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ORIGINAL RESEARCH ARTICLE

Artificial Intelligence Awareness, Perception, and the Science Gap in the MENA Region: An Exploratory Mixed-Methods Study

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ب ةيفاشكتسا مادختسا جهنم طلتخملا

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GRAPHICAL ABSTRACT

Figure 1. Graphical abstract: Input–Process–Outcome overview of the study. The science gap between digital access and AI literacy is the central finding. N = 50; MENA region; mixed-methods desi

HIGHLIGHTS

HG1	Access does not equal literacy — 100% smartphone ownership contrasts with limited AI conceptual understanding.
HG2	Social media shapes AI understanding — 68% of respondents primarily associate AI with social media platforms.
HG3	Professional experience enhances AI literacy — $\chi^2(1, N = 50) = 4.34$, $p = .037$.
HG4	Public perceptions remain uncertain — 44% neutral, 40% negative on AI's quality-of-life impact.

HG5	Education must be a priority — targeted AI literacy initiatives are essential across the MENA region.

ABSTRACT

Artificial intelligence (AI) is rapidly transforming economies, institutions, and everyday life, becoming a central driver of digital transformation worldwide. In many developing contexts, high levels of digital access coexist with limited conceptual understanding of AI, indicating a persistent disconnect between technological exposure and actual digital literacy. This study investigates AI awareness, domain-specific perceptions, and conceptual understanding, while situating these findings within a broader comparative analysis of regional AI adoption patterns across the MENA region. A convergent mixed-methods design was employed, combining a structured survey administered to 50 participants (aged 18+) with a qualitative comparative content analysis of policy documents and media sources across the MENA region. Quantitative data were analyzed using descriptive statistics and chi-square tests, while qualitative data were subjected to thematic content analysis. Results reveal that despite near-universal smartphone ownership (100%) and internet connectivity (96%), AI awareness stood at only 78%, and 68% of respondents primarily associated AI with social media platforms. Three regional AI adoption pathways were identified: exposure-driven, crisis-driven, and state-led. A chi-square test confirmed that professional AI exposure significantly predicts AI literacy, $\chi^2(1, N = 50) = 4.34$, $p = .037$. The findings highlight a persistent science gap between digital connectivity and genuine AI literacy, underscoring the need for targeted educational and policy interventions to develop meaningful public understanding of AI across the MENA region.

Keywords: artificial intelligence; AI awareness; digital literacy; science gap; MENA region; mixed-methods; AI governance; technology acceptance

1. Introduction

The ubiquity of artificial intelligence (AI) in the modern digital ecosystem has made this technology an integral element that affects decision-making across economic, social and governance spheres. AI systems, from recommender engines in our media streaming and shopping applications, to automated Chatbots interacting on customer service forums, have shaped the experiences of billions worldwide on an almost daily basis. However, the public's understanding of how these AI-powered tools work, their strengths and limitations, and their application in society remains poorly studied and extremely varied, particularly in light of the heterogeneous institutional and socio-economic realities found in the MENA (Middle East and North Africa) region.

As digital connectivity is proliferating across the MENA region, the number of individuals engaging with AI-mediated platforms (i.e. Social media, e-commerce, and streaming content) has increased exponentially. Yet, to date, the relationship between a population's level of exposure to online information and their conceptual understanding of AI remains unknown. An understanding of how a population views

AI, that is, to what do they believe it is capable of, where do they identify their value, and what is their opinion of AI regulation, becomes of increasing interest to educators, politicians and researchers striving to ensure that societies are prepared to accommodate the accelerating infiltration of artificial intelligence into daily life.

1.1 Problem Statement

There exists a dangerous disjunction in the MENA region: digital life is widespread and deeply embedded, yet AI knowledge is extremely limited. Billions are passively exposed to AI on their news feeds and recommenders daily, but this immersion remains shallow and confined to the surface interfaces of consumer applications. They are unable to distinguish between AI as entertainment versus AI as infrastructure. Unfortunately, this lack of clear thinking on the implications of AI contributes to misguided policies, underprepared workforces, and a decline in democratic oversight on AI governance. However, the underlying mechanisms driving or limiting AI learning in varying MENA contexts remain under-studied.

1.2 Research Gap

Globally, awareness of AI is a cause for growing interest, but its levels vary greatly. In the MENA region in particular, there exists a lack of empirical research investigating the breadth of awareness and perception of AI and its governance in large segments of the populace. It should also be noted that little comparative research exists comparing and contrasting AI perceptions across countries of varying digital engagement, economic strength, or institutional quality. This study provides an exploratory examination of AI awareness, perceptions, and literacy among participants from the MENA region while situating the findings within a broader regional context.

1.3 Significance of the Study

This research will build upon prior research concerning AI awareness by presenting a comprehensive analysis of public perceptions, situated within a broad comparative study of AI deployment in the MENA region. The findings will inform three main stakeholder groups: first, policymakers who can align digital policy initiatives with needs in public literacy. Second, educators who can prepare students for an AI permeated society and society at large by teaching them about AI concepts across various curriculum disciplines. Third, researchers who gain a fuller understanding of how technological exposure, work experience, and institutional differences interplay to shape human understandings of AI in developing-country settings.

2. Literature Review

The rapid growth of artificial intelligence (AI) has accelerated digital transformation across sectors, leading to the widespread adoption of advanced technologies in both public and private domains. AI refers to those computer systems

or the computational process designed for performing activities that mimic those of the human mind – in other words - performing tasks that require cognition like thinking, learning, perceiving, and decision making skills that humans take in performing (Kaplan & Haenlein, 2019; Russell & Norvig, 2021). AI applications are now widely used across sectors such as banking, healthcare, media, logistics, and education. Despite this widespread adoption, public understanding of how these systems operate often remains limited (Russell & Norvig, 2021; Kaplan & Haenlein, 2019).

2.1 Digitalization and AI literacy

Digitalization means the progressive process of stages ranging from digitizing an information and processes where analogy data to digital, digitalising processes to process optimize and transforming all systemic structures to digital using digitally connected ecosystems to the best and to bring innovation as well. Digital transformation represents a phase for that of digitally enabled systems where AI literacy represents the necessary condition of digital capability, a skill and also knowledge of individuals that are related with the AI systems, beyond those are able to operate AI systems but are able to perceive AI concepts and limits and can actively engagement and reflect upon the utilization of AI and their societal effects Long & Magerko (2020); Kaplan & Haenlein, 2019. In the MENA region, countries with robust AI investment are, for instance, Gulf countries, are driving faster their digital transformation, whereas many others countries have slow implementation due to infrastructure barriers.

2.2 Theoretical Framework

Based on literature reviews, this study builds upon three theoretical lenses in exploring the gap between technology adoption (device ownership) and AI literacy. Digital divide theory is considered as a base framework with three different layers namely first-level digital divide (the access to digital devices and technology), second-level digital divide (difference in use patterns and levels), and third-level digital divide (unequal outcome using technology, or information have not access with to all the individuals) of the digital device have used as background of the work to define digital science divide by explaining the third divide by digital device and digital capability(access to devices and access to meaningful information that come with use and skills, respectively) is the most salient level in this study Long & Magerko, 2020. In addition, the theory of TAM (Technology acceptance Model) has adopted where user perceive value, the utility of a system that includes both perceived ease of use, performance as well as the perceived usefulness and attitude toward using that technology determine whether or not the technology will be accepted or not Davis, 1989). Also the framework for DT will explain how organizations and institutions promote the use of the DT by adopting new strategies and integrating new technology for new service and innovations, the application and utilization of AI is often considered a component part of DT.

Figure 2
Theoretical framework and conceptual mind map

Digital Divide Theory	Technology Acceptance	Digital Transformation
1st divide: access	Perceived usefulness	Digitization
2nd divide: skills/usage	Ease of use	Digitalization
3rd divide: outcomes	Consumer interface bias	Systemic transformation
Access ≠ competence	TAM / UTAUT lens	Institutional frameworks

Note. Theoretical foundations (Digital Divide Theory, Technology Acceptance, Digital Transformation Frameworks) converge on the central science gap construct.

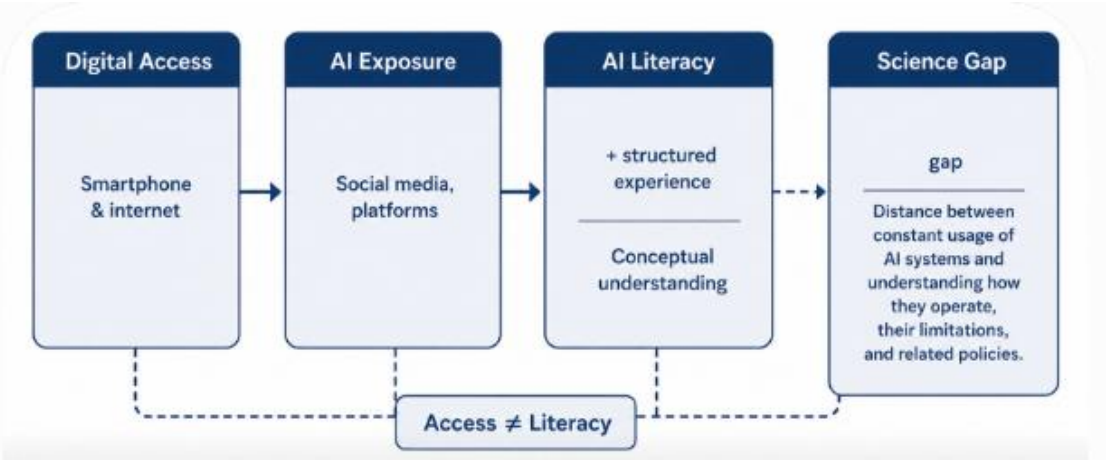
2.3 Empirical Background

Past literature has yielded conflicting results regarding adoption of and awareness to AI across different regional contexts. Within educational settings and organizations in higher education, there has been established associations between use of AI and enhanced decision-making process and efficiencies of business organizations when used in tandem with agile and institutional backing (Agarwal et al. 2010).

Furthermore, literature is beginning to illuminate that use of generative AI can have great impact on student innovative and entrepreneurial activity when offered with an understanding of the application of these technologies (Dwivedi et al., 2023). From regional point of view, we expect to see disparities in pattern of adoption of AI in MENA countries which can be attributed to disparities in their respective level of infrastructure in digital space, institutional capacity as well as allocation of national resources in digital arena. 2.4 Conceptual Model: Digital access and AI Literacy Our conceptual model highlights that access to digital access would not directly lead to relevant AI literacy. More than 83% of the population aged 16 to 64 have at least one internet connectivity (ITU, 2023).

This indicates that majority of people across all regions are exposed to AI applications through the social media platforms and also while at work places and higher education institutions. Exposure does not mean learning; it means interacting with the use of AI while conceptual understanding could differ. This concept can be explained through science gap which can be defined as distance between constant usage of the digitalized or AI system and understanding how such a system operates, its limitations, as well as policy on such A I.

Figure 3
Conceptual Model of Digital Access, AI Exposure, AI Literacy, and the Science Gap



Note. Conceptual model of digital access, AI exposure, AI literacy, and the science gap. Digital access enables AI exposure, but meaningful AI literacy requires structured professional or educational experience beyond passive platform use.

2.5 The AI Science Gap Framework

Research on AI literacy has shown that traditional understandings of the digital divide cannot completely shed light on the new challenges posed by artificially intelligent (AI) applications. These traditionally conceptualize the digital divide in terms of digital inequality related to technology access, digital skills, and tech related outcomes. As more individuals use AI-empowered applications every day, the rapid deployment of AI-empowered technology, to some people may mean that individuals more commonly interact with technology with the minimum to low understanding.

To describe this, we developed the AI Science Gap Framework **(AISGF).**

AISGF. conceptualizes the flow from digital access to a functional use of AI literacy by conceptualizing different levels through which individuals' progress toward meaningful AI literacy and what factors would assist or impede the path between them. It has five key stages: digital access; AI exposure; the AI Science Gap; Structured engagement; AI Literacy; and, Socially AI Ready, that connect the flow among one another. Between the AI exposure phase and AI Literacy phase lies the core construct of our framework: the AI Science Gap. It conceptualizes the process of how individuals move between high-frequency engagement with technology with AI applications and meaningful comprehension of artificial intelligence.

1. Digital Access- refers to availability of technology, or Internet connection, smartphone and smart device access required for being 'included' in the digital age (van deursen, 2020). The presence of such technologies or internet connection does not itself ensure learning or deeper understanding.

2. AI Exposure - the recurrent and routine interaction with artificially intelligently operated system, for instance, using social media feeds, automated search, recommendation platforms or assistant services. While exposing individuals to the presence and the functionality of such AI powered technologies, users' familiarity does not necessarily translate into knowledge about how the technology works behind.

3. The AI Science Gap - refers to situations in which exposure is not matched by structured education, learning, or institutional or professional exposure, where people engage extensively with the technology but lack an in-depth knowledge of the mechanisms and processes governing AI and may have misconceptions about AI. We provide empirical support in this study. In response to the current survey question on level of digitization/internet-usage our respondents scored high whereas we found evidence of the conceptualization and practice of Ai as only used in social media platforms.

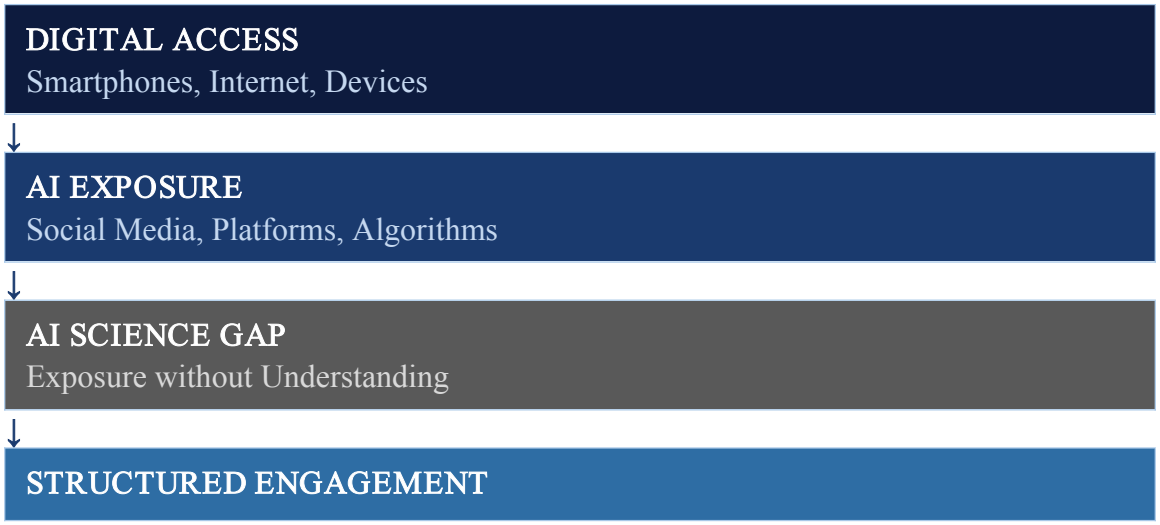
4. Structured Engagement - refers to education and workplace learning that supports the systematic acquire the deeper understanding and skills needed to develop real knowledge about AI (van Dijck, Poell, de Lange and Knuppe 2018). In this way, we may bridge the current AI Science Gap and move individuals from mere exposure to effective usage of artificial intelligence in an advanced technological society. Consistent with the logic outlined, our findings supported that exposure to AI through a work career was associated with the presence of higher literacy of Ai.

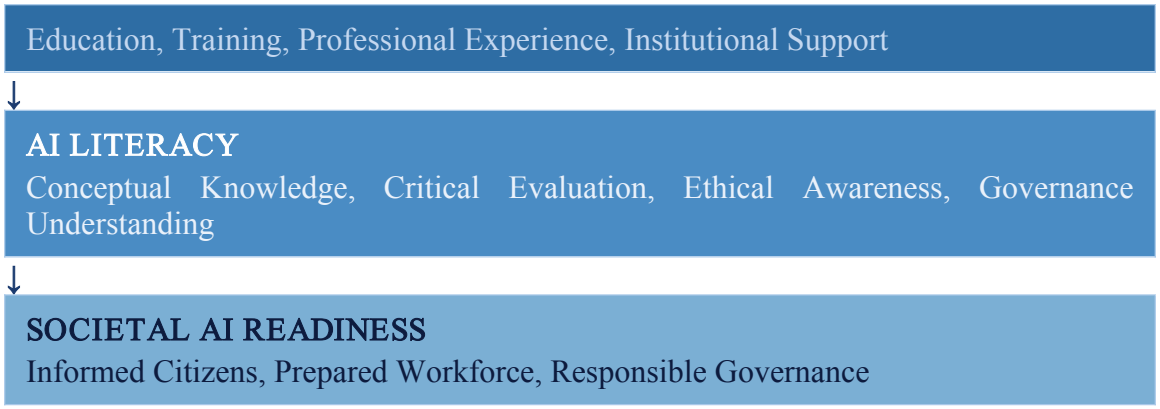
5. AI Literacy - comprises the competencies and understanding of how artificial intelligence systems work, their capabilities, and their implications at personal, societal, ethical, and policy levels (Long & Magerko, 2020). It represents a type of intelligence related to the cognitive ability to interact, participate, contribute, and challenge topics related to AI (Ng et al., 2021)

6. Socially AI Ready - represents individual's ability and institutional ability and governmental capacity in a given society to act decisively, responsibly and proactively to achieve benefits in a AI transformed economy (UNESCO, 2024). AI science gap framework: Toward an in-depth analysis of AI literacy.

According to this conceptual framing, we may suggest that not everyone with internet or tech access will automatically develop adequate AI Literacy but requires the support of a structured educational pathway to gain a clear understanding about AI technologies.

Figure 4
The AI Science Gap Framework (AISGF)





Note. The framework conceptualizes five interconnected stages linking digital access to societal AI readiness, with the AI Science Gap representing the discrepancy between AI exposure and genuine conceptual understanding.

Table 1
Proposition Matrix of the AI Science Gap Framework (AISGF)

Proposition	Statement	Empirical Support
P1	Digital access increases AI exposure.	100% smartphone ownership; 96% internet connectivity
P2	AI exposure alone does not guarantee AI literacy.	68% associate AI only with social media; 78% awareness rate
P3	The gap between exposure and understanding constitutes the AI Science Gap.	Core framework concept
P4	Structured engagement reduces the AI Science Gap.	Education, training, professional exposure bridge the gap
P5	Higher AI literacy increases societal AI readiness.	Framework assumption; requires further research
P6	Professional AI experience strengthens the transition from exposure to literacy.	$\chi^2(1, N = 50) = 4.34$, $p = .037$; Cramer's $V = 0.29$

Note. The proposition matrix summarizes the theoretical propositions underpinning the AI Science Gap Framework (AISGF). Each proposition is linked to its corresponding empirical evidence from the present study where available. Propositions without direct empirical support represent conceptual assumptions that warrant further investigation in future research.

Figure 5
Two-Pathway Model of the AI Science Gap Framework (AISGF)

Pathway 1: From Access To The Gap				
P1 Digital access *100% smartphone · 96% internet*	→	P2 AI exposure *68% → social media only*	→	P3 AI science gap *78% aware · limited conceptual depth*
↓ *Structured Engagement Closes The Gap*				
Pathway 2: From Gap To Literacy				
P6 Empirical evidence $\chi^2(1, N=50) = 4.34, p = .037 \cdot V = 0.29$	←	P5 AI literacy *Enables societal AI readiness*	←	P4 Structured engagement *Closes the science gap*

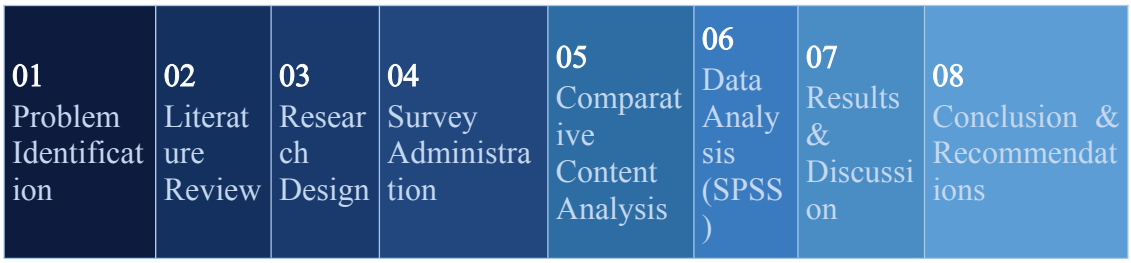
Note. Pathway 1 illustrates the progression from digital access to the AI Science Gap, whereas Pathway 2 shows how structured engagement promotes AI literacy and societal AI readiness.

3. Methodology

3.1 Research Design

This study employed a convergent mixed-methods design to examine public awareness, perceptions, and conceptual understanding of AI within the MENA region. The mixed-methods approach was selected to provide both quantitative evidence regarding levels of AI awareness and qualitative insights into broader regional patterns of AI adoption and governance. By integrating primary survey data with comparative content analysis of secondary sources, the study aimed to develop a more comprehensive understanding of the science gap than either method alone could provide.

Figure 6
Research Workflow of the Convergent Mixed-Methods Design



Note. Research methodology flowchart illustrating the eight-stage process from problem identification through conclusion. Stages 1–4 (dark navy) represent primary quantitative procedures; Stages 5–8 (lighter blue) represent qualitative and integrative phases.

3.2 Participants and Survey Instrument

The quantitative component consisted of a structured survey administered to 50 participants aged 18 years and older, recruited through online distribution channels on a voluntary basis. The survey collected demographic information (age, gender, smartphone ownership, internet access) alongside responses related to AI awareness, perceived domains of AI application, attitudes toward AI's impact on quality of life, and support for AI governance and expansion. The survey instrument was developed specifically for this exploratory study based on the literature on AI literacy, digital transformation, and technology acceptance. Prior to administration, the instrument was reviewed by specialists in education and digital technologies to evaluate item clarity, relevance, and alignment with the study objectives. Feedback from the review process informed minor revisions to wording and item organization. Given the exploratory nature of the study and the relatively small sample size, formal psychometric validation was beyond the scope of the present investigation and is recommended for future research.

3.3 Qualitative Comparative Content Analysis

To contextualize the survey findings within a broader regional framework, a qualitative comparative content analysis was conducted using policy documents, national AI strategy reports, and media publications related to AI across the MENA region. A purposive sample of documents was selected based on relevance to AI policy, implementation initiatives, governance frameworks, and public communication. Each source was reviewed systematically, and recurring themes were identified through inductive coding. The analysis identified three broad pathways of AI adoption across the region: exposure-driven adoption, crisis-driven adaptation, and state-led transformation.

3.4 Data Analysis

Quantitative data were analyzed using descriptive statistics (frequencies and percentages) to summarize participant characteristics and responses. A chi-square test of independence was conducted to examine the relationship between professional exposure to AI and AI literacy. Qualitative data were analyzed using thematic content analysis, with themes identified from policy and media sources compared with survey findings to explore areas of convergence and divergence. The integration of quantitative and qualitative findings followed a convergent merging approach, with results triangulated to identify points of corroboration and complementarity.

4. Results

4.1 Demographic Profile and Digital Baseline

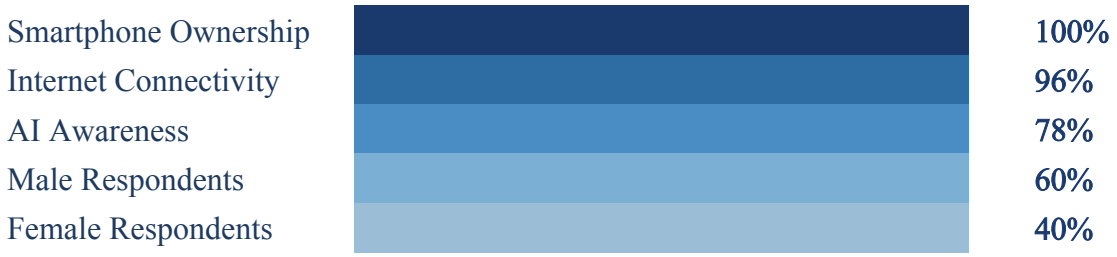
The study cohort reflects a highly connected digital environment. Despite universal smartphone ownership and near-total internet penetration, the reported AI awareness rate of 78%, coupled with the finding that 68% of respondents primarily associate AI with social media platforms, reveals a fundamental disconnect between digital connectivity and conceptual AI understanding. These findings confirm the presence of the science gap at the individual participant level and provide the empirical foundation for the study's broader regional analysis.

Table 2
Demographic Profile and Digital Baseline

Variable	Description
Sample Size (N)	50
Age Range	18+ years
Gender Distribution	60% Male / 40% Female
Smartphone Ownership	100%
Internet Connectivity	96%
AI Awareness Rate	78%

Note. Universal connectivity (100% smartphone, 96% internet) contrasts with 78% AI awareness, revealing a disconnect between digital presence and conceptual understanding.

Figure 7
Digital Baseline and Demographic Profile (N = 50)



Note. Near-universal connectivity (100% smartphone, 96% internet) contrasts with 78% AI awareness, revealing a disconnect between digital presence and conceptual understanding.

4.2 AI Domain Perceptions and Regional Patterns

In order to frame the survey results in the wider regional (MENA) context, a comparative content analysis of media reports and policy papers was conducted. Three models of AI uptake emerged through thematically analyzing those documents. (1) Exposure-driven adoption applies to areas of broad internet access and high levels of social media penetration, yet there is limited AI literacy and limited institutional AI infrastructure in place. (2) Crisis-driven adoption pertains to the spontaneous reactive

uptake of AI to address urgent economic or institutional needs and concerns without coordinated national frameworks. (3) State-led transformation covers areas that, through national AI strategies and policy investments, have moved toward more organized AI development policies, and, in some cases, AI literacy. The survey results reflect those trends; participants identified very high internet connectivity in their daily life, yet about two-thirds of the respondents exclusively linked the concept of AI with social media.

Figure 8
MENA AI Adoption Pathway Framework

Exposure-Driven	Crisis-Driven	State-Led
Driver: Consumer platforms Lebanon, Jordan, Morocco **AI Literacy: Low**	Driver: Economic necessity Egypt, Tunisia, Iraq **AI Literacy: Moderate**	Driver: National policy UAE, Saudi Arabia, Qatar **AI Literacy: Higher**

Note. Three conceptual models of AI adoption identified through comparative content analysis across the MENA region. Countries may reflect characteristics of more than one pathway simultaneously.

Table 3
Summary of Regional AI Adoption Models and Empirical Findings

Category	Finding / Metric	Interpretation
Model: Exposure-Driven	High access; low conceptual literacy	Driven by dominant consumer platforms
Model: Crisis-Driven	Adaptive, reactive adoption	Driven by economic / institutional necessity
Model: State-Led	Top-down institutional transformation	Driven by national policy / investment
AI Awareness	78%	High access does not ensure conceptual understanding
Primary Domain	68% link AI to social media	Public understanding shaped by consumer interfaces
Sentiment	44% neutral / 40% negative	Reflects significant uncertainty on AI impact
Governance	66% support AI expansion	Strong support but low policy engagement
Literacy Driver	Professional exposure (χ^2, $p = .037$)	Structured experience vital for AI literacy

Note. Summary of regional models, key findings, and interpretations from the study cohort ($N = 50$). Chi-square analysis confirmed a significant relationship between professional AI exposure and AI literacy.

Figure 9
Primary Domain of AI Association (N = 50)

Note. 68% of respondents link AI primarily to social media, revealing how consumer platform use dominates public AI understanding in the MENA region.

4.3 Attitudes, Governance, and Chi-Square Analysis

Attitudes toward AI's impact on quality of life remain largely neutral (44%) or negative (40%) among study participants, indicating widespread uncertainty about AI's societal role. Only 16% of respondents held positive views about AI's effect on their quality of life—a finding consistent with the broader pattern of shallow AI awareness driven by consumer platform exposure rather than conceptual understanding. While 66% of respondents support AI expansion in principle, governance preferences remain fragmented, pointing to a need for more structured and inclusive public engagement on AI policy.

Chi-square analysis revealed a statistically significant relationship between professional exposure to AI and AI literacy, $\chi^2(1, N = 50) = 4.34$, $p = .037$. This finding confirms that structured, work-based engagement with AI technologies is a meaningful driver of conceptual AI understanding—lending empirical support to the central thesis that passive consumer platform exposure is insufficient to develop meaningful AI literacy.

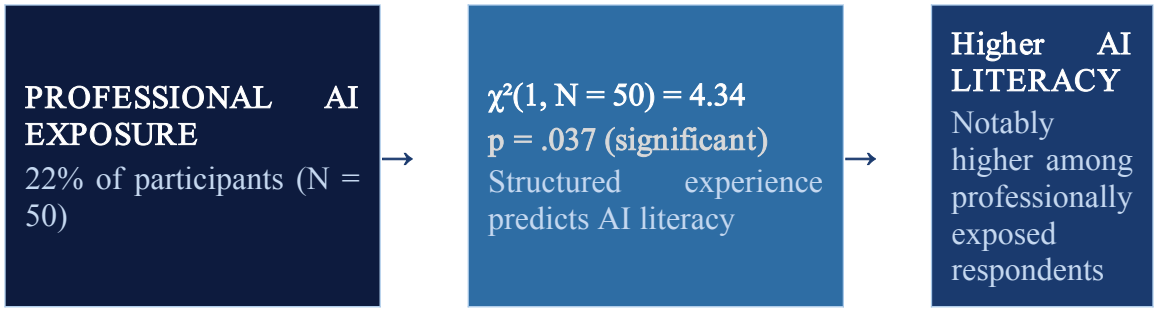
Figure 10
Attitudes toward AI Impact on Quality of Life (N = 50)

Note. Only 16% of respondents held positive views toward AI's impact on quality of life, while the majority were neutral (44%) or negative (40%), reflecting persistent uncertainty about AI's societal role.

Figure 11
Governance Preferences and Professional AI Exposure (N = 50)

Note. While 66% support AI expansion, governance engagement remains fragmented. Only 22% of participants report professional AI exposure — the critical driver of meaningful AI literacy.

Figure 12
Chi-Square Result: Professional AI Exposure and AI Literacy



Note. Chi-square analysis result: Professional AI exposure significantly predicts AI literacy [$\chi^2(1, N = 50) = 4.34$, $p = .037$]. Respondents with structured professional AI experience demonstrate notably higher AI literacy rates than those without such experience.

Table 4
Professional AI Exposure and AI Literacy: Chi-Square Breakdown

Group	n	High AI Literacy	Low AI Literacy
With professional AI exposure	11	**73%**	27%
Without professional AI exposure	39	44%	**56%**
$\chi^2(1, N = 50) = 4.34$, $p = .037$, Cramer's $V = 0.29$ (medium effect) · Fisher's exact $p = .041$			

Note. Participants with professional AI exposure demonstrated higher AI literacy than those without such exposure. Percentages are based on the study sample ($N = 50$).

5. Discussion

The results imply that the primary obstacle for AI adoption in MENA region does not reside with the accessibility to technology per se, but with the translation of the latter into effective and meaningful knowledge. Increasingly, AI-powered systems

are ubiquitous and integrated in our daily life experience, while most people, as consumers or citizens, interact with such systems without knowing the operational principles or influence in decision-making processes. In such a society, AI appears to be everywhere at the level of access, but not necessarily the one, that prepared its population to intelligently manage those same technologies on the personal, professional, and institutional level.

AI literacy does not develop automatically through access to technology or routine exposure to AI-enabled products and services. Although exposure to AI applications may increase familiarity, it does not necessarily lead to meaningful understanding. AI-enabled consumer products are designed to provide seamless user experiences, often concealing the underlying algorithms and decision-making processes. As a result, individuals may become frequent users of AI technologies without developing a deeper understanding of how those systems function.

The findings suggest that patterns of AI development across the MENA region follow three broad pathways: exposure-driven, crisis-driven, and state-led. These pathways are shaped by differences in national priorities, institutional capacity, and policy investment. Each reflects a different recipe of how AI will take roots. These findings indicate that AI literacy is influenced by broader social, educational, and institutional conditions. Investments in AI education, workforce development, and national AI strategies are therefore likely to play an important role in transforming technological adoption into sustainable AI competence, while passive exposure-driven societies are not prone to achieve the same.

One of the clearest findings of this study is the gap between functional interaction with AI technologies and genuine conceptual understanding of artificial intelligence that is, most individuals will perform well by interacting with AIs, although many people are unaware of the basic assumptions behind these tools, their limitations, or the ethically relevant questions they bring up, or the existing and emerging regulations that need addressing to govern their implementation. This contradicts the implicit assumption of digital natives that constant use automatically confers a sophisticated level of knowledge on those technologies.

The findings also highlight the importance of structured engagement in developing meaningful understanding of AI. Learning experiences, through educational programs, workplace activities, and other structured learning opportunity environments such as through institutional knowledge creation are required to foster conceptual clarity and, thus, convert a merely passive exposure into genuine learning opportunities and an understanding of relevant processes, limits, ethics, and existing and emerging laws related to AI.

Based on the previously discussed findings, the present work is proposing the conceptualization of an AI Science Gap framework that captures this phenomenon: technology exposure leads to access; exposure supported by structured engagement leads to understanding; understanding translates to expertise; and expertise combined with understanding leads to competence. Addressing the AI Science Gap requires policies and educational initiatives that support progression from exposure to understanding. Such efforts can help individuals move beyond passive interaction

with AI and develop the knowledge needed for informed participation in an AI-driven society.

These findings resonate with the broader digital divide literature, which has progressively shifted its focus from questions of physical access toward questions of skills, usage, and tangible outcomes (van Deursen & van Dijk, 2014). Just as earlier research demonstrated that owning a device or holding an internet connection does not automatically translate into the competencies needed to use it meaningfully, the present findings extend this logic to the domain of artificial intelligence: near-universal smartphone and internet access among participants did not correspond to a comparable level of conceptual understanding of AI. This continuity suggests that the AI Science Gap identified in this study is not an isolated phenomenon but a contemporary expression of a long-documented pattern in digital inequality research, in which each new wave of technology initially reproduces the same access-versus-competence tension observed in earlier stages of digitalization.

The comparative finding that AI development in the MENA region follows exposure-driven, crisis-driven, and state-led pathways is also consistent with recent comparative policy research on the Gulf states. Albous, Al-Jayyousi, and Stephens (2025) similarly observe that the Gulf Cooperation Council countries pursue rapid, top-down AI adoption underpinned by ambitious national strategies, while formal regulatory and educational mechanisms to build broad-based public AI literacy lag behind investment and infrastructure development. This pattern reinforces the present study's argument that state-led adoption, while effective at accelerating access and institutional capacity, does not by itself guarantee that citizens develop the conceptual understanding necessary to engage critically with AI-driven governance and services. Indeed, the prioritization of economic diversification and ecosystem-building over public AI education in many national strategies may help explain why high digital and institutional investment can coexist with the modest awareness levels reported by this study's participants.

The uncertainty and ambivalence captured in participants' attitudes toward AI's impact on quality of life, with neutral and negative responses far outweighing positive ones, also mirrors patterns documented in cross-national public opinion research. Pew Research Center surveys conducted across multiple countries have consistently found that publics tend to express more concern than excitement about the growing presence of AI in daily life, and that this concern tends to be highest among those with the least familiarity with how AI systems actually function (Pew Research Center, 2025). The present findings extend this pattern to the MENA context, suggesting that ambivalence toward AI is not a regionally specific phenomenon but part of a wider global tendency in which limited conceptual understanding correlates with heightened uncertainty or wariness. This lends further support to the study's central argument that public confidence in AI governance is unlikely to improve through exposure alone and instead depends on deliberate efforts to build genuine literacy.

Finally, the significant relationship identified between professional AI exposure and AI literacy aligns with a growing body of research on the structure and measurement of AI literacy itself. Systematic reviews of AI literacy instruments emphasize that meaningful AI literacy is multidimensional, encompassing not only

awareness of AI applications but also the capacity to evaluate, question, and ethically reason about AI systems, competencies that are rarely cultivated through casual platform use alone (Lintner, 2024). Structured environments such as workplaces and educational institutions appear better positioned to cultivate these dimensions because they typically combine repeated exposure with explicit instruction, feedback, and accountability, conditions that are largely absent from everyday interactions with consumer-facing AI applications such as social media feeds or recommendation engines. This distinction reinforces the present study's call for educational and workplace interventions that go beyond simply increasing AI exposure and instead deliberately cultivate the critical and evaluative competencies that define genuine AI literacy.

5.1 Theoretical Implications

This paper contributed to existing digital divide discourse by extending the analysis of Digital Divide Theory away from concerns regarding access, to that of understanding and competence. Similarly, the analysis also adds to the Technology Acceptance discourse, demonstrating that access to technology does not necessarily translates to adoption, use, and usage of the said technologies without sufficient underlying understanding and conceptual literacy. Finally, the paper contributed to digital transformation research by high lightening the human, and literacy-based aspects that under pin a successful and sustainable digital transformation.

5.2 Practical Implications

From a policy-making standpoint, AI literacy policy development must go further than encouraging digital access, and extend beyond promoting its usages. Policy makers and the wider government apparatus should facilitate access to education programs which promote AI literacy education, in all levels, across all subjects.

Organizational AI strategies and programs should not focus on AI tools alone, but should include components aiming to further educate staff members about AI tools, their limitations, and usage and thus promote deeper knowledge of this complex technology. Media, communications and other professional practitioners engaging with AI on an ongoing basis must also continue the process of public education about AI to clarify misconceptions, provide an accurate context on relevant issues and educate the public in-order to prevent hype driven and ill-intentioned usages and misuse of AIs, and to cultivate educated citizens aware of these powerful technology-driven social tools.

Table 5 summarizes the principal stakeholder groups, their strategic objectives, and recommended interventions for strengthening AI literacy across the MENA region.

Table 5
Strategic Framework for Artificial Intelligence Literacy Interventions

Stakeholder	Key Strategic Objective	Proposed Intervention

Stakeholder	Key Strategic Objective	Proposed Intervention
Policymakers	Governance and oversight	Develop national AI literacy frameworks; integrate AI into school curricula
Educators	Conceptual integration	Shift from operational to critical AI literacy; embed practical AI learning across disciplines
Media	Public awareness	Produce science-based, non-consumer AI explainers; partner with universities
Researchers	Empirical measurement	Develop standardised, cross-national metrics for AI literacy assessment

Note. Strategic framework for AI literacy interventions. Stakeholder objectives and proposed actions aim to bridge the identified science gap between digital access and conceptual understanding.

6. Limitations and Future Research

Several limitations should be considered when interpreting the findings. First, the relatively small sample size (N = 50) limits the extent to which the findings can be generalized to the wider MENA population. The study was intended as an exploratory investigation of AI awareness, perceptions, and literacy rather than a representative regional survey. Consequently, the findings should be interpreted as preliminary evidence that helps identify emerging patterns and inform the development of the AI Science Gap Framework. Future research involving larger and more diverse samples across multiple MENA countries is needed to examine the consistency of these patterns and provide a stronger basis for broader generalization.

Second, the use of digital recruitment methods may have favored technologically engaged, urban, and younger participants, potentially underrepresenting older, rural, or less connected populations. Third, the gender distribution (60% male, 40% female) may not fully capture gender-related differences in AI awareness and perception. Fourth, reliance on self-reported survey responses and secondary sources may have introduced social desirability and interpretation biases. Fifth, the survey instrument was developed specifically for this exploratory study and was not formally validated prior to data collection. Finally, the study focused on general public awareness rather than specialized technical expertise, leaving significant opportunities for future research in specific professional and sectoral contexts.

6.1 Future Research Directions

Future research should focus on several important areas to extend the findings of the present study:

- Large-scale quantitative studies to validate and replicate the observed trends across broader and more diverse populations within the MENA region.
- Cross-national comparative research examining how policy environments, educational systems, and cultural contexts influence AI literacy trajectories.

• Longitudinal studies investigating how educational interventions affect AI awareness, conceptual understanding, and AI literacy over time.
• Qualitative research using focus groups and in-depth interviews to explore how individuals develop and revise their perceptions of artificial intelligence.
• Intervention studies evaluating the effectiveness of AI literacy curricula, public awareness initiatives, and workplace training programs in reducing the AI Science Gap.

7. Conclusion

This study examined public awareness and perceptions of artificial intelligence in the MENA region and explored the factors that influence AI literacy in increasingly digital societies. The findings reveal a clear disconnect between access to technology and meaningful understanding of artificial intelligence. Although participants reported near-universal smartphone ownership and internet connectivity, AI awareness remained limited and was largely shaped by consumer-facing applications. Most respondents associated AI primarily with social media platforms, while attitudes toward AI's impact on quality of life were characterized by uncertainty rather than confidence. These findings suggest that frequent interaction with AI-enabled technologies does not necessarily translate into a deeper understanding of how such systems operate, their limitations, or their broader implications for society.

The findings also provide a clear answer to the central research question. AI awareness appears to be shaped less by access to technology itself and more by opportunities for structured learning and engagement. The significant relationship between professional AI exposure and AI literacy, $\chi^2(1, N = 50) = 4.34$, $p = .037$, indicates that individuals who encounter AI through professional or workplace settings develop a stronger understanding than those whose exposure is limited to everyday digital platforms. Taken together, the results show that widespread digital access has increased exposure to AI technologies, but much of this exposure remains concentrated within social media and consumer applications. Without structured educational or professional engagement, exposure alone is unlikely to produce meaningful AI literacy. This discrepancy between exposure and understanding represents the central phenomenon identified in this study.

A key contribution of this research is the development of the AI Science Gap Framework (AISGF). The framework explains how individuals progress from digital access and AI exposure to AI literacy and, ultimately, to broader societal readiness. The findings indicate that the primary challenge is no longer technological availability but the gap that emerges when exposure occurs without opportunities for deeper learning and critical engagement. In this respect, the framework extends existing discussions of digital inequality by highlighting the importance of knowledge, understanding, and informed participation in AI-driven societies. It also provides a conceptual explanation for why populations with high levels of connectivity may continue to demonstrate limited public understanding of artificial intelligence.

The comparative analysis further demonstrated that AI development across the MENA region follows different trajectories shaped by institutional capacity, national priorities, and policy investment. The exposure-driven, crisis-driven, and state-led

pathways identified in this study illustrate that AI literacy develops within broader educational, social, and policy environments rather than through technology use alone. Consequently, efforts to strengthen AI literacy must move beyond increasing access to digital technologies and focus on creating meaningful opportunities for learning, critical reflection, and informed engagement with AI systems.

Ultimately, the future challenge for the MENA region is not technological adoption but technological understanding. Societies may be increasingly connected, yet genuine readiness for an AI-driven future depends on citizens' ability to understand, evaluate, and engage critically with artificial intelligence and its societal implications. By identifying the AI Science Gap and proposing a framework to explain it, this study contributes a new perspective on AI literacy in the MENA region and offers a foundation for future research, educational initiatives, and policy development aimed at preparing individuals and institutions for a rapidly evolving technological landscape.

Box 1. Key Contributions of the AI Science Gap Framework (AISGF)

1.	**Novel theoretical contribution** — an original extension of digital divide discourse, moving beyond access to understanding and competence.
2.	**Empirical evidence** — statistically significant relationship between professional AI exposure and higher AI literacy ($\chi^2 = 4.34$, $p = .037$, Cramer's $V = 0.29$).
3.	**Regional applicability** — three identified adoption pathways (exposure-driven, crisis-driven, and state-led transformation) with direct policy relevance for MENA digital transformation strategies.
4.	**Practical utility** — provides a framework for designing educational interventions, policy initiatives, and institutional strategies to bridge the science gap.

Declarations

Conflict of Interest: The authors declare no conflict of interest.

Ethics Approval: This study was conducted in accordance with institutional ethical guidelines. All participants provided informed consent prior to completing the survey.

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In preparing this manuscript, the author used artificial intelligence (AI)-assisted writing tools (for the purposes of language editing, grammar checking, and structural clarity. All research design, data collection, analysis, interpretation, and intellectual content were conducted entirely by the author. The AI tools did not contribute to the conception, methodology, findings, or conclusions of this study. The author takes full responsibility for the integrity and accuracy of the work.

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