The Impact of Digital Transformation on Digital Marketing Interaction: The Mediating Role of Citizens' Awareness of AI in Algeria

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Received: 13/03/2026 *Accepted: 01/06/2026* *Published: 15/09/2026*

Abstract:

This study aims to analyze the impact of digital transformation on interaction with digital marketing, while also examining the mediating role of Algerian citizens' awareness of AI use. The study adopts structural equation modeling methodology using partial least squares (PLS-SEM). The study included a sample of 70 citizens, in addition to semi-structured interviews with 50 employees of public sector institutions. The results showed that Algerian citizens' awareness of AI and digital transformation explain 65.3% of the variance in digital marketing. The results also showed that digital transformation not only has a direct impact on digital marketing but also helps raise citizens' awareness of artificial intelligence technologies, resulting in increased interaction with digital marketing.

Keywords : Digital Transformation ; Digital Marketing ; Artificial Intelligence ; PLS-SEM

Jel Classification Codes: M31, O33, O32, D83, L86

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1. INTRODUCTION

The world has recently experienced numerous changes following the adoption of new technologies. Digital transformation has become a central focus for policymakers in most countries. These technologies have triggered a profound revolution in the fields of data, information, and digitization, imposing radical changes on societies. These changes involve a restructuring of organizational frameworks, workflows, and even individual behaviors. Consequently, governments are actively pursuing digital transformation by establishing the infrastructure necessary for digital practices and contemporary developments. They have urged the bodies responsible for implementation to accelerate the digital transformation process (Youcef, 2024) in order to improve the efficiency and quality of services provided to citizens.

Digital transformation is a broad concept encompassing diverse fields such as education, healthcare, commerce, and industry. However, the core aspects of its definition revolve around the concrete changes in working methods resulting from the integration of contemporary digital technologies. It also refers to the adaptation of specific systems or processes to incorporate digital technology or to convert data into a digital format easily processed by computers. Approaches for digital transformation have evolved based on the premise that the use of digital platforms in various activities and processes related to public services can lead to improvements in the quality, effectiveness, and efficiency of these services. In simple terms, digital transformation can be seen as a transition from the analog mode, characterized by a persistent reliance on paper and physical files, to the digital mode, marked by networks, new media, cloud computing, and other digital technologies, all institutions by parallel shifts in practices (Dörner, 2021).

An examination of the evolution of digital transformation reveals that it has gone through several distinct phases. Today, we are facing a new stage, based on generative artificial intelligence. Artificial intelligence is now seamlessly integrated into the fabric of daily life, and AI-powered data analytics have become a cornerstone for organizations across various sectors seeking to extract actionable insights from vast datasets (Chen, 2012) .The practical impacts of adopting artificial intelligence include enhanced innovation and adaptability. Its implementation requires human and technical capital. To mitigate the associated risks, adherence to regulatory requirements and data security protocols is imperative. Furthermore, organizations must adopt comprehensive training and development programs to prepare their workforce for an AI-driven work environment.

Digital marketing is one of the fields most affected by digital transformation and artificial intelligence, largely due to AI's ability to understand and respond to customer needs, which has revolutionized the way businesses interact with their audiences. Chatbots, personalized recommendations, and virtual assistants have become widespread, improving the overall customer experience (Loureiro, 2021). The adoption of artificial intelligence in digital marketing has consequently become a necessity rather than just an option, as it has proven effective in enabling simpler and more cost-effective solutions (Noha, 2023).

Algeria is among the countries seeking to strengthen and support the digital transition across all sectors including digital marketing by adopting modern technologies and digitization, with the

goal of competing internationally and attaining higher rankings in global indices (Hadjar & Bendjelloul, 2023) . However it faces opportunities and challenges, which cause these transformations to proceed cautiously and gradually, amidst limited interest from various media outlets. In this context, the level of public awareness and knowledge of artificial intelligence applications, as well as the readiness of individuals and society to adopt these technologies and assimilate these changes, are essential factors for the success of this process. In this research, we seek to answer the following question: **What is the impact of digital transformation on interaction with digital marketing in Algeria ?and what is the mediating role of citizens' awareness of artificial intelligence?**

2. Theoretical Framework of the Study:

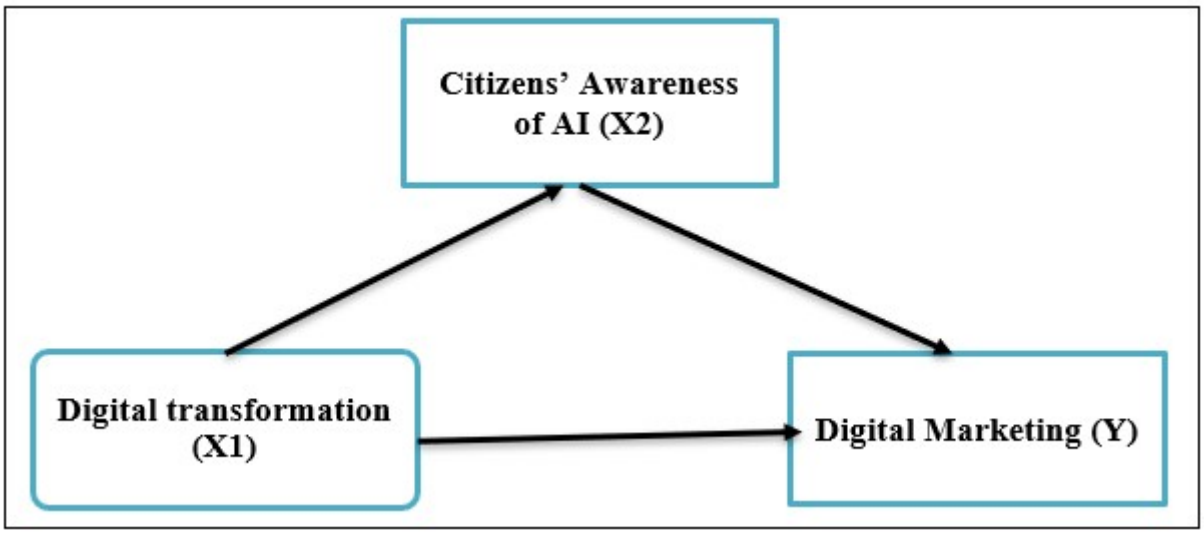
Numerous studies have confirmed that the adoption of artificial intelligence closely aligns with digital transformation and that these two phenomena have far-reaching implications, since they present both opportunities and challenges to governments worldwide. The challenges and opportunities faced by different countries vary according to their technological capabilities and their readiness for change. Among these studies, we can cite Rabbani's (2024) definition of Government Digital Transformation (GDT) as the process of integrating digital technologies into government operations .This integration aims to improve service delivery and strengthen interaction with citizens. Cunyi Yang (2024) discussed digital transformation as a solution that helps governments improve decision-making efficiency, optimize resource allocation, and enhance the quality of public services. Furthermore, it supports the development of digital infrastructure, strengthens technological innovation capabilities, and promotes digital governance.

A study by Szedmák (2025) also confirmed that digital transformation brings significant added value to citizens and helps reduce processing times for administrative transactions. It also enhances transparency, comparability, and efficiency in public administration. Oyekunle's study (2024) highlighted the success factors of digital transformation—namely, organizational leadership and culture, resource availability, data security, and workforce readiness. These factors contribute significantly to the digital transformation driven by artificial intelligence across various fields. Regarding AI adoption in organizations, Chen et al. (2012) demonstrated that organizational culture is an important factor in preparing an organization to adopt artificial intelligence. Cultures that encourage innovation and continuous learning are more receptive to the adoption of artificial intelligence, and employees' readiness to accept and adapt to change affects the successful integration of artificial intelligence into daily operations.

Manyika et al. (2017) argue that the availability of financial and technological resources is a determining factor in facilitating AI adoption, and that investment in equipment, software, and human capital is essential. In the context of digital marketing, a 2022 study by Ciocodeică et al. showed that artificial intelligence has transformed social networks such as Facebook, Instagram, Twitter, and others into tools that facilitate e-marketing campaigns. Artificial intelligence also contributes, through sentiment analysis, to obtain marketing data on customer satisfaction and understand their preferences. Huang and Rust (2022) asserted that the application of artificial intelligence has provided a significant competitive advantage to institutions that have adopted it. This advantage stems from their responsiveness to customers and their ability to identify customer needs and desires more effectively than competitors.

3. Research Model and Hypotheses:

Fig.1. Proposed research model



Source: Prepared by the researcher.

Through the adopted research model, we assume that the digital transformation of institutions has a direct impact on Algerian citizens' awareness of artificial intelligence adoption and their interaction with digital marketing. We also assume that citizens' awareness of artificial intelligence adoption has a direct impact on their interaction with digital marketing. Citizens' awareness of artificial intelligence adoption, in turn, mediates the relationship between digital transformation and digital marketing. The study's hypotheses can therefore be formulated as follows:

Hypothesis 1 (H1): The digital transformation of institutions influences Algerian citizens' awareness of artificial intelligence adoption.

Hypothesis 2 (H2): The digital transformation of institutions influences interaction with digital marketing.

Hypothesis 3 (H3): Algerian citizens' awareness of artificial intelligence adoption influences interaction with digital marketing.

Hypothesis 4 (H4): Algerian citizens' awareness of artificial intelligence adoption plays a mediating role in the relationship between the digital transformation of institutions and interaction with digital marketing.

4. Study Methodology:

This study is exploratory and explanatory, given that artificial intelligence is a relatively new phenomenon in the Algerian context. A comprehensive methodology was adopted using a mixed-methods approach combining quantitative and qualitative methods. Semi-structured interviews were conducted with 50 employees from public sector institutions, including banks, the telecommunications institution Algérie Télécom, and the companies Djezzy and Mobilis. These institutions were selected to assess their readiness to adopt artificial intelligence, as they are considered pioneers in the field of digital marketing. Analysis of these interviews allowed us

to uncover in-depth perspectives on how employees respond to the changes brought about by digital transformation and the prospects for its widespread adoption across different sectors and activities.

As for the quantitative analysis, it relied on the Partial Least Squares (PLS) modeling approach using SmartPLS. This approach focuses on analyzing the variance of variables and predicting relationships within the model rather than primarily emphasizing global model fit. Furthermore, PLS-SEM is considered an appropriate choice when research objectives are exploratory or predictive, or when theoretical knowledge of the relationships between variables is limited or unclear (Joseph F, Hult, Ringle, & Sarstedt, 2013). This makes it an appropriate choice for this study, as it aligns with the exploratory nature of our research and allows us to examine the relationship between the study variables, including Algerian citizens' awareness of the role of artificial intelligence adoption (as a mediating variable) is a new phenomenon in Algerian society that has not been sufficiently examined in previous studies. E-marketing (as a dependent variable) has been increasingly adopted by individuals and institutions, particularly following the rise in internet and social media usage in Algeria. Furthermore, digital transformation (as an independent variable) has been considered in response to the state's efforts to digitize sectors and accelerate the digitalization process. Digital transformation is not limited to infrastructure and internet use but extends to the use of advanced technologies such as artificial intelligence to improve services. This is why it is assumed that digital transformation plays an important role in raising awareness of the use of artificial intelligence in the field of digital marketing.

The sample size required when designing a PLS-SEM model is influenced by the maximum number of paths pointing to a single latent variable. The minimum required sample size can be determined according to the guidelines proposed by Marcoulides and Saunders, considering the maximum number of paths directed toward a latent variable, as defined in the context of the structural equation model (Marcoulides & Saunders, 2006) . The following table presents the required sample size as a function of the number of paths.

Table 1. Required Sample Size Based on the Number of Paths

Minimum Required Sample Size	**Maximum Number of Paths Pointing to a Latent Variable**
52	2
59	3
65	4
70	5
75	6

Source: Ken Kwong-Kay Wong, 2013, 5

The structural model comprises two constructs, and we used a larger sample size than the minimum required, we surveyed **70** users of digital services and online platforms in Algeria, including customers of banking and telecommunications institutions such as Algérie Télécom, Djezzy, and Mobilis. We asked them to assess their knowledge of using digital platforms for marketing and their perception of the impact of integrating artificial intelligence into digital and marketing services, as well as their understanding of the changes resulting from digital transformation. The questionnaire included three latent variables: the digital transformation of

businesses (X1), awareness of AI adoption (X2), and interaction with digital marketing (Y), measured using rating scale items. Thus, by combining quantitative and theoretical methods, we provided an integrated understanding of the impact of Algerian citizens' awareness of the role of AI adoption on digital marketing during the digital transformation process.

5. Study Results:

5.1 Analysis of Interview Results

Semi-structured interviews were conducted with 50 employees from public institutions (banks, Algérie Télécom, Djezzy, and Mobilis). This interview included six questions designed to assess the level of adoption of artificial intelligence and digital transformation in digital marketing within these public institutions. The results are as follows:

_Does your institution currently use artificial intelligence-based solutions in its internal processes (such as data analysis, automated responses, and predictive maintenance) or in the personalization of marketing offers?

The employees' responses to this question were distributed as follows: 42.9% answered "Yes, extensively," 14.3% answered "Yes, but to a limited extent," 28.6% answered "No, we do not rely on artificial intelligence," and the remaining 14.3% answered "I don't know." The findings indicate that these institutions may be in the process of adopting modern technologies or have already begun to integrate artificial intelligence, but not fully, as not all departments are sufficiently informed about the levels of digital transformation and artificial intelligence tools, which necessitates strengthening communication and awareness regarding digital transformation initiatives.

_In which areas is artificial intelligence used within the institution?

Employee responses to this question were distributed as follows: 42.9% " reported that there is no current use," 28.6% " indicated its use in customer service (chatbot, automated responses)," and 28.6% " stated that it is use in network management and automation."

The findings suggest that the largest proportion indicates no current implementation of AI. These may reflect either the absence of AI implementation or uneven adoption across departments, but not in a balanced way across all departments and without a clear strategy, or that its use is limited to certain areas, leaving most employees unaware of its adoption.

_How would you assess the readiness of your institution's digital infrastructure for the implementation of artificial intelligence?

Employee responses to this question were distributed as follows: 50% answered the infrastructure as " highly ready," 21.4% reported that they were unsure," 14.3% answered "partially ready," and 14.3% as "not ready."

These findings suggest that digital readiness is uneven across departments, even though the institution is already investing in infrastructure using advanced information systems (such as ERP or data management systems). However, some employees are not sufficiently aware of the institution's digital capabilities.

_To what extent has artificial intelligence contributed to improving the effectiveness of digital marketing campaigns?

The responses were distributed as follows: 50.2% of participants indicated that AI had “significantly” contributed to improving the effectiveness of digital marketing campaigns, while 28.4% stated that its role was “very limited,” and 21.4% indicated that it played no role in improving marketing campaigns.

This divergence of opinions reflects employees’ varying experiences with AI-supported marketing initiatives. These differences in responses may reflect disparities in the level of AI integration across departments, or a lack of consistency in the implementation of AI-based marketing strategies. Furthermore, the absence of clearly defined performance indicators to measure the impact of AI may contribute to the divergence in assessments of its effectiveness.

_ What are the main challenges related to implementing artificial intelligence within the institution?

Employee responses to this question were distributed as follows: 35.7% cited a "lack of skilled human resources," 21.4% mentioned "weak digital infrastructure," 28.6% referred to "the absence of a clear strategy," and 14.3% cited other reasons such as data privacy and security issues, as well as organizational sustainability. Digital transformation reflects the digital capabilities of an institution.

These findings suggest that the challenge facing institutions is not only technical and does not solely rely on the introduction of new methods and technological equipment, but also requires the implementation of a comprehensive and integrated strategy that includes human capital development, infrastructure enhancement, and establishing legal frameworks to guarantee data security.

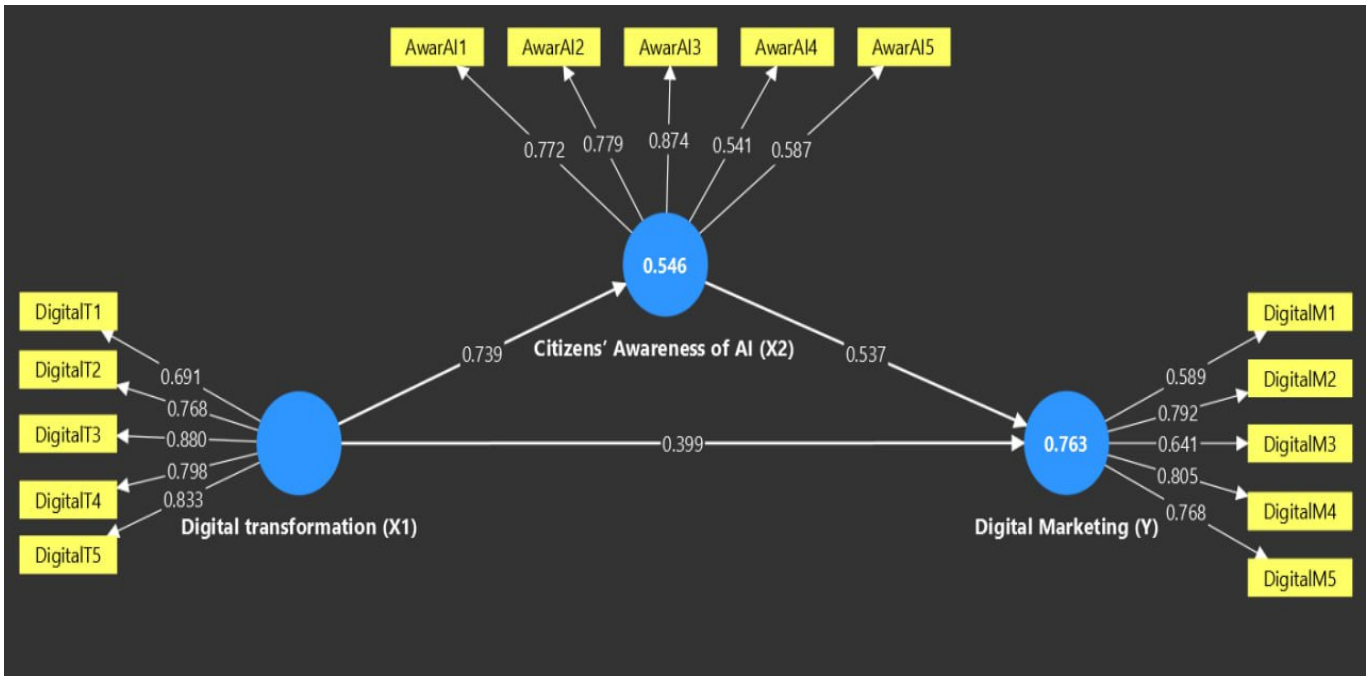
_How do you assess the knowledge of Algerian customers regarding artificial intelligence technologies in your services?

Employee responses to this question were distributed as follows: 16.66% indicated that customers appreciate intelligent services and request more of them, 66.66% indicated that a limited segment interacts with these services, and 16.67% stated that most customers prefer human interaction. This suggests that citizens' digital awareness is still in its early stages, requiring efforts from institutions to promote a culture of transition towards modern technologies.

5.2 Analysis of Questionnaire Results

The following figure presents the PLS-SEM structural model and the relationship between the latent variables, interaction with digital marketing (Y), is modeled as the dependent variable and is predicted by the digital transformation of institutions (x1) and awareness of artificial intelligence (x2). Each of these variables was measured using five indicators. The figure also presents the explained variance (R^2) and the path coefficients, which indicate the strength of influence of each variable.

Fig.1. Structural model of the study



Source: Prepared by the researcher.

5.2.1 Measurement Model Assessment:

The measurement model in this study, as illustrated in the figure above, is specified as a reflective measurement model. To evaluate its quality, were evaluated indicator reliability, internal consistency reliability, convergent validity, and discriminant validity (Kwong & Wong, 2013).

Table 2. Results Summary for Reflective Outer Models

Latent Variable	Indicators	Loadings	VIF	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
Digital transformation (X1)	DigitalT1	0.691	1.204	0.758	0.838	0.513
	DigitalT2	0.768	2.010			
	DigitalT3	0.880	2.528			
	DigitalT4	0.798	1.322			
	DigitalT5	0.833	1.384			
Citizens' Awareness of AI (X2)	AwarAI1	0.772	1.552	0.707	0.809	0.503
	AwarAI2	0.779	1.697			
	AwarAI3	0.874	1.204			
	AwarAI4	0.541	1.518			
	AwarAI5	0.587	1.341			
Digital Marketing (Y)	DigitalM1	0.589	1.229	0.717	0.816	0.501
	DigitalM2	0.792	1.391			
	DigitalM3	0.641	1.482			
	DigitalM4	0.805	1.489			
	DigitalM5	0.768	1.202			

Source: Prepared by the researcher.

_Indicator Reliability:

Indicator reliability is assessed by squaring the outer loading of each indicator. An outer loading value of 0.70 or higher is generally considered acceptable. In the case of exploratory research, it can be equal to or greater than 0.40 (Hulland, 1999) . In this study, the results summarized in Table 2 show that most indicators have loadings above 0.70. A few indicators range between 0.54 and 0.70, which confirms that the measurement models have a satisfactory indicator reliability.

_Internal Consistency Reliability:

To measure the reliability of internal consistency, we use Cronbach's alpha coefficient. Table 2 shows that the Cronbach's alpha values for all latent variables (digital transformation, awareness of artificial intelligence, and e-marketing) indicate satisfactory levels of internal consistency, with values exceeding the minimum acceptable threshold of 0.70, thus demonstrating good internal consistency for all indicators.

_Convergent Validity:

To measure convergent validity, we rely on the Average Variance Extracted (AVE), which must be equal to or greater than 0.5 (Bagozzi, 1988)The results show that the AVE value for the variables of digital transformation and artificial intelligence awareness exceeded the acceptable threshold of 0.50, indicating that the convergent validity of these two variables is established. The AVE values for the digital marketing variable were very close to 0.50 but can be accepted due to the high value of Composite Reliability (CR). We can therefore conclude that the model exhibits an acceptable level of stability and convergent validity.

_Discriminant Validity

According to the Fornell-Larcker criterion, the square root value of the Average Variance Extracted (AVE) for each variable must be greater than the correlation coefficients between that latent variable and the other latent variables (Fornell & Larcker, 1981). From the results of Table 3, we observe that the square root of (AVE) for digital transformation, AI awareness, and digital marketing is greater than the correlation coefficients with the other variables, where 0.716 is greater than the correlation coefficients 0.613 and 0.597, and the value of 0.708 is greater than 0.609 in the second column of the table. This indicates that discriminant validity is established.

Table 3. Discriminant Validity Results

	Digital transformation	**AI awareness**	**Digital marketing**
Digital transformation	0.716		
AI awareness	0.613	0.708	
Digital marketing	0.597	0.609	0.706

Source: Prepared by the researcher

5.2.2 Structural Model Assessment:

_Coefficient of Determination (R^2) :

The structural model results show that R^2 value for the endogenous construct, digital marketing, is estimated at 0.653. This means that both the Algerian citizen's awareness of

artificial intelligence and digital transformation explain 65.3% of the variance in digital marketing. This represents a substantial level of explanatory power.

_Path Coefficients:

The results indicate digital transformation has a statistically significant effect on digital marketing (β = 0.381). It also has positive relationship and effect on awareness of artificial intelligence (β = 0.599), moreover awareness of AI positively and significantly influences digital marketing (β = 0.520).

_Assessing Multicollinearity in the Structural Model (VIF):

We rely on VIF values to determine if there is multicollinearity among the Exogenous variables in structural model analysis. The results shown in Table 2 indicate that all VIF values are between 1.202 and 2.528, i.e., less than 5, thus indicating the multicollinearity is not a concern among the variables in this model.

_Effect Size (f^2):

In addition to assessing multicollinearity, we measure the extent to which Endogenous variables contribute to explaining the internal variable by measuring the effect size (f^2) in the model. Effect size values of 0.02, 0.15, and 0.35 indicate small, medium, and large effects, respectively (Kwong and Wong, 2013). Table 4 shows the results of this test.

Table 4. Effect Size (f^2) Results

Path	**f^2**
Digital Transformation → Awareness of AI	0.559
Digital Transformation → Digital Marketing	0.268
Awareness of AI → Digital Marketing	0.500

Source: Prepared by the researcher

The results presented in Table 4 indicate that digital transformation has important affect on citizens' awareness of AI (f^2 = 0.559), this value indicating that this relationship plays an important role in the structural model. Meanwhile, digital marketing indicating a moderate effect on digital marketing (f^2 = 0.268). This means that digital transformation is not the sole factor influencing digital marketing.

In contrast, citizens' awareness of artificial intelligence has a significant effect on digital marketing (f^2 = 0.500). This indicates that this variable contributes more strongly than digital transformation to explaining the overall variance in digital marketing.

_Mediation Analysis and Total Effects:

To test the mediating role of citizens' awareness of artificial intelligence adoption in the proposed model, we evaluated the direct effect. The results are presented in the following table.

Table 5. Results of direct effect Test (Mediation Analysis)

	Original sample (O)	**Sample mean (M)**	**Standard deviation (STDEV)**	**T statistics (|O/STDEV|)**	**P values**
X1 -> X2	0.599	0.609	0.093	6.430	0.000

X1 -> Y	0.381	0.383	0.080	4.764	0.000
X2 -> Y	0.520	0.523	0.083	6.288	0.000

Source: Prepared by the researcher

The results shown in the table indicate the mediating variable has significant direct effects within the structural model. The T-values exceed the lower limit (1.96), and the P-values were less than (0.05), indicating that all direct paths are statistically significant .

Table 6. Results of the Indirect Effects Test (Mediation Analysis)

	Original sample (O)	**Sample mean (M)**	**Standard deviation (STDEV)**	**T statistics (|O/STDEV|)**	**P values**
X1 -> Y	0.312	0.316	0.056	5.515	0.000
X1 -> X2 -> Y	0.312	0.316	0.056	5.515	0.000

Source: Prepared by the researcher

The results showed that digital transformation has a significant indirect impact through citizen awareness of AI. The T-values were greater than 1.96 and P-values were less than 0.05, this means that digital transformation not only directly influences digital marketing but also contributes to enhancing citizens' awareness of AI technologies, which in turn positively affects their engagement with digital marketing.

6. Discussion Results:

The analysis of the results of the impact of digital transformation on interaction with digital marketing, by testing the intermediary role of raising awareness among Algerian citizens regarding the use of artificial intelligence technologies, showed us that the analysis of interviews revealed that the diversity of workers' responses to all the questions posed reflects the cognitive gap among workers resulting from a lack of awareness of institutional strategies. This hinders the process of integrating artificial intelligence and modern technologies in a comprehensive and effective manner. While there may be a real trend towards digital transformation and the application of artificial intelligence within companies, this trend could be limited to certain systems and not widespread. This explains why some employees are not aware of all the digital technologies used within the company and reflects a lack of awareness and training, which limits employees' understanding of new technologies within companies.

The results showed a positive and statistically significant impact of digital transformation on raising awareness among Algerian citizens regarding the use of artificial intelligence (AI). This indicates that digital transformation is not merely a technical process, but also a social and cognitive one, in which repeated use of digital platforms and smart services leads to the use of AI technologies, even if indirectly. This automatically raises citizens' awareness. This finding aligns with the findings of Dörner et al. (2021), namely that digital transformation represents a fundamental step in building a digital and AI culture among users. It is well established that the use of government digital services in Algeria is increasing at a sustained pace, such as e-banking and communication platforms, which is progressively strengthening citizens' awareness and understanding of smart technologies.

The study's results revealed that digital transformation has a limited direct impact on interaction with digital marketing. This indicates that while digital transformation is a necessary condition for the effectiveness of digital marketing, interaction with marketing cannot be solely

explained by digital transformation. Interaction with digital marketing is influenced by intermediary factors such as trust and technological awareness. Providing a digital infrastructure facilitates access to digital marketing channels, but this must be accompanied by cognitive and behavioral factors to elicit a positive response from user (Lemon & Verhoef, 2016) . In the Algerian context, this finding can be explained by a lack of digital technology knowledge. Some users prefer to stick with legacy systems and avoid using digital platforms as interactive marketing spaces due to a lack of trust or familiarity with them.

The results showed that raising awareness among Algerian citizens regarding the use of AI has a strong and statistically significant impact on their interaction with digital marketing, as confirmed by the high effect size (F^2). This result indicates that technology awareness is one of the main determinants of digital behavior. Therefore, investing in AI awareness could have a greater impact than investing solely in technical infrastructure to improve the effectiveness of digital marketing.

The mediation analysis results demonstrated that raising awareness among Algerian citizens about the adoption of artificial intelligence plays a mediating role in the relationship between the digital transformation of businesses and interaction with digital marketing. This confirms the importance of the cognitive and perceptual dimensions of users on digital marketing practices, both directly and indirectly.

7. Conclusion:

Artificial intelligence plays a crucial role in digital marketing, offering new opportunities for businesses and contributing to sound decision-making. At the same time, implementing AI technologies is one of the most difficult challenges facing businesses, and many decision-makers fail to meet these challenges due to a lack of understanding of how to deploy AI to achieve the desired results. Digital transformation is a key factor in facilitating the integration of AI technologies into the digital marketing sector. It is a institutions digital capabilities that enable it to develop and transform its working methods, moving from outdated to more efficient approaches. Limited institutions readiness for digital transformation and weak digital infrastructure are considered the main obstacles to the adoption of AI in businesses, while fostering a culture of digital literacy and public awareness is a decisive factor. This underscores the need to focus on disseminating a culture of AI adoption and strengthening citizens' cognitive abilities through lifelong learning and the provision of simplified explanations that foster a digital mindset, enabling them to adapt more rapidly to changes in everyday transactions. In general, digital transformation alone does not guarantee high levels of engagement with digital marketing unless it is accompanied by increased public awareness of AI usage.

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