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7

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ELECTRONIC LEARNING AND THE DIGITAL DIVIDE IN SUDAN: A SUSTAINABLE DEVELOPMENT APPROACH FOR E-LEARNING ADOPTION AMIDST PANDEMICS AND CIVIL UNREST

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ABSTRACT

PURPOSE: With the advent of the information age and the growth of the Internet, many countries worldwide have looked into ways to incorporate novice innovation from information technology into their educational system. In tandem with the growth of this new form of innovation in learning, the national innovation system in the Middle East and North Africa (MENA) faced two main obstacles: policies that support the acceptance of novice innovation, and bridging the digital divide. Our study looks into the adoption of e-learning systems in Sudan and provides policies that would help increase the adoption of e-learning systems in Sudan.

DESIGN/METHODOLOGY/APPROACH: The paper is based on reliable and valid constructs that have been validated in several settings. It employs PLS to explore the significance of performance expectancy, effort expectancy, social influence and price value, which shows an intention to use e-learning systems.

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FINDINGS: At the macro level, the study points out a strong need for a public-private partnership to support innovation in e-learning, especially with the advent of pandemics such as COVID-19 and civil unrest. The partnership should work on lowering Internet costs (Internet mobile service provider side) and Internet taxation costs (government side) for students who use the Internet to access e-learning and universities that implement e-learning systems. At the micro-level (student level), performance expectancy, effort expectancy, social influence and price value all showed a positive relationship with intention to use.

ORIGINALITY/VALUE OF THE PAPER: The study explores the validity and reliability of the UTAUT model in the context of Sudan as a North African country, paving the way for more quantitative and empirical research in Sudan. This study would pave the way for further extended research that looks into other factors affecting the development of e-learning systems in the developing world. On the practical side and at the micro-level, universities in Sudan and the MENA region must incorporate digital literacy courses from the student's first year as soon as possible. These courses would empower them to be on the same level as their peers in other parts of the world and help them access the world of knowledge that the Internet has to offer. On the macro-level, public-private partnerships are essential in setting policies that reduce the cost incurred by the student in accessing the Internet across the MENA region. This partnership would help empower students to use these systems at an affordable price, bridging the gap that hinders them from accessing the Internet.

KEYWORDS: *Sustainable Development; E-learning; Education; Civil Unrest; Digital Divide*

INTRODUCTION

The development of the information age has ushered in a new paradigm shift in learning and has paved the way for two-way interaction between students and educators over the electronically mediated system, which we today call e-learning. The development of information e-learning has crossed borders and created new outlets for students and instructors alike worldwide to learn and enrich their academic endeavours. The utilisation of information technology provides a variety of tools and systems, such as the Internet, intranet, e-mails, that enhance e-learning services in accordance with the needs of users. In this respect, e-learning is considered as a facilitator for teaching and research and provides great benefits for all users in the education institutions in terms of time, space, and effort, irrespective of their physical location. Haythornthwaite and Andrews (2011) pointed out that e-learning as a transformative movement is not just the transfer of learning to an online stage but also in research and science. Moreover, they have indicated that e-learning is not bounded by institutional structures of courses, programmes, or degrees, but instead embracing how learning flows across physical, geographical, and disciplinary borders.

Because e-learning is technology-based, many concerns should be paid to its design to ensure that it is clearly understood and accepted by users. Moreover, the effective use of tools of e-learning depends on the perceptions and competencies of users as well as the infrastructure of institutions. However, access to the facilities of e-learning is not evenly available to beneficiaries; this results in what West (2011) termed as the "digital divide", a phrase used to explain the gap between people who can easily use and access technology, and those who cannot. Therefore, the problem of bridging the digital

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divide is persistent in many parts of the world, affecting the implementation and success of initiatives such as e-learning. Several concerns from the implementers of e-learning systems in the developing world have been raised and include, but are not limited to, Internet connectivity and the digital divide, digital literacy, and digital transformation; these were considered barriers to the development of e-learning in the MENA region (El-Masri and Tarhini, 2017; Salloum *et al*., 2019; Bahanshal and Alam Khan, 2021; Gibreel *et al*., 2021; Abdelmonem *et al*., 2023).

With the advent of COVID-19, coupled with the Sudanese Revolution, the e-learning initiative has grown in Sudan because many major universities were on lockdown during this period. Nonetheless, there has not been an extensive empirical study on the factors and barriers to adopting an e-learning system in Sudan during COVID-19 and the civil unrest during the Sudanese revolution. This study is driven by two primary research questions: 1) What factors most significantly influence the adoption and effective use of e-learning systems in the context of Sudan's ongoing challenges, including the COVID-19 pandemic and the Sudanese Revolution? 2) In what ways does the digital divide manifest in Sudan, and how does it impact the efficacy and accessibility of e-learning solutions? To answer these questions, our objectives are twofold: first, to systematically identify and analyse the key determinants of e-learning system acceptance among Sudanese learners and educators; and second, to propose targeted strategies aimed at overcoming the barriers posed by the digital divide. Through this research, we aspire to contribute valuable insights that can inform the design, implementation, and policy frameworks for e-learning in Sudan and similar contexts.

The rest of the paper is organised as follows: the next section provides the literature review with the main focus on the Unified Theory of Acceptance and Use of Technology (UTAUT) in the context of e-learning and its constructs, as well as the empirical results from different economies. This is followed by a description of the research methodology, including the analytical model, the factors/constructs to be explored and data collection. The next section presents the data analysis, while the penultimate section provides a discussion of the results. The final section includes the main conclusions and provides policy implications.

LITERATURE REVIEW

The literature contains different but related learning theories that are employed by professionals to develop e-learning theory and promote its applications and practices in education institutions. These include behaviourism, cognitive and active learning theories, among others. The focus of e-learning theory incorporates cognitive principles that explain the ways in which electronic educational technology can be designed and employed to promote effective learning. The process of e-learning is influenced by a

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10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

diversity of factors that include stakeholders, technology and learning activities. These factors induced and motivated researchers to embark on developing theoretical frameworks that can be applied to investigate the effectiveness and efficiency of the e-learning systems. For example, Aparicio *et al*. (2016), proposed an e-learning theoretical framework based on three dimensions or pillars that include users, technology and services with the objective of integrating the learning strategies, the stakeholders and technology for the sake of assessing the implementation of e-learning systems (Aparicio *et al*., 2016). The proposed theoretical framework is very holistic because, within each pillar of the framework, the researchers spelled out the main participants and activities. For example, within the people dimension, the main stakeholders include students, teachers, professional associations and top management. In the case of e-learning activities, attention was focused on issues related to instructional policies as well as pedagogical models. In the area of technology, the model elaborated on the modes of communication, collaboration and content.

What is important about this framework is that it provides a methodology for undertaking multiple studies in e-learning systems. For instance, Al Kurdi *et al*. (2020) developed a theoretical framework based on the technology acceptance model (TAM) to investigate the main factors that influence students' acceptance of e-learning. According to TAM, two factors determine acceptability of technology, mainly perceived ease of use and perceived usefulness. Their proposed theoretical model went beyond these factors to incorporate social influence, perceived enjoyment and self-efficacy (Al Kurdi *et al*., 2020). Such factors are considered of vital importance in the cultural context of developing countries, including Sudan.

The Unified Theory of Acceptance and Use of Technology (UTAUT) model is regarded as one of the most robust models for understanding technological artefact usage and implementation in the context of Human-Computer Interaction (Venkatesh *et al*., 2003; Venkatesh *et al*., 2012; 2016). The model has demonstrated notable results in assessing users' adoption of information systems while using information systems to complete specific tasks or projects. In the context of e-learning, UTAUT has the following constructs: e-learning performance expectancy, e-learning effort expectancy, e-learning social influence, price value and behaviour intention (Venkatesh *et al*., 2003; Venkatesh *et al*., 2016). It should be noted that there are two versions of UTAUT. The first version has performance expectancy, effort expectancy, social influence, facilitating conditions and behaviour intention (Venkatesh *et al*., 2003). The second version has been revised to amend other constructs, such as price value, that consider the consequence of the information system's perceived price value on the user's intention to use the technology (Venkatesh *et al*., 2016). In line with UTAUT, performance expectancy, effort expectancy, price value and social influence are hypothesised to influence the dependent variable, which is the behavioural intention to use a system.

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E-learning performance expectancy is defined as "the degree to which using a technology will provide benefits to consumers in performing certain activities" (Venkatesh *et al.*, 2003; Venkatesh *et al.*, 2012). Several studies have investigated performance expectancy in e-learning worldwide but not in Sudan or North Africa. Joo *et al.* (2014) looked into performance expectancy in South Korea from a mobile learning perspective connected to e-learning. Their results were significant in adopting e-learning systems (Joo *et al.*, 2014). Several research results confirmed the validity of performance expectancy in e-learning but not in the context of North Africa or Sudan (Joo *et al.*, 2014; Mehta *et al.*, 2019; Marlina *et al*., 2021).

E-learning effort expectancy is defined as "the degree of ease associated with the use of the system" (Venkatesh *et al*., 2003; Venkatesh *et al*., 2012), i.e., the effort a user of an e-learning system takes to secure the means of understanding and to use e-learning systems. Tarhini *et al*. (2017), conducted a study in the UK for students in two universities using effort expectancy as one of their constructs. The results were significant in that effort expectancy of ease of using the system helped in the intention to adopt the e-learning system (Tarhini *et al*., 2017). Developing solid digital skills for students at an early stage helps empower them with the tools and skills needed to use and understand these systems faster and better. Therefore, we wish to explore this construct in the context of Sudan; this is because the National University Sudan has an extensive course on computer usage and applications in their students' foundation years to help bridge the digital divide (Gibreel *et al*., 2021). With the digital divide playing a significant role in the Middle East and North Africa, we wish to explore this factor in the context of Sudan.

Social influence is defined as "the extent to which consumers perceive that important others (e.g. family and friends) believe they should use a particular technology" (Venkatesh *et al*., 2003; Venkatesh *et al*., 2012). Several studies on information and communication technology (ICT) for development point out the effect of social influence on using ICT (Shapiro and Varian, 1999; Agarwal *et al*., 2005). On the other hand, the influence on society based on socio-behavioural and social influence on e-learning has been conducted in countries such as the United Arab Emirates. The studies have revealed that social influence is a significant factor in students' intention to use e-learning systems (Al Kurdi *et al*., 2020). Therefore, we wish to study this factor further in the context of Sudan.

Price value is defined as the "consumers' trade-off between the perceived benefits of the applications and the monetary cost for using them" (Venkatesh *et al*., 2003; Venkatesh *et al*., 2012). The price value was operationalised in this study due to financial constraints. The effect of the price of the Internet is high in the least developed countries such as Sudan (ITU, 2021).

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10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

E-learning is similar to other Internet-mediated systems and might be affected more by price because it is targeted at young students whose disposable income is not high, and some do not even have disposable income to support their Internet usage. We therefore wish to explore this construct in this study. Finally, we wish to explore students' adoption tendencies as they move from year 1 to years 2, 3 and 4. As students are exposed more to the usage of digital software and tools in their academic settings, we propose that students in the later years of their undergraduate studies can adopt and use e-learning systems better than in their first years. We postulate the following hypothesis for this case study in the context of a Sudanese University in the Sudan, National University Sudan.

The MENA region has not been out of reach of newly emerging technologies such as e-learning. Therefore, several researchers have studied the development of e-learning systems in the MENA region. In the Kingdom of Saudi Arabia, at the peak of the COVID-19 pandemic, a study was conducted at King Abdelaziz University (KAU) for professors and students on adopting and using the e-learning system. The study pointed out that most participants had positive attitudes towards e-learning. Furthermore, students were eager to use the e-learning system so they would not lose the chance to finish their academic studies on time (Bahanshal and Alam Khan, 2021).

On the other side of the MENA region in the North African state of Morocco, Ouajdouni *et al*. (2021) explored the adoption of an e-learning system in 12 universities and 31 educational institutions. Their study indicates that lecturer quality affects perceived usefulness, e-learning system usage, and e-learner satisfaction. On the other hand, system quality positively affects perceived use and e-learner satisfaction (Ouajdouni *et al*., 2021). In Egypt, Abdelmonem *et al*. (2023) conducted a survey study collected from over 6,000 survey respondents across 28 universities using e-learning systems among medical students. The study results indicated that the e-learning system was best suited for academic/theoretical education rather than clinical education. Furthermore, the study pointed out that private universities were better at adopting e-learning than governmental universities. Finally, students in rural areas face problems accessing the e-learning system due to the low quality of Internet access (digital divide) compared to their peers in urban areas (Abdelmonem *et al*., 2023).

On the other hand, innovations, quality, trust, and information sharing increase student acceptance of e-learning systems (Abdelfattah *et al*., 2023). Furthermore, studies have also branched out from the adoption aspect of e-learning to students' continuing intention to use parts of e-learning. For example, Alamin *et al*. (2022) explored two models: the technology acceptance model (perceived ease of use, perceived usefulness) and the expectation-confirmation model (confirmation and satisfaction). The study pointed out that perceived ease of use, usefulness, confirmation and satisfaction significantly affect continuance intention to use e-learning (Al Amin *et al*., 2023). Figure 1 showcases some of the pros and cons of e-learning system development in Sudan.

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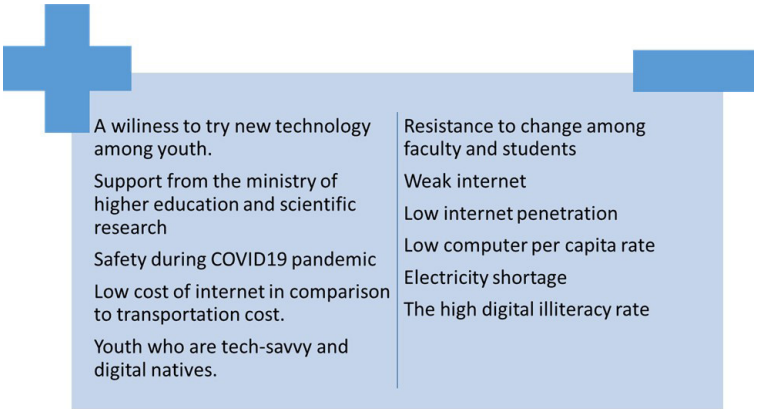

Figure 1 The pros and cons of e-learning adoption in Sudan

Source: Developed by the authors through interviews with students and staff

RESEARCH METHODOLOGY

Research Model and Hypotheses:

This study rigorously employs the Unified Theory of Acceptance and Use of Technology (UTAUT) to explore the intricate dynamics of e-learning system adoption in Sudan, acknowledging the intricate interplay of technology acceptance drivers in a developing country context. Complementing UTAUT, the paper also examines theories surrounding the digital divide, recognising it as a multifaceted phenomenon encompassing not just access to technology but also the skills, motivations, and opportunities to use technology effectively. By intertwining these theoretical perspectives, our analysis goes beyond surface-level observations to unravel deeper insights into the specific challenges and opportunities that shape e-learning in Sudan. This dual-theoretical approach not only anchors our study in robust academic discourse but also illuminates pathways for practical interventions to enhance e-learning adoption. The main constructs of the model are: E-learning Performance Expectancy; E-learning effort expectancy; E-Social Influence; E-learning Price Value. Based on the literature review and previous studies, we formulate the following hypotheses, as shown in Figure 2.

***Hypothesis 1*:** E-learning performance expectancy is positively related to Behaviour intention.

***Hypothesis 2*:** E-learning effort expectancy is positively related to behaviour intention.

***Hypothesis 3*:** E-learning social influence is positively related to behaviour intention.

***Hypothesis 4*:** Internet price value is positively related to behaviour intention.

***Hypothesis 5*:** The number of years of academic studies is positively related to behaviour intention.

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11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

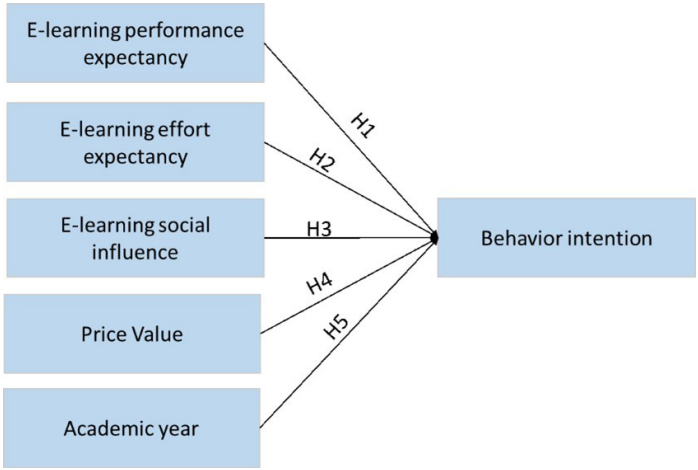

Figure 2 Proposed research framework

Source: Venkatesh *et al.* (2012)

Data Collection

Data were collected by distributing an online web questionnaire for university students during the pandemic and civil unrest era using an online survey questionnaire (Likert scale from 1 to 5). The data were analysed using both the latest version of SPSS 29 and the latest version of SmartPLS 4.0, released on 2023-12-05, for cleaning data and variable imputation and structural equation model (SEM) analysis. This study was conducted at National University, Sudan. All questionnaires administered in this study were gathered from National University Sudan students who used the e-learning system developed by National University Sudan and the Moodle learning management system. National University Sudan uses the Moodle Platform. Moodle, a Modular Object-Oriented Dynamic Learning Environment, is a free and open-source learning management system on the GNU General Public License (Dougiamas and Taylor, 2003). The student who used the Moodle learning management system at National University Sudan was this study's unit of analysis. The number of respondents (cases gathered) was 327. In the case of data inspection and cleaning, from the 327 sample size, 49 cases had missing data points and were removed from the study. Two cases had unreasonable outlier data on the Age variable; both were imputed with the mean of the Age variable, leaving us with a total of 278 cases. The sample is sufficient and adequate to perform the statistical analysis.

DATA ANALYSIS

In this section the paper provides the descriptive statistics, preliminary data analysis and the model results.

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Descriptive Statistics

Regarding gender, 33% were male, and 67% were female. Regarding the year the student is studying, 31% were in the first year, 14% were in the second year, 25% were in the third year, 18% were in the fourth year, and 12% were in the fifth year. Table 1 lists the descriptive statistics of the constructs and observable variables studied in this paper.

Table 1 The descriptive statistics of the constructs and observable variables

	N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Intention	278	0.98	4.91	3.2991	1.17794
Social	278	1.01	5.07	3.3312	1.17237
Price	278	0.93	4.75	2.7106	1.19981
Effort	278	0.98	5.02	3.5266	1.15006
Performance	278	0.97	4.85	3.0356	1.16962
Year	278	1	5	2.66	1.397

Source: Constructed by authors

Preliminary Data Analysis

Preliminary data analyses were assessed using the following phases. The first phase assessed normality with an appropriate test. For normality testing of skewness and kurtosis, Kline (2015) suggested that a dataset should be considered normal if skewness is between –2 and +2, and kurtosis is between –7 and +7. For skewness, all items satisfied the –2 to +2 range, and for kurtosis, all items were in the range of –7 to +7 (Kline, 2015). The second phase, the measurement model, was analysed for convergent validity and discriminant validity. In convergent validity, four items with factor loadings below 0.5 were removed. Most item loadings exceeded the level of 0.8, with more than 60% of items exceeding 0.8 (Hair *et al*., 2013). There was no strong cross-loading in discriminant validity. As for reliability, Cronbach's alpha, a method for measuring internal consistency, was conducted, and results were uniformly above 0.70. Performance expectancy was 0.89, Effort expectancy was 0.84, Social influence was 0.87, Price Value was 0.84; Behaviour intention was 0.87 (Kline, 2015). We assessed the convergent validity by testing that the outer loading and the Average Variance Extracted (AVE) were strong with none dropping below 0.700. The AVE values for all of the constructs ranged from 0.763 to 0.891, indicating good convergent validity, as shown in Table 2 (Hair *et al*., 2019; Hair, Jr. *et al*., 2021). For the third phase, we analysed the structural model assessment. We first assessed the model's explanatory power (R^2); the R^2 shows a variance explained in behaviour intention of 0.589. Furthermore, we also tested for standardised root means of residual (SRMR) that was 0.048; this is within the appropriate threshold level according to Henseler *et al*. 2016 (Table 2).

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11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

Table 2 PLS factor names, items loading, and the validity and reliability of the constructs

Factors	*Items*	*loading*	*Cronbach's Alpha*	*Rho_A*	*Composite Reliability (CR)*	*Average Variance Extracted (AVE)*
Behaviour Intention	BI1	0.944	0.877	0.877	0.942	0.891
	BI2	0.944				
Effort Expectancy	EE1	0.831	0.844	0.851	0.906	0.763
	EE2	0.909				
	EE3	0.880				
Performance Expectancy	PE1	0.918	0.895	0.898	0.935	0.827
	PE2	0.905				
	PE3	0.904				
Price Value	PV1	0.829	0.847	0.859	0.907	0.765
	PV2	0.895				
	PV3	0.899				
Social Influence	SE1	0.912	0.874	0.89	0.922	0.798
	SE2	0.922				
	SE3	0.845				

Source: Constructed by authors

Furthermore, we tested the discriminant validity using the Heterotrait-Monotrait Ratio (HTMT) criteria shown in Table 3, Fornell and Larcker criterion shown in Table 4, and cross-loading testing shown in Table 5 for discriminant validity in which the results confirm the discriminant validity of the constructs.

Table 3 Heterotrait-Monotrait ratio

	BI	*EE*	*PE*	*PV*	*SE*	*Year*
BI						
EE	0.730					
PE	0.749	0.685				
PV	0.58	0.455	0.570			
SE	0.735	0.685	0.714	0.611		
Year	0.165	0.091	0.168	0.026	0.01	

Source: Constructed by authors

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Table 4 Fornell-Larcker criterion

	BI	*EE*	*PE*	*PV*	*SE*	*Year*
BI	0.944					
EE	0.63	0.874				
PE	0.665	0.596	0.909			
PV	0.503	0.388	0.501	0.875		
SE	0.649	0.588	0.638	0.533	0.893	
Year	−0.155	−0.085	0.158	0.004	0.008	1

Source: Constructed by authors

Table 5 Cross-loading of the outer model

	BI	*EE*	*PE*	*PV*	*SE*
BI1	0.944	0.572	0.637	0.479	0.634
BI2	0.944	0.617	0.619	0.471	0.591
EE1	0.508	0.831	0.496	0.314	0.481
EE2	0.592	0.909	0.53	0.323	0.528
EE3	0.546	0.880	0.536	0.382	0.531
PE1	0.637	0.573	0.918	0.471	0.605
PE2	0.572	0.519	0.905	0.481	0.536
PE3	0.602	0.531	0.904	0.414	0.595
PV1	0.377	0.270	0.353	0.829	0.400
PV2	0.468	0.398	0.462	0.895	0.512
PV3	0.468	0.339	0.486	0.899	0.477
SE1	0.574	0.545	0.582	0.509	0.912
SE2	0.651	0.53	0.629	0.505	0.922
SE3	0.501	0.501	0.485	0.405	0.845

Source: Constructed by authors

Model Results

Table 6 explores the model results for hypothesis testing using confirmatory factor analysis. The estimate, *P*-value and status of the hypothesis are either supported or rejected.

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Table 6 The estimate, *P*-Value, and status of the hypotheses are either supported or rejected

Hypothesis	*Path*	*Original sample (O)*	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*	*Status*
H1	PE → BI	0.264	0.262	0.07	3.76	0.000***	Supported
H2	EE → BI	0.262	0.263	0.066	3.944	0.000***	Supported
H4	SE → BI	0.257	0.259	0.072	3.57	0.000***	Supported
H3	PV → BI	0.132	0.132	0.055	2.384	0.017*	Supported
H5	Year → BI	−0.092	−0.091	0.041	2.223	0.026*	Rejected (Inverse relationship)

Notes: ***/* estimate, P-Value, and status of the hypothesis are either supported or rejected; this will be discussed in the next section of empirical results

Source: Constructed by authors

DISCUSSION OF EMPIRICAL RESULTS

***Hypothesis 1*:** (The E-learning Performance Expectancy and Behaviour Intention Hypothesis.) E-learning Performance Expectancy is positively related to Behaviour Intention using the E-learning Moodle System. Joo (2014) explored the effect of performance expectancy in using the e-learning system in Korea and yielded a positive result. In the context of Sudan, we postulate the positive relationship is due to the extensive bridging of the digital divide at the National University of Sudan starting from the first year of university for all majors (Joo *et al.,* 2014). The students are given two significant courses in fundamental computers and computer applications, enabling them to use Internet-mediated and computer systems easily. Furthermore, through online and offline training on the Moodle system, students can sharpen their skills in using it and other related applications such as Windows Office applications.

***Hypothesis 2*:** (The E-learning Effort Expectancy and Behaviour Intention Hypothesis.) E-learning Effort Expectancy with the E-learning Moodle System is positively related to Behaviour Intention in using the E-learning Moodle System. The results of the study yielded a positive relationship. Tarhini *et al.* (2017) explored the construct in two universities in the United Kingdom; the results were significant and similar to our results in Sudan (Tarhini *et al.,* 2017). This further led us to believe that digital literacy courses and practical training would help Sudan students easily accept new e-learning technology.

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After getting this result, we did a one-to-one interview with students and professors; we noticed that one of the significant advantages that allow students to access the course's visual content is its availability on social media sites such as YouTube. It should also be noted that the Moodle system enables the insertion of YouTube content online. There has been extensive training for professors to upload their lectures online on channels such as YouTube and link them with the Moodle systems. This would enable students to access visual content directly from their mobile phones and download lecture slides and other documents from the Moodle system, reducing the effort to access the learning content. This goes hand-in-hand with the fact that mobile systems are more readily available in Sudan and North Africa in general compared to laptops and desktop computers (GSMA, 2017, 2022).

***Hypothesis 3*:** (The E-learning social influence and Behaviour Intention Hypothesis.) E-learning's social influence with the E-learning Moodle System is positively related to Behaviour Intention in using the E-learning Moodle System. The results of the study yielded a positive relationship. The results of the study support similar studies in the region that pointed out the effect of social influence on the usage of e-learning systems (Al Kurdi *et al.,* 2020).

***Hypothesis 4*:** (The E-learning Price value and Behaviour Intention Hypothesis.) E-learning price value with the E-learning Moodle System is positively related to Behaviour Intention in using the E-learning Moodle System. The results of the study yielded a positive relationship. The price of the Internet is one of the significant factors in the usage of the Internet worldwide and helps in bridging the digital divide. The results showcased the importance of Internet prices in students willing to use e-learning systems. Nonetheless, many North African countries are on the fringe of Internet users due to the relatively high price of the Internet compared to the income of the respected country. Therefore, we recommend the following policies in the case of Sudan. A public-private partnership between major telecommunication companies, the universities and the Ministry of Higher Education that devises a mechanism for registering students in universities and offering them Internet packages at lower cost that supports their usage of the university online e-learning systems. In this way, the Internet prices would not hinder student usage of this newly emerging e-learning system in Sudan.

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10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

***Hypothesis 5*:** (The Student Year and Behaviour Intention Hypothesis.) Student year with the E-learning Moodle System is positively related to Behaviour Intention in using the E-learning Moodle System. The study's results yielded an inverse relationship; this is considered an anomaly in the study. In any educational institute, students are expected to master skills as they progress through the years and develop them to a senior level. Similarly, the usage of these e-learning systems goes through a learning curve. However, it seems that higher-level students (Third- and Fourth-Year students) prefer a form of e-learning known as blended learning rather than purely online e-learning. This is also in line with the notion of digital natives and digital immigrants; first-year students seem more exposed to information and communication technology than their senior's counterparts, reducing the barriers to them using the systems efficiently.

CONCLUSIONS, IMPLICATIONS AND LIMITATIONS

In drawing our conclusions, we meticulously compare our findings to existing benchmarks and studies, underscoring the unique significance of performance expectancy, effort expectancy, and social influence in the Sudanese context. This comparison reveals that while these factors are universally recognised drivers of e-learning adoption, their impact is magnified in environments where educational and technological challenges are more acute, as is the case in Sudan. By quantitatively benchmarking our results against these studies, we not only validate our findings but also highlight the critical need for context-sensitive strategies to enhance e-learning effectiveness. This deeper understanding offers actionable insights for policy-makers, educators, and technologists striving to make digital learning more accessible and impactful in developing countries, ultimately contributing to the global discourse on technology-enhanced education. This study would pave the way for further extended research that investigates other factors affecting the development of e-learning systems in the developing world. On the practical side and at the micro-level, universities in Sudan and the MENA region must incorporate digital literacy courses from the student's first year as soon as possible. These courses would empower them to be on the same level as their peers in other parts of the world and help them access the world of knowledge that the Internet has to offer. At the macro-level, public-private partnerships are essential in setting policies that reduce the cost incurred by the student in accessing the Internet across the MENA region. This partnership would help empower students to use these systems at an affordable price, bridging the gap that hinders them from accessing the Internet.

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From a theoretical perspective, the study explored the validity and reliability of the UTAUT model in the context of Sudan as a North African country, paving the way for more quantitative and empirical research in Sudan. In terms of practical implications, the need to provide means and methods by which users of Internet-mediated systems can access information and knowledge is not new around the world. For example, Wikipedia has an initiative called Wikipedia Zero with a public-private partnership with telecommunications in the global south (Wikimedia, 2024). Therefore, a practical implication of the price value aspect of this study is the development of a public-private partnership between local telecommunication and Higher education ministries to provide free access to students who access e-learning websites in universities across Sudan. On the policy implication aspect, reducing taxation on telecommunication fees for students through packages that support student access to educational content online, such as Khan Academy, Coursera, and Edux, would help ease the cost burden for students across Sudan.

Acknowledging the limitations of our study is essential for a balanced interpretation of our findings. Focusing on Sudan as a single-country case study offers in-depth insights but may limit the generalisability of our results to other contexts. The cross-sectional design of our research captures a snapshot in time, but this might not fully encapsulate the dynamic nature of e-learning adoption amidst rapidly evolving global and local challenges. Future research could enrich this field by adopting longitudinal approaches to trace the trajectory of e-learning adoption over time and by expanding the geographical scope to include comparative studies across different countries. By clearly articulating these limitations, we aim to provide a transparent and honest assessment of our study's scope and potential impact, paving the way for further research that builds on our findings.

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10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

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10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

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10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS