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Implementing Technology-Mediated Learning in Universities to Achieve Sustainable Development Goals: King Khalid University as a Case Study

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Abstract

Technology-mediated learning (TML) is the term expressing the current global trend of using information technology to support learning. The use of TML for sustainable development aims to grant people of various ages the expertise, abilities, as well as principles they need to develop and establish a sustainable future. This study assesses, via a case study, how effectively e-learning in higher education can contribute to achieving sustainable development goals (SDGs). An analysis was conducted on the experiences of female students who enrolled in the diploma program at King Khalid University's Khamis Mushait Applied College during the Coronavirus period and the transition to online learning. The two dimensions that were investigated consisted of the effects of information technology on e-learning and sustainable development. The random sample was surveyed in order to collect data. The objective of this paper is to review the current research on technology-mediated learning, Sustainable Development Goals, and the extent to which TML contributes to achieving sustainable development goals. Moreover, the study aims to answer the main question: "How can TML contribute to achieving Sustainable Development Goals?" The data was collected from students at King Khalid University, and they completed the electronic questionnaire to answer the study's questions. The study reaches the conclusion that there is a positive, statistically significant relationship between the impact of technology-mediated education on achieving sustainable development and there is a positive, statistically significant relationship between information technology and technology-mediated education under exceptional circumstances.

Keywords: *Information Technology, E-learning, Technology-Mediated Learning, Sustainable Development Goals.*

1. Introduction

All types of computer-based tools used to generate, store, exchange and use information in their various forms are collectively referred to as information technology [1]. Add to this, information technology (IT) is the process of creating, processing, storing,

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protecting, exchanging and utilizing any kind of electronic data through the use of computers, networking, storage, and other hardware, infrastructure and procedures. The National Institute of Standards and Technology (NIST) defines the term, “Information system”, as [2] “Any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency.” while Oxford English Dictionary defines it as “The branch of technology concerned with the dissemination, processing, and storage of information, esp. by means of computer.”[3]. IT is utilized more frequently in the context of business operations than in personal or recreational use. Software, hardware, databases, networks, cybersecurity, cloud computing, and artificial intelligence are just some of the many topics it covers [4].

The information technology team makes sure that all of the enterprise's infrastructure, systems, data, and applications have connectivity and function effectively. The following three primary tasks are handled by the IT team [5]:

1. It oversees the security and governance of business applications, services, and infrastructure.

2. It deploys and maintains business applications, services, and infrastructure (servers, networks, storage).

3. It monitors, optimizes, and troubleshoots the performance of these components.

IT is a frequently utilized teaching tool that is designed to enhance the effectiveness and productivity of the educational system. Utilizing technology to study is not just about learning through it. In other words, learning through technology means that the student communicates with his instructor and receives education solely through the use of the technology, while learning using technology implies that the technology is being utilized as one technique among many others [6]. The term, "technology-mediated learning", refers more broadly to the use of any technology to mediate learning materials or interactions, while the term "e-learning" refers, especially, to the use of digital computers and the Internet as tools for teaching and learning [7].

1.1 Technology-Mediated Learning

Numerous advantages have been brought about by information technology, such as increased productivity, better decision-making, saving time, and easier access to knowledge and information. Utilizing IT tools in education enhances learning by giving students countless opportunities to make better study decisions, collaborate in more supportive environments, and passionately and constructively share their ideas and experiences [8]. E-learning is one of the advantages of using information technology in the field of education. E-learning is viewed as taking the form of education via the Web totally [9].

An environment in which the learner's interactions with peers, teachers, and/or learning materials (readings, assignments, exercises, etc.) are mediated by advanced information technologies is known as Technology-Mediated Learning (TML) [10]. TML performs an essential function in contemporary educational systems, including online and traditional ones, because of its adaptability, accessibility, and creative methods of knowledge assimilation. The following are some significant tools of TML:

1. Online Learning Platforms: Massive Open Online Courses (MOOCs), learning management systems (LMS), and virtual classrooms are examples of online learning platforms. They offer a platform for asynchronous or real-time communication between educators and students [11].

2. Adaptive Learning Technologies: The ability to adjust how a material is presented in response to a student's performance is the fundamental concept of adaptivity in learning. [12].

3. Collaborative Learning Tools: Collaboration tools like wikis, forums, , chatrooms, workshops and comment boxes allow students to collaborate even when they are physically separated by distance, include Google Docs, Slack, and Microsoft Teams [13].

4. Artificial Intelligence (AI) and Machine Learning: The application of AI and machine learning to education encompasses a wide range of topics that can enhance learning, including performance forecasting, adaptive and predictive learning, group-based learning, analytics, and intelligent tutors [14].

5. Gaming and Simulation: These tools can add interest and fun to the learning process. They can be utilized to provide virtual lab experiences, encourage strategic thinking, and illustrate difficult ideas [15].

6. Augmented Reality (AR) and Virtual Reality (VR): AR and VR can offer immersive, interactive learning environments that increase student engagement and retention [16, 17].

Despite all of its benefits, TML comes with drawbacks. These could include the problems of having access to technology, system issues, the requirement for proficiency with technology, and the potential fewer social interactions [18]. Consequently, in order to create an educational experience that is more inclusive, efficient, and enriching, it is imperative that these above issues be addressed.

1.2 Sustainable Development

The term, "sustainable development", describes an approach to resources use and development in a way that meets the needs of the world's population currently without compromising the ability of future generations to meet their own needs [19]. Economic, social, and environmental sustainability are its three primary pillars [20, 21]:

1. Economic sustainability: Effective and efficient use of resources at a reasonable cost is a prerequisite for economic sustainability. Activities like encouraging sustainable business practices, reducing waste, and promoting responsible consumption can all fall under this category.

2. Social sustainability: Enhancing everyone's quality of life is the main goal of social sustainability. It supports social cohesion, equal opportunity, and the defense of human rights.

3. Environmental sustainability: The preservation and protection of the natural world is referred to as environmental sustainability. This may involve tackling problems like climate change, fostering biodiversity, cutting pollution, and boosting the usage of renewable energy sources.

Sustainable development is based on achieving 17 Sustainable Development Goals (SDGs): No Poverty, Zero Hunger, Good Health and Wellbeing, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, (Industry, Innovation and Infrastructure), Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace Justice and Strong Institutions, Partnerships for Goals [22].

Figure 1: The United Nations Sustainable Development Goals [23]

1.3 Technology-Mediated Learning & Sustainable Development Goals

The concept of sustainable education can be realized through the use of technology and skill development [24]. When sustainable development and technology-mediated education are combined, there are a lot of potential benefits and opportunities that can be ensured. Some possible benefits, opportunities and barriers involved in technology-mediated learning and sustainable development are shown in the following table [13, 14, 15, 16, 17, 18, 25, 26, 27, 28, 29, 30, 31]:

Table 1: The Potential Advantages and Barriers of Appling TML to Achieve Sustainable Development Goals.

SDGs [32]	TML Potential Benefits and Opportunities	TML Potential Barriers
SDG 1: No Poverty (End poverty in all its forms everywhere)	Enables people to get the education they require, including those from underprivileged backgrounds or rural locations.	Issues like Affordability, Accessibility, Digital Literacy, Infrastructural
SDG 4: Quality Education (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.)	Provide educational opportunities to individuals worldwide, irrespective of their geographical location (Accessibility, Flexibility, New skills, ….etc.)	Issues like Digital Divide, Lack of Digital literacy, Cyber Safety, and Ensuring that Technology Enhances rather than distracts
SDG 5: Gender Equality (Achieve gender equality and empower all women and girls)	Will by providing equal learning opportunities, particularly in areas or communities where girls' access to traditional education may be limited.	The potential to identify the digital divide, ensuring equitable access to technology for all.
SDG 7: Affordable and Clean Energy (Ensure access to affordable, reliable, sustainable and modern energy for all)	Solar-powered devices and infrastructure can be provided to provide the necessary power for educational tools in remote areas, giving students access to the Internet and digital platforms for their education and promoting the concept of Affordable and Clean Energy	Access to energy, Infrastructure, Digital Divide
SDG 8: Sustained Economic Growth (Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all)	TME platforms facilitate self-paced learning, Upskilling the Workforce, equal opportunities for everyone to learn, quip workers with valuable digital skills, thereby fostering opportunities for lifelong learning.	The potential to identify the digital divide.
SDG 9: Industry, Innovation, and Infrastructure (Build resilient infrastructure, promote inclusive and	TME encourages the development and use of advanced technology. This can stimulate industrial growth, encourage	Infrastructure Challenges.

sustainable industrialization and foster innovation)	innovation, and develop the infrastructure that coming generations will require by expanding access to high-quality education via digital channels.	
SDG 10: Reduced Inequities (Reduce inequality within and among countries)	Technology can be used to lessen inequality both within and between nations (Availability of Data, Access to Quality Education, Diverse and Inclusive Content, …etc.)	Issues like Digital divide, Digital Literacy, Poor Infrastructure, and Biases in AI Systems.
SDG 11: Sustainable Cities and Communities (Make cities and human settlements inclusive, safe, resilient and sustainable)	Can make education more sustainable, less dependent on physical infrastructure, and more suited to urban developments. Data Gathering and Analysis by the AI can suggest sustainable measures	Providing equal opportunities for everyone, regardless of their socio-economic, geographic, or cultural backgrounds.
SDG 12: Responsible Consumption and Production (Ensure sustainable consumption and production patterns)	Reusing digital learning resources reduces the need to produce and discard physical educational materials.	Needs to be made accessible for all, considering digital literacy and the digital divide issues.
SDG 13: Climate Action (Take urgent action to combat climate change and its impacts)	TME helps to reduce carbon emissions by reducing the need for physical infrastructure and transportation.	Digital Literacy
SDG 16: Peace, Justice, and Strong Institutions (Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels)	Internet platforms have the power to create peaceful communities by fostering mutual understanding, promoting exchanges between cultures, and dismantling prejudice.	Issues like Equal Access and Fair conduct on digital platforms

Even while Technology-Mediated Learning has a lot of potential for sustainable development, there are certain issues that must be considered. For example, the difference between those who have access to technology and those who do not (digital divide), if not purposefully addressed, may result in even more inequality. All members of society must be able to afford, access, and use the TML technology. TML also stresses the necessity for comprehensive education that considers the abilities required to traverse the rapidly changing digital landscape. Digital literacy skills are also crucial for effective TML.

2. Conceptual Framework:

2.1. Literature Review:

The roadmap to a brighter and more sustainable future for all is found in the Sustainable Development Goals. The SDGs aim to tackle the world's major problems, such as poverty, inequality, pollution, climate change, peace, and justice.

E-learning has the potential to help reduce poverty by empowering the socially disadvantaged and less privileged in society including lower-income groups, the handicapped, the sick, and those disabled (particularly people with writing, speaking, and hearing impairments), members of ethnic minority groups, and women affected by cultural and religious prejudice [33]. This is to meet the first development goal of no poverty (Goal 1). In this context, physical location or ability are not critical for successful e-learning.

One of the pillars of Sustainable Development is Goal 4 (Quality education) which seeks to provide inclusive, equitable, high-quality education and encourage opportunities for lifelong learning for everyone [34]. This study demonstrates how, with the use of contemporary technology like satellites, the internet, and cell phones, e-learning can be used to deliver high-quality education to isolated and rural places. When it comes to connecting all educational institutions with the necessary infrastructure to offer high-

quality education that appeals to a broad audience, satellites can be extremely helpful. In order to meet the fourth development goal of high-quality education (Goal 4), an e-learning model has been developed to offer more engaging lectures and information to students who are studying remotely [35].

In order to further Climate Action (Goal 13), the study [36] investigate the potential role that information and communications technology (ICT), and education may play in fostering environmental sustainability in eastern and southern Africa. The results of the study demonstrate that, in the nations under investigation, investments in clean technology and education can be employed in tandem as a complementary strategy to reduce carbon emissions and advance environmental sustainability.

This article [37] discusses the theoretical underpinnings of the gender gap in digital studies at universities and offers an economic analysis, using a straightforward linear regression, on the presence of a correlation between the gender gap in university study and the gender gap in digital studies. A more detailed examination of the digital gender gap in the context of international students from four different income-grouping nations is also provided. The findings indicate a twofold trend: first, there is a clear and noticeable digital divide between high-income and low- and lower-middle-income nations; second, there are variations in access to and usage of technologies that impact the proportion of graduates in higher education by gender. This study proves the need to use technology in education to bridge this gap and achieve the fifth goal, Gender Equality (Goal 5).

2.2. Research Methodology:

The sustainable Development Goals can be greatly advanced through the use of TML, particularly when it comes to innovation, education, economic growth, and sustainable development for the environment. The importance of this research lies in illustrating the following points:

1. Access to Quality Education: Due to the TML, everyone can have access to high-quality education, irrespective of social, economic, or geographic constraints and that directly relates to SDG 4 (Quality Education) [38].

2. Bridging the Digital Divide: Addressing the digital divide is a prerequisite for using TML in a sustainable manner. Innovative approaches to addressing global digital literacy and infrastructure difficulties can be found in this research, which is important for achieving SDGs 4, 8, 9 [39, 40, 41].

3. Fostering Lifelong Learning: TML can support ongoing, self-directed learning, which is essential for adjusting to the quickly evolving labor market. This emphasizes how crucial it is in relation to SDG 8 [42].

4. Environmental Effect: TML can help focus on raising awareness among students with the help of their instructors who can play a vital role in passing the necessary knowledge, skills, attitudes, and values on to students to repair or, at least, slow down the irreversible harm done to the environment. Thus, this field research contributes to the achievement of SDG 13 (Climate Action) [43].

When trying to balance accessibility, quality, and sustainability more effectively in the implementation of technological resources into education, the TML investigation can offer insightful guidance.

2.3 Research Questions

This is a methodological study, and it is conducted involving students from King Khalid University Applied College. The research aims to answer the following questions:

1) What is the impact of Information Technology learning?

2) What is the impact of technology-mediated learning on sustainable development?

3) How can technology-mediated learning contribute to achieving Sustainable Development Goals?

The central limit theorem asserts that the sample means will be roughly and normally distributed in the presence of a population with the mean μ and standard deviation σ, and sufficiently large random samples from the population with replacement, given that the sample size is, at least, equal to or larger than 30 [44]. For that, a sample of 98 students was randomly picked from the KKU Applied College students, Girls Section, in Khamis Mushait. The privacy and confidentiality of the participants' data is ensured by obtaining an informed consent from students before collecting the data and ensuring that participation is completely voluntary.

The questionnaire tool is selected to conduct the field study. The questionnaire method is chosen because it can be applied to a large number of examinees, and it requires less time and effort. The data obtained from the studies is analyzed using statistical methods for the survey data and thematic analysis for the qualitative data to identify trends, patterns, and themes.

To achieve the aims of the study, two hypotheses are considered:

Hypothesis 1: Technology-mediated learning has statistical significance on sustainable development.

Hypothesis 2: Information Technology has a statistical significance on Technology-mediated learning.

3. Research Results:

3.1 Consistency stability of the Scale (Questionnaire)

Internal consistency stability is the level at which the scale phrases (questions) are correlated. The Kuder-Richardson formula 20 is used to determine internal consistency for binary choices while Cronbach's alpha is used for a measure used in statistics and psychology to ascertain the internal consistency or reliability of a test or a scale. The value of Cronbach's Alpha ranges between 0 (no internal consistency) and 1 (high internal consistency) [45]. The following table shows the results of Cronbach's alpha test:

Table 2: Cronbach’s Alpha Scale for Phrases Consistency Coefficients

Axes	Number of Phrases	Consistency Coefficient
First Axis	10	0.931
Second Axis	10	0.947
Total Phrases	20	0.949

From Table [2], the values show there are very high degree of internal consistency of the questionnaire’s questions, where Cronbach’s Alpha is valued for the full scale as (0.949), which shows high stability of internal phrases [46]. That allows the questionnaire’s axes to achieve the study objectives.

3.2 Validity of the Scale

“Validity” means the ability of a construct to measure what it was supposed to measure. The validation is done her in two ways:

1. The validity of the concept, the questions' phrasing and clarity were assessed as part of the content validity test for the phrases on the scales. This could be because the scales were translated from one language to another or because the meanings of the phrases varied depending on the culture of the society. A number of academic reviewers

and subject matter experts were shown the questionnaire. Four reviewers examined the phrases on the scales, assessed how each scale's findings are compatible with one another, accepted some of the phrases, and made modifications to others. Following the questionnaire's retrieval from reviewers, the requested modifications were made, and the final version of the questionnaire was created.

2. Validity of the scale:

Validity testing was conducted for the questionnaire phrases used in collecting data, by calculating the square root of Cronbach's Alpha coefficient, as shown in the following table:

Table 3: Validity Test for the Questionnaire Phrases

Hypothesis	Number of Phrases	Consistency Factor	Validity Coefficient
First axis	10	0.931	0.965
Second axis	10	0.947	0.973
Total Phrases	20	0.949	0.974

The previous table shows that the degree of the validity of the questionnaire phrases is between 0.965, and 0.974, which means that the questionnaire is valid enough to measure what it is supposed to measure.

3.3 Applying the Research Tools:

The questionnaire was designed through Google Forms and was distributed electronically among the population of the target sample. The number of respondents is 98.

3.4 The Statistical Analysis Method Used in the Study:

The data was analyzed through a set of statistical methods appropriate to the nature of the data and the type of the study variables, to achieve the research objectives and test the study Hypotheses. Thus, the following statistical tools are used:

a. The Reliability Test is applied to the questionnaire questions comprising all data, using Cronbach's Alpha coefficient. It is used to measure the internal consistency of the study phrases to verify the validity of performance. The measure is good and appropriate if the value of Cronbach's Alpha exceeds (60%).

b. Descriptive Statistics:

It is used to describe the characteristics of the study sample items by making iterative tables, including repetitions and ratios, to identify the general direction of the sample items for each variable individually, and the standard deviation to determine the amount of dispersion from the arithmetic mean in the examinees' answers to each phrase of the questionnaire. The reference mean for the sample answers was also calculated using the 5-Point Likert Scale to measure respondents' attitudes.

c. Inferential Statistics Methods are used to test the study Hypothesis through a t-test. This test is used to test the statistical significance of the study Hypothesis at a significance level of 5%.

This means that if the value of (t) is calculated at a significance level less than 5%, the null hypothesis is rejected and the alternative (research) hypothesis is valid. On the other hand, if the value of (t) is at a significance level greater than 5%, that means accepting the null hypothesis and therefore, the alternative (research) hypothesis is invalid.

First: Practical Questions:

In this part, the results of the field study are interpreted through the information produced by the statistical data analysis tables based on "general statistical analysis" by estimating

the mean and standard deviation of the study phrases to identify the direction of the study sample and the relative importance of the study phrases.

Table 4: Descriptive Statistics for the First Axis Phrases

The Impact of Information Technology on Sustainable Development	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Weighted Mean	Standard Deviation	Phrase Order	Direction
	Number %	Number %	Number %	Number %	Number %				
1/ The university is aware of the role of information technology in sustaining development in the educational process	23 %23.5	52 %53.1	17 %17.3	4 %4.1	2 %2.0	3.92	0.870	2	Agree
2/ The university uses the information management system in education for sustainable development	26 %25.5	52 %53.1	13 %13.3	7 %7.1	- -	3.99	0.831	1	Agree
3/ The university has state-of-the-art hardware and software	22 %22.4	31 %31.6	25 %25.5	12 %12.2	8 %8.2	3.48	1.203	10	Agree
4/ The university provides training programs and educational courses for its employees	20 %20.4	30 %30.6	32 %32.7	10 %10.2	6 %6.1	3.49	1.115	9	Agree
5/ The university has highly qualified trainers in the field of information technology	26 %26.5	34 %34.7	24 %24.5	10 %10.2	4 %4.1	3.69	1.097	6	Agree
6/ The university keeps pace with the latest information technology with regard to sustainable development	18 18.4	42 %42.9	20 %20.4	14 %14.3	4 %4.1	3.57	1.075	8	Agree
7/ The university constantly updates its website	24 %24.5	40 %40.8	25 %25.5	8 %8.2	1 %1.0	3.80	0.941	4	Agree
8/ The information system at the university meets all students' needs for equitable education and the promotion of lifelong learning opportunities	19 %19.4	48 %49.0	19 %19.4	5 %5.1	7 %7.1	3.68	1.071	7	Agree
9/ The university website provides permanent services	24 %24.5	41 %41.8	19 %19.4	10 %10.2	4 %4.1	3.72	1.072	5	Agree
10/ The university uses information technology in order to provide a flexible learning environment	25 %25.5	50 %51.0	15 %15.3	4 %4.1	4 %4.1	3.90	0.968	3	Agree
Total						**3.725**	**0.8095**	**Agree**	

Table (4) shows that the phrase with the highest order is phrase number 2: "The University uses the information management system in education for sustainable development with a weighted average of (3.99) and a standard deviation of (0.831). The phrase of the lowest order is phase number 3: The University has state-of-the-art hardware and software with a weighted average of (3.48) and a standard deviation of (1.203).

Table 5: Descriptive Statistics for the Phrases of the Second Axis

The second axis The Impact of Information Technology on E learning	Strongly Agree Number %	Agree Number %	Neutral Number %	Disagree Number %	Strongly Disagree Number %	Weighted Mean	Standard Deviation	Phrase Order	Direction
1/ I am fully convinced that information technology serves my e-learning courses	36 %36.7	42 %42.9	10 %10.2	8 %8.2	2 %2.0	4.04	0.994	5	Agree
2/ Education technology enables the promotion of lifelong education opportunities through e-learning	32 %32.7	45 %45.9	11 %11.2	7 %7.1	3 %3.1	3.98	1.005	9	Agree
3/ I am fully convinced of e- learning's partnership in achieving sustainable development in the university	35 %35.7	40 %40.8	18 %18.4	1 %1.0	4 %4.1	4.03	0.979	6	Agree
4/ E-learning makes global knowledge available through information technology	37 %37.8	40 %40.8	16 %16.3	2 %2.0	3 %3.1	4.08	0.949	3	Agree
5/ E-learning provides equal opportunities for everybody, which achieves the sustainable development goal in education	33 %33.7	43 %43.9	14 %14.3	4 %4.1	4 %4.1	3.99	1.010	7	Agree
6/ The quick access to information and its availability supports e-learning	38 %38.8	42 %42.9	15 %15.3	1 %1.0	2 %2.0	4.15	0.866	2	Agree
7/ E-learning enables students to achieve self-development	36 %36.7	38 %38.8	16 %16.3	3 %3.1	5 %5.1	3.99	1.060	8	Agree
8/ The localization of information technology reflects its role in e-learning for sustainable development	29 %29.6	41 %41.8	23 %23.5	2 %2.0	3 %3.1	3.93	0.944	10	Agree
9/ Information technology contributes to recognizing e-learning as an ideal alternative to traditional education in light of exceptional circumstances	37 %37.8	44 %44.9	13 %13.3	3 %3.1	1 %1.0	4.15	0.842	1	Agree
10/ Software support and technical support centers increase the effectiveness of e-learning	35 %35.7	45 %45.9	12 %12.2	2 %2.0	4 %4.1	4.07	0.966	4	Agree
Total						**4.0418**	**0.7937**	**Agree**	

Table 5 shows that the phrase with the highest order is phrase no. 9: "Information technology contributes to recognizing E learning as an ideal alternative to traditional education in light of exceptional circumstances" with a weighted average of (4.15) and a standard deviation of (0.842), while the phrase of the lowest order is number 8: "The localization of information technology reflects its role in e-learning for sustainable development" with a weighted average of (3.93) and a standard deviation of (0.944).

Hypothesis Testing

The First Hypothesis: Technology-mediated learning has statistical significance on sustainable development.

Table 6: t-Test for the First Axis

Phrase	Number (N)	Mean	Standard Deviation	The t-Value Calculated	Degree of Freedom	The *p*-Value	Mean Difference	Direction
1/ The university is aware of the role of information technology in sustainable development in the educational process	98	3.92	0.780	44.608	97	0.000	3.918	Agree
2/ The university uses the information management system in education for sustainable development	98	3.99	0.831	47.528	97	0.000	3.990	Agree
3/ The university has state-of-the-art hardware and software	98	3.48	1.203	28.625	97	0.000	3.480	Agree
4/ The university provides training programs and educational courses for its employees	98	3.49	1.115	30.997	97	0.000	3.490	Agree
5/ The university has highly qualified trainers in the field of information technology	98	3.69	1.097	33.322	97	0.000	3.694	Agree
6/ The university keeps pace with the latest information technology with regard to sustainable development	98	3.57	1.075	32.903	97	0.000	3.571	Agree
7/ The university constantly updates its website	98	3.80	0.941	39.928	97	0.000	3.796	Agree
8/ The information system at the university meets all students' needs for equitable education and the promotion of lifelong learning opportunities	98	3.68	1.071	34.060	97	0.000	3.684	Agree
9/ The university website provides permanent services	98	3.72	1.072	34.380	97	0.000	3.724	Agree
10/ The university uses information technology to provide a flexible learning environment	98	3.90	0.968	39.844	97	0.000	3.898	Agree

The results of Table 6 can be interpreted as follows:

1. The probability value of the significance of the differences between the responses of the study sample members to all the phrases of the first axis is (0.000), which is smaller than the significance level (0.01). This means that the differences between the individuals with the responses (strongly agree, agree, neutral, disagree, strongly disagree) are of high statistical significance.

2. The table above indicates that there are statistically significant differences at a 5% significance level between the responses of the sample members: in favor of (I agree).

From the above, it can be concluded that the first hypothesis, which reads: "There is a positive, statistically significant relationship between the impact of information

technology on achieving sustainable development under exceptional circumstances" has been achieved.

The Second Hypothesis: Information Technology has a statistical significance on Technology-mediated learning.

Table 7: t-Test for the Second Axis

Phrase	Number (N)	Mean	Standard Deviation	The t-Value Calculated	Degree of Freedom	The *p*-Value	Mean Difference	Direction
1/ I am fully convinced that information technology serves my E learning courses	98	4.04	0.994	40.244	97	0.000	4.041	Agree
2/ Education technology enables the promotion of lifelong learning opportunities through E learning	98	3.98	1.005	39.203	97	0.000	3.980	Agree
3/ I am fully convinced of E learning's partnership in achieving sustainable development in the university	98	4.03	0.979	40.770	97	0.000	4.031	Agree
4/ E learning makes global knowledge available through information technology	98	4.08	0.949	42.580	97	0.000	4.082	Agree
5/ E learning provides equal opportunities for everybody, which achieves the sustainable development goal in education	98	3.99	1.010	39.098	97	0.000	3.990	Agree
6/ The quick access to information and its availability supports E learning	98	4.15	0.866	47.488	97	0.000	4.153	Agree
7/ E learning enables students to achieve self-development	98	3.99	1.060	37.261	97	0.000	3.990	Agree
8/ The localization of information technology reflects its role in E learning for sustainable development	98	3.93	0.944	41.184	97	0.000	3.929	Agree
9/ Information technology contributes to recognizing E learning as an ideal alternative to traditional education in light of exceptional circumstances	98	4.15	0.842	48.851	97	0.000	4.153	Agree
10/ Software support and technical support centers increase the effectiveness of E learning	98	4.07	0.966	41.727	97	0.000	4.071	Agree

The results of Table 7 can be interpreted as follows:

1. The probability value of the significance of the differences between the responses of the study sample population to all the phrases of the first axis is (0.000), which is smaller than the significance level (0.01). This means that the differences between the individuals with the responses: (strongly agree, agree, neutral, disagree, strongly disagree) are of high statistical significance.

2. Based on what was stated in the above table, this indicates that there are statistically significant differences at a 5% significance level between the responses of the sample population; in favor of (I agree).

It can be concluded from the above that the second hypothesis, which reads: "There is a positive, statistically significant relationship between information technology and technology-mediated education under exceptional circumstances" has been achieved.

4. Results:

The use of information technology has a direct impact on achieving sustainable development under exceptional circumstances, as the use of information technology contributes to facilitating technology-mediated education opportunities in various circumstances. The use of information technology by the KKU Applied College members also reduces burdens and saves time and effort.

The study demonstrates King Khalid University's keenness on integrating information technology tools into education by providing the electronic platform, e-mail, dialogue rooms, forums, etc., in order to create a flexible educational environment that contributes to achieving sustainable development goals. It is also noted that the university pays heed to updating its website on a regular basis to provide all the information and resources that students need for learning.

5. Recommendations:

1.Acting to provide infrastructure of hardware and networks.

2. Acting to build information networks and electronic support platforms, as well as libraries that are rich in digital sources.

3. Preparing training courses for the teaching staff members and students to train them on the use of information technology in distance teaching and providing them with advanced technological skills.

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