology-related barriers in e-assessments.
6. Analyze the interplay between war-related crises and technological vigilance, highlighting potential pathways for educational resilience in conflict zones.

Research Questions

This study is guided by the following research questions, organized thematically across four domains and cross-cutting dimensions:

- Technical Challenges

- RQ1: How do war-related technical challenges, such as internet outages and electricity cuts, affect students' performance in electronic exams in Gaza?
- RQ2: To what extent does students' ability to handle war-related technical challenges contribute to their technological vigilance?

Economic Challenges

- RQ3: How do financial difficulties during the Gaza crisis, such as internet costs and lack of access to modern devices, impact students' readiness for electronic exams?
- RQ4: What is the relationship between economic challenges caused by the crisis and students' digital preparedness?

Psychological and Social Challenges

- RQ5: To what extent do psychological pressures caused by the war, such as anxiety and instability, influence students' concentration and performance during electronic exams?
- RQ6: How does the lack of family and social support during the Gaza crisis correlate with students' ability to adapt to technological requirements in exams?

Academic Challenges

- RQ7: How do academic challenges, such as lack of platform training and unclear instructions, affect students' performance in electronic exams during the Gaza crisis?
- RQ8: To what extent does crisis-driven disruption to academic resources affect students' technological vigilance?

Technological Vigilance

- RQ9: How do students' levels of preparedness for crisis-driven technological disruptions (e.g., power outages, system failures) impact their performance in electronic exams?
- RQ10: To what extent does students' ability to adapt to rapidly changing technological environments during the crisis influence their academic success?

Interplay Between Challenges and Vigilance

- RQ11: What is the relationship between war-related challenges (technical, economic, psychological, academic) and the development of technological vigilance among students in Gaza?
- RQ12: How has the Gaza crisis influenced students' ability to enhance their technological vigilance for managing electronic exams?

Methodology

Research Design

This study adopts a quantitative, descriptive-correlational research design to explore the effects of war-driven crises on university students' technological vigilance and performance in electronic examinations within the Gaza Strip. The descriptive element aims to capture and

summarize the lived experiences of students engaged in digital learning amid extreme conflict conditions. The correlational component is employed to statistically examine the relationships between different types of challenges—technical, economic, psychological, and academic—and students' digital preparedness and adaptability.

The chosen design is appropriate for studying phenomena that cannot be ethically manipulated, especially within a high-risk, crisis-driven environment like Gaza. It allows for the systematic analysis of patterns and relationships among naturally occurring variables, providing insights that can inform educational interventions, policy design, and humanitarian support strategies in conflict-affected regions.

Context of the Study
The study is situated within the Gaza Strip, a region currently experiencing one of the most devastating humanitarian and infrastructural crises in its modern history. Due to the recent escalation of violence and bombardment, all higher education institutions have been either partially or completely destroyed (UNESCO, 2024), rendering traditional, face-to-face instruction impossible. Consequently, universities have rapidly transitioned to fully online modalities, despite severe constraints such as long-lasting power outages, poor internet infrastructure, and widespread displacement.

Students in Gaza now attend lectures, complete assignments, and undertake examinations entirely online. Most do so from homes with intermittent electricity or from makeshift shelters, where access to stable digital tools and quiet study spaces is extremely limited. In such a context, electronic exams have become not only a test of academic knowledge but also of resilience, adaptability, and technological skill under pressure.

Population and Sampling
The target population for this research includes undergraduate students from all faculties and academic levels enrolled in Gaza's universities during the 2024–2025 academic year. The inclusion criterion required students to have completed at least one electronic exam during the semester in which the study was conducted.

To capture the experiences of those most directly affected by the transition to online assessment, purposive sampling was employed. This method allowed for the intentional selection of participants based on their exposure to the phenomenon of interest—namely, electronic examinations conducted under crisis conditions.

Table 1
Demographic Distribution of Participants (N = 3349)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	2553	76.2
	Male	796	23.8
Academic Level	Level 1	1433	42.8
	Level 2	1134	33.9
	Level 3	572	17.1
	Level 4	210	6.3
Faculty	College of Education	1155	34.5
	College of Management and Finance	651	19.4
	College of Medical Sciences	358	10.7
	College of Computers and IT	348	10.4
	College of Fine Arts	330	9.9
	College of Arts and Humanities	235	7.0
	College of Engineering	126	3.8
	College of Physical Education and Sports	58	1.7
	College of Media	48	1.4
	College of Applied Sciences	40	1.2

Instrumentation
A structured online questionnaire was developed as the primary instrument for data collection. The instrument was designed to measure the degree to which students face war-related challenges and how these challenges affect their engagement with online assessments, particularly in terms of performance and technological vigilance.

The questionnaire was structured into 12 thematic dimensions, each measured using multiple items on a 5-point Likert scale ranging from *Strongly Disagree (1)* to *Strongly Agree (5)*. Items were adapted from existing instruments on digital readiness, psychological resilience, and online learning challenges and were further refined based on the unique socio-political context of Gaza.

To ensure clarity, contextual alignment, and validity, the instrument underwent:
- Expert review by educational researchers and local university faculty,
- Translation validation for bilingual (Arabic–English) accuracy,
- Pilot testing with 50 students to assess item clarity, reliability, and time burden.

The internal consistency reliability (Cronbach's alpha) for all subscales ranged between 0.74 and 0.91, indicating high reliability.

Table2

Summarizing the 12 Dimensions of the Instrument

Dimension	Description	Sample Item
1. Technical Challenges	Measures difficulties with connectivity, devices, and platform glitches	"I experienced power cuts that disrupted my exam."
2. Economic Challenges	Assesses financial limitations affecting readiness and access to technology	"The cost of internet creates a burden during exams."
3. Psychological and Social Pressures	Captures emotional distress, displacement, and social isolation impacts	"Displacement negatively impacts my focus during exams."
4. Academic Challenges	Examines issues like lack of training, unclear instructions, or poor communication with instructors	"I was not trained on how to use the exam platform."
5. Digital Readiness	Assesses preparedness with tools and platforms before exams	"I prepare my devices and software before exams."
6. Technological Vigilance	Evaluates adaptability and responsiveness to tech disruptions	"I create contingency plans in case of technical failures."
7. Adaptation to Change	Measures ability to learn from mistakes and handle new technology	"I can adapt to new updates on the digital platforms."
8. Time Management	Explores planning and pacing during electronic exams	"I develop a plan to manage my time during electronic exams."
9. Critical Thinking and Focus	Assesses cognitive engagement and persistence in the face of distractions	"I analyze exam questions carefully before answering."
10. Digital Ethics and Security	Measures data protection practices and ethical behavior	"I ensure my accounts are secured before participating in online exams."
11. Institutional Support Perception	Gauges perceptions of university support systems for online assessments	"My institution provides adequate support for electronic exam issues."
12. Coping and Resilience Mechanisms	Evaluates self-reliance, stress coping, and learning from prior experiences	"I have learned from previous technical mistakes to improve in future exams."

The final instrument consisted of over 60 items distributed among the dimensions above, ensuring a comprehensive measurement of the phenomena under study.

Data Collection Procedure

Data collection was conducted entirely online, consistent with the reality that physical campuses are non-operational. The questionnaire was distributed using university email systems, student WhatsApp groups, institutional Telegram channels, and learning management systems (LMS). The survey was open for three weeks, with automated reminders issued weekly.

To accommodate infrastructure limitations, the survey was optimized for mobile phones and low-bandwidth environments. It was bilingual (Arabic and English) and required approximately 10–12 minutes to complete.

Participants were informed about the purpose of the research, assured of anonymity and confidentiality, and advised that participation was entirely voluntary. A brief overview page

included the informed consent form, which respondents had to acknowledge before proceeding.

Data Analysis

Data were analyzed using IBM SPSS Statistics 27, employing both descriptive and inferential statistical techniques:

- Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to profile the participants and summarize responses across all questionnaire items.
- Independent samples t-tests were used to explore differences between male and female participants regarding perceived challenges.
- One-way ANOVA assessed differences across academic levels, faculties, and number of electronic exam attempts. Where statistically significant results were obtained, Tukey's HSD post-hoc tests were used to identify between-group differences.
- Pearson correlation coefficients were computed to examine the relationships between types of challenges and technological vigilance.
- Multiple regression analysis was used to determine the predictive power of the various challenges on students' levels of technological vigilance and academic performance in e-assessments.

Ethical Considerations

Ethical approval for this study was granted by the research ethics committee of the corresponding institution. Given the traumatic conditions under which the research was conducted, careful consideration was given to protecting participants' rights and well-being.

- The study posed no physical risk, and all data collection was anonymous.
- Students were provided with a list of mental health resources in case the survey triggered distress related to their living or academic conditions.
- Participation was entirely voluntary, and students were informed that they could exit the survey at any point without any consequences.

The ethical framework ensured that the research process upheld principles of beneficence, autonomy, and justice, particularly important in humanitarian contexts such as Gaza.

Results

Table 3

Demographic factors of participants (n=3349)

Gender	Frequency	Percentage %
Male	796	23.8
Female	2553	76.2
Academic level		
Level1	1433	42.8
Level 2	1134	33.9
Level 3	572	17.1
Level 4	210	6.3
College		
College of arts and humanities	235	7.0
College of management and finance	651	19.4
College of media	48	1.4

College of education	1155	34.5
College of physical education and sports	58	1.7
College of computers and information technology	348	10.4
College of applied sciences	40	1.2
College of medical sciences	358	10.7
College of fine arts	330	9.9
College of engineering	126	3.8

Table 3 presents the demographic characteristics of the study participants (n = 3349). The majority of respondents were female, accounting for 76.2% (n = 2553) of the sample, while male participants represented 23.8% (n = 796). In terms of academic level, most participants were in Level 1 (42.8%), followed by Level 2 (33.9%), Level 3 (17.1%), and Level 4 (6.3%). Regarding the distribution by college, the highest proportion of participants was from the College of Education (34.5%), followed by the College of Management and Finance (19.4%) and the College of Medical Sciences (10.7%). Other colleges represented smaller portions of the sample, including the College of Computers and Information Technology (10.4%), College of Fine Arts (9.9%), College of Arts and Humanities (7.0%), College of Engineering (3.8%), College of Physical Education and Sports (1.7%), College of Media (1.4%), and College of Applied Sciences (1.2%).

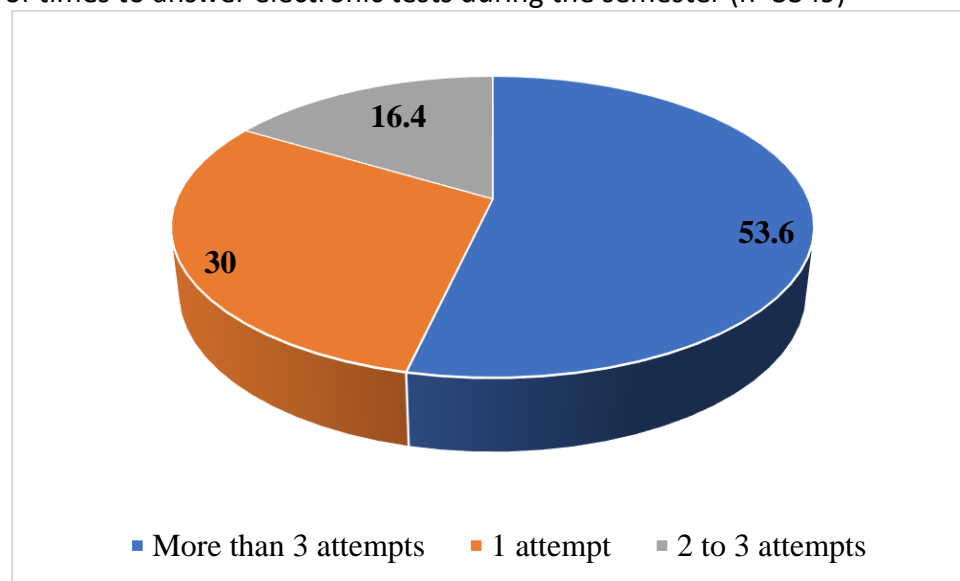Number of times to answer electronic tests during the semester (n=3349)

Figure 1: Number of times to answer electronic tests during the semester

Figure 1 illustrates the distribution of students based on the number of times they answered electronic tests during the semester. The majority of participants (53.6%) reported taking electronic exams more than three times. Approximately 30% of students indicated that they attempted electronic exams only once during the semester, while 16.4% of the participants had taken electronic exams two to three times.

Table 3
Descriptive Statistics of Technical Challenges Faced by Students During Online Examinations

Technical challenge item	Mean ± SD
1. I am having difficulty connecting to the internet while studying online.	4.60 ± 0.66
2. The power outage greatly affected my ability to complete the test.	4.61 ± 0.66
3. Sudden technical glitches affect my exam performance.	4.51 ± 0.69
4. I lacked the knowledge to solve technical problems during the test.	4.09 ± 0.90
5. The devices I use during testing are not efficient enough.	4.01 ± 1.06
6. I am having difficulty dealing with the electronic platforms provided by the university.	3.41 ± 1.19

The data in Table 3 reflect the significant technical barriers that students encountered. Among these, the impact of power outages emerged as the most pressing issue (M = 4.61, SD = 0.66), indicating that unexpected disruptions in electricity supply critically affected students' ability to complete exams. Similarly, poor internet connectivity was reported as a major obstacle (M = 4.60, SD = 0.66), demonstrating that consistent access to reliable internet remains a core challenge for many students. In addition, technical glitches during exams (M = 4.51, SD = 0.69) frequently disrupted the examination experience, contributing to a loss of concentration, increased stress, and potentially lower performance. Furthermore, a substantial number of students indicated they lacked the technical skills to troubleshoot problems during exams (M = 4.09, SD = 0.90), revealing a gap in digital literacy and preparedness for online assessments. The inefficiency of personal devices (M = 4.01, SD = 1.06) also emerged as a concern, suggesting that outdated or low-performing technology hindered students' ability to participate effectively. Lastly, students expressed difficulty navigating electronic platforms provided by the university (M = 3.41, SD = 1.19), which may point to a need for improved platform design and user support services.

Table 4
Descriptive Statistics of Economic Challenges Faced by Students During Online Examinations

Economic Challenge Item	Mean ± SD
The cost of the internet imposes a financial burden during exams.	4.40 ± 0.86
I need a modern electronic device to comfortably take the exams.	4.29 ± 0.96
Limited financial resources hinder my preparation for electronic exams.	4.24 ± 0.91
The lack of home internet forces me to take exams in public spaces.	4.59 ± 0.80
I find it difficult to obtain financial support for purchasing necessary devices or software.	4.37 ± 0.91

Table 4 reveals the financial pressures students experienced in relation to online testing. A significant proportion reported that the high cost of internet services placed a burden on them during exam periods (M = 4.40, SD = 0.86). This is particularly critical in regions where internet access is costly or unreliable. Additionally, students expressed a strong need for modern electronic devices to facilitate online testing (M = 4.29, SD = 0.96), as many found their existing tools inadequate for smooth participation. Limited financial resources were also seen to hinder exam preparation (M = 4.24, SD = 0.91), underscoring the broader socioeconomic inequalities affecting access to education. Notably, the lack of home internet forced many students to complete exams in public spaces (M = 4.59, SD = 0.80), which may have exposed them to distractions, security concerns, or limited resources. Finally, many students found it difficult to secure financial support for the purchase of necessary tools or

software (M = 4.37, SD = 0.91), reinforcing the need for institutional or governmental aid programs to bridge this gap.

Table 5
Descriptive Statistics of Psychological and Social Pressures Experienced by Students During Online Examinations

Psychological and Social Pressure Item	Mean ± SD
I feel anxious about failing due to technical problems.	4.50 ± 0.72
Psychological pressure resulting from external conflicts affects my concentration during exams.	4.64 ± 0.62
The lack of family support makes it more difficult to manage electronic exams.	3.79 ± 1.16
Frequent displacement and instability negatively impact my psychological state during exams.	4.71 ± 0.60
I feel stressed due to a lack of access to internet or technology at the time of the exam.	4.60 ± 0.68
Daily and family responsibilities, particularly due to displacement, hinder my preparation for electronic exams.	4.54 ± 0.72

Psychological and social factors also played a significant role in shaping students' online exam experiences. As shown in Table 4, the highest-rated item was the negative psychological impact of frequent displacement and instability (M = 4.71, SD = 0.60), which could be linked to political conflict, forced migration, or natural disasters. These challenges deeply affected students' emotional well-being and ability to concentrate. Similarly, external conflicts and stressful environments were reported to impair concentration during exams (M = 4.64, SD = 0.62), revealing how personal and community-level crises can intrude upon academic performance. Students also expressed anxiety about failing due to technical problems (M = 4.50, SD = 0.72), indicating a fear that performance would be determined not by knowledge but by technological access and stability. Stress arising from inadequate access to internet and technology during exams was also high (M = 4.60, SD = 0.68), demonstrating how technical and psychological factors interact to exacerbate pressure. Additionally, students facing daily responsibilities or family obligations—especially in displacement settings reported difficulty preparing for exams (M = 4.54, SD = 0.72). A notable proportion also felt unsupported by their families (M = 3.79, SD = 1.16), which may point to a lack of understanding or resources within households to assist students with their educational needs.

Table 5
Descriptive Statistics of Academic Challenges Faced by Students During Online Examinations

Academic Challenge Item	Mean ± SD
Lack of prior training increases the difficulty of exams.	4.23 ± 0.85
Unclear exam instructions make the process more complex.	3.87 ± 1.05
I lack sufficient guidance on how to conduct electronic exams.	3.69 ± 1.11
Questions in electronic exams are sometimes complex and unclear.	3.90 ± 1.02
Difficulty in directly communicating with the course instructor affects my understanding of exam requirements.	4.19 ± 0.96

Table 5 outlines the academic challenges experienced by students in the context of online exams. The most prominent challenge reported was the lack of prior training, which increased the difficulty of examinations (M = 4.23, SD = 0.85). This finding emphasizes the necessity for

pre-assessment orientation sessions or tutorials to familiarize students with the format, expectations, and digital procedures of online exams. Additionally, students noted difficulty in communicating directly with instructors, which negatively impacted their understanding of exam requirements (M = 4.19, SD = 0.96). This indicates a gap in instructor-student interaction, possibly due to reduced accessibility or unclear communication channels in virtual settings. Students also struggled with unclear exam instructions (M = 3.87, SD = 1.05) and complex or ambiguous exam questions (M = 3.90, SD = 1.02), both of which could impair their performance and cause unnecessary confusion. Furthermore, the lack of sufficient guidance on how to conduct electronic exams (M = 3.69, SD = 1.11) highlights an area where institutions can improve support structures to aid student success in digital assessment settings.

Table 6
Descriptive Statistics on Students' Awareness of Technical Challenges During Online Examinations

Awareness Item	Mean ± SD
I have the ability to identify potential technical issues during exams.	3.24 ± 1.11
I can determine suitable solutions for common technical problems.	3.07 ± 1.08
I am able to handle technical malfunctions promptly during exams.	2.89 ± 1.13
I prepare an alternative plan in case of technical failures during exams.	3.11 ± 1.17
I benefit from previous technical mistakes and avoid them in the future.	4.00 ± 0.91

Table 6 presents students' self-reported awareness and preparedness to manage technical issues during online exams. The highest-rated item was the ability to learn from past technical mistakes and avoid them in the future (M = 4.00, SD = 0.91), reflecting a degree of self-directed learning and adaptability. However, other aspects of technical awareness scored lower. For instance, students rated themselves moderately on their ability to identify potential technical issues (M = 3.24, SD = 1.11) and determine suitable solutions (M = 3.07, SD = 1.08). Alarmingly, their ability to handle technical malfunctions promptly during exams scored the lowest (M = 2.89, SD = 1.13), indicating a lack of real-time problem-solving skills under pressure. The practice of preparing alternative plans in case of technical failures was also relatively low (M = 3.11, SD = 1.17).

Table 7
Descriptive Statistics on Students' Digital Readiness for Online Examinations

Digital Readiness Item	Mean ± SD
I prepare in advance to ensure the readiness of devices and software before exams.	4.26 ± 0.75
I allocate sufficient time to understand how to use the exam platform.	4.05 ± 0.84
I test devices and the internet connection before the exam to ensure they function properly.	4.25 ± 0.81
I learn independently how to use the available technological tools.	4.11 ± 0.85

Table 7 demonstrates encouraging findings regarding students' digital readiness for online examinations. The data suggest that most students actively engage in preparing their devices and software before exams (M = 4.26, SD = 0.75) and frequently test their devices and internet connection beforehand (M = 4.25, SD = 0.81). These behaviors indicate a proactive attitude and recognition of the importance of preparation for success in virtual assessments.

Additionally, students reported that they allocate sufficient time to understand how to use exam platforms (M = 4.05, SD = 0.84) and engage in self-directed learning to navigate technological tools (M = 4.11, SD = 0.85).

Table 8
Descriptive Statistics on Students' Adaptation to Technology During Online Examinations

Adaptation Item	Mean ± SD
I am capable of adapting to new updates on digital platforms.	3.76 ± 0.98
I can overcome unexpected technical difficulties during exams.	3.07 ± 1.12
I easily handle changes in the technological tools used in assessments.	3.30 ± 1.09
I use the technological tools available to me effectively during tests.	3.70 ± 1.00

Table 8 presents students' self-perceived ability to adapt to technological changes during online exams. The highest-rated item was students' ability to adapt to new updates on digital platforms (M = 3.76, SD = 0.98), followed closely by the effective use of available technological tools (M = 3.70, SD = 1.00). These findings suggest a generally positive level of adaptability, where students demonstrate a willingness to embrace technological advancements and apply digital tools during assessments. However, students reported lower confidence in their ability to overcome unexpected technical difficulties (M = 3.07, SD = 1.12) and to handle changes in technological tools used in assessments (M = 3.30, SD = 1.09).

Table 9
Descriptive Statistics on Students' Electronic Time Management During Online Examinations

Time Management Item	Mean ± SD
I develop a plan to manage my time during electronic exams.	4.04 ± 0.86
I can allocate enough time to answer all questions in the exam.	3.73 ± 0.99
I know how to switch between questions at the appropriate time during an electronic exam.	3.65 ± 1.05

Table 9 focuses on students' time management skills during electronic examinations. The findings indicate that students are relatively confident in their ability to develop a plan to manage their time (M = 4.04, SD = 0.86), demonstrating foresight and preparation. However, slightly lower means were reported for allocating enough time to answer all questions (M = 3.73, SD = 0.99) and for switching between questions appropriately (M = 3.65, SD = 1.05).

Table 10
Descriptive Statistics on Students' Digital Security and Privacy Practices During Online Examinations

Digital Security and Privacy Item	Mean ± SD
I commit to protecting my data while using electronic exam platforms.	4.36 ± 0.75
I trust the security of the platforms I use for exams.	4.14 ± 0.87
I always follow guidelines related to security and privacy in exam platforms.	4.36 ± 0.74
I ensure my digital accounts are protected before participating in any electronic exam.	4.26 ± 0.84
I avoid using external technologies to assist in solving exam questions.	4.34 ± 0.85

Table 10 reveals encouraging trends regarding students' awareness and practices related to digital security and ethical behavior during online exams. The highest-rated items were

students' commitment to protecting personal data (M = 4.36, SD = 0.75) and following security and privacy guidelines (M = 4.36, SD = 0.74), indicating a strong sense of responsibility and compliance with institutional policies. In addition, students expressed high levels of awareness in avoiding external technologies to assist with solving questions (M = 4.34, SD = 0.85) and ensuring their accounts are protected before taking exams (M = 4.26, SD = 0.84). Confidence in the security of the exam platforms was slightly lower (M = 4.14, SD = 0.87), possibly reflecting concerns about data privacy or previous experiences with system vulnerabilities.

Table 11
Descriptive Statistics on Students' Critical Thinking and Vigilance During Online Examinations

Critical Thinking and Vigilance Item	Mean ± SD
I can analyze exam questions carefully before answering them.	4.15 ± 0.81
I maintain focus effectively despite challenges during the exam.	3.62 ± 1.04
I think thoroughly before answering questions in electronic exams.	4.12 ± 0.83
I learn from my mistakes and avoid repeating them in future exams.	4.33 ± 0.73

Table 11 shows students' self-reported practices related to critical thinking and vigilance during online exams. The highest-rated item was the ability to learn from mistakes and avoid repeating them in future exams (M = 4.33, SD = 0.73), which reflects strong self-reflective practices and a commitment to continuous improvement. This suggests that students are able to use prior experiences both successful and challenging as learning tools to enhance future performance. Students also demonstrated high scores in their ability to analyze exam questions carefully (M = 4.15, SD = 0.81) and to think thoroughly before answering (M = 4.12, SD = 0.83). These findings highlight a well-developed capacity for critical engagement with assessment content. However, the lowest score in this category was related to students' ability to maintain focus despite challenges during exams (M = 3.62, SD = 1.04).

Table 12
Descriptive Statistics on the Relationship Between Challenges and Technological Vigilance

Relationship Item	Mean ± SD
The more technical challenges I face, the better I become at enhancing my technological vigilance.	3.91 ± 0.96
The psychological challenges I face help me develop strategies to manage technology effectively.	3.67 ± 1.02
Surrounding crises pushed me to learn new skills to adapt to electronic exams.	3.86 ± 0.98
Learning to improve technological vigilance has helped me overcome challenges during exams.	3.86 ± 0.92

Table 12 explores how facing various challenges influences the development of students' technological vigilance—their awareness, responsiveness, and preparedness in using digital tools. The results show that students believe technical challenges help enhance their technological vigilance (M = 3.91, SD = 0.96). This suggests that repeated exposure to digital difficulties fosters the ability to anticipate and respond to similar problems in the future, reflecting a form of experiential learning. Similarly, students acknowledged that crises in their surroundings pushed them to learn new skills for adapting to electronic exams (M = 3.86, SD

= 0.98), and that learning to improve technological vigilance has helped them overcome exam challenges (M = 3.86, SD = 0.92). These findings indicate that adversity, although stressful, often serves as a catalyst for growth in digital competency and resilience. However, the psychological challenges faced by students were slightly less effective in fostering technological coping strategies (M = 3.67, SD = 1.02).

Table 13
Differences in the mean score of challenges facing students in the field of artificial intelligence with regard to their demographic factors

Variable	N	Mean ± SD	t/f (df)	p-value
Gender				0.702
Male	796	4.00 ± 0.41	-0.382 (3347)	
Female	2553	4.01 ± 0.39		
Academic level				
Level 1	1433	3.99 ± 0.40		
Level 2	1134	4.01 ± 0.39	1.434, (3, 3345)	0.231
Level 3	572	4.03 ± 0.39		
Level 4	210	4.00 ± 0.42		
College				
College of Arts and Humanities	235	3.98 ± 0.37		
College of Management & Finance	651	4.03 ± 0.41		
College of Media	48	4.16 ± 0.38		
College of Education	1155	4.01 ± 0.40		
College of Physical Education & Sports	58	4.08 ± 0.37	3.506, (9, 3339)	0.000
College of Computers & IT	348	3.97 ± 0.38		
College of Applied Sciences	40	3.97 ± 0.34		
College of Medical Sciences	358	4.03 ± 0.39		
College of Fine Arts	330	3.98 ± 0.40		
College of Engineering	126	3.88 ± 0.41		
Number of electronic exam attempts				
1 attempt	1005	4.03 ± 0.41		
2 to 3 Attempts	550	4.01 ± 0.40	3.826, (2, 3346)	0.022
More than 3 Attempts	1794	3.99 ± 0.39		

Table 13 summarizes the statistical differences in the mean scores of challenges reported by students in the field of artificial intelligence based on their gender, academic level, college affiliation, and number of electronic exam attempts. The independent samples t-test showed no statistically significant difference in the mean scores of challenges between male (M = 4.00, SD = 0.41) and female students (M = 4.01, SD = 0.39), t(3347) = -0.382, p = 0.702. This indicates that both genders experienced a similar level of challenges during online exams, suggesting that gender was not a determining factor in the perceived difficulty of engaging with artificial intelligence-related assessments. A one-way ANOVA revealed no significant differences in the challenges faced by students across academic levels, F(3, 3345) = 1.434, p = 0.231. Although students in Level 3 (M = 4.03, SD = 0.39) reported slightly higher mean scores than those in Level 1 (M = 3.99, SD = 0.40), the differences were not statistically significant. This suggests that the level of academic progress did not significantly influence students' experience of online learning challenges.

In contrast, a statistically significant difference was observed between colleges, $F(9, 3339) = 3.506$, $p = 0.000$. The highest mean score was reported by students in the College of Media (M = 4.16, SD = 0.38), followed by Physical Education & Sports (M = 4.08, SD = 0.37) and Medical Sciences (M = 4.03, SD = 0.39). The College of Engineering had the lowest reported mean score (M = 3.88, SD = 0.41). These differences may reflect variations in digital infrastructure, instructional support, or assessment methods across academic disciplines. For instance, students in media and practical fields might require more intensive use of technology, thereby encountering more challenges. A significant difference was also found regarding the number of electronic exam attempts, $F(2, 3346) = 3.826$, $p = 0.022$. Students who had taken only one exam attempt reported the highest challenge scores (M = 4.03, SD = 0.41), whereas those with more than three attempts had slightly lower scores (M = 3.99, SD = 0.39). This suggests that increased exposure to online assessments may help students adapt and reduce perceived challenges, possibly due to gained experience and familiarity with exam platforms and procedures.

Discussion
The findings of this study underscore the severe and multifaceted impact of war-driven crises on university students' experiences with electronic examinations in Gaza. The results reveal that the intersection of infrastructural collapse, financial instability, psychological trauma, and academic inadequacies has created a deeply challenging environment for digital learning. These challenges not only affect academic performance but also significantly influence the development of students' technological vigilance—their ability to adapt to and manage digital disruptions.

Technical Challenges and Infrastructure Collapse
Students identified power outages and unreliable internet as the most significant technical barriers to completing online exams, with mean scores of 4.61 and 4.60, respectively. These findings are consistent with earlier studies in conflict zones and marginalized regions, which highlight that infrastructural deficiencies directly hinder students' digital participation (Barakat et al., 2013; UNESCO, 2023). For example, Alghamdi and Holland (2020) reported similar findings among Syrian refugees in Jordan, where frequent blackouts and limited access to devices severely disrupted remote learning. Furthermore, this study aligns with Hodges et al. (2020), who differentiate between planned online learning and emergency remote teaching, noting that unplanned transitions to digital platforms often exacerbate inequalities.

Economic Constraints and Inequity in Digital Access
The results also reveal that economic barriers play a substantial role in limiting digital readiness. The high cost of internet access (M = 4.40) and the inability to purchase modern devices (M = 4.29) mirror findings from other studies in low-resource settings. For instance, Zalat et al. (2021) found that financial hardship was a primary inhibitor to online learning engagement in Egypt during the COVID-19 pandemic. Similarly, a UNESCO (2021) report on education under siege emphasized that conflict-induced poverty undermines equitable access to technology and learning opportunities. In Gaza, where a blockade and systemic economic marginalization are ongoing, these challenges are further amplified.

Psychological Distress and Academic Consequences
Students reported significant psychological strain due to displacement (M = 4.71), anxiety over technical failures (M = 4.50), and lack of family support (M = 3.79). These findings corroborate the work of Sirin and Rogers-Sirin (2015), who observed that children and adolescents exposed to conflict zones often exhibit compromised cognitive focus and emotional stability. Research by Murthy and Lakshminarayana (2006) further supports this, showing that academic performance in war-torn settings is closely linked to mental health status. The Gaza context, marked by recurrent trauma, displacement, and insecurity, replicates these psychosocial risks, highlighting the importance of integrating mental health support within digital learning ecosystems.

Institutional Gaps in Academic Support
The academic challenges reported by students—such as lack of training on digital platforms (M = 4.23) and poor instructor communication (M = 4.19)—are indicative of systemic gaps in institutional preparedness. This aligns with findings by Bozkurt et al. (2020), who argue that many educational institutions were ill-equipped to support students during the pandemic, let alone in conflict zones. Similarly, Almahasees et al. (2021) found that in Palestine and Lebanon, students frequently reported inadequate academic scaffolding for online exams. This lack of structured guidance impairs students' ability to effectively navigate new learning modalities and undermines confidence in digital tools.

Technological Vigilance and Adaptive Capacity
Despite these adversities, students displayed commendable levels of technological vigilance. High mean scores were recorded for actions such as device preparation (M = 4.26), platform testing (M = 4.25), and ethical exam practices (M = 4.36). These findings are echoed in studies by Mishra et al. (2020) and Zhang et al. (2022), who found that exposure to frequent digital obstacles can foster resilience, adaptability, and self-regulated learning. Kolb's (1984) experiential learning theory also supports this conclusion, positing that learners develop critical competencies through reflective adaptation to real-life challenges. In Gaza, this process appears to manifest as a pragmatic response to systemic educational breakdowns, enabling students to gradually build the skills required for digital survival.

Comparative Observations
Notably, this study builds on the global literature by emphasizing the cumulative nature of conflict-driven educational barriers. While much of the existing research on online learning during crises focuses on health emergencies (e.g., COVID-19), this study adds unique value by examining educational resilience during ongoing armed conflict. The Gaza context reveals a sharper gradient of adversity, where students must balance survival with academic achievement, often without institutional or familial buffers. The insights generated here are consistent with but more intensified than those in previous literature focused on health-based school closures or refugee displacement scenarios.

Conclusion
This study reveals the harsh educational realities for university students in Gaza as they navigate electronic examinations under the weight of war-driven crises. Students confront not only technical disruptions and economic hardship but also profound psychological and academic pressures. Despite these adversities, they have shown a remarkable capacity to

adapt through digital preparedness and technological vigilance. These findings underscore the importance of fostering educational resilience in conflict zones and call for immediate, coordinated interventions from educational institutions, humanitarian organizations, and policymakers.

Recommendations

1. Invest in Digital Infrastructure: Establish community-based digital learning hubs equipped with backup power and internet access.
2. Integrate Mental Health Support: Embed psychosocial services into online education systems to help students cope with trauma.
3. Faculty and Student Training: Launch capacity-building programs focused on e-assessment strategies, platform navigation, and adaptive problem-solving.
4. Policy Advocacy: Develop national emergency education frameworks that include digital continuity plans during crises.
5. Public-Private Partnerships: Encourage collaboration with tech firms to subsidize devices, software, and data packages for students in need.

Limitations

While this study offers rich insights, it is constrained by several limitations. First, its reliance on self-reported data may introduce bias or inaccuracies in participants' responses. Second, the online data collection method may have excluded students without internet access, who arguably face the greatest challenges. Third, the cross-sectional design limits causal interpretation. Future research should adopt longitudinal or mixed-methods approaches to better capture the evolving nature of educational resilience in conflict zones.

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