RedFame

Studies in Media and Communication
Vol. 14, No. 1; March 2026
ISSN: 2325-8071 E-ISSN: 2325-808X
Published by Redfame Publishing
URL: http://smc.redfame.com

Digital Transformation and Gender Equity in Higher Education: Insights from Algeria

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Received: August 5, 2025 Accepted: September 22, 2025 Online Published: October 4, 2025

doi:10.11114/smc.v14i1.7871 URL: https://doi.org/10.11114/smc.v14i1.7871

Abstract

As digital transformation reshapes higher education globally, questions of equitable access and readiness have become increasingly urgent, particularly in regions marked by structural inequality. This study investigates gender-based differences in digital readiness among higher education stakeholders in Algeria, using data from a large-scale national survey. Eight dimensions of readiness were examined, including digital infrastructure, skills, e-learning engagement, and institutional support. Results reveal statistically significant gender differences in key domains, with male participants reporting higher levels of perceived readiness in infrastructure, skills, and overall preparedness. Other areas, such as administrative support and e-library services, showed no significant disparities. These findings highlight both persistent gaps and emerging areas of parity, calling for more targeted, gender-sensitive interventions in institutional planning. The study contributes to global digital equity literature by providing disaggregated, context-specific insights from North Africa and offers practical policy recommendations to support inclusive digital transformation in higher education.

Keywords: gender differences, digital readiness, higher education, Algeria, e-learning, digital transformation, MENA region

1. Introduction

The rapid digital transformation of higher education, accelerated by the COVID-19 pandemic, has made digital readiness a top priority for institutions worldwide. As teaching, learning, and administrative systems increasingly move online, the ability of students, faculty, and staff to access and effectively use digital tools has become crucial for educational success and fairness. However, as educational institutions shift towards digitally mediated environments, pressing concerns about equitable participation have emerged. This disparity is often worsened by varying levels of digital literacy across genders as well as among students, staff, and educators. Effective integration of digital tools in education requires that students, staff, and faculty possess essential digital literacy skills (Nikou & Aavakare, 2021; Eden et al., 2024). Without this, as Solehudin (2024) highlighted, the benefits of digital engagement may not reach all learners, especially those from marginalised backgrounds (Solehudin, 2024; Adeleye et al., 2024). Ultimately, closing digital divides remains crucial to promoting social equity and ensuring fair access to digital resources across different demographics (Reis-Andersson, 2022; Kono & Taylor, 2021). Digital readiness, defined as the ability to effectively engage with digital tools, platforms, and infrastructure, now underpins academic inclusion, performance, and institutional success.

Gender continues to be a persistent source of inequality within broader societal shifts. Worldwide and in specific regions, women encounter systemic barriers to engaging fully in digitally mediated education, stemming from issues like unequal access, confidence gaps, infrastructure deficits, and cultural norms. This situation is especially prominent in the Middle East and North Africa (MENA), where digital technology offers opportunities but also highlights existing disparities. Despite increased internet access, women's representation in digital participation remains low in the MENA region, and female students in higher education often face cultural and institutional challenges that limit their use of online learning tools and information technologies (Traidi, 2024; Peláez-Sánchez et al., 2023).

This study investigates gender-based disparities in digital readiness among higher education stakeholders in Algeria, a country that exemplifies many of the structural and cultural factors influencing technology adoption in the MENA region. Using a secondary analysis of a large national dataset, the research examines eight aspects of digital readiness, including access to infrastructure, digital skills, engagement with e-learning, and institutional support, with a particular focus on how gender affects perceptions of and interactions with digital systems.

In doing so, the study advances an ongoing debate on technological equity in the digital age. Instead of assuming equal digital access or abilities, it highlights the diverse ways in which readiness is perceived and experienced, and how these perceptions vary systematically by gender. The Algerian context offers a valuable perspective on how gender intersects with access to digital platforms, digital literacy, and institutional engagement within higher education. By emphasising perceptual and experiential differences, the study also explores broader questions of inclusion and perceived access to digital academic opportunities. Ultimately, the research aims to guide more inclusive policy development by pinpointing specific areas where digital inequalities are perceived to exist. The findings provide regionally tailored, gender-sensitive insights for scholars, practitioners, and policymakers committed to equitable digital transformation, not only in North Africa but also across similar postcolonial and resource-variable contexts.

1.1 Relevant Scholarship

Digital transformation in higher education has accelerated globally, especially during COVID-19, which emphasised e-learning and digital readiness for institutions and learners (Pitychoutis & Al Rawahi, 2024; Zine et al., 2023). Digital readiness refers to how prepared individuals and institutions are to adopt digital technologies for learning and administration (Traidi, 2024; Zine et al., 2023). In the Arab World and MENA, understanding digital readiness involves addressing the digital divide, especially the gender-based gap. MENA has one of the world's most significant gender digital divides, with women about 12% less likely to use the internet than men (Traidi, 2024). This disparity impacts women's access to education and opportunities. This review examines recent literature on gender differences in digital readiness in MENA higher education, focusing on digital infrastructure, skills, e-learning, institutional readiness, and gender equity. It also highlights gaps and discusses how the study will contribute to knowledge in this field.

1.1.1 Theoretical Perspectives on Digital Readiness and Gender

Digital readiness and gender issues in technology adoption are complex, influenced by socio-cultural and economic factors. Analysing perspectives on digital readiness and gender offers insights into bridging the gender digital divide and empowering women (Alkabaa, 2022).

Research indicates a declining trend of gender disparities in rural India, driven by empowerment initiatives that enhance digital literacy and access to education, healthcare, and economic opportunities (Sindakis & Showkat, 2024). However, global gender gaps continue, particularly in low- and middle-income countries, with women's digital adoption rates remaining lower (Breen et al., 2024; Kashyap et al., 2020).

Gender diversity in management positively influences digital integration in organisations (Živković et al., 2024; Antonio & Tuffley, 2014), and women's participation in digital platforms benefits families and communities, reinforcing empowerment. Gender-sensitive extension services also increase women's decision-making, notably in agriculture (Ragetlie et al., 2022). Yet, socio-cultural norms and patriarchal barriers hinder women's access to digital technology (Senshaw & Twinomurinzi, 2024; Pawluczuk et al., 2021). Public policies must adopt a gender perspective to bridge the digital divide, increase access, promote emancipation, and challenge gender roles (Arroyo, 2020).

Theories such as digital divide (van Dijk, 2017) and models like TAM (Davis, 1989) and UTAUT (Venkatesh et al., 2003) examine how gender affects technology access and use, emphasising perceptions of usefulness, ease, self-efficacy, and social influence (Spathopoulou & Pitychoutis, 2024). In the MENA region, socio-economic and cultural factors limit women's access to information and communication technology (ICT), affecting digital readiness beyond mere access.

1.1.2 Digital Infrastructure and Access in the MENA Region

The digital landscape in MENA faces unique challenges and opportunities, shaped by the availability of digital infrastructure. Although rapid technological progress exists, digital divides remain. Key issues include information systems; Pitychoutis (2023) emphasised their importance for higher education reform. The pandemic highlighted this need. Digital infrastructure drives economic growth; Bahrini and Qaffas (2019) found ICT adoption, particularly mobile and internet use, promotes regional expansion (Frikha & Gabsi, 2024). Government intervention is essential to foster ICT competition and innovation (Pick & Sarkar, 2015). Despite high levels of education, disparities in digital access persist due to historical and cultural factors, impacting economic and social outcomes (Muschert & Ragnedda, 2024). Public investment in infrastructure is vital, as digitalisation can help reduce poverty, although benefits remain uneven (Ghaly & Serag, 2023). The COVID-19 pandemic accelerated digital adoption, yet access gaps, especially gender gaps, create challenges. Studies reveal that men have higher internet usage rates than women in 9 of 13 Arab countries (Mohieldin & Ramadan, 2024), which is exacerbated by rural, low-income, and household factors (Traidi, 2024). External barriers often restrict women's digital access, affecting their digital readiness and participation.

1.1.3 Digital Skills and E-Learning Readiness

Digital readiness, including self-efficacy and learner autonomy, is vital for online academic success (Çoşkun et al., 2018; Uçar & Uğurhan, 2023). Students with strong digital skills perform better and manage their learning effectively (Kim et

al., 2019; Yavuzalp & Bahçivan, 2021). Navigating digital tools and technologies increases motivation and engagement (Korkmaz & Toraman, 2021). Confident digital skills and adaptable strategies support achievement, especially in remote learning (Huang, 2022; Händel et al., 2020). Enhancing digital competencies is essential across educational settings (Torun, 2019; Kallas & Pedaste, 2022). Access to technology alone is insufficient; digital skills are crucial for effective online learning.

Gender differences in digital skills are evident worldwide: men often report higher technical abilities, while women excel in information and communication tasks. In Arab/MENA regions, social barriers and stereotypes hinder women's digital participation, despite their high representation in STEM (Peláez-Sánchez et al., 2023; Traidi, 2024). Many female students develop strong digital skills but encounter systemic barriers in applying them professionally. E-learning readiness assessments reveal skill gaps among students and faculty, with knowledge and ability being critical for success (Zine et al., 2023). Lack of ICT skills, particularly among women, hampers participation. Some studies show women can perform equally or better in digital skills when provided with equal access and encouragement (Peláez-Sánchez et al., 2023). Efforts to incorporate gender-sensitive digital literacy into curricula are necessary to ensure all students develop comprehensive digital competencies.

1.1.4 Gender Disparities in E-Learning Adoption and Usage

The shift to e-learning in higher education has highlighted gender differences in technology use. Studies in MENA during COVID-19 show disparities and limited parity. In Jordan, Idris et al. (2023) found female students faced less family support and higher stress, risking the reinforcement of gender inequalities without intervention. In Saudi Arabia, Alkabaa (2022) observed men had more positive views of online tools, while women expressed concerns about interaction and balancing responsibilities, influenced by cultural factors. Conversely, Al-Qdah et al. (2025) found little gender difference among faculty members using e-learning tools, suggesting that with proper training, gender gaps can be narrowed. Gender disparities are more evident among students during crises and less among faculty. Institutions should support female students with targeted strategies, and further research is needed on long-term trends to address persistent gaps.

1.1.5 Institutional Readiness and Support Systems

Digital readiness is both individual and institutional, involving infrastructure, support, leadership, and policies influencing gender disparities. In MENA, institutions varied in digital preparedness during the pandemic, affecting students differently, especially women. Well-developed e-learning centres helped some, but gaps in infrastructure, resources, and expertise hindered others, often impacting women more due to social and mobility constraints (Arar & Masry-Herzallah, 2014). Leadership in digital initiatives and policies promoting gender inclusion, such as coding bootcamps and mentorships, have empowered women in STEM, indicating a cultural shift (Ameen & Willis, 2016). Mentorship and targeted programmes build confidence and skills, while strong institutional support reduces gender gaps by ensuring equal access and encouragement. Overall, institutional preparedness significantly shapes gender equity in digital education.

1.1.6 Cultural Norms and Gender Equity in Digital Education

A review of gender in Arab higher education must consider cultural norms and gender equity issues, as deep-rooted social factors influence digital readiness. Many MENA societies, despite their diversity, share patriarchal norms that hinder women's involvement with technology (Traidi, 2024).

Literature suggests that cultural change is vital, as technical solutions alone will not close the gender digital gap. Research shows that traditional gender roles restrict women's access to digital technology; for instance, daughters often face safety issues at internet cafés or labs, and family responsibilities limit their education, especially in technical fields (Wajcman, 2010). These deeply embedded norms discourage women from engaging with technology, reinforcing the 'gender digital divide' a social barrier where women may lack confidence due to socialisation linking technology to men. Although progress has been made, challenges still exist: fewer women pursue higher education in technical disciplines, and many leave the workforce, highlighting a 'leaky pipeline' driven by biases and insufficient support. Both international and local initiatives aim to embed gender perspectives into curricula, foster inclusive teaching environments, and empower women to take on leadership roles in technology.

A human rights approach is recommended, with policies encouraging gender-focused digital literacy and challenging stereotypes that ICT is mainly for men. Countries such as Egypt, Tunisia, and Saudi Arabia have developed national strategies in partnership with UN agencies. Gaps remain in understanding intra-gender differences influenced by socio-economic status, location, and discipline; future research should examine these intersections, such as how female engineering students' experiences differ from those of humanities students in smaller towns.

1.1.7 Research Gaps and Contributions of the Current Study

Reviewing recent literature reveals gaps that this study aims to fill. First, there is a lack of current, comprehensive

data on gender-based digital readiness in Arab higher education. Also, most studies are from the COVID-19 peak, providing limited regional insights. This study offers empirical data from one MENA institution, and it gives a current view of gender differences in the mid-2020s. Second, past research often examined isolated aspects like internet access or digital skills without a unified framework. This study considers infrastructure, skills, usage, and institutional factors together, exploring how they interact and affect outcomes, such as whether support reduces gender skill gaps or infrastructure benefits all equally. Third, few MENA studies test TAM or UTAUT models with gender. This research will apply these frameworks to see if they hold or need adaptation for cultural and gender differences. Overall, the study aims to provide updated data, an integrated analysis, and theoretical insights tailored to the MENA context, helping promote gender equity in digital readiness for higher education.

2. Method

2.1 Research Design

This study employed a **quantitative, cross-sectional design** based on secondary analysis of an open-access dataset originally created by Zine (2025). The aim of the analysis was to investigate gender-based differences in perceptions of digital readiness across higher education institutions in Algeria, focusing on eight dimensions: digital infrastructure, digital skills, e-learning, overall digital readiness, administrative support, change readiness, e-management, and e-library. This design was informed by established frameworks such as the TAM and UTAUT, which highlight perceived ease of use, perceived usefulness, facilitating conditions, and attitudes as influential in digital technology engagement, dimensions reflected in the dataset's constructs. Although the dataset is country-specific, it offers a valuable empirical foundation for exploring gendered patterns in digital engagement that could inform future regional studies.

2.2 Dataset and Instrumentation

The dataset used in this study was obtained from Mendeley Data (DOI: 10.17632/dt9xzrfs55.1) and was assembled from 1,012 respondents, including students, faculty, and administrative staff across Algerian higher education institutions. The measurement tool employed in the original data collection was developed through a systematic literature review and expert consultation, and it was validated using exploratory and confirmatory factor analysis, ensuring its psychometric robustness.

The instrument employed in this study consists of eight validated constructs. **Digital Infrastructure** assesses the availability, quality, and accessibility of institutional technological resources, including internet connectivity, computer labs, and IT support. **Digital Skills** measures respondents' self-perceived competence in using digital tools, software applications, and communication platforms essential for academic and administrative tasks.

E-learning assesses perceptions of the usability and effectiveness of online learning systems, such as learning management platforms and digital content delivery. **Digital Readiness** was computed as a composite index from Digital Infrastructure, Digital Skills, and E-learning, and is reported on an integer scale of 2–10 (higher values indicate greater readiness). The component subscales are reported on their original 1–5 Likert metrics. For readability, subscales are scored on a 1–5 scale, and the composite is scored on a 2–10 scale; the results are unaffected by linear rescaling.

Administration Support assesses how well institutional leadership promotes and enables digital initiatives through strategic guidance and resource allocation. **Change Readiness** evaluates individuals' willingness and confidence in adapting to technology-driven change within higher education contexts.

E-management evaluates the effectiveness and user-friendliness of digital administrative services, including registration systems and internal workflows. Lastly, **E-library** assesses access to and satisfaction with online academic resources such as databases, journals, and digital library support.

All items were measured on a **five-point Likert scale** (1 = Strongly disagree, 5 = Strongly agree), and the dataset was provided in a fully anonymised, coded format. Cronbach's alpha coefficients for the dimensions ranged from .76 to .92, indicating high internal reliability.

2.3 Participants

The dataset included responses from 1,012 individuals affiliated with higher education institutions in Algeria. Participants represented a range of key roles within these institutions: students (66.8%), academic staff (20.5%), and administrative personnel (12.7%), providing a comprehensive view of digital readiness across stakeholder groups. Although the sample comprised various stakeholder groups, gender was the primary variable of interest in this analysis; role-based differences are beyond the scope of this study. The sample included individuals from different institutions, such as both public universities and technical colleges.

The gender distribution was roughly balanced, with 52.57% male and 47.43% female respondents, enabling meaningful comparisons of gender-based perceptions. Participants ranged from early adulthood to late career stages, although

specific age brackets were not provided in the original dataset. Given the dataset's scope, the participant group reflects a diverse range of experiences with digital technologies in teaching, learning, and institutional operations.

2.4 Data Analysis

The data were analysed using IBM SPSS Statistics (Version 26). Descriptive statistics (means and standard deviations) were first calculated to summarise participants' responses across all dimensions. Inferential analysis was then performed using **one-way ANOVA** to assess statistically significant gender differences. Given that gender was the sole independent variable, one-way ANOVA was considered suitable for detecting mean differences across readiness dimensions. For all tests, the level of statistical significance was set at $\mathbf{p < .05}$.

No data imputation or transformation procedures were necessary, as the dataset was complete and ready for immediate analysis. Assumptions of normality and homogeneity of variance were checked before conducting ANOVA.

2.5 Ethical Considerations

Although the dataset was obtained from a publicly available repository and contained only anonymised data, ethical approval for the re-analysis was obtained from the Research Ethics Committee of the American University of the Middle East. The study adheres to ethical principles for secondary data use, including respect for data ownership, transparency, and academic integrity.

3. Results

The current research aimed to examine gender-based differences across various aspects of digital readiness in higher education institutions, specifically emphasising infrastructure, skills, and management elements vital for digital transformation. Detailed statistical analyses were carried out using ANOVA tests to detect significant differences between male and female respondents in each area investigated.

3.1 Digital Infrastructure

Analysis of Digital Infrastructure (Table 1) revealed statistically significant differences between male and female respondents ($F(1, 1010) = 4.72$, $p = .030$). Male respondents generally rated the existing digital infrastructure higher than their female counterparts. Specifically, males appeared to perceive technological infrastructure such as network availability, computer labs, and technical support as more adequate and sufficient compared to females.

Table 1. Digital Infrastructure

Gender	Mean Rating	Standard Deviation
Male	2.79	0.81
Female	2.68	0.79

This indicates a possible gender disparity in experiences or expectations regarding institutional provision of essential technological tools and infrastructure. The differences highlighted emphasise the need for higher education institutions to review infrastructural policies and practices to ensure fair experiences and expectations across genders.

3.2 Digital Skills

One of the most notable findings emerged within the Digital Skills dimension (Table 2), showing highly significant gender-based disparities ($F(1, 1010) = 14.18$, $p < .001$). Males reported significantly higher self-assessed competence in using digital tools, software applications, and digital communication compared to female respondents.

Table 2. Digital Skills

Gender	Mean Rating	Standard Deviation
Male	3.10	0.66
Female	2.93	0.77

This significant difference can be linked to several underlying factors, such as access to technology from a young age, societal norms shaping gender roles in technology participation, and variations in involvement in technology-related courses or extracurricular activities. As a result, these disparities highlight the urgent need for targeted digital literacy and skill development programmes specifically aimed at closing the existing skills gap. Educational policymakers and institutional stakeholders must acknowledge these gaps to design effective interventions that improve digital skills among female students, promote inclusivity, and optimise the use of digital resources throughout the student population.

3.3 E-learning

The E-learning dimension (Table 3) also revealed significant gender differences ($F(1, 1010) = 5.86$, $p = .016$). This dimension measured perceptions related to the availability, accessibility, and effectiveness of online learning resources and platforms provided by institutions. Females tended to report lower satisfaction levels and perceived poorer accessibility to digital learning resources compared to males.

Table 3. E-Learning

Gender	Mean Rating	Standard Deviation
Male	3.03	0.88
Female	2.89	0.87

This discrepancy may indicate broader challenges such as limited familiarity with digital platforms, potential biases in designing e-learning environments, or unequal access to appropriate devices and internet connections. These findings are especially relevant as reliance on digital platforms for remote or hybrid learning increases. Institutional strategies aiming to optimise e-learning environments should therefore include gender-based accessibility and usability assessments, ensuring online educational platforms are inclusive, user-friendly, and capable of effectively addressing the diverse needs of all students.

3.4 Digital Readiness

The overall Digital Readiness score (Table 4), which combines perceptions of infrastructure, digital skills, and institutional management, revealed a statistically significant gender difference ($F(1, 1010) = 4.86$, $p = .028$). This combined measure is a composite reported on a 2–10 scale, and indicates a systemic disparity where males, on average, viewed their institutions as more digitally prepared than females.

Table 4. Digital Readiness

Gender	Mean Rating	Standard Deviation
Male	6.51	1.45
Female	6.31	1.42

While the absolute difference in mean scores is relatively modest (0.20), the statistical significance suggests a consistent pattern in which male participants perceive their institutions as better equipped for digital transformation. This may reflect a cumulative effect of gender-based disparities identified in more specific domains such as digital skills and e-learning access. Institutions aiming for successful digital transformation must therefore adopt a holistic approach that tackles multiple interconnected factors at the same time. The integration of broad, gender-sensitive policies and initiatives can be crucial in ensuring consistent perceptions and experiences of digital readiness across various student groups.

3.5 Administration Support

Interestingly, no statistically significant gender differences appeared in perceptions of Administration Support ($F(1, 1010) = 2.52$, $p = .113$). As Table 5 shows, both genders reported similar levels of satisfaction with administrative encouragement and backing for digital initiatives, indicating that institutional administrative practices related to digital transformation are perceived consistently across genders.

Table 5. Administration Support

Gender	Mean Rating	Standard Deviation
Male	2.78	0.87
Female	2.69	0.87

This finding suggests that administrative practices might already include inclusive strategies or that support structures within administration could be less vulnerable to gender-based disparities than other sectors.

3.6 Change Readiness

The analysis of Change Readiness (Table 6) also did not find statistically significant gender differences ($F(1, 1010) = 3.23$, $p = .073$). Both male and female respondents showed similar levels of readiness and openness towards institutional changes driven by digital initiatives.

Table 6. Change Readiness

Gender	Mean Rating	Standard Deviation
Male	3.64	0.94
Female	3.53	0.96

These results are encouraging, indicating a broadly uniform acceptance and adaptability towards digital changes across gender lines. Such uniformity in readiness for change represents an essential facilitator for successful digital transformation initiatives, indicating that students across genders are generally receptive to digital advancement within institutional settings.

3.7 E-management

E-management (Table 7) similarly showed no significant gender-based differences ($F(1, 1010) = 1.97$, $p = .160$). E-management practices, including online administrative services, digital communication systems, and management processes, were similarly rated by both genders.

Table 7. E-Management

Gender	Mean Rating	Standard Deviation
Male	3.08	0.88
Female	3.00	0.86

These findings indicate effective gender-neutral delivery and perception of institutional management functions provided digitally. The consistency here underscores the adequacy of current e-management practices to meet the general needs of students regardless of gender, suggesting minimal need for gender-specific adjustments in this area.

3.8 E-library

Finally, E-library (Table 8) resources, such as digital databases, online access to scholarly materials, and digital library support services, showed no statistically significant gender disparities ($F(1, 1010) = 0.41$, $p = .523$). Both genders reported comparable satisfaction with digital library resources, indicating that institutional digital library provisions effectively meet diverse student needs regardless of gender.

Table 8. E-Library

Gender	Mean Rating	Standard Deviation
Male	2.93	1.06
Female	2.88	1.09

These findings demonstrate successful implementation and equitable usability of digital library services, further validating the effectiveness of current library management practices.

3.9 Summary of Findings

To give a clearer overview of the statistical results across all eight dimensions of digital readiness, Table 9 below summarises the mean scores by gender, significance levels, and whether each comparison indicated a statistically significant difference. This consolidated view highlights the areas where gender differences are most apparent and those where equality seems to have been reached, providing a foundation for the interpretive analysis in the following discussion section.

Table 9. Summary of Findings

Dimension	Male Mean	Female Mean	p-value	Significant?	Effect Size
Digital Infrastructure	2.79	2.68	.030	✓	Small
Digital Skills	3.10	2.93	<.001	✓✓	Small–Medium
E-learning	3.03	2.89	.016	✓	Small
Digital Readiness	6.51	6.31	.028	✓	Small
Admin Support	2.78	2.69	.113	✗	–
Change Readiness	3.64	3.53	.073	✗	–
E-management	3.08	3.00	.160	✗	–
E-library	2.93	2.88	.523	✗	–

3.10 Implications in Higher Education

The findings of this study have important implications for institutional policy and practice in higher education, especially in the era of digital transformation. Statistically significant gender differences in perceptions of digital infrastructure, digital skills, and e-learning highlight areas where targeted, equity-focused interventions are needed. These findings support arguments in the literature that equitable digital readiness is not just about access but also about perceived competence, confidence, and social empowerment (Traidi, 2024; Peláez-Sánchez et al., 2023). Furthermore, in line with the UTAUT framework, enabling conditions and perceived ease of use, both shown to differ by gender, are vital factors for increasing digital engagement across all student groups (Venkatesh et al., 2003).

In response, higher education institutions should implement multifaceted strategies that address both technical and socio-cultural dimensions of digital readiness. Targeted initiatives could include workshops specifically designed to enhance digital skills among female students, infrastructural improvements focusing on equitable access, and comprehensive evaluations of e-learning platforms to ensure they meet diverse accessibility standards. Furthermore, fostering an institutional culture that actively promotes gender inclusivity in digital engagement and technological proficiency will be instrumental in bridging the identified gaps.

Finally, although certain areas, such as administration support, change readiness, e-management, and e-library, displayed encouraging consistency across genders, focused efforts to address gaps in digital infrastructure, skills, and e-learning remain essential. These targeted strategies will be crucial in achieving comprehensive digital readiness and ensuring fair digital transformation within higher education institutions.

4. Discussion

This study investigated gender-based disparities in digital readiness among stakeholders in Algerian higher education, concentrating on eight interconnected dimensions. The findings confirm that despite significant institutional efforts towards digital transformation, important gender gaps remain in areas such as digital infrastructure, digital skills, and e-learning engagement. These results support previous studies indicating that digital equity cannot be assumed through universal provision alone but must be actively monitored and supported with gender-sensitive strategies (Traidi, 2024; Peláez-Sánchez et al., 2023).

The gender gap in perceived digital infrastructure reflects earlier findings that women in the MENA region face indirect structural barriers that limit their ability to fully utilise institutional resources (Mohieldin & Ramadan, 2024; Traidi, 2024). Although higher education institutions may offer equal physical access to digital spaces, external socio-cultural factors, such as limited mobility, shared device restrictions, or household responsibilities, can hinder female participation. Consequently, infrastructure may be equally available but not equally accessible or usable. This discrepancy highlights the importance of distinguishing between nominal access and functional access, especially in postcolonial, resource-variable settings like Algeria.

Digital skills emerged as the area with the most noticeable gender difference. Consistent with regional and global literature (Granić, 2022; Peláez-Sánchez et al., 2023), male respondents reported significantly higher self-perceived competence in using digital tools. While this does not necessarily reflect actual skill levels, it aligns with previous findings that female learners often internalise gendered messages about technological proficiency, leading to reduced confidence and engagement. As shown in studies from both MENA and global contexts, this "confidence gap" often results from earlier access disparities, limited role models, and persistent stereotypes linking technical expertise with masculinity (Antonio & Tuffley, 2014; Wajcman, 2010). The implication is that interventions to enhance digital skills among women must go beyond technical training and address psychological and cultural aspects of perceived competence.

Gender differences in e-learning engagement were also statistically significant, with women reporting lower satisfaction and perceived accessibility. This reflects the cumulative effect of challenges discussed in the literature: reduced autonomy at home, fewer supportive learning environments, and unequal access to personal devices (Idris et al., 2023; Alkabaa, 2022). While such findings were particularly evident during COVID-19, the current study shows that these challenges continue (and are even more significant) in the post-pandemic era. Furthermore, the results suggest that e-learning environments themselves may not be universally inclusive. Platform design, digital pedagogy, and instructional accessibility all warrant examination from a gender equity perspective. In contrast, no significant gender-based differences were found in perceptions of administrative support, change readiness, e-management, or e-library services. This consistency suggests that institutional systems focused on centralised delivery and support, particularly those with standardised access models, may already operate in more gender-inclusive ways. These findings align with the literature on institutional readiness, which argues that strong administrative backing, inclusive policies, and equal provision of digital resources can help neutralise gender gaps (Zine et al., 2023; Alzaabi et al., 2021). The observed parity in these areas also provides a promising foundation for developing more targeted interventions (e.g., in skills and infrastructure).

Importantly, these results support the theoretical assumptions of the TAM and the UTAUT. As TAM suggests, perceived usefulness and ease of use, both of which are likely influenced by digital skills and e-learning satisfaction, play central roles in technology adoption (Davis, 1989). UTAUT extends this by recognising gender as a key moderating factor in the relationship between enabling conditions and technology use (Venkatesh et al., 2003). The study's findings emphasise that gendered perceptions of digital competence and institutional readiness shape stakeholder engagement with digital tools, particularly in environments experiencing rapid transformation.

Overall, the results provide a multidimensional view of digital readiness, showing that some gender gaps remain while others seem to be narrowing. This complexity emphasises the need for nuanced, context-aware institutional strategies. For example, while improvements in infrastructure and access are crucial, they will not be effective unless supported by cultural shifts that validate women's presence in digital spaces. Similarly, achieving equity in digital skills development requires both inclusive curriculum design and prominent female leadership in digital education initiatives (Pawluczuk et al., 2021; Hurley, 2021).

In summary, this study contributes to the growing body of research on gender and digital transformation in higher education by offering empirical, disaggregated, and contextually grounded evidence from North Africa. While instances of parity indicate that inclusive institutional frameworks are possible, the persistent disparities in infrastructure, skills, and e-learning highlight the need for strategic, gender-sensitive measures. As higher education in the MENA region continues its digital expansion, equity must remain a central focus, not only as a moral obligation but also as a foundation for genuine digital resilience.

4.1 Limitations and Future Directions

Although this study offers valuable insights into gendered aspects of digital readiness in Algerian higher education, several limitations need to be recognised. First, employing a cross-sectional, self-reported survey design limits the ability to establish causality and may introduce response bias. Participants' perceptions might not always accurately reflect their actual digital skills or institutional capacities. Second, the sample is geographically restricted to Algeria; although the findings might relate to broader MENA patterns, they should not be generalised without caution. Third, gender was analysed using a binary framework, which overlooks the experiences of non-binary or gender-diverse individuals. Finally, while the instrument covered key aspects of digital readiness, it did not include variables such as cybersecurity awareness or mobile-first digital access, which could also impact perceptions.

Future research should adopt longitudinal designs, mixed methods, and broader gender models to deepen understanding of digital inclusion across diverse educational settings. Comparative studies covering multiple MENA countries could also reveal regional patterns and inform policy development.

5. **Conclusion and Recommendations**

5.1 Conclusion

This study reveals modest yet statistically significant gender differences in Digital Infrastructure, Digital Skills, and E-learning within Algerian higher education, with the overall Digital Readiness score following the same trend. Conversely, perceptions of Administration Support, Change Readiness, E-management, and E-library are generally similar across genders. Rather than implying a deficit, these results highlight specific, manageable obstacles, primarily reliable device access, stable connectivity, and confidence with essential tools for daily studies. Overcoming these challenges calls for targeted, context-sensitive interventions rather than broad reforms, focusing on enhancing the reliability and usability of digital resources for women.

Equity can lay a foundation for further growth. When institutional procedures, library services, and change processes are viewed similarly by women and men, targeted improvements to infrastructure and skills can strengthen existing advantages rather than create new ones. A pragmatic, student-centred approach is supported by evidence: expand reliable access; develop practical skills aligned with commonly used tools; and offer accessible, responsive support when needed. Co-designed usability reviews of the learning management system (LMS) and assessment workflows, along with increased availability of offline-first materials, are likely to make the experience easier for all students, especially those with bandwidth limitations.

Monitoring should align with the constructs used in this study to enable continuous rather than sporadic evaluation. A small set of gender-disaggregated indicators, such as verified device access, LMS log-ins, completion of basic digital-skills certificates, use of laboratory hours, and time-to-resolution for digital help tickets, can be reviewed each semester. Given the small effect sizes observed, significant short-term convergence is neither expected nor necessary; steady, cumulative progress remains the goal.

Faculty and administrative staff face their own role-specific challenges and opportunities during the digital transition, beyond just students. Faculty benefit from support in creating time-efficient instructional designs, inclusive assessment workflows within LMS, and micro-credentials for CPD focusing on practical classroom tools instead of abstract platforms. Administrative staff, who maintain the digital infrastructure, need streamlined, interoperable e-management systems and brief, task-focused training to reduce ticket backlogs and prevent errors in registrarial, HR, and finance processes. Emphasising role-specific enablement for these groups enhances the core capacities that ensure student-facing improvements are sustainable.

Finally, considering the acknowledged limitations, including secondary analysis, cross-sectional design, and potential imbalances in role distribution, cautious interpretation is advised and directions for future research are suggested. Replications using longitudinal and mixed-methods designs, reinforced by measurement-invariance checks, would help determine whether the observed gaps are stable, expanding, or contracting, depending on institutional contexts. By basing recommendations on the specific pattern of differences and highlighting locally driven implementation, this article seeks to provide a practical pathway for a fairer and more resilient digital transformation in Algerian higher education.

5.2 Recommendations

At universities and colleges, the primary focus should be on establishing reliable access as standard. Device-loan programmes and affordable procurement channels for students who need them, along with extended Wi-Fi coverage and dependable uptime in libraries, study corridors, and learning commons, tackle the most urgent infrastructure barriers. Safe, well-lit computer spaces with late opening hours are especially valuable for students balancing study with family or work commitments. Course materials should, where possible, be made offline-first (downloadable packets and

assessment options tolerant of intermittent connectivity), and departments should adopt procurement and classroom-technology practices that minimise bandwidth use.

A second priority is capacity. Short, credit-bearing or micro-credentialled digital skills modules embedded in first-year study skills or research methods courses can focus on the tools students actually use, such as LMS navigation, productivity suites, citation managers, and academic integrity platforms. For academic staff, the Centre for Teaching and Learning, in partnership with the e-learning/IT unit, should deliver one workload-protected micro-credentialled course each semester on LMS assessment workflows, inclusive online pedagogy, and basic learning analytics, supported by peer mentoring led by experienced women academics. These should be complemented by responsive, 'just-in-time' support through on-site and virtual desks that resolve issues quickly, reducing frustration that can lead to disengagement. Mentoring networks led by senior women students or teaching assistants can help normalise help-seeking, provide relatable examples, and foster confidence.

To prevent the platforms themselves from amplifying inequities, institutions should regularly review the usability of the LMS and e-assessment workflows, in collaboration with women students. Accessibility-by-design templates and plain-language navigation reduce unnecessary mental effort for all users, making participation more consistent. Improvements should be evaluated using the same indicators mentioned above so that course-level changes directly inform institution-level monitoring.

Progress is more sustainable when indicators, targets, and timelines are clearly defined. Administrative teams, including the Registrar's Office, HR, and IT support, should conduct 60–90-minute focused clinics timed with peak periods such as registration and exams. They should embed concise standard operating procedures directly into e-management screens and introduce simple key performance indicators, such as median ticket resolution time and rework rates, into semester reviews. Universities ought to adopt a streamlined set of gender-disaggregated metrics aligned with the eight discussed dimensions, reviewing them regularly, preferably at each semester's end. Examples include narrowing the device-access gap by a set percentage during the next academic year or increasing the percentage of women earning foundational digital skills certificates. LMS can support transparent discussions at programme and department levels without adding undue administrative burden.

At the sector level, public decision-makers and quality assurance bodies can support and enable institutional efforts within existing governance frameworks. Recognition of university-delivered micro-credentials in digital skills would underscore their value and encourage participation. Light-touch guidance on publishing gender-disaggregated indicators would assist institutions in consistent monitoring. Arrangements with connectivity providers that improve affordability for educational use, alongside collaborative development of high-quality open educational resources in Arabic and other languages used by institutions, can reduce entry barriers while respecting local priorities. These options are provided for consideration and adaptation within established policy frameworks.

Acknowledgments

Not Applicable.

Authors contributions

Conceptualisation: F.S. & K.M.P.; Methodology: F.S. & K.M.P.; Investigation: F.S., K.M.P., & J.D.; Resources: K.M.P., F.S., & JD; Writing - original draft preparation: K.M.P. and F.S.; Writing, review and editing: F.S., J.D., & K.M.P.; Visualisation: F.S. & K.M.P.; Supervision: F.S. and K.M.P. All authors have read and approved the final manuscript.

Funding

Not Applicable.

Competing interests

The authors declare no conflict of interest.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Redfame Publishing.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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