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Academic Leaders' Attitudes Toward Artificial Intelligence Applications in Leadership Work in Light of The Diffusion of Innovation Theory: The Impact of Possession of Digital Literacy

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Abstract

The study aimed to examine the impact of academic leaders' possession of digital literacy on their attitudes toward artificial intelligence applications in leadership work in light of the diffusion of innovation theory at Umm Al-Qura University (UQU). The study used a descriptive correlational approach with a random sampling method, and overall, 158 academic leaders were sampled. The findings indicated a positive attitude among academic leaders toward artificial intelligence applications in leadership work (M = 4.006, SD = 0.567), and their degree of possession of digital literacy was high (M = 3.949, SD = 0.641). There was also a significant positive impact of possessing digital literacy on academic leaders' attitudes toward artificial intelligence applications in leadership work, in line with the diffusion of innovation theory (β = 0.597, p < 0.05). This study recommends spreading awareness and establishing a culture of utilizing artificial intelligence applications in leadership work at Saudi universities.

Keywords: *Academic Leaders' Attitudes; Artificial Intelligence Applications; Diffusion of Innovation Theory; Digital Literacy.*

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Introduction

Although artificial intelligence (AI) technologies are still in their infancy (Infosys, 2018), The Kingdom of Saudi Arabia was ranked first in the "government strategy" sector of a recently published AI report from Tortoise Intelligence, which evaluated the use of AI in more than 60 countries globally (Saudi Press Agency, 2023). This ranking is the consequence of numerous promising AI-related actions implemented by the Kingdom, including establishing a dedicated and approved national strategy for AI, the existence of a government agency dedicated to AI, funding and budgeting for AI, and setting and following up on national goals for AI (Saudi Press Agency, 2023). In contemporary times, most higher education institutions have transitioned from traditional methods to modern ones characterized by AI techniques, thus increasing their innovation and performance efficiency (Luo, 2018). Academic scholars and practitioners in higher education institutions worldwide are striving to provide digital leadership and achieve innovation in a knowledge-driven economy. Additionally, as sources of knowledge, universities have increased the benefits of using AI technology in leadership, teaching, and learning (Long & Magerko, 2020).

Specifically, AI aims to produce intelligent systems capable of human-like learning and reasoning; it has numerous advantages and has been successfully applied in various industrial fields, including educational institutions (Zhao et al., 2020). For instance, AI can be employed to analyze data for decision-making, monitor team performance and productivity, and improve the process of production and service provision (OECD, 2022). Additionally, AI increases efficiency through improving learning and planning, as AI systems can make predictions and select options that maximize the organization's value (Russell & Norvig, 2016). According to Infosys (2018), 9 out of 10 C-level executives reported positive and tangible benefits from utilizing AI within their organizations, and 66% stated that employing AI technologies for management process automation aided in delivering quick results. Additionally, Purdy and Daugherty (2016) highlighted that when organizations adopt AI in their work, they can increase innovation and enhance profitability by an average of 38%. According to Xu et al. (2021), AI is growing fast and is considered a robust scientific research paradigm.

Previous studies have demonstrated that innovation diffusion in higher education is driven by leadership approaches favoring digital literacy and AI (Božić, 2023; Alhejaili, 2022; Barger et al., 2021; Guribie et al., 2021; Nazari et al., 2021; Al-Masry & Al-Tarawneh, 2021; Pedró, 2020; Omar et al., 2017; AlMubarraz, 2008). Indeed, academic leaders may explore AI technology integration to overcome professional skill gaps and develop an original conceptual framework for the digital leadership transformation of higher education institutions in the modern job market (Okunlaya et al., 2022). Consequently, academic leaders at Saudi universities must be aware of

and prepared to diffuse AI innovation and applications in their institutions, which will help these institutions survive and thrive (Lauterbach & Bonim, 2016).

Based on this necessity to integrate the use of AI into higher education institutions, the current study examines academic leaders' attitudes toward AI applications in light of the diffusion of innovation theory. Specifically, this theory attempts to explain how, why, and what new ideas and technologies spread quickly (Roger, 1995). Roger's (2003) five essential factors influencing the spread of innovations are used in this study: relative advantage, compatibility, trialability, simplicity, and observability. Omar et al. (2017) indicated that this diffusion process strongly depends on human capital since individuals are first exposed to innovation, and subsequently, if they are interested in the innovation, they may attempt to learn more about it and decide whether to embrace or refuse it once adequate information has been acquired. Accordingly, academic leaders at Saudi universities are essential participants in influencing the success of adopting AI.

In relation to attitudes toward AI technologies, digital literacy is critical to survival in the digital era, as well as to the advancement of AI applications (Eshet, 2004). Aviram and Eshet-Alkalai (2006) defined digital literacy as a combination of technical-procedural, cognitive, and emotional-social skills. Notably, according to Ng (2012), an individual's adaptation to new or emerging technologies is an indicator of whether an individual is digitally literate. Furthermore, Sule (2021) argued that digitally illiterate individuals are excluded from the digital world; thus, possessing digital literacy is a significant skill required for the growth and development of institutions.

As a result, for higher educational institutions, digital literacy must be prioritized (Sule, 2021). Indeed, higher education institutions must strengthen their digital literacy skills to confront the challenges of the 21st century corporate environment, and institutions must be innovative and creative to capitalize on this potential for transformation (Buliva, 2018; Deja et al., 2021). These challenges of the new digital era are best addressed by having digitally competent leaders at all levels of the workplace to allow for involvement and collaboration in using information technologies to drive organizational progress. Regarding leadership, the emergence of a digital economy is pushing higher education institutions to adopt leadership models based on digital literacy and creative industries (Brasca et al., 2022). Indeed, academic leadership driven by digital literacy enhances technology diffusion and innovation. Therefore, academic leaders at Saudi universities should go beyond their routines and focus on enhancing digital literacy and implementing new methods to spread innovation and employ AI applications. When university leaders have sufficient digital literacy, they are more likely to adopt AI applications and support innovative institutions.

Purpose of the Study

The study aims to explore the attitudes of academic leaders at UQU toward the application of AI in leadership work in light of the diffusion of innovation theory. The study also aims to determine the level of digital literacy of academic leaders at UQU. Finally, the study's key objective is to reveal the impact of the academic leaders' possession of digital literacy on their attitudes toward AI applications in leadership work.

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Research Problem

Digital transformation involving the application of AI in numerous fields is a significant priority in the Saudi Vision 2030. The Kingdom has been interested in AI since its early stages; for example, the government established the Saudi Data and Artificial Intelligence Authority (SDAIA) in 2019 as a national reference for everything related to AI, including regulation, development, and operation (Saudi Press Agency, 2023). Aramco's adoption of AI solutions in drilling and exploration is a pioneering example presented by the Kingdom in the field of AI; indeed, this action enabled Aramco to currently be at the top of the list of energy companies in terms of their use of solutions that guarantee environmental sustainability. At the Global AI Summit 2022, Aramco announced a new strategic project called the "Global AI Corridor," which aims to build and commercialize an AI ecosystem in the Kingdom of Saudi Arabia with a partnership with a US-based AI company named Beyond Limits. NEOM, the Dream City, is another example of a significant project within Saudi Vision 2030 that invests in AI; specifically, "The Line" is a large project in NEOM city focusing on how to plan cities for the next 150 years and how the Kingdom can adapt AI and data solutions to build sustainable societies. Additionally, the Saudi Digital Experience Maturity Index for Government Services (DXMI) Report (2023) indicated that most of the 24 Saudi application platforms e.g., public platforms using AI to provide services to citizens included in the report were competent, as the general result of the DXMI reached 80.68%, and that there are ample opportunities for progress and growth in this field.

Despite the trend toward using AI applications, the knowledge regarding their various advantages, and the focus of the Saudi Vision 2030 on digital transformation using AI applications, the use of AI at Saudi universities is still within the minimum limits set by the Saudi Vision 2030 (Aldosari, 2020). AI is already utilized in higher education; however, many academic leaders need to be more aware of its scope and, more crucially, what it entails (Hinojo-Lucena et al., 2019). Hence, there is an increasing need to spread the culture of using AI applications, particularly at Saudi universities, and to conduct more research into AI (Al Madawi, 2022; Aldosari, 2020). However, some Saudi universities have started to establish AI centers to keep pace with the progress in the field of AI. For example, King Saud University established the AI Center for Advanced Studies (THAKAA), which specializes in researching, developing, and innovating AI solutions. The center provides many services in partnership with faculty members working in research and innovation, human capacity building, and consulting services based on best practices, standards, and the latest technologies (King Saud University, 2023).

AI applications have become an essential part of modern life; illiteracy today is not among those who do not know how to read and write but rather among those who do not understand digital technologies and do not deal with them (Ng, 2012). Moreover, Al-Anazi (2022) asserted that the digital trends in the Saudi Vision 2030 require a sweeping organizational change, and AI applications are one of the most potent strategies that enhance innovation and increase competitiveness. Although previous studies have examined the environment in Saudi universities (Alhejaili, 2022; Al-Anazi, 2022; Aldosari, 2020; AlMubarraz, 2008), no work has addressed the impact of digital literacy on individuals' attitudes toward AI applications in light of the diffusion of innovation theory in Saudi universities.

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Based on the current research base, the following questions are proposed in this research:

RQ1: What is the level of digital literacy of academic leaders at UQU?

RQ2: What is the attitude of academic leaders toward the application of AI in leadership work in light of the diffusion of innovation theory at UQU?

RQ3: What is the impact of the academic leaders' possession of digital literacy on their attitudes toward AI applications in leadership work in light of the diffusion of innovation theory at UQU?

Study Hypothesis

H1: Higher levels of digital literacy among academic leaders may be correlated with more positive attitudes toward AI applications in leadership work in light of the diffusion of innovation theory.

Significance of the Study

The importance of the study lies in the necessity of adopting AI in higher education to increase innovation, accuracy, and flexibility in academic leadership work. The current study supports the leadership and management literature by investigating academic leaders' attitudes toward the application of AI in leadership work in light of the diffusion of innovation theory and identifying their levels of digital literacy. The study also seeks to reveal the impact of academic leaders' possession of digital literacy on their attitudes toward AI applications in leadership work. The results of this study may inform officials in the Saudi Ministry of Education about the level of possessing digital knowledge among academic leaders and the significant of using AI applications, especially in leadership work within higher education institutions.

Study Delimitations:

1. The study was limited to investigating the impact of academic leaders' possession of digital literacy on their attitudes toward AI applications in leadership work in light of the diffusion of innovation theory at UQU.
2. The study sample was the academic leaders at UQU (dean, vice dean, department chair, and vice department chair).
3. The study was conducted during the academic year 2023.

Study Terminology

Attitudes: Attitudes can be described as a set of ideas, emotions, and behavioral tendencies associated with socially relevant items, societies, circumstances, or symbols (Michael & Graham, 2005). Specifically, attitudes toward AI applications in leadership work can be explained as a set of positive and negative beliefs, feelings, and behaviors taken by leaders (e.g., academic leaders) toward using AI applications in leadership work. These attitudes include the individual's stance toward the significance of AI in leadership work and the extent of its benefit to the university and society. In this study, attitudes are measured based on the score achieved by the respondent on the study instrument prepared for this purpose.

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Digital Literacy (DL): According to Ng (2012), a person's digital literacy can be evaluated according to their capacity to adapt to new or emerging technologies. According to this study, digital literacy is a set of digital skills that enable academic leaders to adapt to using AI applications in leadership work.

Artificial Intelligence Applications: According to Baker and Smith (2019), AI can be defined as applications that perform cognitive functions typically related to human brains, such as learning and problem-solving. According to this study, AI is a set of applications that simulate human intelligence to assist academic leaders in performing their leadership work efficiently and intelligently.

The Diffusion of Innovation (DOI) Theory: The diffusion of innovation theory aims to predict how decisions are made to adopt new ideas or technologies, as well as how new ideas and technologies diffuse, the reason for this diffusion, and the rate of diffusion by understanding individual patterns in the adoption of these products (Rogers, 2003). The diffusion theory of innovation relies on five factors to predict user behavior: relative advantage, compatibility, trialability, simplicity, and observability (Rogers, 2003). According to this study, the diffusion of innovation theory is a theory that can be used to predict academic leaders' attitudes toward AI applications in leadership work and that predicts their behavior based on the five primary factors of the theory.

Literature Review

Digital Literacy

In the 21st century, digital leadership is critical. The possession of digital literacy within higher education, particularly for academic leaders, supports individuals in their leadership work responsibilities and helps to develop the educational process. Indeed, Podorova et al. (2019) asserted that digital literacy has become increasingly significant in higher institutions, as it facilitates work and qualifies individuals for future careers. Additionally, Gutiérrez-ngel et al. (2022) emphasized that universities are undergoing dramatic changes due to the rise of digital technology, which demands a new paradigm in which academics must be digitally literate. According to Green et al. (2014), to be digitally literate, an individual must be able not only to search and manage digital information but also to analyze and integrate it. The significance of possessing digital literacy was confirmed by Ng (2012), who stated that the illiterate today are not individuals who cannot read and write but instead those who do not possess digital literacy. Digital literacy is undoubtedly a required skill in the era of digital transformation, and currently, acquiring digital literacy skills is more straightforward than ever, especially with increasing free access to information and the current diversity of sources of knowledge.

Overall, academic leaders must be digitally literate in order to advance their leadership work and education processes by employing AI applications and innovative strategies. Digitally literate leaders can absorb and take accountability for their work, increasing the demand for education (Mashhadia & Kargozarib, 2011), also they can take accountability for their leadership work, and thus, increase the demand for education among the population. To support digital transformation in higher education, equal emphasis should be placed on developing digital literacy

skills and infrastructure (Naz, 2020). However, this digital transformation will also expose academic leaders to technological challenges, and academic leaders should master the understanding of new technologies and overcome these difficulties through digital literacy.

Definitions of Digital Literacy

Based on a review of the previous literature on digital literacy, there appears to be no standard definition of the concept, since multiple definitions have developed in response to technological advancements and application contexts. Indeed, most authors provide definitions based on their individual understanding of digital literacy. In terms of the broadest definition, Eshet-Alkalai (2004) described digital literacy as a "survival skill in the digital era." Other definitions go further to define digital literacy as the abilities required to live, learn, and work in a society where communication and information access are mediated by digital technologies such as internet platforms, social media, and mobile devices (Zhang, 2023). Taskin and Ok (2022) defined digital literacy as the capacity to use the Internet and digital technology to search for, organize, assess, and complete activities. Moreover, the European Commission (2010) defined digital literacy as the demanded competencies to perform digital skills and the professional use of information and communication technology (ICT) for work, communication, leisure, and learning. The expansion of ICT and smartphones has compelled officials in higher education to continuously train and acquire digital skills, including decision-making, information handling, and communication. Notably, Ng (2012) defined digital literacy as a person's ability to adapt to new or emerging technology. Hence, being digitally literate means possessing digital literacy skills. However, although these definitions are helpful, they should be revisited frequently owing to changing technological settings.

Dimensions of Digital Literacy

Some scholars have recognized multiple dimensions of digital literacy (Slue, 2021; Santoso et al., 2019; Ng, 2012), while others have reduced this to a single dimension (Taskin & Ok, 2022; Ustundag et al., 2017). In general, digital literacy includes three key dimensions: technical, cognitive, and social-emotional. Firstly, the technical dimension of digital literacy entails possessing operational and technical abilities that assist a person in using ICT for learning and other daily activities (Ng, 2012). For example, some individuals can use smart applications to obtain fast and effective services, meaning they are digitally literate. Secondly, the cognitive dimension includes high-level capabilities such as problem-solving, complexity management, logical thinking, planning, and results management (Martínez-Bravo et al., 2022). Ng (2012) mentioned that this dimension necessitates the proper evaluation and selection of software programs. Accordingly, the cognitive dimension comprises management skills and critical thinking in searching and assessing digital information. Finally, the social-emotional dimension involves a sense of belonging to a global community, a multicultural perspective, network engagement, and digital communication (Martínez-Bravo et al., 2022). Indeed, this social-emotional dimension correlates with the ability to communicate, socialize, and learn ethically and intentionally via the Internet (Ng, 2012), as well as including digital citizenship, societal and cultural challenges associated with technology, and legal and ethical behavior (Martínez-Bravo et al., 2022; Law et al., 2018). Since all of these dimensions involve vital skills, being digitally literate

requires academic leaders in higher education to observe all of these critical dimensions. However, Ustundag et al. (2017) built on the dimensions mentioned by Ng (2012) and performed a factor analysis to reach a single dimension of digital literacy consisting of 10 items, which the current study adopts.

AI Applications in Leadership Work

AI is a significant turning point in human history according to its modern methods and applications in management and leadership processes in various disciplines. As Pisica et al. (2023) highlighted, higher education is an essential area that significantly shapes the minds of society's leaders. Therefore, universities are seeking to shift from traditional methods of management and leadership processes to employing the latest programs and applications to improve their performance and develop their capabilities. AI is already being implemented in higher education institutions, although many academics are unaware of its extent and, more importantly, what it involves (Hinojo-Lucena et al., 2019).

The widespread adoption of AI profoundly changes how leaders lead, from the tasks of recruiting and training to inspiring teams and combining AI and human power (Infosys, 2018). AI has created new prospects for students, professors, and academic leaders in higher education by expediting decision-making and streamlining procedures. Since decision-making is at the center of higher educational leadership, AI is critical in boosting the accuracy and efficiency of academic leaders' data-informed decision-making (DIDM) (Wang, 2020). Indeed, even though human judgment outperforms AI in terms of making moral decisions based on values, leadership duties are typically time and resource-intensive, and AI applications can improve and simplify leaders' decision-making in higher education (Ahmad et al., 2022; Wang, 2021). For example, numerous leadership duties, such as record-keeping, grading, scheduling, and lesson planning, can be automated using AI, as highlighted by Igbokwe (2023). In this context, Assenova (2020) noted that AI has become a vital component of educational systems and the primary mechanism for obtaining a competitive advantage in the education services market, as the development of new courses and programs requires AI applications. Additionally, Haluza and Jungwirth (2023) claimed that although there is still more work to be done before any tangible impact of AI applications such as GPT-3 on essential jobs can be identified, some evidence implies that AI may have a positive impact when applied correctly. Therefore, it has become necessary for university academic leaders to educate themselves in AI applications in order to make accurate decisions and save time in implementing multiple leadership tasks.

Definitions of AI Applications

The concept of AI has evolved and changed over time, as AI capabilities have advanced enormously. As a result, AI is difficult to define, and there is no widely agreed definition of the concept (Russell, 2010). Although there is no standardized definition of AI from scholars, some define AI based on their backgrounds. For instance, Crompton and Burke (2023) defined AI as computing systems that are capable of engaging in human-like processes such as learning, adaptation, synthesis, self-correction, and data usage for complicated processing tasks. Since 1955, emeritus Stanford Professor John McCarthy has described AI as a science founded on engineering and manufacturing intelligent machines (Manning, 2020). Moreover, Sheikh et al. (2023) defined

AI as a technique that allows machines to mimic diverse, complicated human skills; in particular, AI involves the performance of complex tasks by computers in complex contexts. The European Commission (EC) also provides a definition formulated by the High-Level Expert Group on Artificial Intelligence (AI HLEG); according to their group, AI is technologies that exhibit intelligent work via assessing the surroundings and acting autonomously to achieve planned objectives. Finally, Brown et al. (2020) stated that AI is a comprehensive concept that includes a wide range of developing technologies such as machine learning, deep learning, computer vision, natural language processing, robots, and machine learning. Overall, the overwhelming number of AI definitions in circulation is not the result of negligence but of the phenomenon of AI itself (Sheikh et al., 2023), as well as the different influences of the technology (Peifer et al., 2022).

AI Applications in Leadership Work in Higher Education

Leaders and leadership are vital in successfully implementing and using AI applications (Peifer et al., 2022). According to Popenici and Kerr (2017), the spectrum of options for using AI applications in higher education is constantly expanding; however, the generalization of AI across multiple contexts must be explored further. Guan et al. (2020) reviewed over 400 research articles from 2000 to 2019 on applying AI techniques in higher education, and they suggested raising awareness about the opportunities and constraints of AI in the higher education context. Similarly, Zawacki-Richter et al. (2019) systematically reviewed research on AI applications in higher education out of 2,656 initially identified publications from 2007 to 2018. The results highlighted four areas of Artificial Intelligence in Education (AIEd) applications in academic support and institutional and administrative services: prediction, assessment, personalization, and intelligent tutoring systems.

In terms of the area of prediction, in higher education, AI applications can be used for predicting individual performance, quality management, accelerated decision-making, knowledge development, and monitoring team development. Predicting individual performance is a prominent example of an AI application in higher education leadership. Indeed, according to Igbokwe (2023), AI systems can examine individual performance data, among other factors, to determine and anticipate individuals at risk of falling behind on their work. Academic leaders can intervene early in these instances and thereby boost overall performance. Pedró (2020) provided a similar statement, mentioning that AI applications in higher education can increase students' learning and motivation, thus decreasing student drop-out or inactivity and increasing completion of studies.

Furthermore, AI is critical for expediting decision-making through data-driven analytics (Ahmed et al., 2023). In this context, AI-driven analytics can automate the decision-making process among academic leaders, allowing them to respond to institutional changes efficiently and quickly. AI can also help improve higher education leadership work by improving team development through adaptive and interactive feedback. According to Barret et al. (2019), integrating AI into higher education allows teachers and staff to interact more efficiently and effectively. As a result, the applications of AI in higher education leadership are both extensive and valuable.

However, risks associated with AI can arise at any level of development, although controls can help to mitigate them (Pedró, 2020; Cheatham et al., 2019). For example, Zawacki-Richter et al. (2019) mentioned that critical reflection on the risks of AIEd is almost absent, meaning a deeper

investigation of the ethical and educational methods for implementing AIEd in higher education is required. Božić (2023) argued that even though the use of AI increases digital skills and has benefits for workers, it has some potential dangers, such as ethical concerns, privacy risks, lack of human judgment, cybersecurity vulnerabilities, workforce displacement, property issues, and legal and regulatory considerations (Rodrigues, 2020; Cheatham et al., 2019). To overcome such risks caused by AI, Cheatham et al. (2019) suggested using a set of strategies, such as considering the ethical aspects of applications, ensuring adequate privacy measures, including workers in decision-making rather than completely replacing human judgment, improving workers' skills in using AI, ensuring the robust implementation and adoption of AI technologies in the workplace, and ensuring adherence to legal and AI-related regulatory requirements. According to Cheatham et al. (2019), AI has proven to have both significant advantages and disadvantages. As a result, higher education officials must proceed with caution when capitalizing on the emerging trend of using AI technologies. Simultaneously, institutions should be protected from the consequences of trying applications whose practicality has yet to be established. Overall, AI applications are essential in university leadership, as they power data analysis for decision-making, improving team performance, productivity monitoring, and improving production and service processes. Moreover, since higher education leadership is time- and resource-consuming, AI can streamline activities such as scheduling and budgeting.

Diffusion of Innovation Theory

As proposed by Everett Rogers, the diffusion of innovation (DOI) theory is a significant approach to understanding the adoption of technology, particularly AI, in higher education. Specifically, DOI theory describes the path and pace of acceptance of innovations and new ideas. Overall, the DOI model provided by Everett Rogers in 1962 is critical for understanding the process of adopting innovations, making this model the best fit for researching technology adoption, such as AI in higher education. Almaiah et al. (2022) stated that incorporating AI technologies into educational systems delivers several benefits that improve learning experiences. In this regard, higher education institutions must realize the importance of innovative technologies such as AI for improving leadership job experiences. DOI theory comprises the fundamental elements of innovation, adopters, and communication channels through which academic leaders and other stakeholders in higher education can implement AI applications.

Additionally, the main dimensions of DOI relevant for the adoption of AI are relative advantage, compatibility, trialability, simplicity versus complexity, and observability. Specifically, Almaiah et al. (2022) mentioned that relative advantage is the most potent dimension in innovation adoption; in this sense, for AI, individuals are more likely to use AI applications if they view them as valuable. As an example, according to Raman et al. (2023), the AI-powered ChatGPT has been demonstrated to be a beneficial resource within higher education for poetry, essays, software development, research, and other areas. Nonetheless, some view AI as a threat that may raise ethical issues in academia and cause a divide among educators. Accordingly, this issue leads to another DOI dimension, compatibility, which involves assessing how innovation fits into the new structure and the users' beliefs, as noted by Almaiah et al. (2022). The other DOI attributes are also equally crucial in adopting AI applications in higher education. As a result, the

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DOI provides a theoretical framework that may be used to inform the implementation of AI applications in higher education.

Definitions in the DOI

Based on Rogers' (2003) explanation and evaluation of his DOI, various authors have provided distinctive definitions or theoretical bases for this significant theory of the innovation process. While acknowledging that the DOI was founded by Rogers (1962), the theoretical basis of the DOI used in Isman and EL Mrassni's (2023) study was that the approach explains how innovations, products, and new concepts are spread across society. The authors noted that elements such as the characteristics of the adopters, innovation, and the social context affect the speed of adoption of innovations. Similarly, Fuah and Ganggi (2022) defined the diffusion of innovation as the process of spreading new ideas through communication via the media that occurs within a specific time frame. Additionally, Fuah and Ganggi (2022) further stated that the DOI can be defined as a change in the functioning and structure of social systems. Conversely, Call and Herber (2022) viewed the DOI as a theory that aims to explain variances in adoption rate and innovation breadth. Overall, most authors arguably cite, define, and understand DOI in the context of Rogers' original definition.

Dimensions of the DOI

Rogers's DOI incorporates five dimensions that facilitate the spread of innovations: (1) relative advantage, (2) compatibility, (3) complexity versus simplicity, (4) observability, and (5) trialability (Rogers, 2003). Relative advantage, as mentioned earlier, is the most potent element in innovation adoption; specifically, according to Pinho et al. (2021), relative advantage refers to the extent to which individuals perceive the adoption of an innovation as an improvement. In the case of AI applications, this advantage refers to the perception of the usefulness of the application. Compatibility involves the degree to which individuals believe that the innovation is consistent with the potential adopters' values, experiences, and needs (Rogers, 2003; Pinho et al., 2021). Indeed, in the context of higher education, it is essential to understand and implement innovation models that meet individuals' needs and beliefs.

Complexity refers to the ease of use and understanding of an innovation; in particular, Call and Herber (2022) defined compatibility as the extent to which an innovation is seen as challenging to understand and apply. When innovations are more complex, potential adopters are less likely to use them. Conversely, the simplicity dimension is the extent to which an innovation is seen as relatively easy to understand and utilize. Consequently, simpler innovations are more likely to be used by potential adopters. Observability influences the adoption rate, as individuals are more likely to adopt new innovation if it is visible in organizations or others have adopted it (Pinho et al., 2021; Rogers, 2003). Indeed, such visibility prompts potential adopters to ask about the innovation, thus increasing the adoption rate. Finally, trialability involves the degree to which a person can test the innovation before adopting it. Menzli et al. (2022) stated that an innovation being widely tested increases the likelihood of its adoption. Additionally, Currie and Spyridonidis (2019) explained how leaders are critical players in spreading and sustaining innovation and

suggested focusing on leadership configuration in innovation diffusion. Overall, these dimensions of the DOI are vital variables in understanding the adoption rate of innovations.

Methodology

A descriptive survey approach was employed for the purpose of this study, as this approach was the most appropriate for addressing the study problem and allowed for the exploration of the perspectives of the individuals in the study sample and describing their awareness of the study variables. The study utilized a descriptive correlational approach to describe and analyze the impact of the academic leaders' possession of digital literacy on their attitude toward AI applications in leadership work in light of the DOI at UQU.

Study Sample

The study population consisted of all academic leaders, including dean, vice dean, department chair, and vice department chair at UQU during the academic year 2023, with a total population size of 256 according to the official university's website. A stratified random sampling procedure was implemented. The appropriate sample size was 153, according to Thompson's (2012) equation for determining sample size. Participation in the study was voluntary, and an electronic questionnaire was distributed to the target sample via official e-mail after obtaining the necessary official approvals from UQU. The number of participants in the study was 158 individuals, which was an appropriate number to achieve the purpose of the study.

In the current study, there were more male participants (129, 81.6%) than females (29, 18.4%). Most of the academic leaders were aged between 40 and 50 years (78, 49.4%), and some were aged 50 years and over (17, 10.8%). Most of the academic leaders were in the rank of associate professor (75, 47.5%), followed by those in the rank of assistant professor (63, 39.9%), while some were of the rank of full professor (20, 12.7%). Furthermore, the study showed that most academic leaders had taken less than five technological courses (112, 70.9%), and a few of them had not taken any technological courses (7, 4.4%).

Study Instrument

A questionnaire was designed to answer the study's questions and test its hypothesis, including two scales based on related previous studies. The study instrument was presented to eight educational leadership, administration, and psychology specialists at Saudi universities to assess the content validity. The psychometric properties were also verified by conducting a pilot study with 30 participants from the study population, who were confirmed to be outside the actual study sample. The following is a presentation of the psychometric properties of the study's scales:

Scale Assessing Attitude Toward Artificial Intelligence Applications in Leadership Work in Light of the Diffusion of Innovation Theory

Attitudes can be described as psychological expressions regarding a specific construct with a degree of acceptance or disapproval (Eagly & Chaiken, 1993). Additionally, attitudes can be defined as an individual's typical thoughts and feelings regarding something or someone, which can be both positive and negative (Ricards & Schimidth, 2003). Previous studies vary in their goals

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and purposes in relation to examining AI applications and the DOI theory (e.g., Al-Masry and Al-Tarawneh 2021; Aldosari 2020; Guan et al. 2020; Zawacki-Richter et al. 2019; Ocaña-Fernández et al. 2019; Currie and Spyridonidis, 2019; Hassan, 2010; Celik et al. 2014; AlMubarraz, 2008). However, no study has examined attitudes toward AI applications in leadership work in light of the diffusion of innovation theory.

Three elements make up attitudes: a cognitive component, which includes the information and facts that the individual possesses about a specific topic; an affective component, which consists of the emotions and feelings that affect the individual's acceptance or rejection of a specific topic; and a behavioral component, which is the individual's positive or negative behavioral responses to a specific topic (Scandura, 2017; Zanna &Rempel, 1999; Krosnick et al., 1992; Eagly & Chaiken, 1993).

In light of the DOI theory, a scale was designed to measure academic leaders' attitudes toward AI applications in leadership work based on previous related studies (Rogers, 2003; Atkinson, 2007; Lee et al., 2011; Celik, al., 2014; and Ajouz et al., 2020). The questionnaire comprised 20 items across five dimensions: relative advantage (5 items), compatibility (5 items), trialability (4 items), simplicity (3 items), and observability (3 items), which entirely capture academic leaders' attitudes toward AI applications in leadership work. Pearson's correlation coefficients were calculated to estimate the scale's internal consistency for each item with its dimension and for each dimension with the total score. Specifically, as presented in Table 1, the correlation scores of attitudes toward AI applications in leadership work ranged from 0.632 to 0.874 and were statistically significant ($p \leq 0.01$). The correlation coefficients for the total score in each dimension ranged from 0. 640 to 0. 851 and were also statistically significant ($p \leq 0.01$). The scale's reliability was also verified by computing the Cronbach's alpha; specifically, a large Cronbach's alpha of 0.811 was identified for the total scale, and the five main dimensions had acceptable reliabilities of 0.727, 0.865, 0.668, 0.782, and 0.747, respectively. These results show that the study instrument is highly reliable and can be relied on to meet the study's objectives.

Table 1

Pearson correlation coefficients for each item of attitude toward AI applications in leadership work with the total score of its dimension (N = 30).

Dimension 1		Dimension 2		Dimension 3		Dimension 4		Dimension 5	
N	R	N	R	N	R	N	R	N	R
1	.742**	6	.756**	11	.865**	15	.767**	18	.839**
2	.837**	7	.743**	12	.844**	16	.662**	19	.638**
3	.751**	8	.843**	13	.793**	17	.874**	20	.831**
4	.660**	9	.682**	14	.632**				
5	.719**	10	.794**						

Pearson correlation coefficients for the total scores in each dimension.

Dimension 1		Dimension 2		Dimension 3		Dimension 4		Dimension 5	
R	.739**	R	.851**	R	.672**	R	.743**	R	.640**

** *Correlation is significant at p < 0.01* (2-tailed).

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Scale Assessing Digital Literacy

Certain previous studies on digital literacy have divided it into dimensions (Slue, 2021; Santoso et al., 2019; and Ng, 2012), whereas others have adopted a single dimension (e.g., Taskin & Ok, 2022 and Ustundag et al., 2017), as used in the current study. As an example, Ustundag et al. (2017) adapted Ng's (2012) digital literacy scale, conducted a factor analysis, and concluded that 10 items on the scale fall into one factor explaining 40% of the overall variability. In the current study, the digital literacy questionnaire had 10 items. According to Table 2, all the correlation coefficients between the digital literacy items and the total scores were statistically significant ($p \leq 0.01$) and reached high values, indicating that the instrument has a high degree of internal consistency.

Table 2

Pearson correlation coefficients for each item of digital literacy with the total scores (N = 30).

Variable	Correlation Coefficients for Items									
	1	2	3	4	5	6	7	8	9	10
Digital Literacy	.752**	.634**	.881**	.772**	.598**	.731**	.684**	.867**	.866**	.841**

** *Correlation is significant at p < 0.01 (2-tailed).*

Cronbach's alpha values were also utilized to assess the internal consistency of the study instrument. The digital literacy scale had a large Cronbach's alpha value of 0.833, which indicates that the instrument is highly reliable and can be utilized effectively to meet the study's objectives.

Response Scales

The responses to all study scales were estimated using a five-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). To classify the arithmetic means and the sample's responses, the measure of attitude toward AI applications in leadership work was converted into a binary scale (scores from 1 to <3 = negative, scores from 3–5 = positive). Additionally, the measure of possession of digital literacy was also converted into triple grading (scores from 1 to <2.33 = low; scores from 2.33 to <3.66 = medium; scores from 3.66–5 = high).

Results and Discussion

The purpose of this study was to examine the impact of academic leaders' possession of digital literacy on their attitudes toward AI applications in leadership work in light of the DOI theory at UQU. In this section, the study findings are discussed in relation to the aspects of measuring the level of digital literacy of academic leaders, the attitude of academic leaders toward the application of AI in leadership work in light of the DOI theory, and the impact of possessing digital literacy on attitudes toward AI applications in leadership work in light of the DOI theory.

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Results of the Level of Digital Literacy and the Attitude of Academic Leaders toward the Application of AI in Leadership Work in Light of The DOI Theory

Table 3

The arithmetic means and standard deviations of the sample responses for the study variables, arranged in descending order according to the arithmetic mean (N = 158).

Variable	Dimension	Number of Items	Mean	Standard Deviation	Level (High, Moderate, Low)
Digital Literacy		10	3.949	0.641	High
Attitude Toward AI Applications in Leadership Work in Light of The Diffusion of Innovation Theory	Observability	3	4.082	0.626	Positive
	Simplicity	3	3.994	0.544	Positive
	Compatibility	5	3.972	0.524	Positive
	Trialability	4	3.927	0.529	Positive
	Relative Advantage	5	3.892	0.515	Positive
	Total	20	4.006	0.567	Positive

According to Table 3, academic leaders at UQU have positive attitudes toward AI applications in leadership work in light of the DOI theory (M = 4.006). This result confirms that academic leaders at UQU have positive cognitions, feelings, and behaviors that support the use of AI applications in leadership work. The standard deviation value (SD = 0.567) indicates considerable harmony in the responses of the study sample and the convergence of their views on the scale items. These positive attitudes may be attributed to the awareness of academic leaders at UQU of the significance of using AI applications in leadership work in line with the country's general orientation toward digital transformation in all government sectors, as highlighted by the National Vision 2030.

The findings of the current study are in line with the findings of Guan et al. (2020), who retrieved over 400 research publications on the application of AI and found that an emerging orientation toward AI is occurring, particularly in the educational system. Similarly, the study results are consistent with the work of Al-Masry and Al-Tarawneh (2021), who found that academic leaders had relatively positive attitudes toward using AI in education, scientific research, community service, and resource management. However, this study's results are inconsistent with the findings of Aldosari (2020), who stated that there was a low level of understanding of the processes of applying AI at Prince Sattam Bin Abdulaziz University.

Specifically, the observability dimension showed the highest score, indicating that academic leaders had the most positive attitude toward AI applications in this dimension (M = 4.082, SD = 0.626). The scores for the other dimensions of attitudes toward AI applications in leadership work were relatively close in terms of magnitude. Moreover, the relative advantage dimension showed the lowest attitude score ranking, with an arithmetic mean of 3.892 (SD = 0.515). This result does not correspond with AlMubarraz (2008), who stated that compatibility is the most important dimension for faculty members in relation to adopting the Internet, followed by the relative advantage of use and social image.

According to Table 3, the degree of digital literacy among academic leaders was high (M = 3.949, SD = 0.641), which may be explained by the fact that the study sample had a high

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education level (Ph.D. or above). In turn, such digital literacy is crucial for moving toward applications of AI in leadership work within the university. Indeed, Alhejaili (2022) confirmed that possessing digital literacy skills is the starting point for educational leaders to lead the desired digital transformation in directing and managing educational sectors. The study findings are consistent with Shatnawi's (2022) results, which indicated a high level of digital knowledge among university professors. However, this finding disagrees with those of Alhejaili (2022), who stated in his critical appraisal of the Saudi Arabian educational context that there is little familiarity with digital literacy as a transformational leadership style and that the effectiveness of this leadership style is dependent on the educational leader's self-efficacy and digital competence and the school's digital capabilities.

Results of the Impact of Possessing Digital Literacy on Attitudes toward AI Applications in Leadership Work in Light of the DOI Theory

The study hypothesis (H1) was tested to answer Q3, which related to testing the impact of possessing digital literacy on attitude toward artificial intelligence applications in leadership work in light of the DOI Theory.

H1: Higher levels of digital literacy among academic leaders may be correlated with more positive attitudes toward AI applications in leadership work in light of the DOI theory.

To test the study hypothesis and examine the relationship between the study variables, a simple linear regression analysis was used. The assumptions of normal distribution, independence of residuals, and homogeneity of variance were also verified as follows:

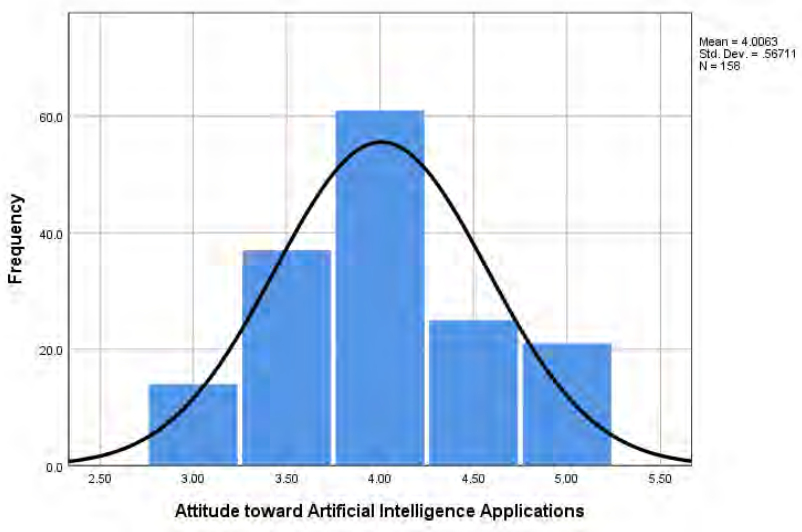

Figure 1: Histogram of attitudes toward AI applications in leadership work

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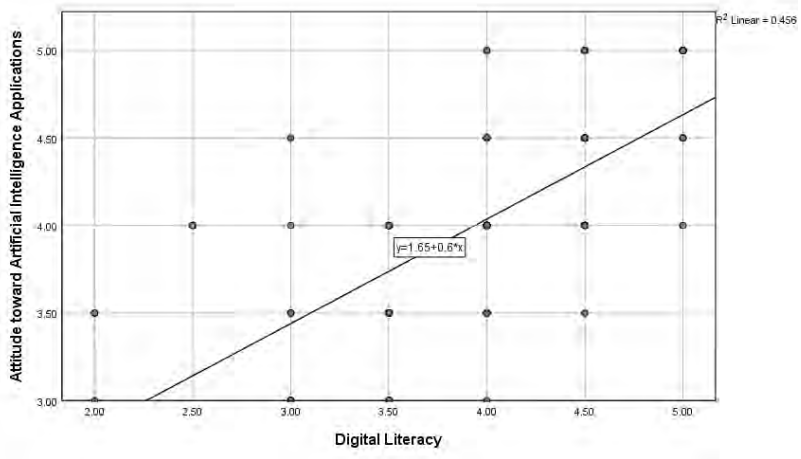

Figure 2: Scatter plot of digital literacy against attitudes toward AI applications in leadership work

As shown in Figure 1 above, the attitudes of academic leaders toward AI applications in leadership work had an approximately normal distribution. Additionally, as highlighted in Figure 2, the positivity of attitudes of academic leaders toward AI applications in leadership work in light of the DOI theory increases with increasing digital literacy. Specifically, the scatter plot indicates a positive linear relationship between the possession of digital literacy and the attitudes of academic leaders toward AI applications in leadership work.

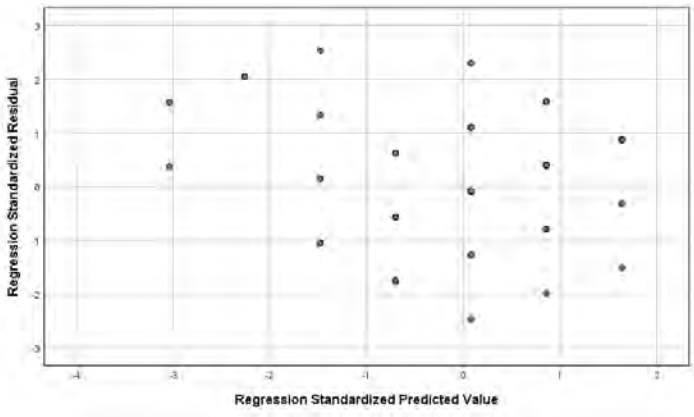

Figure 3: Residual plot

Based on the histogram in Figure 1, the normality assumption required for regression analysis was met. According to Figure 2, the scatter plot demonstrates that the linearity assumption was also satisfied. In Figure 3 above, the data points in the residual plot are randomly distributed about zero, indicating that the independence of residuals and the homogeneity of variance assumptions required for regression analysis were met.

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Regression Analysis

As shown in Table 4, the regression model was statistically significant (F (1, 156) = 130.58, p = 0.000). This result demonstrates that the model is a good fit for the data. The R^2 value of 0.456 indicates that 45.6% of the total variance in the attitudes of academic leaders toward AI applications in leadership work could be explained by the possession of digital literacy. Moreover, the results showed a significant regression coefficient (β = 0.597, $p < 0.05$), indicating that a unit increase in possession of digital literacy increases attitude toward AI applications by 0.597. There is sufficient evidence to support the hypothesis that the possession of digital literacy for academic leaders at UQU has an impact on their attitudes toward AI applications in leadership work in light of the DOI theory.

Table 4

Results of a simple linear regression analysis of the impact of possessing digital literacy on attitudes toward AI applications in leadership work in light of the DOI theory (N = 158).

	Model		ANOVA			Coefficients		
	R	**R2**	**DF**	**F**	**Sig.***	**β**	**T**	**Sig.***
Digital Literacy	0.675	0.456	1	130.58	0.000	0.597	11.43	0.000

*Note. *p ≤ 0.05*

The findings discussed in this work highlight that high digital literacy among academic leaders engenders a positive attitude toward AI applications in leadership work in light of the DOI theory. Specifically, the attitudes toward using AI applications and exchanging information about such applications through educational programs and administrative work were exceedingly positive. The results were consistent with those of Sudarsana et al. (2019), who observed high levels of technical problem-solving, the use of new technologies, and increasing ICT skills in administrative work in Indonesia's education system. The findings align with those of Alhejaili (2022), who emphasized that possessing digital literacy skills is essential for educational leaders in controlling and managing academic sectors to lead the digital transformation. Indeed, digital literacy supports the performance of administrative duties and running academic programs using AI applications and other digital platforms. To ensure high levels of digital literacy at institutions of learning, it is necessary to integrate and utilize technology in teaching practices (Afridi & Chaudhry, 2019; Akram et al., 2022). In turn, such technology offers relative advantages such as high work performance, leadership efficiency, and quality work and leadership experience. Indeed, Božić (2023) asserted that digital literacy enhances the ability of professionals to effectively use digital technologies and AI applications to improve work and outcomes. According to Ng (2012), the ability to adapt to new or emerging technologies is a measurement of an individual's digital literacy, in line with the DOI theory. Therefore, the academic leaders' positive attitudes toward adopting AI in leadership work in this work is an indicator of them being digitally literate at the university.

Furthermore, AI applications should meet university leadership requirements, work lifestyles, and knowledge of current trends in university education (Kengam, 2020). Academic leaders should have the means to experience AI in leadership work, use them at any time, and

benefit from testing and trying them. Indeed, there is a need to ensure the ease of use, access, and usability of such applications if academic leaders are to enhance their digital literacy and adopt these applications. The results of the current study show that academic leaders have increased discussion and information exchange around AI applications. Therefore, UQU might benefit from this positive attitude toward AI applications in leadership work and raise awareness of AI applications through specialized educational programs and activities in AI.

The results affirm that academic leaders in higher education institutions, such as at UQU, strive to offer good-quality leadership and achieve innovation in the current knowledge-driven economy. Başaran and Yalman (2022) observed that the use of ICT in schools depends on the learning institutions' digital capacities. Universities can confront modern organizational challenges and seize available opportunities that come with digital literacy and innovations in teaching and learning (Chaudhry & Kazim, 2022). Indeed, the modern work environment and teaching institutions utilize information technology, especially with the use of AI, to create innovative and creative academic programs and activities (Bason, 2018). UQU, as an institution of higher education, benefits from the digital literacy abilities of its academic leaders, as this increases the positivity of their attitudes toward AI applications in their leadership work. Such leaders can also cope with the challenges of the 21st century academic environment and research by encouraging innovation and creativity.

Conclusion and Implications

The study results showed a high level of digital literacy among academic leaders at UQU, which engenders positive attitudes toward AI applications in leadership work in light of the DOI theory. Specifically, the attitudes toward using AI applications and exchanging information about these applications through educational programs and administrative work were positive. The results show that academic leaders have high discussion and information exchange around artificial intelligence applications. Furthermore, it is also essential to raise awareness of AI applications through educational programs and activities. Finally, the possession of digital literacy for academic leaders at UQU significantly impacts their attitudes toward AI applications in leadership work in light of the diffusion of innovation theory.

The findings of this study hold significant implications regarding the importance of academic leaders' attitudes toward AI applications in leadership work in light of the DOI theory. Overall, academic leaders have a positive attitude toward AI applications in leadership work, and academic leaders who possess digital literacy are more oriented toward applying AI in leadership work than others. Therefore, officials at Saudi universities should benefit from these positive attitudes among academic leaders by fulfilling all the requirements for applying AI in leadership work. In addition, greater attention must be paid to digital literacy and its development among academic leaders. In terms of future research, this study suggests that other variables that might impact academic leaders' attitudes toward using AI applications in leadership work should be measured, such as those related to governance, legislation, systems, and the support of senior leadership.

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Recommendations

Based on the significant impact of academic leaders' digital literacy on their attitudes toward AI applications in leadership work in light of the DOI theory, the following recommendations are provided:

1. A culture of using artificial intelligence applications in leadership work at Saudi universities should be developed and fostered to facilitate and improve work professionalism.
2. The positive attitudes among academic leaders toward AI applications should be utilized by developing and adopting technologies that help accomplish leadership tasks while saving time, effort, and costs in academic settings.
3. The concept of AI in leadership work at Saudi universities should be consolidated by developing a digital culture for emerging and second-level leaders.
4. Digital literacy leadership should be integrated into educational programs for university students.
5. Sufficient support should be provided for those with digital literacy who wish to innovate technological solutions in performing leadership and educational work.
6. National leadership cadres specializing in AI in leadership work should be formed at Saudi universities.
7. Strategic solutions should be developed to improve digital knowledge in the field of AI in leadership work at Saudi universities.

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