International Journal of INNOVATION AND KNOWLEDGE MANAGEMENT IN MIDDLE EAST AND NORTH AFRICA (IJIKMMENA)

V9 • N1/2 • 2021

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تنشر بالتعاون مع المنظمة العالمية للتنمية المستدامة

ISSN: 2042-5988 (Print); 2042-5996 (Online)

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E-LEARNING AND THE DIGITAL DIVIDE ROLE IN TRANSFORMING HIGHER EDUCATION IN SUDAN:
AN EXPLORATORY CASE STUDY ANALYSIS

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International journal of
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IN MIDDLE EAST & NORTH AFRICA

ISSN: 2042-5988 (Print) | 2042-5996 (Online)

IJIKMMENA V9 N1/2 2021

OPEN ACCESS

DOI: 10.47556/J.IJIKMMENA.9.1.2021.6

RESEARCH PAPER

E-learning and the Digital Divide Role in Transforming Higher Education in Sudan: An Exploratory Case Study Analysis

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CITATION: Gibreel, O. A., Mahdi, M. A., Saeed, A. A. (2021): E-learning and the Digital Divide Role in Transforming Higher Education in Sudan: An Exploratory Case Study Analysis, Vol 9, No. 1/2, pp. 95 -108.

RECEIVED: 23 March 2021 / **REVISED:** 4 September 2021 / **ACCEPTED:** 6 September 2021 / **PUBLISHED:** 23 November 2021

Abstract

Purpose: This paper explores the factors and barriers to e-learning in Sudan from a digital divide perspective.

Design/methodology/approach: The paper is based on a mixed-method case studies approach. Employing an exploratory case study method, we explore the factors and barriers to e-learning and bridging the digital divide in Sudan and their ramifications on the development of higher education in Sudan. The paper employs the following models and theories from e-learning and the digital divide perspective: Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), and Theory of Reasoned Action (TRA). It does this through an overarching model termed the Unified Theory of Acceptance and Use of Technology (UTAUT). The paper studies the following factors from the above models and theories: e-learning performance expectancy, e-learning effort expectancy, e-learning social influence, e-learning facilitating conditions, price value, and behaviour intention.

Findings: The study shows that Sudan has excellent opportunities to develop through the e-learning sector, especially given recent global pandemics such as COVID-19. Nonetheless, there is a strong need to investigate factors such as Internet self-efficacy and price value for the development and growth of e-learning in Sudan.

Original contribution of the paper: The paper explores the role of e-learning and the digital divide in higher education development in Sudan. Previous work has studied the digital divide and higher education in other Middle East and North Africa (MENA) sub-regions and countries but not in Sudan; they also excluded the above-stated factors and barriers.

Research limitations/implications: The paper could have pursued further research with a larger sample size and used both exploratory and confirmatory factor analysis to further analyse Sudan's current e-learning environment.

Practical implications: The paper's practical importance is that it lays the ground for further investigation into the development of e-learning systems in Sudan. Considering the digital divide in Sudan, there is a need to evaluate the development and usage of e-learning systems in Sudan from an holistic perspective, shedding light on both the supply side and the demand side of how e-learning is developing and shaping higher education in Sudan.

Keywords: *E-learning; Emerging market; Learning management system; Information system; Knowledge management; Information and communication technology for development*

Introduction

The present ever-changing reality of technology, education, and society is witnessing a rise in Internet usage, leading in turn to an increase in the development and use of e-learning systems worldwide. This has been further accelerated with the reoccurrence of global pandemics such as COVID-19 (Radha *et al*., 2020; Sanad and El-Sayyed, 2020; Tera and Rabie, 2020). Internet access has seen tremendous growth around the globe and more recently in many parts of the developing world. It is estimated that Internet penetration has reached five billion users worldwide, and Africa has seen significant growth in the percentage of users, reaching 13% (Internet World Stats, 2020). Globally, there has also been considerable development in e-learning during the current global COVID-19 pandemic (Radha et al., 2020). Sudan has seen growth in teleconference applications such as Zoom and a slow rise in e-learning systems around the country. In July 2020, the Sudanese Ministry of Higher Education and Scientific Research, under Minster/Professor Intisar Saghiroun, highlighted the need to start using e-learning systems from 14 July 2020 (University World News, 2020). In a recent UNESCO statement, over 204,000 Sudanese university students have had their studies halted due to Sudanese universities shutting down during successive waves of the COVID-19 pandemic (University World News, 2020).

This study's research objective is to explore the development of e-learning in one of Sudan's major universities, National University, Sudan. The primary research question will examine factors such as e-learning performance expectancy, e-learning effort expectancy, e-learning social influence, e-learning facilitating conditions, price value, and behaviour intention. These factors are the central construct of

the Unified Theory of Acceptance and Use of Technology (UTAUT) developed and theorised first by Venkatesh *et al*. (2003) and later by Venkatesh *et al*. (2016). In an exploratory case study method, this paper explores the following research questions: What e-learning effort expectancy is needed by the students at National University, Sudan?; What do students of National University, Sudan think about the system they are using and how it helped them use the e-learning system? (part of the facilitating condition construct). Our third research question looks at the effect of Internet price value for students at National University, Sudan. The fourth research question investigates how students at National University, Sudan responded when asked to continue using the e-learning system (part of the behaviour intention).

The remainder of the paper is constructed as follows. The following section is a literature review used to assess the current state-of-the-art research in e-learning and the digital divide. This is followed by a discussion of the methodology used in this paper, and a case study analysis section. The paper ends with sections discussing the conclusions and future research implications.

Literature Review

E-learning has seen tremendous growth in developing new initiatives in the past few months due to the COVID-19 pandemic. Countries with a large digital divide have also seen great initiatives that consider schools' and universities' e-learning system usage. As with any information technology system, understanding how users accept or use the technology can play a significant role in its success, hence the rise in theories theorising the usage and acceptance of information technology systems such as the technology acceptance model (Davis, 1989) or unified theory of acceptance and use (Venkatesh *et al*., 2003; Venkatesh *et al*., 2016).

In the Middle East and North Africa (MENA) region's e-learning development and usage, there have been numerous research studies on this important topic. For example, Tasmeen *et al*. (2020) studied Qatar's e-learning systems' development; they concluded that Qatar's strong Internet speed and penetration rate were major factors in students accessing e-learning systems compared to Pakistan and the Turkish Republic of Northern Cyprus (Tasmeen *et al*., 2020). For the United Arab Emirates (UAE), Salloum *et al*. (2019) conducted a case study that showcased how four factors (namely innovativeness, trust, quality, and knowledge sharing) incentivised students to use the e-learning system (Salloum *et al*., 2019). In the case of Oman, Tawafak *et al*. (2020) observed in their study that positive acceptance of teacher e-learning systems played a moderating role in the e-learning system (Tawafak *et al*., 2021)

On the other side of the MENA region, in Morocco, Ouajdouni *et al*. (2021) studied the usage of e-learning systems by students from 12 Moroccan universities and 31 Moroccan educational institutions. Their findings indicated that the instructor quality effect perceived usefulness, e-learning system use, and e-learner satisfaction. Furthermore, system quality positively affects perceived usefulness and e-learner satisfaction (Ouajdouni *et al*., 2021)Moroccan universities switched to the e-learning approach as an alternative to face-to-face education. At this level the assessment of e-learning systems success becomes a necessity. This data article aims to identify e-learning systems success determinants during the COVID-19 pandemic. The data was collected from students of the Moroccan Higher Education Institutions. The research data are collected via an on a self-administered online questionnaire, from a sample of 264 university students. The responses are collected from students of 12 Moroccan universities and 31 Moroccan educational institutions. The data were analyzed using a structural equation modeling method under the Partial Least Squares approach (PLS-SEM. In the case of Egypt, Sanad and El-Sayyed (2020) studied e-learning usage and suggested that "e-learning programs be organized to develop English language skills such as reading, vocabulary, and speaking". Second, "learning strategies such as gamification can be used through e-learning to develop vocabulary knowledge and retention". Third, "e-learning can be used with corpus linguistics to develop students' vocabulary and reading comprehension skills" (Sanad and El-Sayyed, 2020).

In the case of Sudan, several universities started e-learning initiatives and National University, Sudan seems to have fully transitioned into online e-learning classes in several colleges. UTAUT has shown remarkable results in gauging technology users' needs while using technology to achieve certain tasks or projects. This case study is constructed on the unified theory of technology acceptance and usage, namely, e-learning performance expectancy, e-learning effort expectancy, e-learning social influence, e-learning facilitating conditions, price value, and behavior intention (Venkatesh *et al*., 2003; Venkatesh *et al*., 2016).

There have been two versions of UTAUT. The first version included performance expectancy, effort expectancy, social influence, facilitating conditions, and behaviour intention (Venkatesh *et al*., 2003). The second version was updated to include other constructs, such as price value that considers the effect of technology on user intention to use the technology (Venkatesh *et al*., 2016). Next, this paper showcases a preliminary pilot study model for the usage of e-learning system at National University, Sudan.

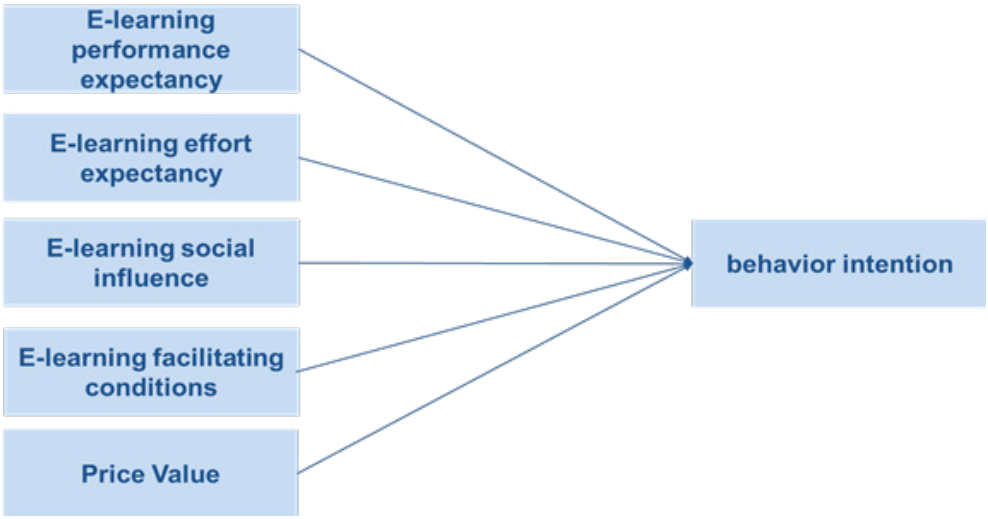


Figure 1: Unified Theory of Technology Acceptance (2nd version)

Source: Based on Venkatesh *et al*., 2012

Methodology

For its methodology, this case study uses an exploratory case study approach; this could be defined as "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its context using multiple sources of evidences" (Robson, 1993). The following steps were taken to conduct the case study. First, a theory-based questionnaire was devised from the UTAUT (Venkatesh *et al*., 2003; Venkatesh *et al*., 2016) and then adapted to the local context in terms of e-learning usage. The questionnaire was distributed to students of the Clinical & Industrial Pharmacy, Medical Laboratory, and Physiotherapy as they were the colleges that had seen the most significant growth in e-learning development and usage. As this questionnaire was still in its pilot testing stage, feedback was solicited on both the questionnaire itself and issues that students might face in understanding and responding to the questionnaire.

Case Study Analysis

As stated in the introduction, in terms of case study analysis, this case study explores the development of an e-learning system at the National University, Sudan, established in 2005 when it was initiated as the National College for Medical and Technical Studies. Later, the Ministry of Higher Education and Scientific Research approved the initiation of four bachelor programmes in medicine, pharmacy, physiotherapy, and health informatics. In 2008, additional colleges were added, including a bachelor of nursing and midwifery, medical laboratory technology, and administrative studies, such as business administration, accounting, marketing, and management information systems. In 2009 the university became the first and the only ISO-9001-2008 certified higher education institution in Sudan in relation to its quality management of academic programmes. In 2016, National University, Sudan was accredited by the British Accreditation Council (BAC) and is presently the only university in Sudan certified by the council for its educational quality and excellent administrative system. The e-learning initiative started in November 2020 and has since grown rapidly. Table 1 showcases the development of e-learning initiatives at National University, Sudan.

Table 1: E-learning initiative at National University, Sudan

No.	Faculty	No. of classes (on odd semesters)	No. of uploaded lectures (PDF,PPT)	No. of uploaded lectures (Recorded lectures + PDF,PPT)	Percentage
1	Medicine & Surgery	23	1(4.3%)	7(30.4%)	34.7
2	Clinical & Industrial Pharmacy	24	_	24	100
3	Medical Laboratory Science	18	_	18	100
4	Faculty Of Physiotherapy	20	15(57%)	1(5%)	80
5	Dental Medicine And Surgery	23	_	9(39%)	39
6	Radiolography & Medical Imagine Sciences	30	9 (30%)	1(3.3%)	33.3
7	Computer Science & Information Technology	27	_	1(3.7%)	3.7
8	Engineering & Architecture : Civil Engineering	21	7(33.3%)	_	33.3
	: Architecture & Building	20	1(5%)	_	5
	:Electrical & Electronics	24	8(37.5%)	1(4.2%)	41.7
9	Nursing & Midwifery Sciences	17	_	1(5.9%)	5.9
10	Administrative Sciences	40	_	_	0
11	International Relations & Diplomatic	27	_	_	0

Source: Statistics from National University, Sudan committee led and developed by Associate Professor Mohamed Abdelghadir Mahdi

The above table reveals that colleges such as Clinical & Industrial Pharmacy, Medical Laboratory, and Physiotherapy have seen the most significant growth in utilising e-learning systems. The above-stated three colleges have seen most of their classes uploaded online for students to view through the Learning Management System of National University, Sudan. Currently, colleges such as Administrative Science and International Relations are initiating their e-learning projects to transition their lectures online and help students access their educational content online.

This case study initiated a survey for the above-stated departments, namely Clinical & Industrial Pharmacy, Medical Laboratory, and Physiotherapy. The pilot project survey yielded 166 respondents and their basic demographic information is presented in Figure 2. This includes the respondents' age, the majority being in the 18 to 23-year cohort. Figure 3 shows the respondents' gender, the majority being female.

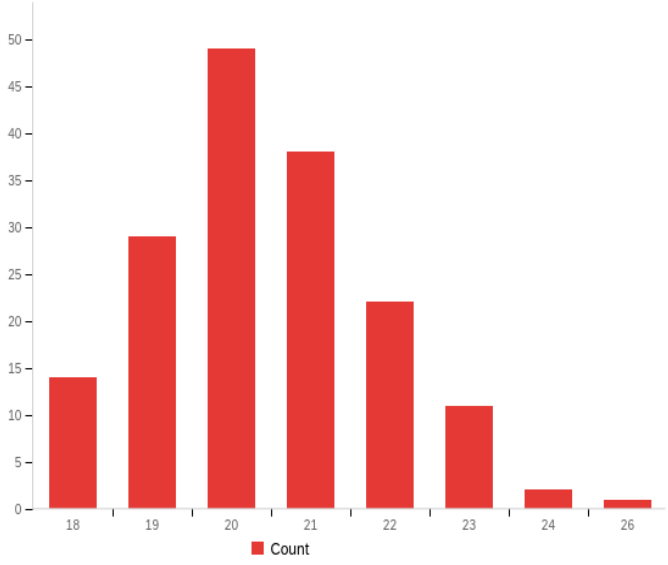
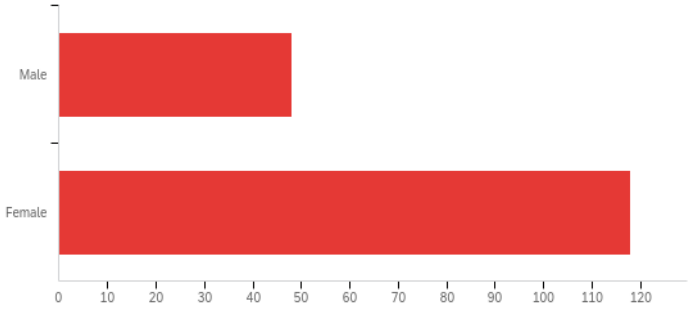


Figure 2: Age of respondents

Source: Developed by authors using qualtrics XM



Note: In terms of gender, the respondents were mainly females.

Figure 3: Gender of respondents

Source: Developed by authors using qualtrics XM

In terms of their university level (Figure 4), Level 1 students are first introduced to e-learning systems and the learning management system before they start taking classes online; therefore, relatively few participated in this survey. Figure 5 gives the number of respondents by college.

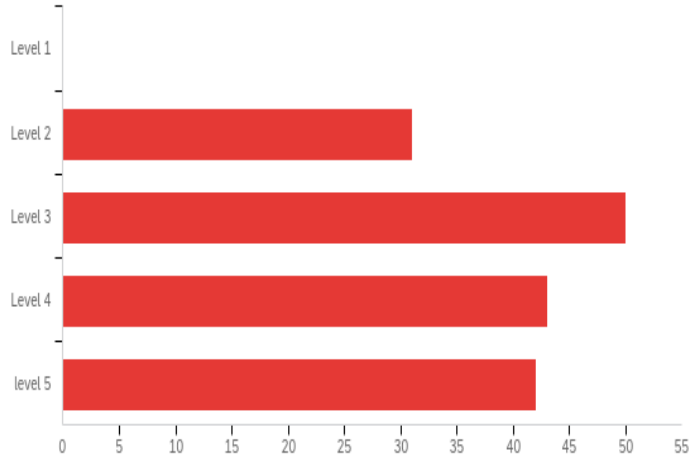


Figure 4: University level of student respondents to the e-learning survey

Source: Developed by authors using qualtrics XM

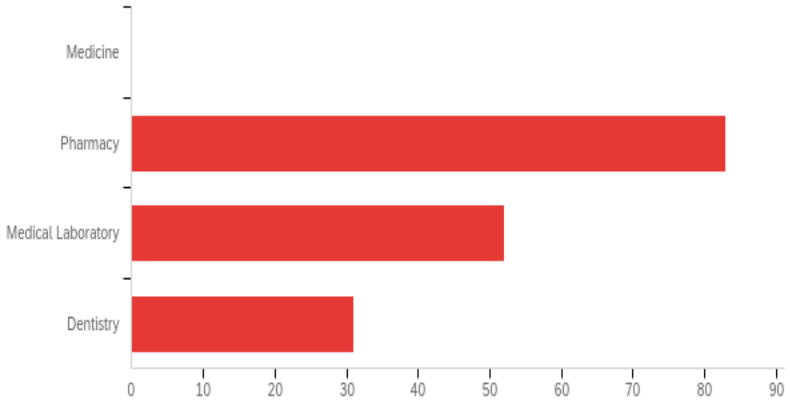


Figure 5: Number of respondents by college

Source: Developed by authors using qualtrics XM

This paper now presents a sample of the items used in the case study. Four items were selected from four constructs, namely e-learning effort expectancy, e-learning facilitating conditions, e-learning price value, and e-learning behavior intention (Venkatesh *et al*., 2003; Venkatesh *et al*., 2016).

E-learning effort expectancy is defined as "the degree of ease associated with the use of the system" (Venkatesh *et al*., 2003). The first item in the constructs of e-learning effort expectancy is "I find National University e-learning websites are easy for me to use" (Venkatesh *et al*., 2003). The results for this item reveal strong skewness towards strongly agree on the Likert scale (Figure 6). This is in line with the efforts initiated by National University, Sudan to educate first-year students on its campus in computer and English language skills. This in turn bridges the digital divide on technology literacy factors and opens the gate for students to access the wealth of knowledge available on the Internet in the English language. These two factors, coupled with training in the use of e-learning systems, has helped students master the usage of the National University's e-learning system.

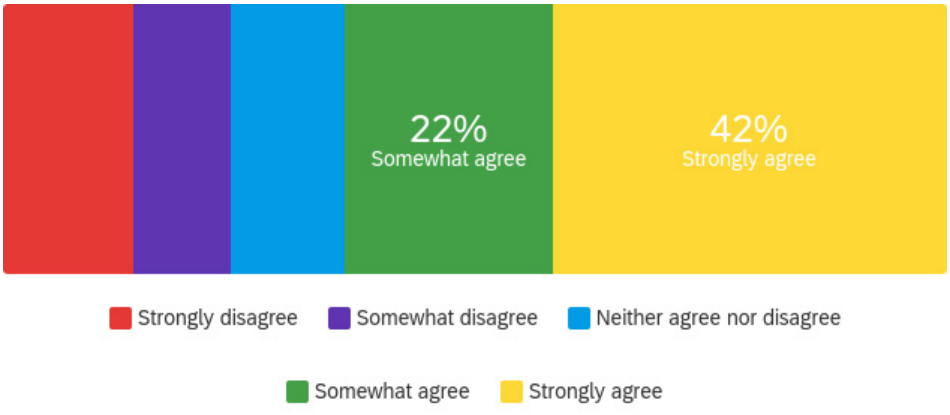


Figure 6: "I find National University e-learning websites are easy for me to use"

Source: Developed by authors using qualtrics XM

The e-learning facilitating condition is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (Venkatesh *et al*., 2003). Item 1 was stated as "I have the resources necessary to use National University e-learning websites" (Venkatesh *et al*., 2003). National University, Sudan has been expanding its computer labs ever since its inception in 2005. The campus now has five large computer labs across campus with Wi-Fi Internet in major meeting areas and lecture rooms. The results of the item show strong skewness towards somewhat agree and strongly agree.

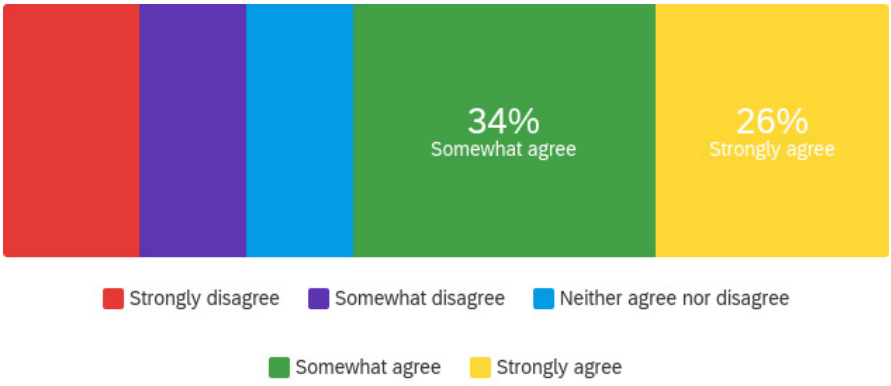


Figure 7: "I have the resources necessary to use National University e-learning websites"

Source: Developed by authors using qualtrics XM

Price value is defined as "consumers' cognitive tradeoff between the perceived benefits of the applications and the monetary cost for using them" (Venkatesh *et al*., 2012). Item 1 was stated as "Internet is reasonably priced" (Venkatesh *et al*., 2003). National University, Sudan has opened five labs across campus to enable students to access the Internet. Furthermore, free WiFi is available within the campus. Nonetheless, there is a need for a public-private partnership (PPP) initiative to further reduce the cost of the Internet to students beyond the campus during these turbulent times of COVID-19. A public-private partnership would help universities, students and parents in supporting their goal of helping students access content easily and with a lower financial burden on both students and parents. The partnership would also act as a corporate social responsibility booster for the public relations image of local and international telecommunication companies as they would support the development of Sudan's higher education sector.

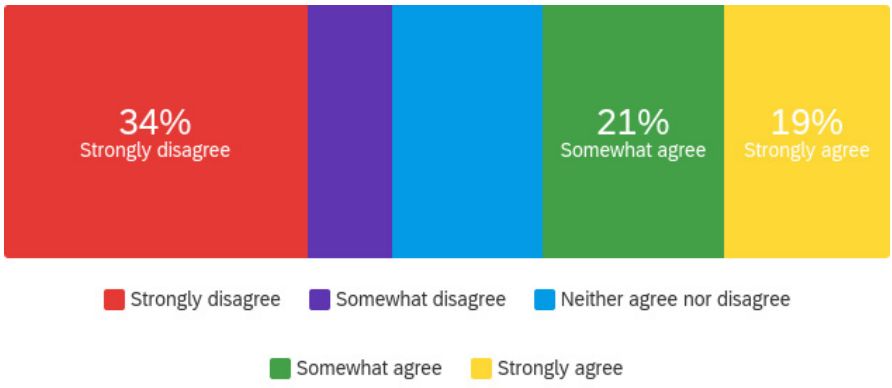


Figure 8: "Internet is reasonably priced"

Source: Developed by authors using qualtrics XM

Behavior intention is defined as a construct that "will have a significant positive influence on technology usage" (Venkatesh *et al*., 2003). Item 1 was stated as "I intend to use National University e-learning websites in my future learning activities" (Venkatesh *et al*., 2003). Overall, the combination of training and on-campus access to the Internet and computer labs had led to skewness towards somewhat agree and strongly agree. As student learning curves develop, students can be expected to master the National University, Sudan learning management system and overcome other factors that might hinder their access to online lectures.

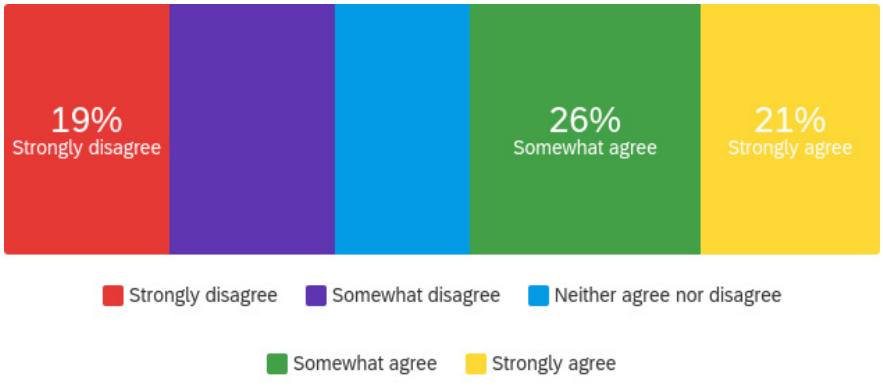


Figure 9: "I intend to use National University e-learning websites in my future learning activities"

Source: Developed by authors using qualtrics XM

Conclusions

In conclusion, there is a need for the development of e-learning initiatives in the developing world. Presently, e-learning initiatives in Sudan are still in their initial stage. There is a need for more awareness and skills-building, both at the student and faculty level. It should be noted that a Public-Private Partnership (PPP) between major telecommunication companies in Sudan, such as Zain, MTN and Sudani, with the Sudanese government and public and private universities would help reduce Internet access costs for educational purposes. The success of National University, Sudan in fully implementing e-learning management systems for all courses for colleges, such as Pharmacy and Medical Laboratory, reveals that with more planning and stronger commitment, much could be done. Sudan is still working on expanding its Internet penetration rate and the promising aspect of e-learning is yet to be capitalised by other universities similar to National University, Sudan, which aspires to play a pivotal role in the development of e-learning initiatives, not only in Sudan but also across the MENA region.

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Biography

Dr Omer Gibreel is currently a Mentor for the Clinton Global Initiative University (CGIU), an initiative of the Clinton Foundation, in the area of economic empowerment. Omer is a Fulbright Scholar, and has Bachelor's degrees in Computer Science and Engineering, and Business Administraiton from Korea University, a Master's degree in Management Information Systems from Seoul National University, and a PhD in the area of Technology Management. His research interests include Technology Management and Innovation, Frugal Innovations and Entrepreneurship, Sustainable Designs, Information and Communication Technology for Development, Social Commerce, Electronic Commerce, and E-participation in emerging markets. Omer has been published in prominent journals such as *Electronic Commerce Research and Application*, and the *Journal of Sustainability*. He has also presented at international conferences such as the International Conference on Electronic Commerce and Pacific Asia Conference on Information Systems (PACIS).

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