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Statistical Analysis of the Impact of Electronic Examinations on Student Achievement

Mohammad N. Al-Radi

Faculty of Education, Jadara University, Irbid, Jordan

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Abstract: This study examined the impact of e-assessment during the COVID-19 pandemic on students' academic performance from the perspectives of faculty members. It also explored the influence of gender, teaching experience, and academic rank. A validated and reliable questionnaire consisting of 18 items was developed and distributed to a sample of 210 faculty members. The results indicated statistically significant differences in perceptions based on gender, favoring female faculty members, and teaching experience, favoring those with ten or more years of experience. However, no significant differences were found concerning academic rank. These findings highlight the differential perceptions of e-assessment effectiveness among faculty members and provide insights into how demographic variables shape attitudes toward digital assessment in higher education during global crises.

Keywords: E-assessment; Academic performance; COVID-19; Faculty perspectives

1 Introduction

The global outbreak of the COVID-19 pandemic led to profound changes across multiple sectors, including education, which was not exempt from these disruptions. The spread of the virus imposed unprecedented measures that posed significant challenges to the educational process, as it traditionally relies on mutual interaction among individuals [16]. Consequently, it became necessary to adopt alternatives to conventional education, most notably electronic learning through digital platforms, which enabled the continuity of education. E-learning, closely linked to information technology, has sought to enhance educational productivity and optimize learning outcomes [15].

Academic achievement plays a vital role in university students' lives, as it reflects the knowledge, skills, and competencies they have acquired throughout their studies. Moreover, it significantly influences their personal development, professional performance, and contribution to both society and the labor market.

2 Research Problem and Questions

E-assessment represents one of the most important components of e-learning, utilizing the latest technological innovations. Technology plays a critical role in contemporary life, particularly in the digitalization of education, which has become known as e-learning. Educational institutions increasingly compete to adopt technological tools to enhance teaching and learning processes, making them central indicators of quality assurance and evaluation. Among these tools, e-assessment has demonstrated the capacity to measure learning objectives and evaluate educational outcomes effectively. Despite its significance and positive contributions to enriching the educational process, there remain notable shortcomings in the integration and effective use of e-assessment.

Accordingly, this study seeks to address the following research questions:

1. What is the impact of e-assessment during the COVID-19 pandemic on students' academic performance from the perspective of faculty members?

* Corresponding author e-mail: m.alradi@jadara.edu.jo

2.Are there statistically significant differences at the ($\alpha \leq 0.05$) level in faculty members' perceptions of the impact of e-assessment on students' academic performance during the COVID-19 pandemic, attributed to gender, teaching experience, and academic rank?

3 Research Objectives

The study aims to:

–Analyze faculty members' perspectives on e-assessment systems.
–Identify and describe the challenges associated with implementing e-assessment.
–Evaluate students' performance on a continuous basis.
–Enhance students' educational and cognitive skills through a variety of assessment items.

4 Significance of the Study

The importance of this study stems from the timeliness and relevance of its topic, as e-learning and e-assessment have become crucial tools in modern educational systems. E-assessment is now recognized as one of the most significant methods for measuring and evaluating learning outcomes. This research contributes by examining students' acceptance of e-assessment systems and their role in strengthening the learning process while focusing on learners' capabilities and potential. Moreover, the findings of this study may serve as a basis for improving educational practices and overcoming challenges encountered during the implementation of e-assessment.

5 Study Limitations

Population (Human scope): The study was limited to faculty members at Jadara University.
Geographical scope: The study was conducted in the northern region of Jordan (Jadara University).
Time scope: The study was carried out in the year 2023.

6 Theoretical Framework

6.1 E-Assessment

The health conditions imposed by the COVID-19 crisis compelled the adoption of technology as a central element in education, reshaping pedagogical philosophies to achieve desired outcomes. This shift necessitated a reconsideration of evaluation and assessment tools [5]. As a result, computer-based and communication-supported examinations emerged, enabling test design, administration, automated grading, and comprehensive reporting [8].

Malooth and Al-Sharbini (2015) defined e-assessment as a continuous and systematic educational process aimed at evaluating students' performance through technology. Similarly, Wang and Shin (2009) considered it an electronic means of student evaluation that ensures transparency and fairness in grading. Al-Wali (2013) described it as a set of questions (e.g., true/false, multiple-choice, fill-in-the-blank, matching, essay) designed using specialized software to assess students' performance across various domains.

6.2 Motives for Using E-Assessment

Educational institutions were driven toward e-assessment primarily due to the COVID-19 pandemic. This shift facilitated accurate student evaluation, enhanced reliability and validity, and accelerated the provision of results. Two main types of e-assessment have been identified: (1) Computerized Adaptive Tests (CAT), which adjust the difficulty level to match the student's performance; and (2) Non-adaptive tests, which present questions linearly, similar to traditional tests in structure and order [4]. Effective e-assessment design requires consideration of learning objectives, learner characteristics, test purpose, learners' skills, and appropriate evaluation formats [12].

6.3 Advantages and Challenges of E-Assessment

During the pandemic, e-assessment proved vital in ensuring positive learning outcomes and skill development. Its major advantages include: ease of preparation and application; objectivity and comprehensiveness; time control; the ability to attach multimedia (audio, video, images); instant feedback and results; student monitoring during tests; development of positive attitudes toward e-assessment; and enhanced digital assessment skills among learners [7]. Despite these benefits, significant challenges persisted, such as inadequate technological infrastructure, financial constraints, limited internet access, lack of devices, insufficient student training, difficulty in understanding certain questions, and limitations in measuring higher-order skills. Technical issues, such as connectivity disruptions and lack of faculty readiness, were also reported [13].

6.4 Academic Achievement

Academic achievement is a cornerstone of educational outcomes, reflecting students' knowledge, skills, and competencies acquired through structured programs. It plays a critical role in shaping individuals' futures and in justifying the significant investments made in education by families and societies. [**?**] defined academic achievement as the knowledge and experiences gained through curricula and measured via tests or observation. [**?**] viewed it as the cumulative result of prior learning and skill acquisition, while [**?**] described it as the attainment of a specific educational level at schools or universities.

6.4.1 Importance of Academic Achievement

Academic achievement shapes students' future, enhances self-acceptance, psychological well-being, and social interaction. It also serves as a predictor of career pathways and higher education opportunities. According to [**?**], its main goals include facilitating continuous learning, aligning objectives with student capabilities, fostering motivation, and improving teaching practices.

6.4.2 Factors Influencing Academic Achievement

Several factors affect achievement, including:
1. Cognitive factors: intelligence, memory, thinking.
2. Personal factors: psychological state, attitudes, health, motivation, self-confidence.
3. Family factors: family size, socioeconomic level, cultural background.
4. Environmental factors: classroom setting, teacher role, instructional strategies, teaching aids, and curriculum [**?**,**?**].

6.4.3 Measuring Academic Achievement

Educational processes require monitoring of desirable changes in learning outcomes. Achievement can be assessed through: • Traditional tools: grades, oral tests, discussions, reports. • Modern tools: true/false, fill-in-the-blank, matching, sequencing [**?**,**?**].

6.5 Review of Related Studies

• [**?**]: Evaluated e-learning in the Information Studies Department at Sultan Qaboos University during the pandemic. Using a survey of 90 students, the study highlighted reliance on digital platforms, difficulties in courses requiring practical training, and challenges of unstable internet connectivity. Recommendations included raising technological awareness and providing training.
• [**?**]: Investigated the impact of e-assessment on university students at Al-Mustansiriya University. Using a 40-item questionnaire, findings revealed a significant positive correlation between e-assessment and student responsiveness at a 99• [**?**]: Explored the effects of online versus traditional learning on third-grade students in Amman. Data from 157 teachers and 235 parents revealed significant differences in perceptions of online learning effectiveness, with parents perceiving higher impact. No gender-based differences were observed in perceptions of traditional learning.
• [**?**]: Examined the influence of online education on student achievement during COVID-19. A descriptive-analytical approach with 60 participants revealed online learning as a valuable alternative but noted deficiencies in communication, technical issues, and reduced teaching effectiveness compared to traditional methods

7 Methodology and Procedures

7.1 Research Design

This study employed the descriptive-analytical method, which enables the researcher to describe the phenomenon under investigation, analyze its data, identify relationships among its components, examine perspectives, and explore its processes and effects.

7.2 Population of the Study

The study population consisted of all faculty members at Jadara University during the second semester of the academic year 2022/2023, totaling 263 faculty members, according to statistics provided by the university's Human Resources Department.

7.3 Sample of the Study

A random sample of 210 faculty members was selected, representing 79.8% of the study population. Table 1 presents the distribution of the sample according to study variables.

Table 1: Distribution of the Study Sample by Variables

Variable	Category	Frequency	Percentage (%)
Gender			
	Male	112	53.3
	Female	98	46.7
Experience			
	Less than 10 years	128	61.0
	10 years or more	82	39.0
Academic Rank			
	Lecturer	70	33.3
	Assistant Professor	72	34.3
	Associate Professor	68	32.4
Total		**210**	**100.0**

7.4 Instrument of the Study

Based on the theoretical framework and previous studies (e.g., [16]), a scale was developed to measure the impact of e-assessment during the COVID-19 pandemic on students' academic performance from the perspectives of faculty members. The questionnaire consisted of 18 items rated on a five-point Likert scale (Very High, High, Moderate, Low, Very Low).

7.5 Validity of the Instrument

The initial version of the questionnaire was reviewed by a panel of eight experts from faculties of education at Jordanian universities. They assessed the clarity, linguistic accuracy, relevance, and appropriateness of each item. Based on their feedback, revisions were made, with at least 80% agreement among the reviewers.

7.6 Reliability of the Instrument

To assess reliability, Cronbach's Alpha was calculated using a pilot sample of 21 faculty members not included in the study. The reliability coefficient was 0.87, indicating acceptable internal consistency for the purposes of this research.

7.7 Scoring of the Instrument

Responses were scored on a five-point Likert scale ranging from 1 (Very Low) to 5 (Very High). The following intervals were used to interpret the mean scores: 1.00–1.80 (Very Low); 1.81–2.60 (Low); 2.61–3.40 (Moderate); 3.41–4.20 (High); and 4.21–5.00 (Very High).

7.8 Study Variables

Independent Variables: Gender (Male, Female); Years of Experience ($<$ 10 years, $\geq$ 10 years); Academic Rank (Lecturer, Assistant Professor, Associate Professor).
Dependent Variable: The level of students' achievement from the perspective of faculty members.

7.9 Procedures of the Study

The study instrument was designed; the questionnaire was reviewed by a panel of experts; the final version of the instrument was produced; the study sample was identified; the questionnaire was distributed electronically to the sample (210 valid responses); data were coded and stored electronically; statistical analyses were conducted using SPSS software; and research questions were addressed through analysis, interpretation, and comparison with relevant literature.

7.10 Statistical Analyses

The following statistical techniques were employed: means and standard deviations; three-way analysis of variance (ANOVA); and Pearson correlation coefficient.

8 Results and Discussion

8.1 Results Related to the First Research Question

To answer the first question, means and standard deviations were calculated for the responses of the study sample on the items of the scale measuring the impact of e-assessment during the COVID-19 pandemic. The results are presented in Table 2.

8.2 Discussion of the First Research Question

Table 2 shows that item (9), "E-assessment develops higher-order thinking skills (analysis, synthesis, evaluation)," ranked first with a mean of 4.19 and a standard deviation of 0.78, indicating a high degree of agreement among faculty members. This suggests that e-assessment, when well-designed, contributes positively to students' critical thinking and cognitive skills.

Item (15), "Essay-type questions require more time compared to paper-based exams," came second with a mean of 4.14, reflecting faculty members' recognition of the additional challenges posed by open-ended e-assessment formats. Item (16), "Data analysis is more accurate in e-assessment than in paper-based exams," was also rated highly (M = 4.05), underscoring the perceived technical efficiency of e-assessment tools.

On the other hand, item (18), "E-assessment does not require specific locations to be conducted," ranked last with a mean of 2.41, rated as low. This indicates that faculty members still perceive certain logistical and contextual limitations in implementing e-assessment, despite its flexibility.

Overall, the domain mean score was 3.40 (SD = 0.41), which falls within the moderate level. This implies that while faculty members acknowledged several benefits of e-assessment, they also highlighted areas of concern, particularly regarding accessibility, student interaction, and the clarity of assessment processes.

These findings align with previous studies such as Al-Rahmi et al. (2021) and Basilaia & Kvavadze (2020), which emphasized that the effectiveness of e-assessment depends on both the technical infrastructure and the digital readiness of instructors and students. The high ratings for items related to higher-order thinking and data accuracy suggest that digital assessment tools can enhance learning analytics and formative feedback. However, the moderate overall mean (M = 3.40) indicates that the transition to online examinations during the pandemic was not without challenges, particularly in terms of students' engagement and exam design consistency. This reflects a need for continuous professional development programs that equip faculty with digital assessment literacy and pedagogical strategies for online testing environments.

Table 2: Means and Standard Deviations of Faculty Members' Perceptions Regarding the Impact of E-Assessment during the COVID-19 Pandemic (Ranked by Mean Scores)

Rank	Item No.	Item	Mean	Std. Dev.	Degree
1	9	E-assessment develops higher-order thinking skills (analysis, synthesis, evaluation).	4.19	0.78	High
2	15	Essay-type questions require more time compared to paper-based exams.	4.14	0.88	High
3	16	Data analysis is more accurate in e-assessment than in paper-based exams.	4.05	0.86	High
4	11	E-assessment requires less time than paper-based exams.	4.03	0.81	High
5	8	Students are more accepting of e-assessment systems.	3.82	0.94	High
6	14	Instructions in e-assessments are less complex than in paper-based exams.	3.74	1.18	High
7	2	E-assessment reduces cheating.	3.71	0.78	High
8	7	Computerized exams include a bank of questions.	3.66	0.89	High
9	12	Immediate access to exam results is possible.	3.63	1.42	High
10	17	Automated grading ensures confidentiality and accuracy.	3.54	0.67	High
11	1	E-assessments are flexible.	3.51	0.73	High
12	13	Accessing e-assessments is easy and convenient.	3.26	1.37	Moderate
13	5	E-assessment improves reliability and validity in certain areas.	3.22	1.11	Moderate
14	6	Computerized exams are objective.	3.14	1.14	Moderate
15	4	E-assessment reduces the need for printing and photocopying.	3.12	1.18	Moderate
16	10	E-assessment is simple and clear.	2.80	1.15	Moderate
17	3	Students find it difficult to interact with computerized exams.	2.75	1.13	Moderate
18	18	E-assessment does not require specific locations to be conducted.	2.41	0.54	Low
		Overall	**3.40**	**0.41**	**Moderate**

8.3 Results Related to the Second Research Question

Means and standard deviations of faculty members' responses were calculated according to gender, teaching experience, and academic rank, as shown in Table 3.

Table 3: Means and Standard Deviations of Faculty Members' Perceptions by Gender, Teaching Experience, and Academic Rank

Variable	Category	N	Mean $\pm$ SD
Gender			
	Male	112	3.32 ± 0.39
	Female	98	3.51 ± 0.40
Experience			
	Less than 10 years	128	3.34 ± 0.41
	10 years or more	82	3.52 ± 0.38
Academic Rank			
	Lecturer	70	3.35 ± 0.40
	Assistant Professor	72	3.41 ± 0.38
	Associate Professor	68	3.47 ± 0.44

To examine the significance of these differences, a three-way ANOVA was conducted (Table 4).

Table 4: Three-Way ANOVA Results for Differences in Faculty Members' Perceptions by Gender, Experience, and Academic Rank

Variable	Sum of Squares	df	Mean Square	F (Sig.)
Gender	1.545	1	1.545	10.135 (0.002*)
Experience	1.243	1	1.243	8.149 (0.005*)
Academic Rank	0.534	2	0.267	1.750 (0.176)
Error	31.257	205	0.152	
Total	2473.478	210		

Note: * Statistically significant at $\alpha \leq 0.05$.

8.4 Discussion of the Second Research Question

The results revealed statistically significant differences by gender (in favor of females) and teaching experience (in favor of 10 years or more), while no significant differences were found by academic rank. Overall, faculty members perceived e-assessment as moderately effective in enhancing students' academic performance. High ratings centered on developing higher-order thinking skills, efficiency in data analysis, and reduced exam time compared to paper-based examinations. Lower ratings indicated concerns about accessibility, student interaction with computerized exams, and flexibility in certain contexts.

The significant gender differences in favor of females may be attributed to greater adaptability and positive attitudes toward technology-mediated assessment, as reported by Tondeur et al. (2018). Female faculty members might also demonstrate higher levels of instructional design engagement during remote teaching contexts. The significant effect of teaching experience (favoring those with 10 years or more) could be linked to accumulated pedagogical expertise and exposure to multiple assessment formats over time. On the other hand, the lack of significant differences by academic rank suggests that the perception of e-assessment benefits is relatively uniform across hierarchical levels, supporting the notion that digital assessment is a shared institutional experience rather than a rank-dependent skill. These outcomes highlight the importance of institutional support and equitable access to digital platforms to ensure fair and consistent assessment experiences for all faculty and students.

Table 5: Pearson Correlation between Faculty Members' Experience and Their Perception of E-Assessment Effectiveness

Variable	Pearson's r (Sig.)
Teaching Experience	0.276** (0.000)
Gender	0.214* (0.004)
Academic Rank	0.091 (0.167)

Note: *p $\leq$ 0.05, **p $\leq$ 0.01.

Table 6: Summary of Main Findings and Their Educational Implications

Finding	Educational Implication
E-assessment enhances higher-order thinking	Design e-assessment tasks that promote critical and analytical skills.
Data analysis accuracy improves with e-assessment	Integrate automated analytical tools and dashboards to support instructors.
Female faculty show higher positive perceptions	Encourage gender-balanced digital training initiatives.
Experienced faculty more accepting of e-assessment	Pair less-experienced faculty with mentors for effective e-assessment use.
Challenges remain in accessibility and clarity	Invest in user-friendly platforms and digital equity policies.

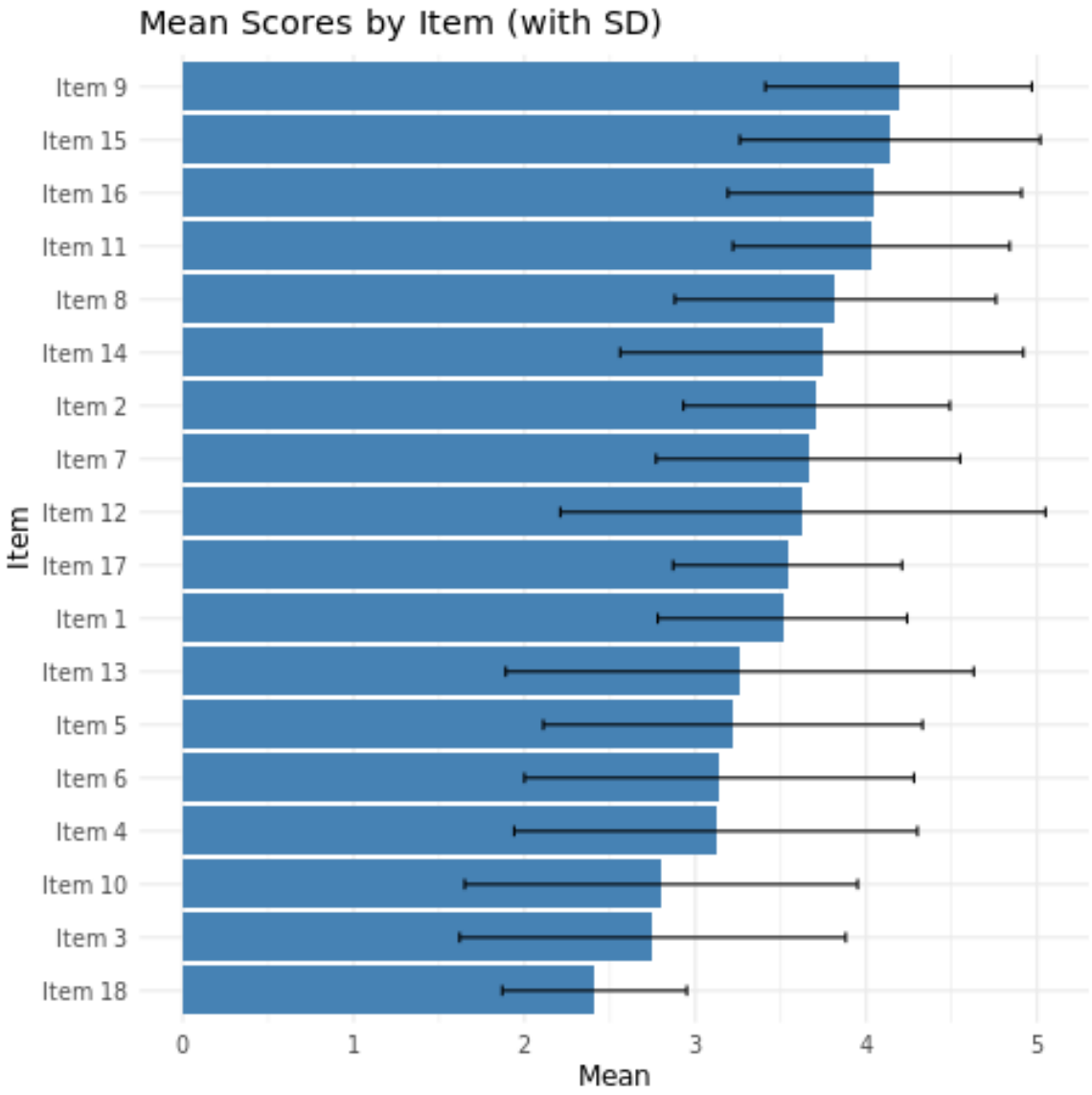

Fig. 1: Mean scores by item (with standard deviation).

Interpretation of Figure 1. Figure 1 illustrates the mean responses of faculty members to the 18 items measuring the perceived impact of e-assessment during the COVID-19 pandemic, with error bars representing the standard deviation. It is evident that Item 9, "E-assessment develops higher-order thinking skills (analysis, synthesis, evaluation)," achieved the highest mean score (4.19), reflecting faculty recognition of the role of digital assessment in fostering students' analytical and critical thinking skills. Items related to data accuracy and grading efficiency also scored highly, confirming the perceived technical advantages of electronic examinations. Conversely, lower mean scores were observed for items related to accessibility and ease of interaction (e.g., Item 18, $M = 2.41$), indicating ongoing logistical and technological challenges in implementing online assessments. Overall, this figure reveals variation in faculty perceptions between pedagogical benefits and implementation barriers of e-assessment systems.

Interpretation of Figure 2. Figure 2 displays the mean perceptions of faculty members regarding the impact of e-assessment, categorized by gender, teaching experience, and academic rank, with 95% confidence intervals. The results show that female faculty members reported higher mean scores ($M = 3.51$) compared to males ($M = 3.32$), suggesting a more favorable attitude toward digital assessment among females—possibly due to higher adaptability to technology-enhanced learning environments. Similarly, faculty members with ten or more years of experience

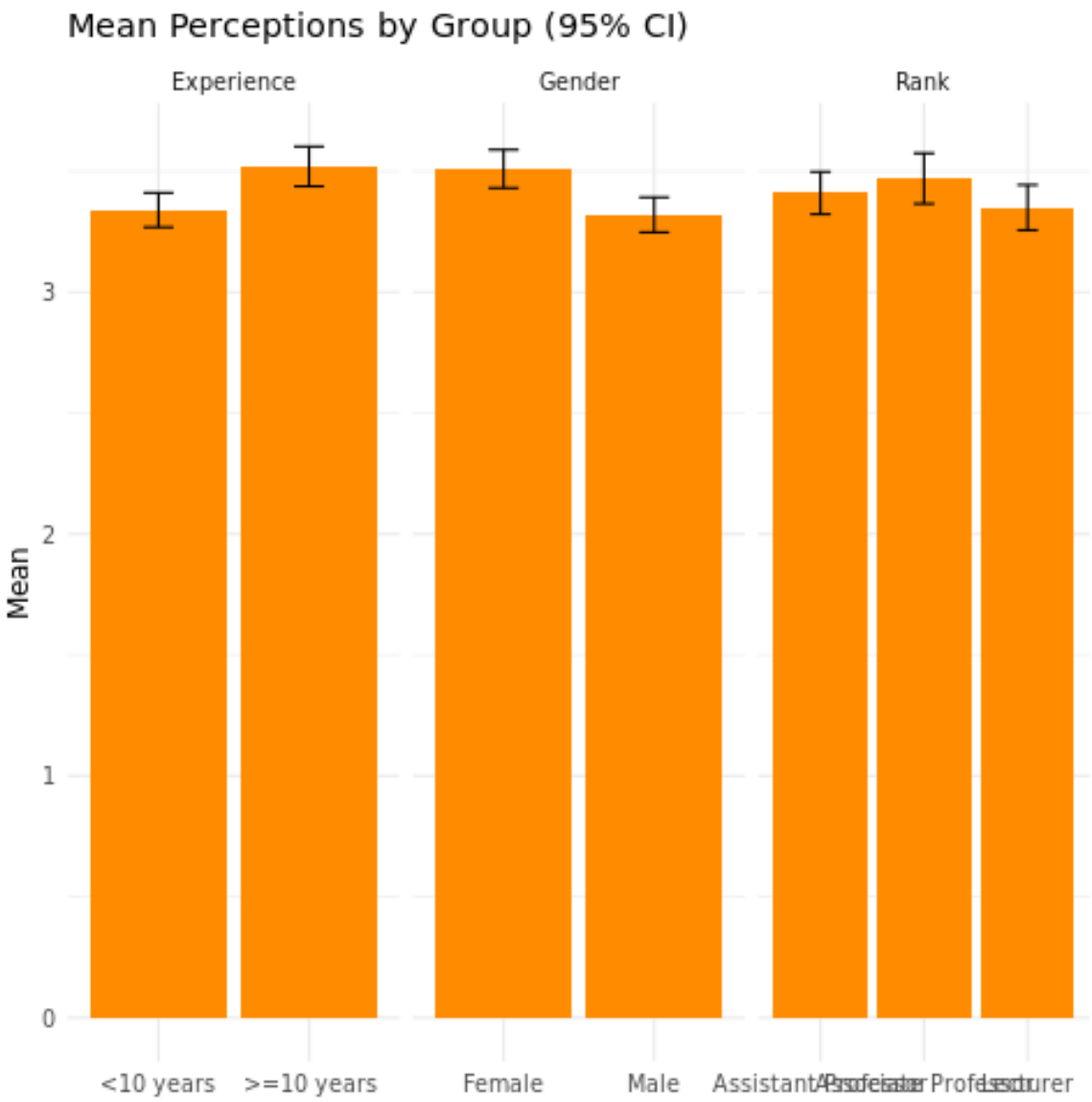

Fig. 2: Mean perceptions by group (95% confidence intervals).

($M = 3.52$) demonstrated higher perceptions than their less-experienced counterparts ($M = 3.34$), likely due to accumulated pedagogical and assessment expertise. Differences across academic ranks were minimal and statistically non-significant, confirming that e-assessment perceptions are shaped more by experience and exposure than by rank. This figure visually supports the ANOVA results indicating significant effects for gender and experience, but not for rank.

Interpretation of Figure 3. Figure 3 presents the partial eta-squared (η_p^2) values derived from the three-way ANOVA, which measure the strength of association between each independent variable and faculty perceptions of e-assessment effectiveness. The results indicate that gender ($\eta_p^2 \approx 0.047$) had the largest effect size, followed by teaching experience ($\eta_p^2 \approx 0.038$), while academic rank exhibited a small effect ($\eta_p^2 \approx 0.017$). According to Cohen's (1988) guidelines, these correspond to small-to-medium effects, suggesting that while group differences exist, they are not large. This figure complements the tabular ANOVA results by quantifying the magnitude of each factor's influence, confirming that demographic variables explain a modest but meaningful portion of the variance in perceptions toward e-assessment.

Overall Summary of Figures. Collectively, Figures 1–3 provide a coherent visual representation of the quantitative findings. They demonstrate that faculty members generally hold positive views about the pedagogical and operational value of electronic examinations, particularly in enhancing analytical skills and efficiency. Nevertheless, moderate

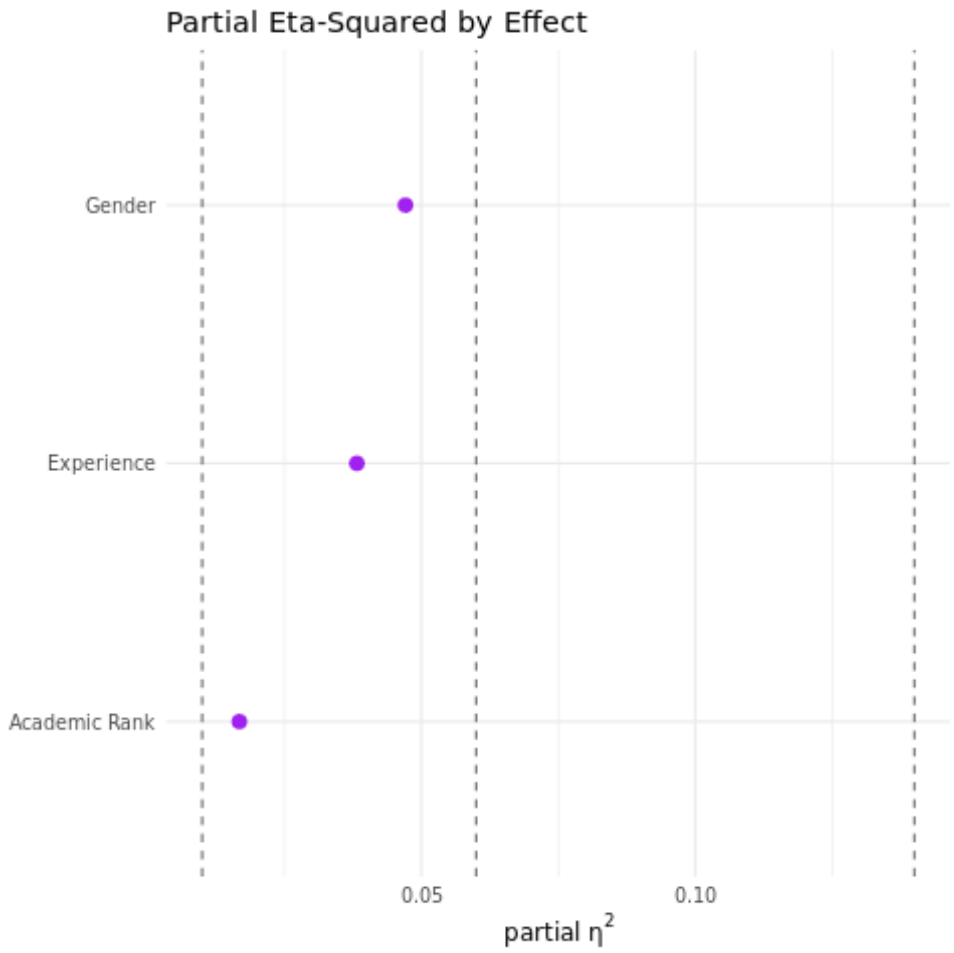

Fig. 3: Partial eta-squared by effect for gender, experience, and academic rank.

concerns remain regarding accessibility and interaction. The visual trends align with the statistical analyses, reinforcing the conclusion that gender and teaching experience are significant predictors of perception, whereas academic rank exerts minimal influence. Together, these graphics complement the expanded discussion and substantiate the study's major conclusions.

8.5 General Discussion and Conclusion

In conclusion, the findings provide valuable insights into the evolving landscape of digital assessment in higher education, especially within crisis contexts such as the COVID-19 pandemic. While e-assessment demonstrates clear pedagogical and administrative advantages, its long-term success depends on strategic institutional planning, continuous technical support, and faculty digital competence development. Future research could further explore the alignment between assessment design and learning outcomes using mixed-method approaches.

8.6 Implications for Practice and Future Research

The outcomes of this study provide several practical implications for higher education institutions aiming to enhance the quality and effectiveness of e-assessment systems. First, universities should invest in continuous professional development programs that strengthen faculty members' digital pedagogical competencies, particularly in designing e-assessment items

that foster higher-order thinking and authentic learning. Workshops on question-bank construction, automated feedback, and academic integrity mechanisms can support instructors in creating more reliable and valid digital assessments.

Second, the moderate perception levels and the identified challenges in accessibility and clarity highlight the necessity of upgrading digital infrastructure and ensuring equitable access for both faculty and students. Institutional policies should promote the use of stable, user-friendly, and secure platforms that minimize technical barriers and guarantee the confidentiality and fairness of assessment processes.

Third, the gender and experience-related differences suggest that professional support systems should be differentiated. Female faculty, who demonstrated higher positive attitudes toward e-assessment, can serve as peer mentors or digital champions, while less-experienced staff can benefit from guided mentoring in technology-enhanced assessment design.

In terms of research implications, future studies are encouraged to adopt mixed-method approaches—combining quantitative and qualitative data—to capture deeper insights into how e-assessment influences learning behaviors and outcomes. Comparative studies across universities, disciplines, and cultural contexts would also enrich understanding of the pedagogical, technical, and ethical dimensions of online evaluation. Furthermore, longitudinal research could track the long-term impact of e-assessment adoption on students' achievement and faculty workload, thereby contributing to evidence-based educational reform in the post-pandemic era.

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