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Employing Educational Technology to Enhance the Principles of Sustainable Development in Higher Education Institutions: An Exploratory Study at Al-Huda University College

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Abstract

The idea of this research is to shed light on the value added by the use of technology in improving the educational effectiveness of higher education institutions and enhancing their teaching and learning processes, in order to achieve optimal development for the Internet generation with its evolving educational requirements, characteristics, and technologies. The study addresses the dimensions of educational technology (e-learning, multimedia, self-assessment, collaborative learning) and the dimensions of sustainable development (economic, environmental, social). The present study adopted Al-Huda University College as the research setting; the sample comprised the college's employees across various positions and specializations, totaling 134 individuals. A questionnaire was used as the main tool for data collection and analysis; all questionnaires were retrieved and deemed valid. Data were analyzed using SPSS v.27 and AMOS v.24. The study yielded a set of conclusions, the most important of which is that employing educational technology is a significant factor in achieving sustainable development in higher education and scientific research through integrating technology into the learning environment. Moreover, e-learning and self-assessment enhance students' awareness and sense of responsibility, leading to a fair and equitable educational environment that supports the social dimension of sustainable development. At the same time, the study offered several recommendations, foremost among them the need to establish a clear institutional strategy for integrating educational technology with the college's sustainable development goals, as well as the continuous training of academic and administrative staff to use educational technology effectively and to align it with sustainable development objectives.

Keywords: *educational technology; sustainable development; collaborative learning.*

1. Introduction

Quality in education constitutes one of the most vital foundations for achieving sustainable development in societies, as it not only enhances individuals' skills and knowledge, but also contributes to building their capacities to confront future challenges and devise innovative solutions to the world's escalating problems. This is achieved by reinforcing

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sustainability within education, leading to the development of educational systems that are more flexible and more capable of adapting to economic, environmental, and social changes, in order to achieve and ensure balanced and sustainable progress.

Today, educational technology in its various forms serves as the bridge that connects us to new knowledge and to the formation of a scientific community capable of effecting positive change in society (Al-Qahtani, 2025: 113).

Digital technology strengthens the educational field by serving the instructional process, as it facilitates access to scientific information and its retrieval for use in advancing educational practice. In most instructional contexts, the use of modern technology in learning functions as support for theory or relies on lecturing indeed, often as an extension of lecturing itself. Moreover, since the beginning of the twenty-first century, discourse on expanding the use of advanced educational technology has increasingly moved toward "education through advanced media," that is, explicitly and clearly toward digital education. All of this stems from the impact of these media on the quality of education. Hence, contemporary educational imperatives impose a new scientific reality: the need to consider employing these technologies to benefit core instructional situations in education as well as vital, real-world contexts (Boukrisa, 2013: 62–87).

2. Research Methodology

2.1 Research Problem

The research problem is encapsulated in the following main question:

What is the relationship between educational technology and sustainable development at Al-Huda University College?

In light of this, the following sub-questions help delineate the research problem more clearly:

a) To what extent are the requirements of educational technology (e-learning, multimedia, self-assessment, collaborative learning) available at Al-Huda University College?
b) Is there a correlation between the requirements of educational technology (e-learning, multimedia, self-assessment, collaborative learning) and sustainable development at Al-Huda University College?
c) Is there an effect of the availability of educational technology requirements across its dimensions (e-learning, multimedia, self-assessment, collaborative learning) on sustainable development and its dimensions at Al-Huda University College?
d) Do respondents' views within the university differ regarding the requirements of educational technology (e-learning, multimedia, self-assessment, collaborative learning) and their relationship to improving staff performance, across personal characteristics (gender, age, educational attainment, academic rank, current position, years of service)?

2.2 Research Significance

The significance stems from the necessity of employing information technology across all fields in general, and in education in particular, in our present era, due to its effective role in the educational process. Information technology is pivotal to education, which has been the gateway through which societies and educational institutions (universities) have entered modernity to keep pace with accelerating global development. The challenges facing the educational process including increasing student numbers, the knowledge explosion, the technological revolution, and the communications revolution have driven educational institutions to adopt and integrate technology into the educational process and to develop it, given its positive and effective role. The importance of the study lies in identifying the role of information technology in sustainable development within the educational process.

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2.3 Research Objectives

The present study seeks to achieve several objectives, the most important of which are:

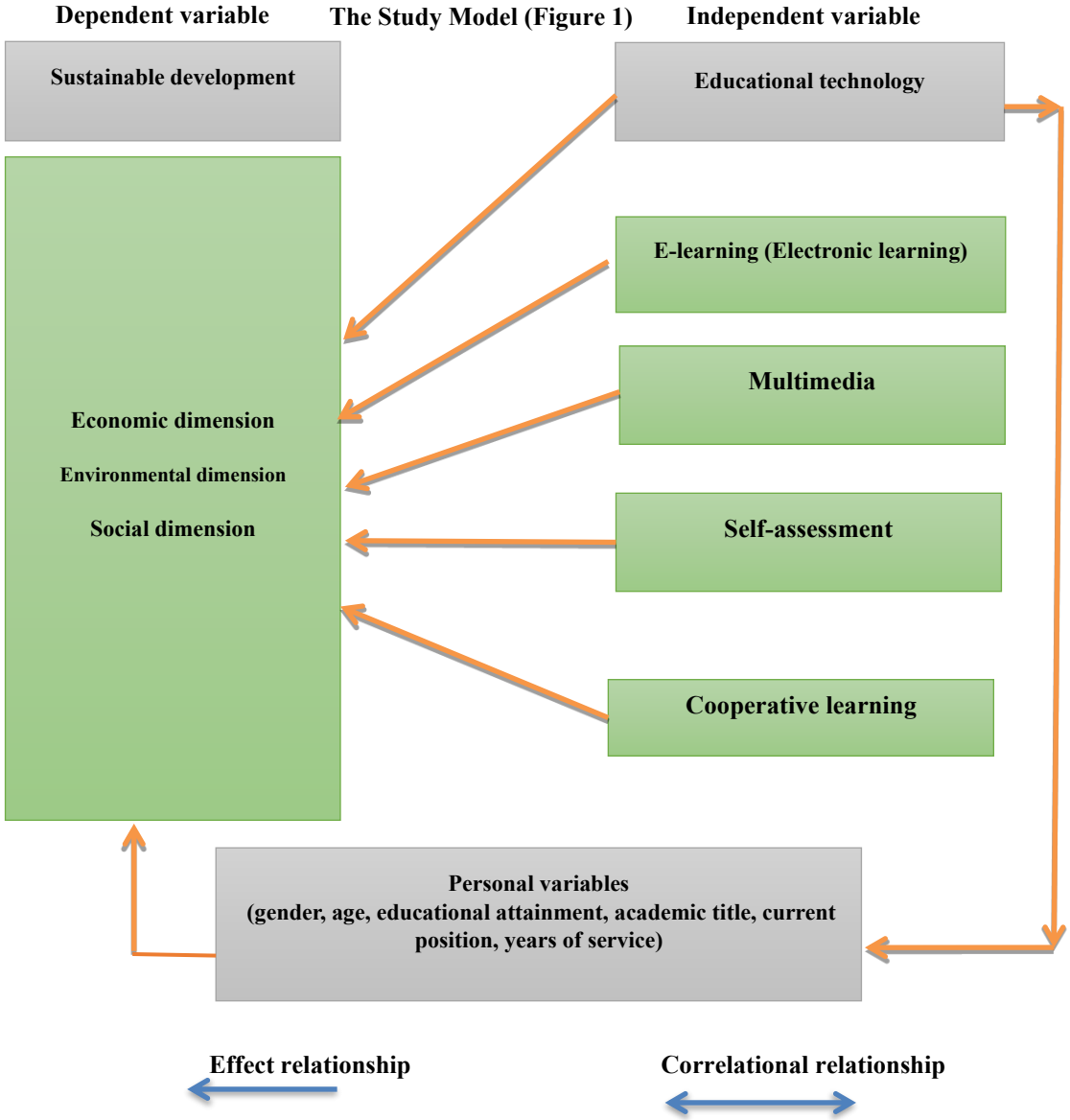
i. The principal objective is to determine the extent to which educational technology enhances sustainable development at Al-Huda University College by discussing intellectual and theoretical perspectives that call for a fundamental transformation of the educational process, in line with the rapid (economic and technological) shifts observed in contemporary societies.

ii. Encouraging institutions to provide means and methods that simplify the teaching process and to develop tools that foster interaction between instructors and students within the educational institution.

iii. Identifying the dimensions of educational technology and distinguishing it from traditional education, as well as discerning the advantages of modern education through the dimensions of educational technology.

iv. Proposing recommendations that build future-oriented visions to develop the role of technology in the educational process, which will, in turn, contribute to cultivating individuals' thinking within the educational institution in the future.

2.4 Research Model:



Source: Prepared by the researcher

2.5 Research Hypotheses

The hypotheses address the research problem and include two main issues from which a number of hypotheses branch:

Main Hypothesis 1: There is a statistically significant correlational relationship ($\alpha \leq 0.05$) between the dimensions of educational technology as a whole namely, e-learning, multimedia, self-assessment, and collaborative learning and the dimensions of sustainable development (economic, environmental, social) at Al-Huda University College.

Main Hypothesis 2: There is a significant effect of the dimensions of educational technology as a whole namely, e-learning, multimedia, self-assessment, and collaborative learning on the dimensions of sustainable development (economic, environmental, social) at Al-Huda University College.

2.6 Research Boundaries

Research boundaries are divided into spatial, temporal, human, and scientific boundaries:

1. Spatial boundaries: Al-Huda University College was targeted as the study population; it is one of the educational institutions affiliated with the Iraqi Ministry of Higher Education and Scientific Research.
2. Temporal boundaries: The temporal boundary of the research is the year 2025.
3. Human boundaries: The researcher relied on a sample of 134 individuals from Al-Huda University College.
4. Scientific boundaries: Identifying the dimensions of educational technology and their relationship to sustainable development in educational institutions.

2.7 Statistical Methods Used

Statistical methods were employed to analyze the questionnaires distributed to the surveyed sample as follows:

a) Use of Cronbach's alpha coefficient: Reliability generally refers to the instrument's or scale's ability to yield consistent results when reapplied to a similar group of individuals or under similar conditions after a certain period.

b) Internal consistency of the scale (split-half): The split-half test is used to ensure the reliability of the scale employed.

c) Descriptive statistics: Used to describe the characteristics of the study sample and to present and analyze respondents' answers according to the questionnaire items, as well as to compute response rates, overall mean, frequency distributions, arithmetic means, standard deviations, and the coefficient of variation.

d) Common Method Bias (CMB) test: This is one of the important tests for obtaining accurate estimates and valid relationships; the Harman single-factor test was used to detect the presence or absence of bias due to common method variance.

e) Confirmatory factor analysis (CFA): Used to evaluate the responses of the studied sample by measuring the correlations between the observed items (questions) and the latent dimension they represent, as well as to identify the correlations among the overall variables (dimensions) of the studied constructs.

f) Simple Regression Analysis: One of the statistical methods used to clarify the effects between two variables, one dependent and the other independent.

g) Kolmogorov–Smirnov test (normality test): Considered one of the most important statistical criteria used to test normal distribution and is suitable for large sample sizes; through this test, the normality of the studied variables is assessed.

2.8 Study Methodology

The researcher adopted the descriptive-analytical methodology, which is based on describing a phenomenon and analyzing it to interpret it based on the data collected and the inferences drawn. This methodology is among the most preferred in such studies, as it analyzes and describes the field phenomenon under investigation by relying on information obtained from the actual environment of the university comprising the research sample. It focuses on analyzing and interpreting the current state and on identifying the effects and relationships that exist among the variables.

2.9 Methods of Data Collection and Information Analysis

1- The theoretical aspect: The researcher relied, in collecting information, on numerous Arabic and foreign scientific sources, including books and periodicals, in addition to using the World Wide Web (Internet).

2- The field aspect: The questionnaire form (*) was the main source adopted by the researcher to obtain the data for the applied aspect, as the number of distributed questionnaires reached (134) forms. Each form included a number of items distributed across three axes, with the first axis representing (gender, age, educational attainment, academic title, current position, years of service), while the remaining axes are presented in the following table:

Variables	Dimensions
Educational Technology	E-learning, multimedia, self-assessment, cooperative learning
Sustainable Development	Economic, environmental, social

3. Theoretical Framework

Introduction: In this era that has led to a knowledge explosion, an information revolution, and the rapid flow of information technology, there has been a reflection in the impact on university plans and strategies, which in turn has manifested in sustainable development to reach and catch up with advanced countries and the progress they have achieved.

Educational technology in universities has become a foundation for everything that supports activities aimed at enhancing education to achieve integration in education through the exchange of knowledge and technical cooperation, and capacity building for sustainable development. This, in turn, facilitates communication in all directions, in addition to being an effective economic pillar in the life of the individual and society (Al-Daami, 2011: 69).

First Requirement: The Concept of Educational Technology and Its Role in Higher Education If we look at educational technology within the framework of the general educational system, it becomes clear that it is a subsystem or system with educational objectives consistent with the goals included in the general educational system. Through the objectives of this system, an interacting set of human and material elements that make up the system is realized. The elements of the general system interact with the educational technology system as well as with other subsystems within it to achieve the desired objectives. We can view educational technology as a system or framework composed of multiple, integrated elements through which the goals of the system and the framework are achieved, represented by a set of human and material elements, goals, devices, content, instructional strategies, evaluation, and instructional materials. There remains confusion between one aspect of educational technology the use of devices and various instructional equipment and educational technology itself. This has led to the use of terms such as instructional aids, as well as visual and auditory aids, when referring to educational technology and vice versa. Here, we see that educational technology may be confined to being merely instructional aids (Barakat et al., 2024: 366).

1-1 The Concept of Educational Technology Educational technology is defined as "everything used in the field of education as well as learning, including information and communication technologies that are employed for the purpose of storing, processing, retrieving, and transferring information from other places, and which works to develop and utilize all modern means to improve the educational process, such as the computer and its software, Internet technologies such as e-books, databases, email, encyclopedias and classrooms, e-learning, voicemail, digital libraries, interactive television, compact discs, distance education, multimedia, satellite television broadcasting, voice communication, written communication, and educational websites" (Rashm, Smaili, 2023: 6).

Educational technology is also defined as the use of tools and all modern technological media to improve the educational process, which leads to enhancing students' understanding. This term encompasses a wide range of software and hardware that can be used in schools and universities and aims to provide a better educational environment that facilitates access to and sharing of useful information, thereby enhancing student productivity (Al-Nahi and Al-Najjar, 2024).

1-2 The Role of Educational Technology in Higher Education Technology plays an important role in the educational process through the provision of educational services and its significant role in dealing with the massive numbers of students. Technology in education has helped in the preparation of advanced and modern educational systems and in creating new forms of learning to adapt to the problem by discovering new types of education (open education and distance education), with the teachers' role changing to organizer and guide of the educational process (Jasim and Ubayd, 2024: 277).

Galbraith defines educational technology as "the systematic application of the organization's scientific knowledge for practical purposes" (Suleiman, 2020: 1285). We can list below the most important dimensions of information technology, which are as follows:

a- E-learning E-learning is considered an educational scientific breakthrough that relies on (electronic artificial intelligence) to design interactive as well as visual programs, store them, and present them as educational outputs built on the skills of thinking and critique (Ghassan, 2015: 30).

b- Multimedia Multimedia is considered one of the teaching methods, as it gives the learner the opportunity to face unfamiliar educational issues and situations, which requires interpretation by the learner in light of their existing prior experiences, and to create active learning that enables the learner to acquire information presented via computer screens in the form of texts, sounds, drawings, images, and video clips. Teaching with multimedia may affect the

learner's achievement and ability to understand, and even the acquisition of practical skills that enable the learner to continue the learning process (Al-Adwani, 2020: 227).

c- Self-assessment Self-assessment is considered one of the institutional tools for ensuring and improving the quality of education, taking into account the goals set by the institution as well as its resources, purposes, and the conditions within which it operates. The subject of quality and its assurance has been linked to autonomous quality monitoring and, subsequently, to the enhancement of factors of self-management as well as financial and administrative transparency and accountability in universities. Hence, self-assessment in higher education institutions aims to identify the degree of alignment between prevailing practices at the university and standards in its various fields, as well as the strengths and weaknesses in university performance. This is done in light of the requirements to achieve quality and accreditation standards, and to determine the starting point for building and implementing a continuous improvement plan to meet the requirements of quality and accreditation standards that enable us to determine the extent to which the standards are met (Abu Deqa and Al-Dajni, 2011: 7).

d- Cooperative learning Cooperative learning refers to classroom instructional methods in schools and universities that learners use to perform educational activities in small groups, with each group consisting of 2–6 learners who work together effectively and help one another, thereby raising the level of each individual in the group and achieving their shared educational goal. In return, they receive recognition and rewards based on the collective performance of these learners, and their performance is compared with a pre-prepared simulation to determine the extent of the group members' progress in performing the tasks assigned to them.

Cooperative learning is defined as an organization of the classroom, where learners are placed into small groups, each consisting of at least four individuals who cooperate and interact with one another, strive to solve their problems, and discuss their ideas (Al-Samarrai and Sajid, 2019: 492).

3.1 The Concept of Sustainable Development and Its Objectives

3.1.1 The Concept of Sustainable Development

In 1983, the United Nations General Assembly established the World Commission on Environment and Development, which later became known as the Brundtland Commission. In 1987, the Brundtland Report was published by the Commission and provided definitions of sustainable development. The Commission described sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs. In the years following the publication of the Brundtland Report, sustainable development became "the dominant paradigm of the environmental movement" (Ali, 2020: 4945).

Dimensions of Sustainable Development:

According to the definitions of sustainable development, it becomes clear that it comprises three dimensions characterized by interconnection and integration within a framework distinguished by orderly management and the optimal utilization of renewable resources.

a- The economic dimension

Current societies and their development must be economically viable in a way that prevents future generations from bearing the burden of these costs. The time factor can also be considered extremely important in development from the perspective of setting plans and timelines to provide needs over long and varying periods (Mir and Muhammad, 2024: 103).

b- The environmental dimension

The environment is fundamental to the existence of human activity and to preserving the natural and biotic milieu and passing it on to future generations. This dimension appears in preserving the atmosphere by reducing pollution resulting from industry and transportation, and by raising standards of energy use alongside reliance on renewable energies such as solar energy (Kamal, 2018: 282).

c- The social dimension

This dimension refers to the relationship between humans and nature, as well as to the advancement and well-being of human beings through the continuous improvement of access to educational and health services, the provision of security, and the protection of human rights. Sustainable development, through its social dimension, does not suffice with generating growth; rather, it distributes its returns fairly, renews the environment instead of destroying it, and empowers human beings instead of marginalizing them. Accordingly, it relies on the participation of the individual in society; hence, it may be termed human development for people and by people (Abd al-Rahman, 2024: 353).

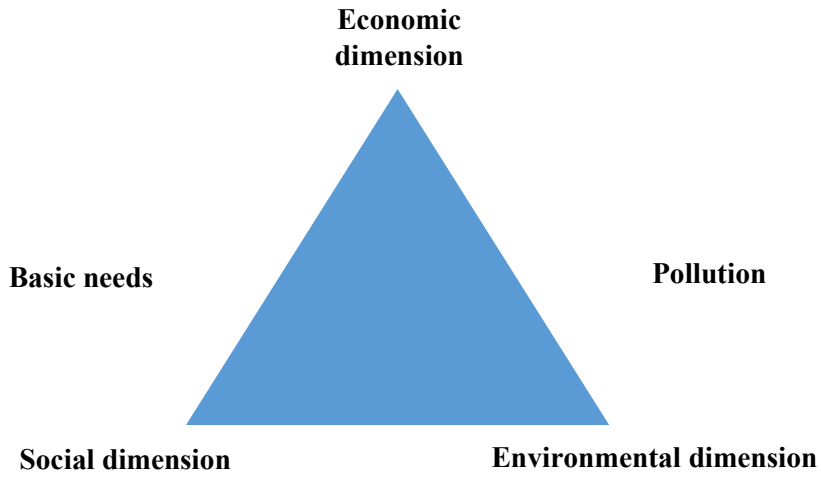


Figure (2): The Triangle of the Core Dimensions of Sustainable Development

Source: Sharif (2022), Resorting to Environmental Auditing as a Pathway to Achieving Sustainable Development: A Survey Study of the Opinions of a Sample of Accountants and Auditors at the Northern Technical University, Vol. 4, No. 4.

3.1.2 Sustainable Development Goals

a) Goal 4: Quality Education

Digital finance helps individuals with limited or low income manage educational expenses more effectively, which has prompted schools and universities to improve their financial management. This, in turn, facilitates the provision of resources to support faculty members and teachers and to supply advanced educational materials and technologies that enhance learning outcomes. On the other hand, information and communication technologies open all avenues for distance education and create opportunities for lifelong learning, providing high-quality remote education. E-

learning platforms also offer new methods of learning and support reforms in higher education institutions and other educational facilities, making education easier and more accessible to all, including persons with disabilities (Mousa et al., 2021).

b) Goal 13: Climate Action

Smart finance assists individuals, local communities, governments, and businesses in mitigating and combating all harmful effects of climate change and in preparing adequately for them, by enhancing resilience and stimulating sustainable investments. Smart applications especially in the fields of energy, buildings, transport, smart services, and agriculture can address climate change and reduce its severity, as well as decrease resource use and waste. They also play a vital role in the real-time exchange of climate and weather information, early warning, strengthening and supporting resilience, and climate adaptation (Mousa et al., 2021).

Practical Aspect

This study focuses on two variables: the independent variable, educational technology, and the dependent variable, sustainable development. The aim is to identify the relationships between these two variables. The questionnaire comprising dimensions related to both variables was subjected to expert validation. SPSS V.27 and AMOS V.24 were used for the analysis. Initially, descriptive statistics will be conducted for the participants' personal information, as presented in the following section.

Description of the Investigated Sample

Questionnaires were distributed to a sample of 134 individuals. The survey was administered to respondents from Al-Huda University College. The personal information collected included gender, age, educational attainment, academic rank, current position, and years of experience at the Ministry of Higher Education and Scientific Research.

Description of the Respondents

This subsection presents a description of the respondents' personal information, as shown in Table (1) below:

Personal Information

Table (1): Description of the Respondents

Description	Category / Division	Number	Percentage
Gender	**Male**	**85**	**63%**
	Female	**49**	**37%**
Age	**Under 25**	**15**	**11.2%**
	25–35 years	**41**	**30.6%**
	36–45 years	**52**	**38.8%**
	Over 45	**26**	**19.4%**
Educational attainment	Bachelor's degree	**24**	**17.9**
	Master's degree	**68**	**50.7**
	Doctorate (PhD)	**42**	**31.4**
Academic title	Assistant Lecturer	**69**	**51.5%**
	Lecturer	**33**	**24.6%**

	Assistant Professor	**11**	**8.2%**
	Professor	**21**	**15.7%**
Current position	Unit Officer	**38**	**28.4%**
	Branch Manager	**23**	**17.2%**
	Head of Department	**4**	**3%**
	Other	**69**	**51.4%**
Years of experience at the Ministry of Higher Education and Scientific Research	Less than 5 years	**50**	**37.3%**
	5 to 10 years	**34**	**25.4%**
	More than 10 years	**50**	**37.3%**

Gender: Male respondents accounted for 63%, while female respondents accounted for 37% of the surveyed sample.

Age: The under-25 age group accounted for 11.2%; the 25–35 age group accounted for 30.6%; the 36–45 age group accounted for 38.8%; and the over-45 age group accounted for 19.4% of the surveyed sample.

Educational attainment: The "Bachelor's or below" category accounted for 17.9%; the Master's category accounted for 50.7%; and the Doctorate (PhD) category accounted for 31.4% of the surveyed sample.

Academic title: The Assistant Lecturer category accounted for 51.5%; the Lecturer category accounted for 24.6%; the Assistant Professor category accounted for 8.2%; and the Professor category accounted for 15.7% of the surveyed sample.

Current position: The Unit Officer category accounted for 28.4%; the Branch Manager category accounted for 17.2%; the Head of Department category accounted for 3.0%; and the Other categories accounted for 15.4% of the surveyed sample.

Years of experience at the Ministry of Higher Education and Scientific Research: The "less than 5 years" category accounted for 37.3%; the "5 to 10 years" category accounted for 25.4%; and the "more than 10 years" category accounted for 37.3% of the surveyed sample.

Statistical description of the studied variables

This subsection describes and diagnoses the study variables by presenting response rates, the overall mean, frequency distributions, arithmetic means, standard deviations, and coefficients of variation for the educational-technology variable and the sustainable-development variable, as shown in Table (2) below:

Table (2): Overall mean, frequency distributions, arithmetic means, standard deviations, coefficient of variation, and response rates for the studied variables

Items	response scale										Arithmetic mean	Standard deviation	Relative importance (%)	Item ranking
	Strongly agree (5)		Agree (4)		Moderately agree (3)		Disagree (2)		Strongly disagree (1)					
	ك	%	ك	%	ك	%	ك	%	ك	%				
Educational Technology	37.10	27.70	71.15	53.09	16.80	12.54	6.90	5.14	2.05	1.52	4.003	0.841	80.052	1
Total	80.79				12.54		6.67							
Sustainable Development	34.07	25.41	72.33	54.02	19.53	14.57	7.07	5.27	1.00	0.72	3.981	0.817	79.612	2
Total	79.44				14.57		5.99							

Results interpretation The above results show that the variable "Self educational technology" had a response percentage of 80.052, a mean of 4.003, and a standard deviation of 0.841. This variable received an overall agreement rate of 80.79%; the disagreement rate was 6.67%; and the rate of respondents who were unsure was 12.54%.

The variable "Sustainable development" had a response percentage of 79.612, a mean of 3.981, and a standard deviation of 0.817. This variable received an overall agreement rate of 79.44%; the disagreement rate was 5.99%; and the rate of respondents who were unsure was 14.57%.

Reliability test of the questionnaire The questionnaire reliability measure is an important metric for assessing the consistency of the measurement instrument across combined dimensions. The stratified alpha coefficient (Feldt & Brennan, 1989) was used. Reliability coefficient values were classified into two levels: values above 70% are considered high, while values below 70% are considered low. Cronbach's alpha is defined as a measure of test reliability and validity. Cronbach's alpha is an important metric for research results and for generalizing those results. Table (3) below shows the stratified Cronbach's alpha test for the study variables.

It is noted from Table (3) below that the stratified alpha coefficient value reached 0.96, which is greater than 0.70 for the study variables. Therefore, based on the stratified alpha coefficient, it can be said that the study variables demonstrate strong reliability.

Table (3) Reliability measurement for the study variables

Primary variables	Stratified alpha coefficient for combined dimensions
Educational technology	0.96
Sustainable development	

Internal Consistency of the Study's Variables and Dimensions

Internal consistency represents the interrelation among the questions within a single dimension, which in turn reflects the study variable. If we aim to measure internal consistency at the level of each variable of the study, the process is carried out by calculating the mean of the absolute correlation coefficients between pairs of correlations among the questions within the same variable. Wu, M. et al. (2016) indicate that if the value of this mean is greater than or equal to (0.3), this demonstrates the presence of internal consistency.

Table (4): Values of Internal Consistency at the Level of the Main Variables

Inter-Item Correlations					
Primary variables	**Mean**	**Minimum**	**Maximum**	**Variance**	**NO. of Item**
Educational technology	**0.46**	**0.24**	**0.75**	**0.009**	**20**
Sustainable development	**0.46**	**0.21**	**0.67**	**0.007**	**15**

From Table (4) above, it can be observed that there is internal consistency for both variables. It is noted that the variable of Educational Technology had a mean of 0.46, with the lowest correlation value among the questions reaching 0.24 and the highest correlation value reaching 0.75, while the variance value amounted to 0.0009 among the questions of this variable. As for the variable of Sustainable Development, it also had a mean of 0.46, with the lowest correlation value among the questions reaching 0.21 and the highest correlation value reaching 0.67, while the variance value amounted to 0.0007 among the questions of this variable.

Common Method Bias (CMB) Test

The Common Method Bias (CMB) test is one of the important tests for obtaining accurate estimates and valid relationships. Studies have indicated that this bias may originate from several reasons, such as the lack of use of diverse sources for data collection, administering the scale at one point in time, lack of diversity in the Likert scale used in the questionnaire, the similarity and ambiguity of some statements, the length of the questionnaire, among others. The *Harman single-factor test* was employed to detect the existence or non-existence of common method bias. Bagozzi and Yi (1991) indicated that if the value of this test exceeds 50%, this provides evidence of the presence of common method bias.

Based on the data of the current study, the value of this test was (CMB = 43.170%), which is less than (50%). Therefore, it can be concluded that there is no issue of common method bias.

Normality Test

The probability distribution test of the studied variables is one of the fundamental requirements in any statistical analysis, as most estimation methods and hypothesis tests require the essential assumption that the studied variables follow a probability distribution, usually the normal distribution. The failure to meet this assumption necessitates the use of alternative methods instead of the ordinary least squares (OLS) method in estimating the parameters of the regression model, such as generalized least squares, distribution-free methods, or weighted least squares, among others.

The *Kolmogorov-Smirnov* criterion is one of the most important statistical measures used to test normality and is particularly suitable for large sample sizes. Through the Kolmogorov-Smirnov test, the normality of the studied variables was examined, as shown in Table (5) below.

From the results of Table (5), it is observed that the two studied variables do not belong to a normally distributed population. With this violation of the assumption, traditional estimation methods cannot be used, and it becomes necessary to employ other estimation methods that do not require the fulfillment of this assumption.

Table (5): Normality Test of the Study Data

Primary variables Educational technology	Test of Normality		
	Kolmogorov Smirnov		
	Statistic	Df	Sig
Primary variables	0.107	134	0.001
Educational technology	0.117	134	0.000

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is one of the important tests in evaluating the responses of the studied sample. It measures the correlations between the observed variables (questions) and the dimension they represent, in addition to identifying the correlations among the latent variables (dimensions) of the studied variables. This, in turn, allows for the evaluation of the model proposed by the researcher against the sample model.

Figure (1) illustrates the factor loadings (correlations) of the observed variables (questions) with the latent variables they indicate, with their values shown on the single-headed arrows between each question and its corresponding latent variable, as well as the correlation coefficients between each pair of latent variables, represented on the double-headed arrows.

Furthermore, Table (6) presents the standardized regression weights (SRW – factor loadings) and the unstandardized regression weights, along with their corresponding p-values. The most important indicator in Table (6) is the standardized regression weights (SRW), which represent the factor loadings (correlations) of the questions with the dimension they belong to. According to sample size considerations, most of these values are expected to exceed (0.45) (Hair et al., 2010).

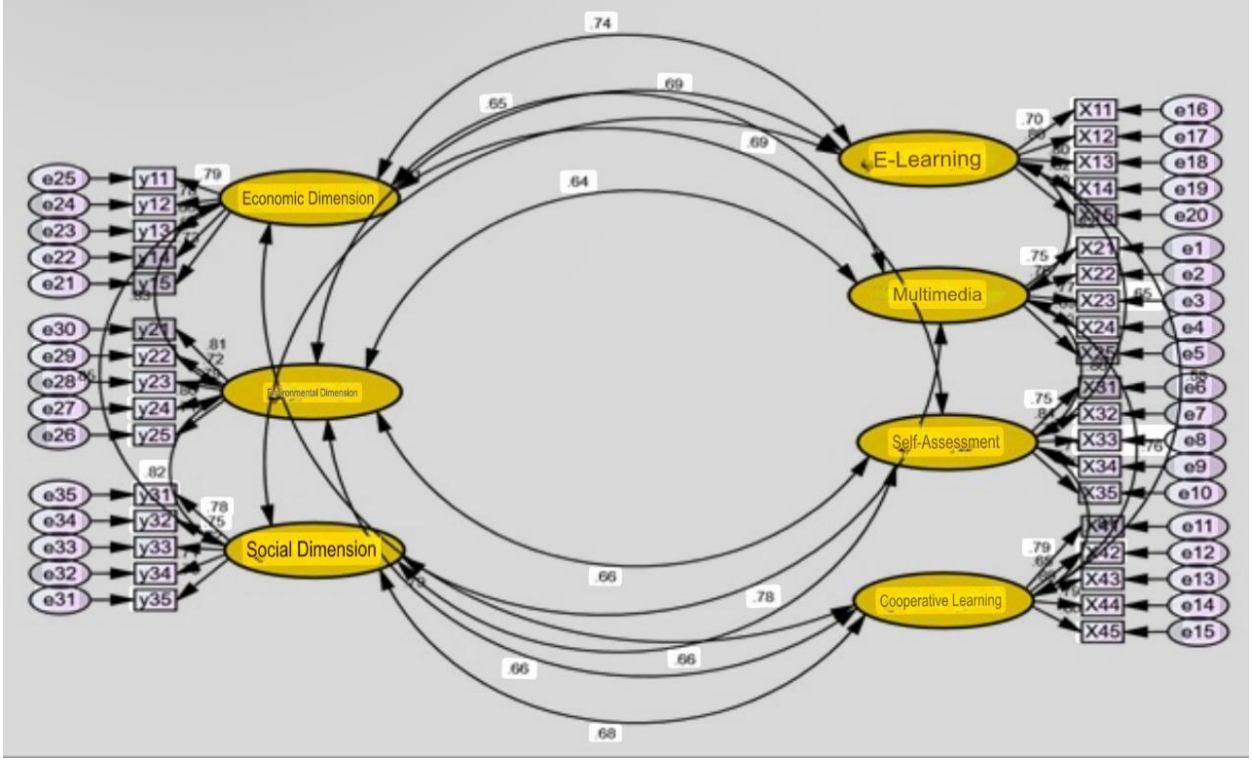


Figure (3): Confirmatory Factor Analysis of the Study Variables' Dimensions

Table (6): Standardized and Unstandardized Regression Weights of the Confirmatory Factor Analysis Results

Parameter			Estimate	SRW	P-value
X11	<---	**E-learning**	1.000	0.704	0.005
X12	<---		0.969	0.797	0.002
X13	<---		1.207	0.795	0.001
X14	<---		1.122	0.818	0.002
X15	<---		0.695	0.602	0.004
X21	<---	**Multimedia**	1.000	0.748	0.002
X22	<---		1.034	0.762	0.002
X23	<---		1.081	0.766	0.003
X24	<---		0.896	0.688	0.002
X25	<---		1.048	0.834	0.002
X31	<---	**Self-assessment**	1.000	0.747	0.002
X32	<---		1.007	0.837	0.001
X33	<---		0.855	0.756	0.002
X34	<---		0.879	0.708	0.002
X35	<---		0.882	0.757	0.001
X41	<---	**Collaborative learning**	1.000	0.788	0.002
X42	<---		0.785	0.648	0.003
X43	<---		1.052	0.893	0.003

Parameter			Estimate	SRW	P-value
X44	<---		0.928	0.789	0.001
X45	<---		1.058	0.799	0.002
y11	<---	**Economic dimension**	1.017	0.791	0.003
y12	<---		0.962	0.777	0.002
y13	<---		0.818	0.662	0.002
y14	<---		0.733	0.556	0.002
y15	<---		1.000	0.732	0.002
y21	<---	**Environmental dimension**	1.093	0.806	0.001
y22	<---		1.012	0.718	0.001
y23	<---		0.993	0.787	0.001
y24	<---		1.083	0.805	0.002
y25	<---		1.000	0.708	0.001
y31	<---	**Social dimension**	1.167	0.782	0.002
y32	<---		1.295	0.754	0.001
y33	<---		1.146	0.723	0.003
y34	<---		1.128	0.713	0.004
y35	<---		1.000	0.700	0.002

From Table (6) above, which includes the standardized regression weights, it is observed that all values were statistically significant, as indicated by the *p-value*, which was less than 0.05. It can also be noted that the values of the standardized regression weights were high and greater than 0.45, which indicates strong correlations between the questions and the latent variables (dimensions). Moreover, based on the goodness-of-fit indices shown in Table (7), it is observed that all indicators were within the specified values (James et al., 2006). Therefore, by relying on the values of the goodness-of-fit indices in Table (7) and the standardized regression weights (SRW) in Table (6), the model can be considered reliable for testing the study's hypotheses, as the questions represented the dimensions of the variables.

Table (7): Goodness-of-Fit Indices of the Confirmatory Factor Analysis

Indices	Value	Result
CMIN/DF		**Consistent**
GFI	0.98	**Consistent**
AGFI	0.97	**Consistent**
NFI	0.97	**Consistent**
PGFI	0.84	**Consistent**
RFI	0.97	**Consistent**
RMR	0.043	**Consistent**

4. Study Hypotheses

In this section, the hypotheses of the study will be tested as follows:

1- Correlation Hypothesis

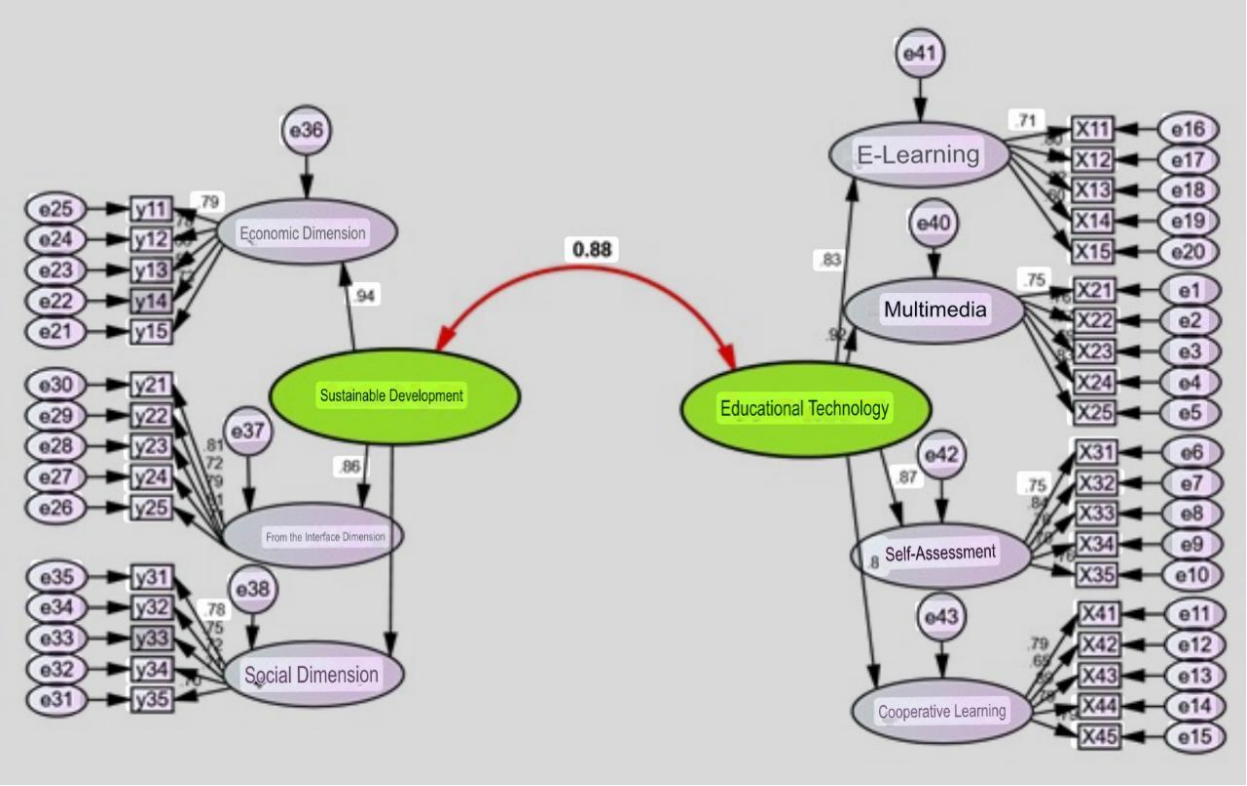
The first main hypothesis: There is a statistically significant correlation ($\alpha \leq 0.05$) between the dimensions of educational technology as a whole namely, e-learning, multimedia, self-assessment, and collaborative learning and the dimensions of sustainable development (economic, environmental, and social) at Al-Huda University College.

From Table (8) below, it is observed that the correlation coefficient between the variable of educational technology and the variable of sustainable development was positive, indicating that the relationship between the two variables was a direct one. It is also noted that the correlation coefficient was (0.88), and this coefficient was statistically significant, as indicated by the p-value (0.003), which was less than 0.05. In addition, both the lower and upper bounds of the 95% confidence interval, with values (0.786, 0.951) respectively, had the same sign at the 0.05 significance level. This leads to the acceptance of the alternative hypothesis, which states that there is a significant correlation between the variable of educational technology and the variable of sustainable development.

Table (8): Correlation between the Variable of Educational Technology and the Variable of Sustainable Development

First Variable	Direction of the Relationship	Second Variable	Correlation Value	P-value	95% Confidence Interval	
					Lower	Upper
Educational Technology	⟷	**Sustainable development**	0.88	0.003	0.786	0.951

Figure (4) below illustrates the relationship between the variable of Educational Technology and the variable of Sustainable Development:



2- **Effect Hypothesis:**

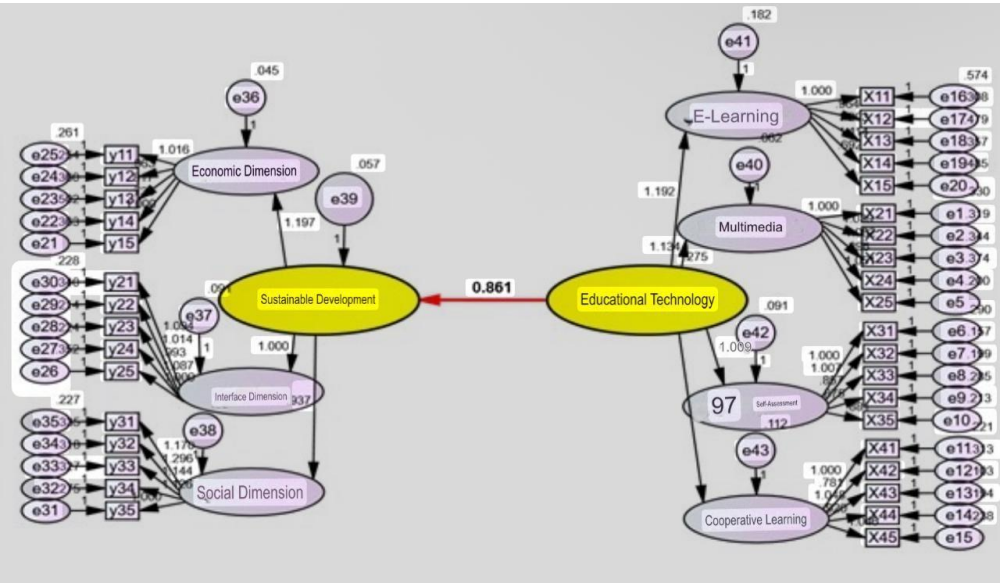
The second main hypothesis: There is a statistically significant effect of the dimensions of educational technology as a whole namely, e-learning, multimedia, self-assessment, and collaborative learning on the dimensions of sustainable development (economic, environmental, and social) at Al-Huda University College.

From Table (9), which shows the estimated parameter value for the variable of educational technology, it amounted to (0.861), indicating that this relationship is direct, as reflected by the positive sign of this estimated parameter. The standard error (S.E.) was (0.243), and the effect of the educational technology variable on the sustainable development variable was statistically significant, as the p-value (0.002) was less than (0.05). Furthermore, the 95% confidence interval showed consistent signs, with the lower and upper bounds being (0.550, 1.530), respectively. Accordingly, based on the above results, it can be concluded that the alternative hypothesis is accepted, stating that the variable of educational technology has a direct and statistically significant effect on the variable of sustainable development at the significance level ($\alpha < 0.05$).

Table (9): Results of the Significant Effect of the Educational Technology Variable on the Sustainable Development Variable

Independent Variable	Direction of Effect	Dependent Variable	Regression Coefficient Estimate (β)	Standard Error of the Regression Coefficient S.E.(β)	P-value	95% Confidence Interval	
						Lower	Upper
Educational Technology	→	Sustainable Development	0.861	0.243	0.002	0.550	1.530

Figure (5) below illustrates the effect of the variable Educational Technology on the variable Sustainable Development:



5. Conclusion

In light of the foregoing and based on the results of this study, it is evident that the utilization of educational technology in its various dimensions (e-learning, multimedia, self-assessment, collaborative learning) constitutes a fundamental and pivotal element in the development of the educational system. It is not merely an update of instructional tools but a strategic means through which the objectives of sustainable development, in its three dimensions, are supported and achieved. This is accomplished by reinforcing the principles of sustainable development within higher education and scientific research institutions. These technological tools not only enhance the quality of the educational process but also contribute directly to supporting the dimensions of sustainable development (economic, environmental, and social).

From an economic perspective, they help reduce educational costs, expand access to learning, increase efficiency, and provide lifelong learning opportunities without the need for excessive resources. From an environmental perspective, they contribute to reducing reliance on paper resources and traditional educational technologies with negative impacts, while digital education reduces the consumption of natural resources such as energy and promotes a culture of sustainability on campus. From a social perspective, they enhance opportunities for collaborative and interactive learning, support inclusivity and equality in education, accommodate individual differences, and promote cooperation and participation.

Accordingly, the success of higher education and research institutions in fulfilling and achieving their developmental mission depends largely on their ability to integrate educational technology into their strategies and employ it systematically to achieve sustainable education. Such education prepares generations capable of responding to contemporary challenges, keeping pace with development, and contributing to building a more sustainable and equitable future.

5.1 Conclusions

i. The utilization of educational technology is a significant practice in achieving sustainable development within higher education and research institutions through the integration of technology into the learning environment.
ii. Multimedia and e-learning contribute to enhancing the efficiency of the learning process and increasing access to knowledge at lower costs, thereby supporting the economic dimension of development
iii. E-learning and self-assessment enhance students' awareness and sense of responsibility, creating a fair and equitable learning environment that supports the social dimension of development.
iv. The systematic use of educational technology reduces reliance on traditional resources, thereby promoting the environmental dimension and preserving natural resources effectively.
v. The relationship between educational technology and sustainable development is integrative and requires strategic planning and institutional commitment to achieve its objectives efficiently and effectively.

5.2 Recommendations

i. It is essential to establish a clear institutional strategy for integrating educational technology with the sustainable development goals of the college.
ii. Continuous training of academic and administrative staff on the effective use of educational technology, linking it to sustainability objectives, should be prioritized.
iii. Strengthening digital infrastructure in higher education and research institutions to ensure inclusive and equitable access to e-learning.

iv. Encouraging scientific research on technological innovations that promote and support sustainable development in the education sector

v. Building partnerships with local and international institutions, including universities, to support the application of sustainable development principles through digital education and sustainable practices on campus.

Developing digital curricula that consider economic, environmental, and social issues and guide students toward their role in sustainable development.

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