The Impact of Technological Innovativeness on the Intention to Utilize Digital Transformation: An Application of Diffusion of Innovation in the Egyptian Private Universities

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Abstract

The purpose of this research is to empirically examine the impact of diffusion of innovation (DOI) on adoption intention to utilize Digital Transformation (DT), as well as to examine the moderation role of gender and education level between diffusion of innovation and adoption intention to utilize DT. The objectives of this research are: to examine how DOI affects adoption intention to utilize DT in the Egyptian private universities, to identify how DOI affects technological innovativeness in the Egyptian private universities, to investigate how technological innovativeness affects adoption intention to utilize DT in the Egyptian private universities, to test the mediation role of technological innovativeness in the relationship between DOI and adoption intention to utilize DT in the Egyptian private universities, to identify the most influential barriers affecting DT adoption in the Egyptian private universities and to develop a framework for the relationship between DOI on adoption intention to DT with mediating role of technological innovativeness in the Egyptian private universities using structural equation modelling. This research used a quantitative analysis by using a questionnaire tool to gather required data and structural equation model analyses (SEM) using AMOS software. The results found that all hypotheses are supported. And the mediation effect indicates that there is partial mediation effect of the technological innovativeness between diffusion of innovation and adoption intention to utilize DT in the Egyptian private universities.

***Keywords**: DOI, Digital Transformation, Technological Innovativeness, Higher Education, Egyptian Private Universities.*

Introduction

In recent years, the global landscape of higher education has witnessed a transformative shift driven by the rapid integration of digital technologies and the advent of Industry 4.0. When examining Industry 4.0 concerns in the service sector, Peterson (2018) pointed out that, depending on the capabilities of both the individuals and the organization, the challenges of Industry 4.0 necessitate ongoing innovation and learning. Consequently, appropriate management approaches are essential to the growth of dynamic capabilities as well as to the creation of a learning and innovative environment (Amara, 2022). The contemporary digital era has brought unprecedented opportunities and challenges for various sectors and domains, such as business, health, education, and government. One of the key imperatives for these sectors and domains is to

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embrace DT, which is the process of using digital technologies to create or modify existing business processes, products, services, or models, to enhance customer value, operational efficiency, and competitive advantage (Bharadwaj et al., 2013; Hanelt, 2021). DT can be also regarded as a type of innovation that requires the adoption of new or improved digital capabilities by the organization and its stakeholders.

In the realm of higher education, higher education institutions (HEIs) globally and particularly in developing regions like Egypt are recognizing the need to digitally transform academic and administrative processes to improve quality, competitiveness, and operational efficiency (Hair et al., 2021). That's why, such institutions undergoing DTs must address issues such as integrating information and communications technology (ICT) into all phases of the teaching and learning process. (Nashaat et al., 2022). Private universities strive to adapt to the demands of the modern era, as the concept of DT has emerged as a pivotal force shaping the educational ecosystem.

Being a developing country, Egypt faces many challenges in its economic, social, and educational sectors. The Egyptian government has recognized the importance of DT and innovation for achieving sustainable development and improving the quality of life of its citizens, and in an attempt to cope up with the global business ecosystem, several initiatives and policies have been implemented to promote the adoption and diffusion of information and communication technologies (ICT) in various domains, such as financial services, healthcare, agriculture, and education (Kamel, 2021). Despite the fact that the adoption of digitally enabled learning in Egypt can offer an affordable and more appropriate solution to the country's higher education demand by bridging the gap between the number of university places currently available in Egypt and the country's growing demand for higher education, the Egyptian Ministry of Higher Education has not yet fully dominated the Egyptian market. (El Gamal et al., 2011). The process of adopting and implementing DT in any field is not a straightforward or simple process, as it involves various factors, such as the characteristics of the innovation, the characteristics of the adopters, the communication channels, the time, and the social context (Rogers, 2003). These factors can be explained by the diffusion of innovation theory, which is a widely used framework to understand how, why, and at what rate new ideas and technologies spread in a social system (Rogers, 2003). According to this theory, there are five main factors or attributes that influence the adoption behavior of a technology or an innovation, namely; relative advantage, compatibility, complexity, trialability, and observability. These factors can affect the perceived usefulness, ease of use, risk, attitude, and behavioral control of the potential adopters, which in turn can affect their adoption intention and behavior and influence their decision to adopt or reject the innovation. (Davis et al., 1989). Another factor that can influence the adoption and implementation of DT is technological innovativeness, which is the degree to which an individual or an organization is willing and able to adopt new or improved technologies that enhance their performance or outcomes (Garcia & Calantone, 2003; Barua & Urme, 2023).

Previous studies have shown that an individual's level of technological innovativeness plays a significant role in the adoption of new technologies (Agarwal & Prasad, 1998; Aldwan et al., 2023). As technological innovativeness refers to an individual's willingness to try out any new information technology (Lu et al., 2003; Al-Qaysi et al., 2021), individuals who score high on technological innovativeness tend to have positive attitudes toward new technologies and are more likely to adopt them earlier than others (Agarwal & Prasad, 1998; Al-Adwan et al., 2023). However, successful large-scale adoption and implementation of emerging information technologies is significantly influenced by key user acceptance determinants like compatibility and individual innovation (Straub, 2009; Scherer et al., 2019) whose study examines evidence on the role of compatibility perceptions in shaping faculty and students' intentions to accept innovations enabling transformation in universities, moderated by inherent technological innovativeness.

Previous studies have applied diffusion of innovation theory to explain user adoption in the context of e-learning systems (Al-Busaidi & Al-Shihi 2010; Alqabbani et al., 2021), cloud computing (Oliveira et al., 2014), and social media (Pai & Tu, 2011). However, research integrating diffusion of innovation theory with techno-

logical innovativeness to predict adoption intention of DT is still scarce. As well as research on the relationship between technological innovativeness and adoption intention of DT, especially in developing countries.

Scholars argued that progress requires moving from fragmented digitization towards more coordinated, stakeholder-centered digitally enabled visions (Gkrimpizi et al., 2023). However, tactical adoption processes within universities often overlook user perspectives (Pham et al., 2021). Clarifying how diffusion variables influence staff technology embracement empowers administrators to proactively cultivate enabling environments for transformative innovations. Findings also provide comparative insights into antecedents for technological acceptance within developing country contexts.

DT has brought new elements that can bolster teaching, such as digital platforms and contents and innovative educational methodologies, the use of these resources can enable more customized, self-regulated, collaborative, and stimulating learning (Benavides et al., 2020). Therefore, Higher education institutions (HEIs) will have to modernize teaching, assessment, and certification. In the context of HEIs, the adoption and implementation of DT is not an instant process. That's why, long-term planning is required, and an evaluation and feedback system should accompany the process, as it involves various challenges and barriers, such as the resistance to change, the lack of resources, the lack of skills, the lack of support, and the lack of alignment (Alshammari et al., 2019).

Private universities in Egypt find themselves at the intersection of tradition and innovation, navigating the complexities of adopting cutting-edge technologies to enhance teaching, learning, and administrative processes (Kaputa et al., 2022). This research endeavors to explore the relationship between the diffusion of innovation and the adoption intention to utilize DT through technological innovativeness within the context of Egyptian private universities. The research also highlights the most influential factors that influence the adoption of DT in Egyptian private universities.

Literature Review

DOI is considered as the independent variable, technological innovativeness is considered as the mediator variable, and the intention to utilize DT is considered as the dependent variable.

DOI

The DOI theory proposed by Rogers (2003) suggests that the adoption of new technologies is influenced by several factors related to innovation itself as well as its potential adopters. This theory has been implemented extensively to understand the adoption of new technologies in various settings, among them is the education field. Previous research has examined the influence of perceived attributes of innovations like relative advantage, compatibility, complexity, trialability and observability on technological innovativeness in universities (Al-Azawei & Lundqvist, 2015; Al-Azawei et al., 2017).

Relative Advantage: Rogers (2003) defined relative advantage as "the degree to which an innovation is perceived as being better than the idea it supersedes". The cost and social status motivation aspects of innovations are elements of relative advantage. For instance, while innovators, early adopters, and early majority are more status-motivated for adopting innovations, the late majority and laggards perceive status as less significant. Moreover, Rogers categorized innovations into two types: preventive and incremental (non-preventive) innovations. To integrate technology successfully into teacher education courses, teacher education faculty should see the need to provide helpful experiences for themselves and their students (Schmidt, 1995; Khan, 2018).

Compatibility relates to the fact that learners feel that the innovation is compatible with their standards, prior involvements, and the desires of the probable adopters. Moore & Benbasat (1991) and Liu (2020) were also of the same view stating that if the e-learning system goes in line with the learners' values, needs and experiences, then the level of perceived compatibility is high. This research employs the term "learner's

perspectives" to denote the viewpoints of individuals regarding the advantages they can derive from utilizing the E-learning system. Prior research on the adoption of information systems has frequently employed perceived compatibility as a measure of users' inclination to use (Venkatesh et al., 2003; Zhao et al. 2021).

Complexity refers to the degree of difficulty in comprehending innovations and the perceived ease of their use by the end-user. According to this definition, the present study uses these terms to describe the level of difficulty perceived by the learner, which influences their learning performance. Prior studies have revealed that if end users regard the e-learning system as being complicated, their inclination to utilize the system is diminished (Tobbin, 2010; Al-Rahmi et al., 2019). A technological innovation might confront faculty members with the challenge of changing their teaching methodology to integrate the technological innovation into their instruction (Parisot, 1995; Thompson et al., 2023), so it might have different levels of complexity. If hardware and software are user-friendly, then they might be adopted successfully for the delivery of course materials (Martin, 2003; Mhlongo et al., 2021).

Observability The term refers to the degree to which the effects of an innovation are observable by others. Individuals were more likely to adopt the innovation if the results were observable and efficient considering speed of acquisition and functionality. Visibility is regarded as a catalyst for peer discourse on novel concepts (Yang, 2020).

Technological Innovativeness

Technological innovativeness is the degree to which an individual or an organization is willing and able to adopt new or improved technologies that enhance their performance or outcomes (Tiberius et al., 2021). Garcia & Calantone (2003); Barua & Urme (2023) clarified in their research paper that technological innovativeness can be seen as a determinant or an outcome of DT, depending on the perspective. From a supply-side perspective, technological innovativeness can be seen as a driver or a facilitator of DT, as it reflects the ability and the motivation to create or adopt new digital solutions. From a demand-side perspective, technological innovativeness can be seen as a result or a measure of DT, as it reflects the extent and the speed of adopting new digital solutions.

Technological innovativeness interprets innovation at a technical level as a prerequisite for the innovation-decision-making process in DOI. It is a perception that the new technology is original and creatively different from existing technology (Rogers, 1995). Robertson (1967) cited in Oh et al., (2022) reported that the process of consciously realizing thoughts, acts, and things was what had been previously unseen. Some new technologies are not innovative, novelty and innovation are not synonymous (Talwar et al., 2020), and innovation is necessary for change to occur. We can say that digital technology is technologically inventive because it is both new and a huge development in this area.

Intention to Utilize DT

DT is the process of using digital technologies to create or modify existing business processes, products, services, or models, to enhance customer value, operational efficiency, and competitive advantage (Bharadwaj et al., 2013; Hanelt, 2021). DT has become a priority for organizations as they seek ways to remain competitive through innovative use of technologies (Oliveira et al., 2014). Universities are no exception in this digital age, as they aim to transform teaching, learning, and operations with new digital tools and technologies. However, successful transformation depends on user adoption and willingness to utilize new systems (Al-Busaidi & Al-Shihi, 2012; Alqabbani et al., 2021).

Higher Education Institutions are transforming into a novel university model. In his study, Cawood (2018) identified several influential factors that will mold the future of universities. These factors include heightened competitiveness, shifts in digital behavior, transformations in the workforce, global mobility, the democratization of knowledge and access, ongoing learning, and the elimination of industry borders.

Similarly, Bloomberg (2018) encompasses cultural transformation, customer-focused modifications, and comprehensive business-ecosystem alterations. Chapco-Wade (2018) said that the need for this is also influenced by university consumers (students) who, due to the current era, have elevated digital expectations from the university. Universities are encountering a competitive atmosphere and are compelled to utilize new digital capabilities to remain pertinent.

DOI and Adoption Intention

DOI theory posits that diffusion of an innovation is determined through a series of communication channels and social networks, and is influenced significantly by potential adopters' perceptions regarding the key attributes of the innovation (Rogers, 2003). These factors shape users' overall attitude and subsequently their intention to adopt and utilize the innovation. Each plays an important role, for instance relative advantage and compatibility have been found to have a positive significant effect while complexity has a negative effect on adoption (Lai, 2017).

Several studies have applied DOI in the higher education context to understand faculty and student acceptance of various IT solutions supporting teaching, learning and administration. For example, Bhatiasevi (2016) surveyed faculty members to analyze perceptions based on DOI characteristics towards an e-learning system introduced in a Thai university. All factors except complexity were found to positively influence behavioral intention, consistent with other studies that mention that complexity impedes technology acceptance (Skoumpopoulou et al.,2018). Additionally, individual differences such as technological innovativeness have been shown to be an important characteristic determining the adoption of IT solutions by faculty and students alike (Fathema et al., 2015; Scherer et al., 2019).

DOI and Technological Innovativeness

Studies have demonstrated that the DOI is influenced by a number of factors, including the perceived characteristics of the innovation, the person's attitude towards the innovation, and the social norms and pressures. Graf-Vlachy et al. (2018), for example, showed that people's attitudes towards technology adoption are influenced by their social norms and peer pressure.

In the meantime, it is crucial to take into account the distinctive features of the local higher education scene when thinking about applying the DOI theory in Egyptian private universities. In 2019, Altbach et al. outlined the prospects and problems that face higher education in Egypt, including those pertaining to infrastructure, funding, and governance. These factors may have a major impact on how technical advances spread among private universities in the Egyptian context.

Furthermore, the significance of organizational culture and leadership in influencing the process of technology adoption was underscored by Xanthopoulou et al. (2022). The primary conclusion is that is that organizational innovation and culture strength are correlated in a curvilinear relation. Optimal levels of cultural strength with regard to innovativeness are found in cultures that are moderately strong. Long-term performance is expected to be higher than that of organizations with strong and weak cultures, and these cultures are expected to be associated with higher rates of administrative, technological, and cultural innovation.

Technological Innovativeness and Adoption Intention

Previous studies have found that a person's level of technological innovativeness influences their willingness to accept new technologies early. Technological innovativeness refers to a person's willingness to experiment with any new information technology (Granić& Marangunić, 2019).

Furthermore, the literature on the influence of DOI and technological innovativeness on adoption intentions to use DT in underdeveloped countries is extremely scarce. Alshammari et al. (2020), for example, investigated the influence of diffusion of innovation factors (relative advantage, compatibility, complexity, trialability, and observability) on cloud computing adoption intentions among faculty members at Saudi Arabian universi-

ties. They found that relative advantage, compatibility, and trialability had a positive and substantial influence on adoption intention, whereas observability and complexity had a negative and minor influence. They also found that faculty members' attitudes and perceived behavioral control affected the adoption intention.

Conceptual Framework and Hypotheses

Based on the literature review, the research conceptual framework was formulated in Figure- 1:

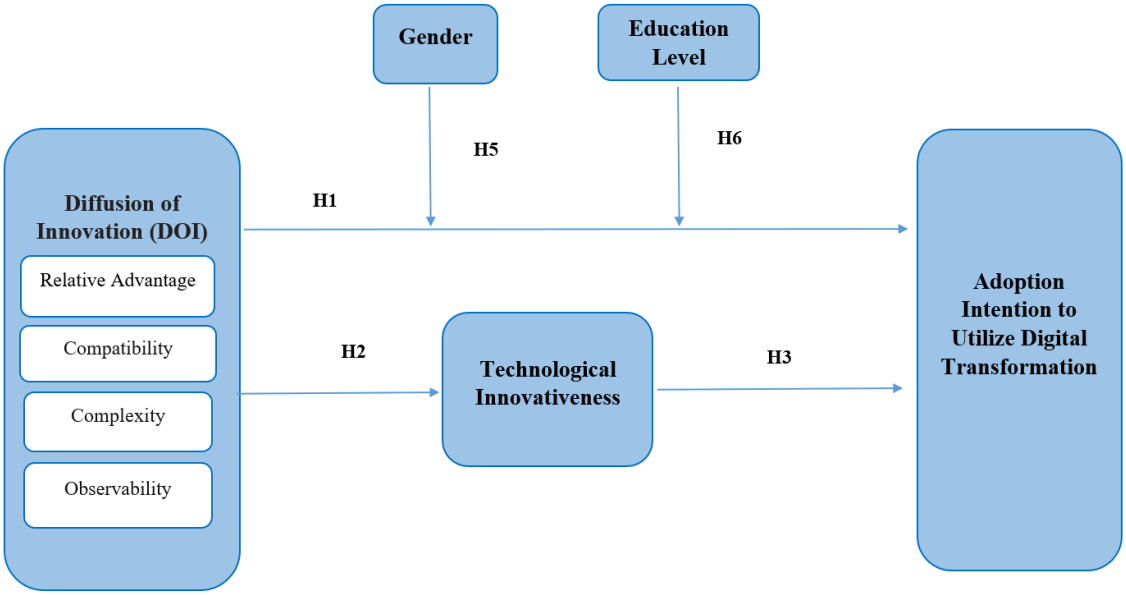

Figure- 1: Conceptual Framework

Research Hypotheses

Based on the conceptual framework, the hypothesized model, and a review of the related studies and theories, the following hypotheses are formulated for the current study:

- **H1:** DOI has an impact on Adoption Intention to Utilize DT in the Egyptian private universities.
- **H2:** DOI has an impact on Technological Innovativeness in the Egyptian private universities.
- **H3:** Technological Innovativeness has an impact on Adoption Intention to Utilize DT in the Egyptian private universities.
- **H4:** Technological Innovativeness mediates the relationship between DOI and Adoption Intention to Utilize DT in the Egyptian private universities.
- **H5:** Gender moderates the relationship between DOI and Adoption Intention to Utilize DT.
- **H6:** Education Level moderates the relationship between DOI and Adoption Intention to Utilize DT.

Research Methodology

According to Creswell (2012), quantitative research is an inquiry approach useful for describing trends and explaining the relation among variables found in the literature. To conduct this research, a questionnaire is used for data collection. The population of this study is the academic and administrative staff in the Egyptian private universities as being the main responsible stakeholders of the DT process in the Egyptian private universities. Cluster sampling is a probability sampling procedure in which the population is divided into discrete groups or clusters prior to sampling. A random sample (systematic or simple) of these clusters is then drawn. The groups are termed clusters in this form of sampling and can be based on any naturally occurring grouping (Saunders et al., 2019). In this study, the research population is the academic and admin-

istrative staff of the Egyptian private universities. The research sample is the academic and administrative staff working in Egyptian private universities that are selected according to the applied cluster random sampling technique according to the geographical location. A survey questionnaire was sent via (google forms online surveys) as the tool of gathering the desired primary data. The data collected from the questionnaires is analyzed with the Statistical Package for Social Sciences (SPSS) version 25 to analyze quantitative data including descriptive statistics (frequencies and percentages) and inferential statistics (correlations) and Structural Equation Model analyses (SEM) using Analysis Moment of Structures (AMOS) software version 26, will analyze the hypothesized models. Table-1 lists the operational definitions of the research model.

Operational Definitions

Table 1: Operational Definition

Variable	Dimensions	Source(s)
Independent Variable: Diffusion of Innovation	Relative Advantages Compatibility Complexity Observability	Al Breiki et al., (2023) Huang et al., (2020) Moore & Benbasat (1991)
Mediator variable: Technological Innovativeness		Oh et al., (2022)
Dependent variable: Adoption Intention to Utilize DT		Esterhuyse et al., (2016) de Kok & Klaiber (2022) Priya et al., (2018)

Results and Findings

The research questionnaire was administered to sevenhundred (700) respondents, 430 questionnaires representing 61.4% were returned, and 42 questionnaires representing 6% were incomplete or ineligible or refusals and 270 (38.6%) were not reached. There were 388 acceptable responses, a response rate 55.4%, which is highly adequate for the nature of this study.

Measurement items have standardized loading estimates of 0.5 or higher (ranging from 0.514 to 0.909 at the alpha level of 0.05, indicating the convergent validity of the measurement model. Discriminant validity shows the degree to which a construct is different from other constructs (Hair et al., 2019).

The Average Variances Extracted (AVE) should always above 0.50 (Hair et al., 2019). The AVE of the constructs (Relative Advantage = 0.562, Compatibility =0.533, Complexity=0.7592, Observability = 0.702, Technological Innovativeness = 0.699 and Adoption Intention to Utilize DT= 0.719) are more than 0.500. Overall, these measurement results are satisfactory and suggest that it is appropriate to proceed with the evaluation of the structural model.

Composite reliability (CR) (Relative Advantage = 0.828, Compatibility =0.601, Complexity=0.852, Observability = 0.921, Technological Innovativeness = 0.920 and Adoption Intention to Utilize DT= 0.939). So, it clearly identified that in measurement model all construct have good reliability.

Tolerance and Variance Inflation Factor (VIF) were examined to identify multicollinearity issue Hair et al. (2011) recommended that multicollinearity is a concern if VIF value is higher than 5 and tolerance value is <0.20. Table-2 indicates that multicollinearity did not exist among the exogenous latent constructs as all VIF values were <5 and tolerance values exceeded 0.20 as suggested by Hair et al. (2011). Thus, multicollinearity is not an issue in the present study. Table -2 shows the VIF values and tolerance values.

Table 2: Assessment of Multicollinearity

Variable	Tolerance	VIF
Relative Advantage	.683	1.465
Compatibility	.509	1.965
Complexity	.512	1.953
Observability	.906	1.104

Measurement Model Results: The 6 factors were subjected to CFA using the AMOS software. DF was 359 (it should be more than 0), $\chi 2$ /DF has a value of 2.604, that is less than 3.0 (it should be less than or equal 3.0). The RMSEA was .058 (it should be less than 0.08). The TLI

index was .936 which is very close to 1.0 (a value of 1.0 indicates perfect fit). The CFI was .944. All indices are close to a value of 1.0 in CFA, indicating that the measurement models provide good support for the factor structure determined through the CFA. The results of the structural model are shown in Figure- 2 and Table- 3.

Structural Model

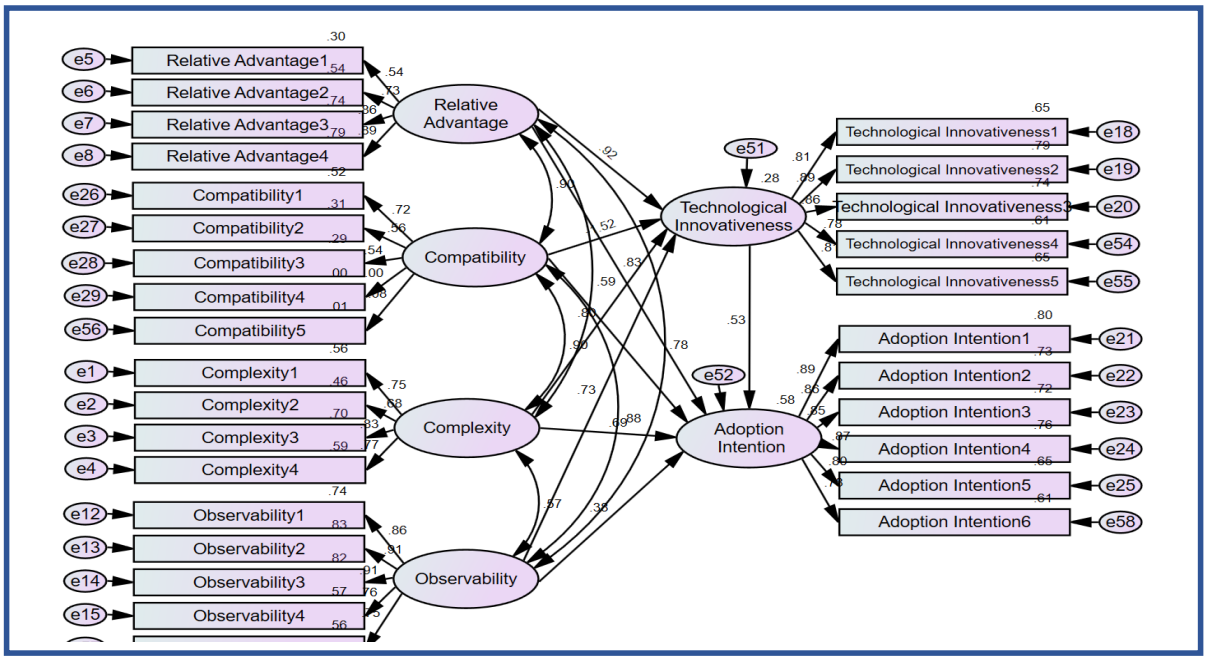

Figure (2) Structural Model (Final Result)

The Structural Model Validity Final Result

The results of structural model, using the AMOS software, show that DF was 364 (it should be more than 0), $\chi 2$ /DF has a value of 2.852, that is less than 3.0 (it should be less than or equal 3.0). The RMSEA was .062 (it should be less than 0.08). The TLI index was .926 which is very close to 1.0 (a value of 1.0 indicates perfect fit). The CFI was .934. All indices are close to a value of 1.0 in CFA, indicating that the measurement models provide good support for the factor structure determined through the CFA.

Table 3: Structural Model Final Result

Goodness of Fit Measures	Name of index	Model Result	Remark
Chi-Square	$\chi 2$	1038.172	accepted
Degrees of Freedom	DF	364	accepted
Chi-Square/ Degrees of Freedom	$\chi 2$ /DF	2.852	accepted
Comparative Fit' Index	CFI	.934	accepted
Tucker Lewis Index	TLI	.926	accepted
Root Mean' Square Error of Approximation	RMSEA	.062	accepted

Discussion

The primary aim of this study is to evaluate the impact of DOI on the Adoption Intention to Utilize DT. The objectives are to investigate the relation between DOI and Adoption Intention to Utilize DT in the Egyptian private universities, to investigate the relation between DOI and Adoption Intention to Utilize DT in the Egyptian private universities, to identify the relation between Technological Innovativeness and Adoption Intention to Utilize DT in the Egyptian private universities, to test the mediating role of Technological Innovativeness in the relation between DOI and Adoption Intention to Utilize DT in the Egyptian private universities, to examine the moderating role of Gender and Education Level between Diffusion of Innovation and Adoption Intention to Utilize DT and to highlight the most influential factors affecting the adoption of DT in the Egyptian private universities.

Regarding the First Objective: To investigate the relation between DOI and Adoption Intention to Utilize DT in the Egyptian private universities. Due to the individual tests of significance of the relationship between the variables. It reveals that, (β = 0.828, CR (Critical Ratio) = 22.556, CR > 1.96, p = 0.000, p<0.05). Therefore, (**H1$_{.1}$:** Relative Advantage has an impact on Adoption Intention to Utilize DT in the Egyptian private universities) is supported. This result is consistent with Naruetharadhol et al., (2021) who assessed that relative advantage had the most substantial impact on adoption intentions for educational cloud computing services.

H1$_{.2}$: Compatibility has an impact on Adoption Intention to Utilize DT in the Egyptian private universities. (β = 0.228, CR (Critical Ratio) = 8.918, CR > 1.96, p = 0.000, p<0.05) is supported. This is consistent with Taherdoost (2018). Multiple technology acceptance studies highlight compatibility as a key driver of users' willingness to utilize new digital tools and platforms across various contexts (Oliveira et al., 2014).

H1$_{.3}$: Complexity has an impact on Adoption Intention to Utilize DT in the Egyptian private universities. (β = 0.692, CR (Critical Ratio) = 13.564, CR > 1.96, p = 0.000, p<0.05). is supported. Studies have found that perceived complexity negatively influences employees' intention to adopt new technologies related to DT. This effect is pronounced when the technologies are perceived as relatively difficult to use and understand (Lee et al., 2019). Employees with lower technological innovativeness may struggle to learn complex new systems and therefore resist adoption (Wang et al., 2010). This dynamic has been explored across industries but appears especially relevant in higher education, where resources for training and support may be limited (Abdullah et al., 2022). However, organizations with innovative cultures and technology-focused leaders can inspire greater adoption intention despite complexity (Rodrigues et al., 2016). Additionally, hiring and cultivating technologically innovative staff helps buffer against perceived complexity barriers to adoption (Lee et al., 2019).

H1$_{.4}$: Observability has an impact on Adoption Intention to Utilize DT in the Egyptian private universities. (β = 0.379, CR (Critical Ratio) = 3.543, CR > 1.96, p = 0.000, p<0.05). is supported. This result is consistent with Lee et al., (2019); and Rodrigues et al., (2016) who demonstrated that, observability significantly predicts adoption of new tools related to DT found observability significantly predicts adoption of new tools related to DT. HEIs are facing various challenges and opportunities in the digital era, such as the increasing demand for quality education, the changing needs and expectations of students and employers, the growing competition and globalization, and the rapid development and diffusion of new technologies (Altbach et al., 2019). Therefore, HEIs need to embrace DT as a strategic imperative to enhance their performance, competitiveness, and sustainability. Based on the above results "**H1:** Diffusion of innovation has an impact on Adoption Intention to Utilize DT in the Egyptian private universities" is supported.

Regarding the Second Objective: To examine the relation between DOI and Technological Innovativeness in the Egyptian private universities.**H2$_{.1}$:** Relative Advantage has an impact on Technological Innovativeness in the Egyptian private universities. (β = 0.923, CR (Critical Ratio) = 18.967, CR > 1.96, p = 0.000, p<0.05) is supported. This is consistent with Lee et al. (2019) who demonstrated that the relative advantage of technological innovations was a key factor in determining their role in shaping technological innovativeness.

H2$_{.2}$: Compatibility has an impact on Technological Innovativeness in the Egyptian private universities. (β = 0.516, CR (Critical Ratio) = 13.070, CR > 1.96, p = 0.000, p<0.05) is supported. Alshammari et al., (2019) examined the impact of compatibility, relative advantage, complexity, and observability on the adoption intention of cloud computing among faculty members in Saudi Arabian universities. They found that compatibility and relative advantage had a positive and significant impact on adoption intention, while complexity and observability had a negative and insignificant impact. They also found that the adoption intention was mediated by the attitude and the perceived behavioral control of the faculty members.

H2$_{.3}$: Complexity has an impact on Technological Innovativeness in the Egyptian private universities. (β = 0.800, CR (Critical Ratio) = 14.971, CR > 1.96, p = 0.000, p<0.05) is supported. Research has shown

that complexity can have both positive and negative effects on technological innovativeness. On the one hand, complexity can lead to the development of more sophisticated and innovative technologies, as it allows for the integration of multiple components and systems, leading to increased functionality and performance (Poutanen et al., 2016). On the other hand, complexity can also lead to increased costs, longer development times, and higher risk of failure (Khosravi et al.,2019). Moreover, Venkatesh &Morris (2000) and Maheshwari (2021) examined home computer users and found complexity had little influence on innovativeness once participants gained experience using the technologies. However, innovations that have been seen as initially complex can still achieve widespread usage if complexity barriers are proactively addressed. Training workshops, user manuals, helpdesk support, and customization options enabled successful implementations of management technologies (OECD, 2016). Within a university, complexity perceptions declined as professors and students gained first-hand experience with a new course management system (Fathema et al., 2015).

$H2_{.4}$: Observability has an impact on Technological Innovativeness in the Egyptian private universities. ($\beta = 0.729$, CR (Critical Ratio) = 12.728, CR > 1.96, p = 0.000, p<0.05) is supported. Observability plays a key role in inter-firm technology diffusion, as companies are more likely to imitate innovations when implementation consequences are readily apparent in competing organizations (Greve, 2011). At the individual level, several studies demonstrate that potential technology users are more influenced by innovations they can directly observe providing value to peers (Bandura, 1986; Tang et al., 2023). Such visibility builds interest and perceived usefulness of new technologies (Venkatesh & Davis, 2000; Al-Fraihat, 2020). Based on the results "**H2:** Diffusion of innovation has an impact on Technological Innovativeness in the Egyptian private universities" is supported.

Regarding the Third Objective: To identify the relation between Technological Innovativeness and Adoption Intention to Utilize DT in the Egyptian private universities. The result ($\beta = 0.530$, CR (Critical Ratio) = 8.504, CR > 1.96, p = 0.000, p<0.05) is supported. This result is consistent with (Agarwal & Prasad, 1998; Al-Adwan, et al., 2023). Within higher education, faculty and administrators' technology readiness is increasingly vital for successful Dt initiatives (Porter & Graham, 2016). Moreover, previous studies have found that an individual's level of technological innovativeness influences their intention to adopt new technologies early on. Technological innovativeness refers to a person's willingness to experiment with any new information technology (Granić& Marangunić, 2019).

Regarding the Fourth Objective: To test the mediating role of Technological Innovativeness in the relation between DOI and Adoption Intention to Utilize DT in the Egyptian private universities. A statistically significant indirect effect between Relative Advantage and Adoption Intention to Utilize DT through Technological Innovativeness (P = 0.004, P<0.05). The results of the mediation effect indicate that there is partial mediation effect of Technological Innovativeness between the relation of Relative Advantage and Adoption Intention to Utilize DT. In addition, a statistically significant indirect effect between Compatibility and Adoption Intention to Utilize DT through Technological Innovativeness (P = 0.004, P<0.05). The results of the mediation effect indicate that there is partial mediation effect of Technological Innovativeness between the relation of Compatibility and Adoption Intention to Utilize DT. This result is consistent with what was concluded in a study by Abd El Aziz (2018), that there is a partial mediation role of Technological Innovation between the research variables; compatibility, economic factors and social factors on Mobile Learning Performance in the Egyptian higher education sector.

Moreover, a statistically significant indirect effect between Complexity and Adoption Intention to Utilize DT through Technological Innovativeness (P = 0.003, P<0.05). The results of the mediation effect indicate that there is partial mediation effect of Technological Innovativeness between the relation of Complexity and Adoption Intention to Utilize DT. Furthermore, a statistically significant indirect effect between Observability and Adoption Intention to Utilize DT through Technological Innovativeness (P = 0.004, P<0.05). The results of the mediation effect indicate that there is partial mediation effect of the Tech-

nological Innovativeness between the relationship of Observability and Adoption Intention to Utilize DT. Based on the results (**H4:** Technological Innovativeness mediates the relation between Diffusion of innovation and Adoption Intention to Utilize DT) is supported. This is consistent with Wang et al., (2020) who supported that, an organization's technological innovativeness orientation strengthens adoption intentions for digital advancements. Technologically innovative universities actively experiment with and implement emerging technologies (Ahmedova., 2023), which positively affects adoption. More innovative users face fewer barriers in accepting innovations with high perceived relative advantage (Fathema et al., 2015). An individual's inherent innovativeness in the technological domain, reflecting their willingness to experiment with new technologies, has been established as an important precursor to adoption decisions in education and beyond (Fathema et al., 2015).

Regarding the Fifth Objective: To investigate the moderation role of gender between DOI and Adoption Intention to Utilize DT.

The interaction effect of "Gender" on the linkage between Relative advantage and Adoption Intention to Utilize DT is stronger for "Male". (Beta (β) Value for "Male" =. 868 and Beta (β) Value for "Female" =.756

The interaction effect of "Gender" on the linkage between Compatibility and Adoption Intention to Utilize DT is stronger for ""Male". (Beta (β) Value for "Male" =.321 and (Beta (β) Value for "Female" =.145.

The interaction effect of "Gender" on the linkage between Complexity and Adoption Intention to Utilize DT is stronger for "Female". (Beta (β) Value for "Female" =.700 and Beta (β) Value for "Male" =.690.

The interaction effect of "Gender" on the linkage between Observability and Adoption Intention to Utilize DT is stronger for "Male". (Beta (β) Value for "Male" =. 411 and Beta (β) Value for "Female" =.386. Based on the results (**H5:** Gender moderates the relation between Diffusion of innovation and Adoption Intention to Utilize DT in the Egyptian private universities) is supported.

Regarding the Sixth Objective: To investigate the moderation role of Education Level between DOI and Adoption Intention to Utilize DT

The interaction effect of "Education Level" on the linkage between Relative advantage and Adoption Intention to Utilize DT is stronger for "Master degree". (Beta (β) Value for "Master degree" =. 860, Beta (β) Value for "Bachelor degree" =.832 and Beta (β) Value for "PhD- DBA degree" =.793.

The interaction effect of "Education Level" on the linkage between Compatibility and Adoption Intention to Utilize DT is stronger for "Bachelor degree". (Beta (β) Value for "Bachelor degree" =. 213, (Beta (β) Value for "Master degree" =.180 and Beta (β) Value for "PhD- DBA degree" =.040.

The interaction effect of "Education Level" on the linkage between Complexity and Adoption Intention to Utilize DT is stronger for "Bachelor degree". (Beta (β) Value for "Bachelor degree" =.690, Beta (β) Value for "PhD- DBA degree" =.665 and Beta (β) Value for "Master degree" =.651.

The interaction effect of "Education Level" on the linkage between Observability and Adoption Intention to Utilize DT is stronger for "Master degree". (Beta (β) Value for "Master degree" =. 344, Beta (β) Value for "Bachelor degree" =.329 and Beta (β) Value for "PhD- DBA degree" =.263. Based on the results (**H6:** Education Level moderates the relationship between Diffusion of innovation and Adoption Intention to Utilize DT in the Egyptian private universities) is supported.

Regarding the final objective: The frequency of "Barriers to DT Adoption" indicates that the majority (342) of respondents selected "Weak, unsupportive, and limited IT infrastructure", which is 16.8% as the most influential barrier to DT in the Egyptian private universities, the next highest is 8.1% of respondents (165) "Employees reluctant to leave their comfort zone", the 3rd level of respondents 7.7% selected "Insufficient funds". The 4th level of respondents 7.6% selected "Lack of IT support service ", the 5th level of respondents 7.6% "Insufficient digital technology skills", the 6th level of respondents 7.6% Organizational resistance to

change", the 7th level of respondents 6.8% "Attitudes and beliefs about digital technology", the 8th level of respondents 6.6% "Lack of commitment to adopt DT". The 9th level of respondents 6.1% "Lack of organizational leadership skills to ideate, plan and lead execution". The 10th level of respondents 5.6% "Lack of government plan, and policy ", the 11th level of respondents 5.4% "Lack of interest in technology and innovation", the 12th level of respondents 5.0% "Lack of time to incorporate digital technology", the 13th level of respondents 4.8% "Uncertain economic environment" and the 14th level of respondents 4.2% "Difficulty of embedding ICT into higher education". Consequently, this goes in line with what was mentioned by Khourshed et al., (2023) to help with quality improvement, the development of a learning organizational culture should be studied, as well as human-computer interaction, education, and training. Also, decision-makers should provide suitable training to lecturers to teach them how to use digital technology and AI applications as a teaching method that satisfy the needs of each student. (Ragheb et al., 2022).

Authors' Contribution

This paper has dual significance both academically and practically.

Academic Contribution: the current paper fills the gap in the literature regarding using the DOI theory in the higher education field in developing countries, namely Egyptian private universities, as well as developing a model that contributes to other models that have recommended expanding the investigative scope using structural equation modelling technique. Results show that, the estimated structural model corroborated the nine hypotheses, as Diffusion of innovation (Relative Advantage, Compatibility, Complexity and Observability) construct explained 28.2% of Technological Innovativeness variance ($R^2 = 0.282$), Besides, Diffusion of innovation (Relative Advantage, Compatibility, Complexity and Observability) through Technological Innovativeness explained 58.5% of Adoption Intention to Utilize DT variance ($R^2 = 0.585$).

Practical Contribution: this paper gives insights to managers and practitioners who work in the Egyptian private universities on how to cope with and adapt to the transformative shift driven by the rapid integration of digital technologies that the sector faces. The study also highlights the potential drivers and potential challenges in regards of DT adoption in the HE sectors. DT presents a unique opportunity to address the challenges, support the continuity of education, and build a more resilient and inclusive educational environment for the future. By adopting a comprehensive, collaborative, and innovative approach, Egyptian higher education institutions can harness the power of digital technologies to overcome the barriers imposed by the conflict and ensure that all students can access quality education. In doing so, these institutions can contribute to the country's long-term growth, fostering the development of a skilled and competitive workforce equipped to face the challenges and opportunities of the 21st century. Ultimately, successfully implementing a DT strategy in the Egyptian higher education is imperative for the immediate needs of both the country's students and educators and a crucial investment in the future of Egypt.

Limitations and suggestions for future research

Firstly, because this study was cross-sectional, it is not possible to investigate the nature of cause-and-effect connections between the variables. Future study should therefore focus on the requirement for a longitudinal strategy.

Secondly, because this study's sample was limited to one nation (Egypt) and private universities, it is important to proceed with caution when interpreting the results. Even though the research context is extremely specialized, it is thought that the conclusions apply to various fields and nations.

Thirdly, a cluster sample approach was used to gather information from respondents over a predetermined period, which led to a limitation. The range of respondents who might participate was restricted by the short time window for data collecting. Because responses are acquired based on respondents' accessibility and may not give a representative sample, the cluster sampling approach used to gather responses may have also limited the range of respondents who would participate.

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