
| RESEARCH ARTICLE

Leveraging Artificial Intelligence Applications to Enhance Awareness of Sustainable Development Goals in Saudi Arabia: An Applied Study

Dr. Abdal Halim Mousa Yagub Abdalrazig*¹, Dr. Omer Elsheikh Hago Elmahdi², Dr. ALOTAIBI, ABDULLAH FALAH³

¹ *Gezira University, Sudan*

² *OUS, affiliated to Taibah University, KSA*

³ *National Defense University, Saudi Arabia*

Corresponding Author: Dr. Abdal Halim Mousa Yagub Abdalrazig, Email: Ahalim124@gmail.com

| ABSTRACT

This study aimed to examine the role of artificial intelligence in advancing the Sustainable Development Goals (SDGs) within the framework of Saudi Arabia's Vision 2030. The research explored several potential impacts of artificial intelligence on supporting sustainable development across its economic, social, and environmental dimensions, considering both the public and private sectors. A survey-based methodology was employed. The study concluded with several recommendations, including increasing investment in research and development related to the use of artificial intelligence to enhance public awareness of sustainable development, and strengthening collaboration among government entities, private-sector organizations, and civil society to promote the effective use of artificial intelligence in this domain.

| KEYWORDS

Artificial intelligence, sustainable development, media awareness

| ARTICLE INFORMATION

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Introduction

Sustainable development has emerged as one of the most influential conceptual frameworks guiding contemporary development policies. It is grounded in the principle of meeting the needs of the present without compromising the ability of future generations to meet their own needs, through achieving an integrated balance among economic, social, and environmental dimensions. Over time, this concept has evolved from a theoretical proposition into a strategic reference point that shapes national and international development plans, influences decision-making processes, and forms the foundation of long-term development programs. Within this context, sustainable development is no longer the sole responsibility of governments; rather, it has become a shared responsibility involving media, educational, technological, and community institutions. This shift underscores the importance of public awareness regarding its issues, goals, and indicators.

Media awareness plays a pivotal role in supporting sustainable development pathways by building knowledge, shaping attitudes, and motivating informed community participation. Modern digital media is no longer merely a transmitter of information; it has become an active agent in constructing social perception and guiding collective behavior, particularly with the advancement of interactive communication tools and intelligent content platforms. Consequently, there is a growing need to leverage advanced technologies to enhance sustainability-related awareness messages, ensuring their effective and clear dissemination across diverse audience segments.

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Amid the digital revolution, artificial intelligence has emerged as one of the most significant drivers of transformation in the fields of media, communication, and data analytics. It has enabled unprecedented capabilities in processing big data, predicting trends, automating content production, and tailoring communication messages to audience characteristics and interests. AI applications offer unique opportunities to support awareness of sustainable development by analyzing development indicators, building early-warning systems, and developing interactive educational and media tools that simplify complex concepts and translate them into accessible, shareable content.

Recent scientific literature indicates that artificial intelligence can contribute to a wide range of Sustainable Development Goals, either directly through environmental and economic applications or indirectly by improving knowledge systems, decision-making processes, and resource-management efficiency (Vinuesa et al., 2020). International reports further emphasize that integrating AI into development pathways requires a robust governance and ethical framework that maximizes benefits while minimizing risks, ensuring transparency, accountability, and digital inclusion (UNESCO, 2021).

Building on this foundation, the present study focuses on exploring the role of artificial intelligence in enhancing awareness of sustainable development, assessing the effectiveness of AI tools in expanding societal knowledge of sustainability issues, and analyzing the communicative and cognitive opportunities AI offers to support development efforts. The study adopts an integrated perspective that brings together the technological dimension and the media-based awareness dimension. AI-driven technological innovation offers interdisciplinary insights into educational frameworks, addressing technological integration, ethical challenges, and equitable access in higher education" (Elsheikh Hago Elmahdi et al., 2025).

This study aimed to examine the role of artificial intelligence in advancing the Sustainable Development Goals (SDGs) within the framework of Saudi Arabia's Vision 2030, exploring its impacts across economic, social, and environmental dimensions" (Mousa, 2026).

Study Objectives

This study aims to address the following key areas:

Assessing the extent of participants' knowledge regarding the role of artificial intelligence in sustainable development.

Examining the effectiveness of using artificial intelligence in enhancing awareness of sustainable development.

Identifying the potential opportunities that artificial intelligence may offer in achieving and expanding awareness of the Sustainable Development Goals (SDGs).

Research Problem and Questions

Khidr (2013, p. 150) argues that formulating a research problem in an interrogative form helps establish a clear connection between the study's main variables. Accordingly, the problem of this study is encapsulated in the following central question:

"How effective is the use of artificial intelligence in enhancing awareness of sustainable development?"

From this main question, the following sub-questions emerge:

To what extent are participants knowledgeable about the role of artificial intelligence in sustainable development?

How effective is the use of artificial intelligence in enhancing awareness of sustainable development?

What potential opportunities can artificial intelligence offer in achieving and expanding awareness of the Sustainable Development Goals?

Research Hypotheses

The study seeks to test the following hypotheses:

Are there statistically significant differences in participants' responses regarding the role of artificial intelligence in sustainable development attributable to gender?

Are there statistically significant differences in participants' responses regarding the role of artificial intelligence in sustainable development attributable to educational level?

Research Methodology

This study employed the **survey method**, utilizing two of its five primary forms: a public survey and content analysis. In addition, the descriptive-analytical approach was used to describe and interpret the phenomenon under investigation and its dimensions. This was achieved through reviewing historical sources, and drawing on statistical data as well as printed and published information from local and international scientific journals and periodicals.

Masha'qbeh (2010, p. 61) defines the survey method as "a set of phenomena that constitute the subject of research, comprising a number of units that form the research population over a sufficient period of time, with the aim of establishing a fundamental base of data and information within a specific field and processing them analytically."

Statistical Data Analysis

The study will employ the **Statistical Package for the Social Sciences (SPSS)** to analyze the field data. The significance level adopted in the present study for all hypothesis tests and correlation analyses is **95% confidence**, meaning that statistical results will be accepted at a **p-value ≤ 0.05** .

Key Terms of the Study

Artificial Intelligence (AI): Fahmi (2023) explains that this emerging field seeks to understand the complex mental processes performed by the human mind during thinking, and subsequently translate these cognitive processes into equivalent computational operations that enhance the computer's ability to solve complex problems.

Sustainable Development: A global socio-economic term adopted by the United Nations to outline a roadmap for environmental, social, and economic development worldwide. Its primary goal is to improve the living conditions of every individual in society, develop production methods and tools, and manage them in ways that do not lead to the depletion of the Earth's natural resources. Relying solely on economic indicators to evaluate development efforts has become misleading due to their limitations in capturing social dimensions (Abu Al-Futouh, 2022).

Theoretical Framework of the Study

This study is grounded in the **Unified Theory of Acceptance and Use of Technology (UTAUT)**, as it is directly relevant to the study's focus on examining the role of artificial intelligence in enhancing awareness of sustainable development. According to Breik (2022), this theory is built upon several foundational models, most notably the **Technology Acceptance Model (TAM)**, which is considered a comprehensive framework for understanding how individuals accept and adopt various technological applications across multiple fields, including media, healthcare, education, and industry. TAM can also be employed to identify the factors influencing individuals' behavioral responses toward such applications.

The model plays a significant role in explaining the factors that affect the adoption of information technology. Within TAM, two primary factors form the basis of the relationship governing technology use: **behavioral intention** and **actual usage behavior**. Both are shaped by **perceived usefulness** and **perceived ease of use** (or expected effort), in addition to **voluntariness of use**, **facilitating conditions**, and demographic and social factors that influence technology acceptance and adoption.

Abdel-Razek (2022) similarly argues that the theory incorporates several models, with TAM being the most prominent due to its capacity to explain how individuals accept and adopt technological applications across diverse domains such as media, healthcare, education, and industry. It also helps identify the determinants that shape individuals' behavioral tendencies toward these applications. The model thus contributes to understanding the factors influencing the adoption of information technology.

The theoretical framework is grounded in the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), explaining how users accept and adopt technological applications through perceived usefulness and perceived ease of use (Mousa, 2026).

TAM is built upon several key assumptions, as noted by Pan et al. (2005), including:

When users perceive a system as easy to use and requiring minimal cognitive effort, they are more likely to develop a positive attitude toward using it.

When users find a system useful for accomplishing their tasks, they tend to form favorable attitudes toward it.

When users hold positive attitudes toward a system, they are more likely to use it frequently and intensively, which ultimately reflects the system's success.

According to Al-Sudhan (2021), the Technology Acceptance Model (TAM) is considered one of the most robust and widely adopted models for explaining the factors influencing the adoption and use of technology. This is attributed to several reasons:

TAM is grounded in a strong theoretical foundation and is characterized by its simplicity in formulation and in the interpretation of its data.

The model has been extensively tested across numerous scientific studies aimed at understanding and explaining information-technology usage behavior, and it has consistently demonstrated reliability and statistically trustworthy results.

TAM is regarded as an advanced theoretical model, derived from both the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB). Consequently, it is expected to explain and predict users' actual behavior regarding technology acceptance with greater accuracy than other theoretical models.

The model can be applied at both the individual and organizational levels, making it suitable for explaining and interpreting the factors influencing technology adoption across different contexts.

Previous Studies

First Study: The study by Al-Haleem Al-Ashy, Sh. A., & Badi, D. H. (2021)., titled *"Harnessing Artificial Intelligence for Business Competitiveness in Achieving Sustainable Development Goals,"* examined artificial intelligence in relation to awareness, knowledge, empowerment, implementation, and competitiveness, as well as the mediating role of social, environmental, and technological innovation. The study employed an exploratory methodology and reached several key findings:

The relationship between artificial intelligence and business competitiveness is highly significant.

There is a partial mediating effect between AI awareness and competitiveness.

Policymakers should initiate strategies to integrate AI-driven innovations.

Second Study: The study by Senadjki and Abdelhak (2023), also titled *"Harnessing Artificial Intelligence for Business Competitiveness in Achieving Sustainable Development Goals,"* pursued similar objectives by investigating AI awareness, knowledge, empowerment, and implementation in relation to competitiveness, along with the mediating role of social, environmental, and technological innovation. Using an exploratory research design, the study concluded:

The relationship between artificial intelligence and competitiveness is very strong.

AI awareness has a partially mediated effect on competitiveness.

Policymakers must develop strategies to integrate AI innovations.

Third Study: The study by Al-Enazi (2022), titled *“Artificial Intelligence as an Approach to Achieving Sustainable Development in the Business Environment in Line with Saudi Vision 2030,”* aimed to analyze the role of artificial intelligence as an entry point for achieving sustainable development goals within business environments aligned with Vision 2030. The study adopted an inductive approach and analyzed a sample of 20 previous studies. Key findings included:

AI applications have proven effective in improving and developing business environments by reducing time and effort and providing solutions to complex problems.

AI applications have contributed to attracting and enhancing investments and have generated substantial profits in several advanced countries that employ AI in business environments.

Saudi Arabia ranks among the leading Arab countries in the global AI index, contributing to the revitalization of the national economy.

Fourth Study: The study by Al-Qahtani (2022), titled *“The Role of Artificial Intelligence in Achieving Sustainable Development within the Framework of Saudi Vision 2030,”* sought to identify the role of AI in achieving the Sustainable Development Goals within the context of Vision 2030. Using a descriptive-analytical methodology, the study concluded:

Artificial intelligence has been successfully applied in several fields, including medicine, education, financial markets, industry, and search engines.

The use of artificial intelligence contributes significantly to achieving the Sustainable Development Goals.

Fifth Study

The study by Rizq (2022), titled *“Artificial Intelligence as a Requirement for Achieving the Sustainable Development Goals,”* examined the extent to which artificial intelligence influences the achievement of the Sustainable Development Goals. The study employed a **descriptive-experimental methodology** and focused on the experiences of both the Kingdom of Saudi Arabia and the Arab Republic of Egypt in applying AI technologies. The study reached several important findings:

The rapid advancement of artificial intelligence must be accompanied by organizational understanding and oversight of AI-based technologies.

The NEOM project in Saudi Arabia is considered one of the most advanced real-world applications of artificial intelligence.

Sixth Study

The study by Al-Shareeda, Nadia, and colleagues (2021), titled *“Artificial Intelligence in Accounting Education and Its Role in Achieving the Sustainable Development Goals in the Kingdom of Bahrain: Applied Science University as a Model,”* aimed to examine the relationship between artificial intelligence in accounting education and its role in achieving the Sustainable Development Goals in Bahrain. The study adopted a **descriptive-analytical approach** applied to the University of Applied Sciences in Bahrain and reached several key findings:

The application of artificial intelligence in accounting education contributes to achieving **seven out of the seventeen Sustainable Development Goals**.

Bahrain possesses a strong AI infrastructure, as it holds a leading regional position in digital transformation—ranking **first in the Arab world** and **fourth globally** in the ICT Development Index.

Commentary on Previous Studies

The current study benefited significantly from the reviewed literature in identifying the methodological approaches employed, clarifying the concepts of artificial intelligence and sustainable development, understanding the Sustainable Development Goals

(SDGs), and examining how artificial intelligence contributes to their achievement. A review of prior studies reveals a consistent agreement that artificial intelligence plays a substantial role in advancing sustainable development objectives.

This study addresses the relationship between artificial intelligence, media, and sustainable development through several thematic dimensions, as outlined below:

First Theme: The Media Role of Artificial Intelligence

Contemporary life is witnessing rapid technological transformations that are reshaping human societies globally. These transformations stem largely from the increasing reliance on artificial intelligence technologies—tools that had no real presence in the past but have now permeated nearly every aspect of modern life. This technological shift has opened wide horizons across various sectors, with the media field being one of the most profoundly affected.

The dominance of artificial intelligence within media practices has led to fundamental changes in the nature of media work. AI has introduced new capabilities and opportunities that must be optimally leveraged. As Al-Enazi (2022) notes, artificial intelligence has transformed business and commercial environments, shifting traditional physical stores into digital platforms that operate across borders while reducing cost and effort.

A 2018 survey by *The Economist* reported that respondents expected artificial intelligence to have a positive impact on growth (90%), productivity (86%), innovation (84%), and job creation (69%). Moreover, 77% of respondents anticipated that AI would enhance the sustainability of economic growth. In media institutions, AI applications rely on a range of technologies, including augmented reality, automated news generation, big-data analytics, chatbots for audience interaction, and automated linguistic correction tools.

Artificial intelligence has also expanded the reach of information produced by media organizations, enabling broader dissemination and more efficient engagement with audiences. AI technologies represent a major advancement in media environments due to their ability to address challenges and overcome obstacles that hinder media activities. Beyond the media sector, AI's influence extends to broader societal and economic domains, positioning it as a driving force of future human development. Its advantages and contributions to media functions cannot be overlooked.

Algorithms and Their Role

An algorithm is a set of mathematical and logical steps arranged sequentially to solve a specific problem. The term originates from the work of the 9th-century scholar Abu Ja'far Muhammad ibn Musa al-Khwarizmi, whose contributions laid the foundation for algorithmic thinking. Initially, algorithms were limited to three structures: sequence, selection, and repetition. Today, algorithms are essential for enabling computers to process data efficiently (Dalia Abdulaziz Al-Harbi *et al.* (2025). The integration of AI algorithms and professional communication competencies in digital newsrooms and public relations significantly enhances audience sentiment analysis and workflow development (Al-Sabbati & Abdalrazig, 2025; Alismail & Abdalrazig, 2025).

Tihama Sameeh Mousa Al-Ja'afrah. (2023), classifies algorithmic operations into several types:

Looping: Repeating a process multiple times, such as calculating 2^{50} .

Branching: Allowing the computer to process complex equations automatically.

Selection: Choosing between alternatives, often used in sorting numbers in ascending or descending order.

Sequence: Executing commands in a predetermined order.

Second Theme: The Relationship Between Media and Artificial Intelligence

The media sector is undergoing rapid structural transformations driven by technological advancement, particularly the accelerating development of artificial intelligence technologies and their applications. The relationship between media and artificial intelligence has evolved into one of functional and cognitive integration, as intelligent systems have reshaped patterns of content production,

distribution mechanisms, and modes of audience consumption. Recent literature indicates that the integration of algorithmic systems into digital newsrooms is no longer experimental; rather, it has become an essential component of the operational infrastructure of news production—from data collection to publication and audience-specific content customization (Pavlik, 2024).

AI applications in the media rely on machine learning and deep learning algorithms capable of analyzing massive volumes of textual, visual, and auditory data. These capabilities have enabled practical advancements in areas such as automated summarization, topic extraction, classification, content recommendation, and the generation of text and images. Foundational references in artificial intelligence emphasize that these capabilities stem from mathematical models that learn from data and improve their performance through iteration and feedback, making them highly suitable for deployment in digital media environments (Russell & Norvig, 2021).

Artificial intelligence has also contributed to the development of machine translation tools, audience-interaction analytics, multimedia content creation, and editorial decision-making through predictive analytics. These tools help media organizations accelerate production cycles, reduce costs, and enhance personalization. However, they also introduce professional and ethical challenges related to accuracy, bias, and transparency. Contemporary studies in media and AI stress that the true value of these technologies emerges when they are integrated within a framework of human oversight and clear editorial standards (Pavlik, 2023).

Modern artificial intelligence is built upon an integrated structure that includes computational power, big data, and advanced algorithms, which has led to the rapid expansion of its applications across various sectors, including media. Both introductory and specialized literature outline the practical foundations of these systems and explain how they have transitioned from theoretical models to real-world applications in industry and digital content production (Taulli, 2023).

Media can thus be viewed as an organically interconnected system with artificial intelligence, where both contribute to redefining professional roles and media functions. The most competitive institutions will be those capable of developing integrative models that combine technical efficiency with human editorial judgment, ensuring the maximization of benefits, the mitigation of risks, and the preservation of credibility and content quality (Russell & Norvig, 2021).

Third Theme: Sustainable Development

Sustainable development is defined as *“an activity that leads to the highest possible enhancement of social well-being while preserving available natural resources and minimizing environmental harm.”*

The concept of development refers to *quantitative change*, which may occur **spontaneously**, such as population growth, or **voluntarily**, such as expanding cultivated land or increasing the production of a specific crop (Al-Qahtani, 2022).

The planning process for sustainable development does not emerge in a vacuum; rather, it is guided by well-structured strategies. Sustainable development seeks to achieve several core objectives, most notably the eradication or reduction of poverty, the provision of food security, the enhancement of agricultural systems, the guarantee of inclusive education for all individuals, and the assurance of access to water and sanitation services—managed in a sustainable manner.

In this context, societies strive to support technologies that enable optimal sustainable development. This has led to increasing interest in studying artificial intelligence and harnessing its tools and techniques to achieve the Sustainable Development Goals (SDGs), making AI one of the most prominent global development priorities today.

Indicators for Measuring Sustainable Development

According to Al-Baba (1995, p. 101), several key indicators are used to measure sustainable development, including:

Enhancing the level of economic performance: This involves improving productivity, increasing national output, advancing scientific and technological progress, and fostering the information revolution.

Ensuring the provision of essential goods and services: This refers to meeting the basic needs of citizens and residents within a dynamic framework that continuously improves the quality of products and services.

Expanding employment opportunities: This is achieved by reducing both visible and hidden unemployment through the optimal utilization of the largest possible share of human resources.

Fourth Theme: Media Awareness and Sustainable Development

Media awareness refers to efforts aimed at creating public understanding through various media channels, enabling audiences to recognize and engage with specific issues or problems in an informed, responsible, and positive manner. Achieving effective media awareness requires media institutions to adopt well-designed campaigns and clearly defined communication strategies.

Media awareness is one of the key tools used to address societal challenges. When media outlets are employed systematically and scientifically within structured strategies, they can effectively reach audiences and achieve the desired impact. Media has demonstrated its influential role in advancing sustainable development through continuous awareness campaigns. Its function is no longer limited to transmitting news; rather, sustainable development has become a central priority for contemporary societies, necessitating the use of communication tools characterized by wide reach and interactivity. These tools play a pivotal role in educating individuals and communities and enhancing their awareness of development issues.

Media also plays a fundamental role in the life of individuals and societies, contributing to socialization processes and supporting sustainable development. It exerts strong influence on various aspects of social life, including education and politics. As a result, media has become capable of empowering individuals by providing information in accessible and appealing ways. It is therefore essential to employ media positively and responsibly to address or mitigate social issues. Recent empirical analyses highlight the critical role of electronic press and digital media platforms in providing coverage on food security, environmental sustainability, and public awareness (Abdalrazig et al., 2024; Alismail & Abdalrazig, 2023).

According to Al-Dagher (2012, p. 65), sustainable development consists of three main components:

Economic Component: Based on the principle of enhancing social welfare and eliminating poverty through the optimal use of natural resources.

Social Component: Concerned with the relationship between humans and nature, and with improving the well-being of populations by ensuring access to essential health and educational services, meeting minimum security standards, and upholding human rights.

Environmental Component: Focused on preserving the physical and biological resource base and protecting ecological systems.

Methodological Procedures of the Study

First: Research Method

This study is descriptive in nature and employed the **descriptive research method**, as it is well-suited to the study's objectives and research questions. Within this framework, an **electronic questionnaire** was used as the primary data-collection tool to obtain information that would help answer the study's questions and achieve its objectives.

Second: Research Population

The research population consists of **students and faculty members** at **King Faisal University** and **Imam Abdulrahman bin Faisal University** in the Eastern Province of Saudi Arabia.

Justifications for Selecting the Time Frame

The strong interest of universities in the Eastern Province in the issues of **sustainable development** and **artificial intelligence**.

King Faisal University's adoption of **sustainable development as its institutional identity**.

The registration of numerous **scientific patents** related to artificial intelligence and sustainable development in universities within the Eastern Province.

Third: Research Sample

The actual sample obtained for the study consisted of **286 participants**, collected through an electronic application distributed via a link sent to the research population. *Description of the Research Sample According to Demographic Variables*

1. Description of the Research Sample According to Gender

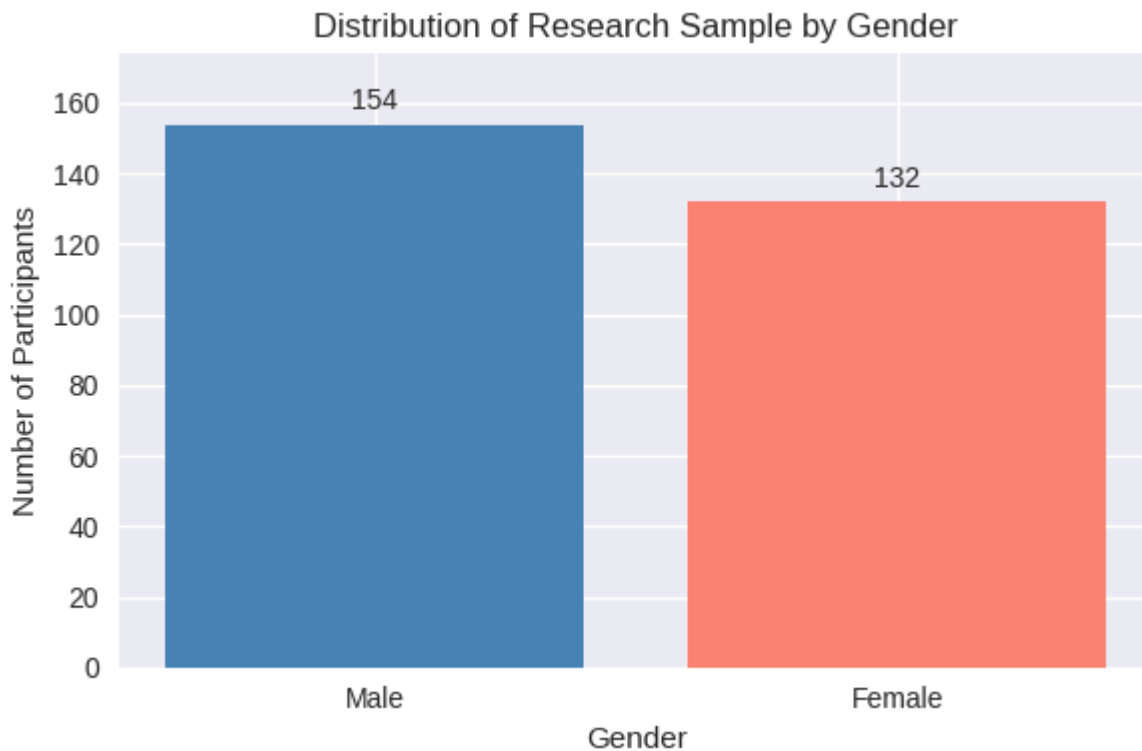
Table (1) presents the distribution of the research sample according to gender.

Table (1) Distribution of the Research Sample by Gender

No.	Gender	Frequency	Percentage (%)
1	Male	154	53.8%
2	Female	132	46.2%
Total	—	286	100%

Figure (1) illustrates the graphical distribution of the research sample by gender.

The following chart illustrates the distribution of the research sample according to gender.



2. Description of the Research Sample According to Educational Level

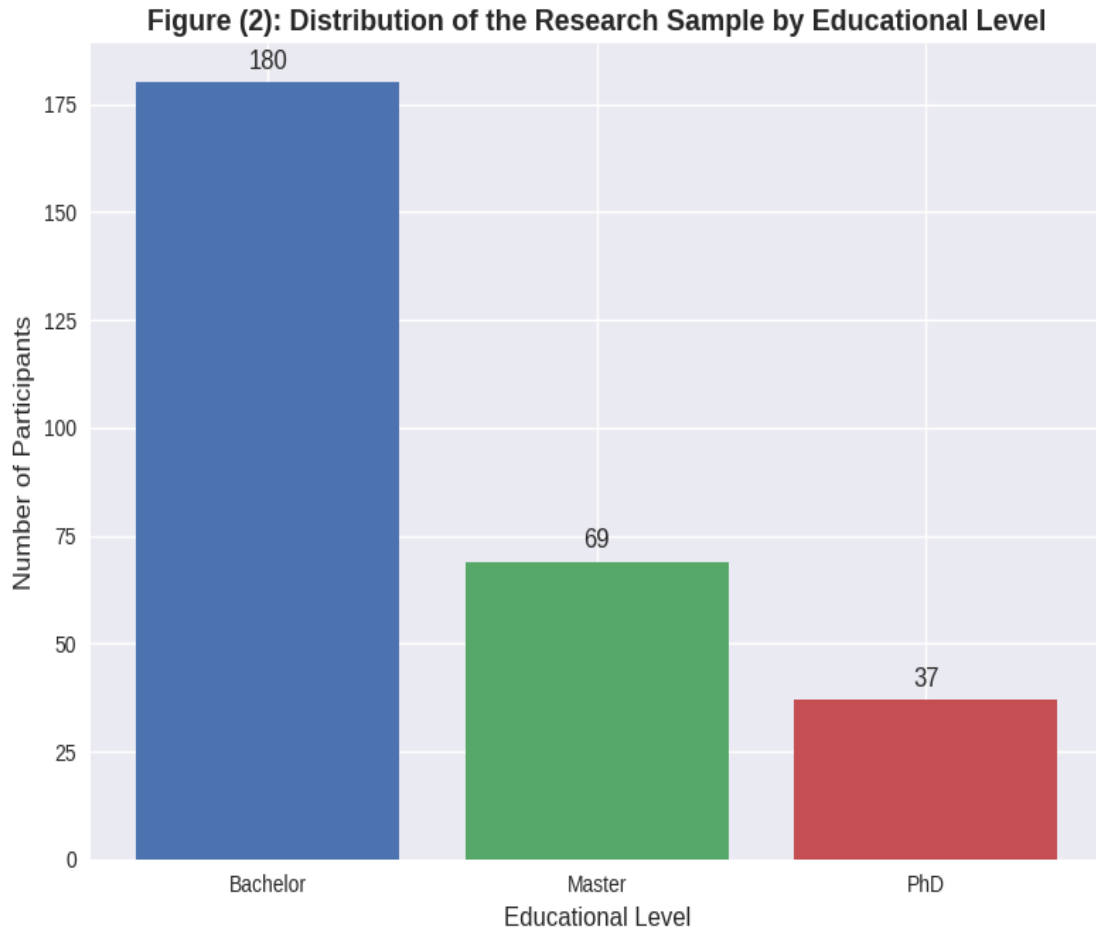
Table (2) presents the distribution of the research sample based on educational level.

Table (2) Distribution of the Research Sample by Educational Level

No.	Educational Level	Frequency	Percentage (%)
1	Bachelor's Degree	180	62.9%
2	Master's Degree	69	24.2%
3	Doctorate (PhD)	37	12.9%
Total	—	286	100%

The following chart illustrates the distribution of the research sample according to educational level.

Figure (2). A graphical representation of the research sample distribution according to educational level.



Fourth: Research Instrument

The research instrument consisted of a questionnaire designed to measure the role of artificial intelligence in achieving the Sustainable Development Goals (SDGs) and in expanding awareness of these goals.

The questionnaire was composed of two main sections:

Section One: This section included demographic information, specifically: **gender** and **educational level**.

Section Two: This section comprised three thematic dimensions, as follows:

First Dimension: The extent of respondents' knowledge regarding the role of artificial intelligence in sustainable development.

Second Dimension: The effectiveness of using artificial intelligence in enhancing awareness of sustainable development.

Third Dimension: The potential opportunities that artificial intelligence may offer in achieving the Sustainable Development Goals and expanding public awareness of them.

Validity and Reliability of the Questionnaire (Psychometric Properties)

Cronbach (2004, p. 46) defines reliability as the degree to which a measurement instrument yields consistent and accurate scores. To ensure the **validity** and **reliability** of the current study, the psychometric properties of the questionnaire were examined. The results of the reliability and validity analyses are presented below.

A. Reliability of the Questionnaire

Reliability refers to the extent to which the results obtained from an instrument remain stable and unchanged when the instrument is administered repeatedly to the same sample under similar conditions.

To verify the reliability of the instrument, two methods were employed: **Cronbach's alpha** and the **split-half method**, as follows:

Cronbach's Alpha for the Entire Questionnaire: The overall reliability coefficient for the questionnaire was **0.91**, indicating a high level of internal consistency.

Cronbach's Alpha for Each Dimension: Reliability coefficients for each of the questionnaire's dimensions were also calculated, as presented in **Table (3)**.

Table (3). Cronbach's Alpha Reliability Coefficients for Each Dimension of the Questionnaire

Dimension	Number of Items	Cronbach's Alpha
First	5	0.73
Second	6	0.81
Third	9	0.86
Total	20	0.91

The results presented in Table (3) indicate that the Cronbach's alpha coefficients for all questionnaire dimensions are relatively high, ranging from **0.73 to 0.86**. These values reflect satisfactory to excellent internal consistency across the different dimensions of the instrument.

Furthermore, the reliability of the questionnaire was also assessed using the **split-half method**. The overall reliability coefficient, calculated using the **Spearman-Brown formula**, reached **0.81**, which likewise indicates a strong and acceptable level of reliability. Table (4). Split-Half Reliability Coefficients for Each Dimension of the Questionnaire

Dimension	Number of Items	Split-Half Reliability Coefficient
First	5	0.71
Second	6	0.77
Third	9	0.77
Total	20	0.71

The results presented in Table (4) demonstrate that the split-half reliability coefficients for all questionnaire dimensions are relatively high, ranging from **0.71 to 0.77**. These values indicate acceptable internal consistency across the different dimensions of the instrument.

Such findings confirm that the questionnaire possesses strong reliability characteristics, suggesting that it is suitable for achieving the objectives of the present study. Moreover, the stability of the reliability coefficients implies that the instrument is capable of producing consistent and dependable results if the study were to be replicated under similar conditions. B. Validity of the Questionnaire

1. Content Validity (Expert Review)

After developing the questionnaire, it was submitted to a panel of **five experts** in the relevant field to evaluate the appropriateness of the dimensions for measuring the phenomenon under investigation, the suitability of each item for its corresponding dimension, and the clarity and accuracy of item wording. The experts were also invited to suggest additions, deletions, or modifications as needed.

An agreement criterion of **80% or higher** was adopted. Based on the experts' feedback, no dimensions were removed from the instrument; however, several items were reworded for improved clarity. The final version of the questionnaire consisted of **20 items** distributed across **three dimensions**.

2. Internal Consistency Validity

Internal consistency validity was assessed by calculating the **correlation coefficients** between each item and the total score of the dimension to which it belongs, as well as the correlation between each item and the overall questionnaire score. These results are presented in **Table (5)**.

Table (5). Internal Consistency (Correlation Coefficients) for the Questionnaire Items

Item	Correlation with Dimension	Correlation with Total Score	Item	Correlation with Dimension	Correlation with Total Score
Dimension 1			Dimension 3		
1	0.66**	0.54**	11	0.70**	0.69**
2	0.60**	0.42**	12	0.66**	0.68**
3	0.71**	0.55**	13	0.60**	0.57**
4	0.70**	0.59**	14	0.71**	0.62**
5	0.66**	0.52**	15	0.68**	0.59**
Dimension 2			16	0.81**	0.73**
6	0.73**	0.67**	17	0.64**	0.54**
7	0.67**	0.58**	18	0.72**	0.68**
8	0.73**	0.61**	19	0.71**	0.62**
9	0.68**	0.59**	20	0.63**	0.56**
10	0.80**	0.75**			

(\) Correlation is statistically significant at the 0.01 level.

The results in Table (5) show that all items are positively and significantly correlated with their respective dimensions and with the total questionnaire score at the **0.01 significance level**. The correlation coefficients ranged from **0.42 to 0.81**, indicating a **high degree of internal consistency validity** across all items.

Table (6). Internal Consistency Correlation Coefficients for the Questionnaire Dimensions

Dimension	Correlation with Total Score
First	0.79**
Second	0.90**
Third	0.91**

(\)\) Correlation is statistically significant at the 0.01 level.

The results presented in Table (6) show that all questionnaire dimensions are positively and significantly correlated with the overall questionnaire score at the **0.01 significance level**. The correlation coefficients ranged from **0.79 to 0.91**, indicating a **high degree of internal consistency validity** across all dimensions. These findings confirm that the questionnaire dimensions are strongly aligned with the overall construct being measured, thereby supporting the instrument's suitability for achieving the objectives of the present study and its ability to yield stable and reliable results upon repeated administration.

Fifth: Statistical Methods Used in the Study

The data were analyzed and processed using the **Statistical Package for the Social Sciences (SPSS)**, employing the following statistical techniques:

Pearson correlation coefficient

Cronbach's alpha reliability coefficient

Split-half reliability coefficient using the **Spearman–Brown formula**

In addition, the following statistical procedures were used to analyze the questionnaire data:

Weighted means, standard deviations, and relative weights

Independent samples t-test (T-test)

One-way analysis of variance (One-Way ANOVA)

Scheffé post-hoc test for multiple comparisons

Determining Agreement Levels and Relative Weights

The levels of agreement were determined based on the arithmetic mean and the cut-off points of the three-point Likert scale used in the instrument (ranging from 1 to 3). The scale range was calculated as follows:

$$\text{Range} = (3 - 1) = 2$$

$$\text{Length of each interval} = 2 \div 3 = 0.67$$

This value was then added sequentially to the lowest point on the scale (1) to determine the upper limit of each interval. The classification criteria are presented in **Table (7)**.

Table (7). Agreement Levels and Categories Based on Weighted Mean and Relative Weight

No.	Relative Weight (%)	Weighted Mean	Agreement Level	Category
1	33.33 – 55.66%	1.00 to < 1.67	Disagree	Low
2	55.66 – 77.99%	1.67 to < 2.34	Neutral	Moderate
3	77.99 – 100%	2.34 to 3.00	Agree	High

Cut-off Point (Adequacy Threshold)

The cut-off point was determined by calculating the **75th percentile** of the score range (1–3). Accordingly, the adequacy threshold was set at a score of **2.25** or higher.

Results of the Study

Answer to Research Question One:

To what extent are respondents knowledgeable about the role of artificial intelligence in sustainable development?

To address this question, **weighted means**, **standard deviations**, and **relative weights** were calculated for the respondents' answers regarding their level of knowledge about the role of artificial intelligence in sustainable development. The results are presented in **Table (8)**.

Table (8). Weighted Means and Relative Weights for Respondents' Knowledge of the Role of Artificial Intelligence in Sustainable Development

Item No.	Statement	Weighted Mean	Standard Deviation	Relative Weight (%)	Rank	Agreement Level
1	Artificial intelligence plays an important role in enhancing awareness of sustainable development.	2.76	0.58	91.99	2	Agree
2	The use of technology and artificial intelligence contributes to environmental protection.	2.77	0.53	92.32	1	Agree
3	Directing efforts toward adopting technologies such as artificial intelligence enhances awareness of the importance of sustainability.	2.65	0.68	88.32	5	Agree
4	The use of artificial intelligence helps improve planning for sustainable development projects.	2.69	0.66	89.66	4	Agree
5	I am interested in learning more about how artificial intelligence can support awareness of sustainable development.	2.73	0.61	90.99	3	Agree
Overall Mean for Dimension One	—	2.72	0.60	90.66	—	Agree

Interpretation of Results

The results presented in Table (8) indicate the following:

Respondents expressed an **overall agreement** regarding their knowledge of the role of artificial intelligence in sustainable development, with a weighted mean of **2.72**, a relative weight of **90.66%**, and a standard deviation of **0.60**. This low standard deviation reflects **high consistency** among respondents' answers. Moreover, the overall mean exceeds the **cut-off point (2.25)**, indicating a **high level of knowledge** among the sample regarding the role of artificial intelligence in sustainable development. This finding aligns with the results of **Al-Qahtani & Ayed (2022)**, who concluded that artificial intelligence contributes significantly to achieving the Sustainable Development Goals.

The highest-ranked item was **Item (2)**: *"The use of technology and artificial intelligence contributes to environmental protection,"* which obtained the highest weighted mean (**2.77**), indicating strong agreement among respondents.

The lowest-ranked item—while still within the "Agree" category—was **Item (3)**: *"Directing efforts toward adopting technologies such as artificial intelligence enhances awareness of the importance of sustainability,"* which recorded the lowest weighted mean (**2.65**).

Answer to Research Question Two:

What is the effectiveness of using artificial intelligence in enhancing awareness of sustainable development?

To address this question, **weighted means**, **standard deviations**, and **relative weights** were calculated for the respondents' answers to determine the level of effectiveness. The results are presented in **Table (9)**.

Table (9). Weighted Means and Relative Weights for the Effectiveness of Using Artificial Intelligence in Enhancing Awareness of Sustainable Development

Item No.	Statement	Weighted Mean	Standard Deviation	Relative Weight (%)	Rank	Effectiveness Level
6	Artificial intelligence contributes to achieving the economic goals of sustainable development.	2.67	0.64	88.99	3	High
7	The use of technologies such as artificial intelligence improves the social and cultural life of communities.	2.62	0.69	87.32	5	High
8	Artificial intelligence helps provide sustainable solutions to environmental and pollution problems.	2.63	0.66	87.66	4	High
9	Directing investments toward developing sustainable technologies, such as artificial intelligence, enhances sustainable development.	2.69	0.61	89.66	2	High
10	Artificial intelligence plays a role in empowering communities to achieve the Sustainable Development Goals.	2.61	0.67	86.99	6	High
11	Artificial intelligence contributes to promoting sustainable economic growth.	2.71	0.61	90.32	1	High

Item No.	Statement	Weighted Mean	Standard Deviation	Relative Weight (%)	Rank	Effectiveness Level
Overall Mean for Dimension Two	—	2.66	0.65	88.65	—	High

Interpretation of Results

The results presented in Table (9) indicate the following:

Respondents rated the **effectiveness of using artificial intelligence in enhancing awareness of sustainable development** as **high**, with a weighted mean of **2.66**, a relative weight of **88.65%**, and a standard deviation of **0.65**. The low standard deviation reflects **high consistency** among respondents' answers. Additionally, the overall mean exceeds the **cut-off point (2.25)**, confirming a **high perceived level of effectiveness**.

The highest-ranked item was **Item (11)**: "*Artificial intelligence contributes to promoting sustainable economic growth*," which obtained the highest weighted mean (**2.71**), indicating that respondents strongly perceive AI as a driver of sustainable economic development.

The lowest-ranked item—while still within the "High" effectiveness level—was **Item (10)**: "*Artificial intelligence plays a role in empowering communities to achieve the Sustainable Development Goals*," which recorded the lowest weighted mean (**2.61**).

Answer to Research Question Three:

What are the potential opportunities that artificial intelligence can offer in achieving the Sustainable Development Goals and expanding awareness of them?

To address this question, **weighted means**, **standard deviations**, and **relative weights** were calculated for the respondents' answers regarding the potential opportunities artificial intelligence may provide in achieving the Sustainable Development Goals (SDGs) and enhancing awareness of them. The results are presented in **Table (10)**.

Table (10). Weighted Means and Relative Weights for the Potential Opportunities Provided by Artificial Intelligence in Achieving the SDGs and Expanding Awareness

Item No.	Statement	Weighted Mean	Standard Deviation	Relative Weight (%)	Rank	Agreement Level
12	Artificial intelligence technologies can improve quality of life in sustainable communities.	2.63	0.67	87.65	4	Agree
13	Adopting artificial intelligence technologies can improve employment opportunities in sustainable fields.	2.48	0.76	82.66	9	Agree
14	Artificial intelligence can provide sustainable solutions to health and well-being challenges.	2.59	0.67	86.32	7	Agree
15	Adopting artificial intelligence can improve resource-use efficiency and reduce waste.	2.62	0.66	87.32	5	Agree
16	Employing technologies such as artificial intelligence can achieve sustainable development in developing communities.	2.59	0.68	86.32	8	Agree

Item No.	Statement	Weighted Mean	Standard Deviation	Relative Weight (%)	Rank	Agreement Level
17	Investing in sustainable technologies such as clean energy and resource management can lead to sustainable economic growth.	2.67	0.61	88.99	2	Agree
18	Relying on smart technologies can improve quality of life and contribute to achieving the SDGs.	2.66	0.63	88.66	3	Agree
19	Applying smart and inclusive technologies can enhance social inclusion in support of sustainable development.	2.60	0.66	86.66	6	Agree
20	Artificial intelligence can play a role in promoting innovation and developing solutions to sustainable development challenges.	2.71	0.60	90.32	1	Agree
Overall Mean for Dimension Three	—	2.61	0.66	86.99	—	Agree

Interpretation of Results

The results presented in Table (10) indicate the following:

Respondents expressed an **overall agreement** regarding the potential opportunities that artificial intelligence can offer in achieving the Sustainable Development Goals and expanding awareness of them, with a weighted mean of **2.61**, a relative weight of **86.99%**, and a standard deviation of **0.66**. The low standard deviation reflects **high consistency** among respondents' answers. The overall mean exceeds the **cut-off point (2.25)**, indicating a **high perceived level of opportunity**.

The highest-ranked item was **Item (20)**: "Artificial intelligence can play a role in promoting innovation and developing solutions to sustainable development challenges," which obtained the highest weighted mean (**2.71**). This finding aligns with Al-Haleem Al-Ashy, Sh. A., & Badi, D. H. (2021), who emphasized the need for policymakers to initiate strategies for integrating artificial intelligence innovations.

The lowest-ranked item—while still within the "Agree" category—was **Item (13)**: "Adopting artificial intelligence technologies can improve employment opportunities in sustainable fields," which recorded the lowest weighted mean (**2.48**). This result is supported by **Al-Anzi (2022)**, who found that artificial intelligence applications have proven effective in improving and developing business environments by reducing time and effort and providing solutions to complex problems.

Testing the First Hypothesis

Are there statistically significant differences in respondents' perceptions of the role of artificial intelligence in sustainable development attributable to gender?

To test this hypothesis, the **independent samples t-test** was used to examine whether statistically significant differences exist between the mean scores of respondents according to gender. The results are presented in **Table (11)**.

Table (11). Independent Samples t-Test Results for Differences in Respondents' Perceptions According to Gender

Dimension	Gender	n	Mean	Standard Deviation	t-value	df	Significance Level
First Dimension	Male	154	13.43	2.09	1.39	284	Not significant
	Female	132	13.77	1.99			
Second Dimension	Male	154	15.74	2.72	1.08	284	Not significant
	Female	132	16.09	2.86			
Third Dimension	Male	154	23.15	4.19	1.42	284	Not significant
	Female	132	23.85	3.92			

Interpretation of Results

The results presented in Table (11) indicate that:

There are **no statistically significant differences** between male and female respondents in their perceptions of the role of artificial intelligence in sustainable development across all three dimensions.

This suggests that **gender does not influence** respondents' views regarding the role of artificial intelligence in sustainable development.

In other words, the responses of the research sample were **consistent across gender groups**, indicating similar levels of awareness and perceptions among both males and females.

Testing the Second Hypothesis

Are there statistically significant differences in respondents' perceptions of the role of artificial intelligence in sustainable development attributable to educational level?

To test this hypothesis, a **one-way analysis of variance (One-Way ANOVA)** was conducted to examine whether statistically significant differences exist between the mean scores of respondents according to their educational level. The results are presented in **Table (12)**.

Table (12). One-Way ANOVA Results for Differences in Respondents' Perceptions of the Role of Artificial Intelligence in Sustainable Development According to Educational Level

Dimension	Source of Variance	Sum of Squares	df	Mean Square	F-value	Significance
First Dimension	Between groups	52.016	2	26.01	6.42	0.01
	Within groups	1147.12	283	4.05		
	Total	1199.13	285			
Second Dimension	Between groups	45.48	2	22.74	2.59	Not significant
	Within groups	2172.95	283	7.70		
	Total	2218.44	285			

Dimension	Source of Variance	Sum of Squares	df	Mean Square	F-value	Significance
Third Dimension	Between groups	77.14	2	38.57	2.33	Not significant
	Within groups	4473.11	283	16.50		
	Total	4550.26	285			

Interpretation of ANOVA Results

The results in Table (12) indicate the following:

There are **no statistically significant differences** in respondents' perceptions for the **second** and **third** dimensions attributable to educational level.

However, there **are statistically significant differences** in the **first dimension**, which measures respondents' knowledge of the role of artificial intelligence in sustainable development, attributable to educational level.

To determine the direction of these differences, **Scheffé's post-hoc test** was applied. The results are presented in **Table (13)**.

Table (13). Scheffé Post-Hoc Test Results for the First Dimension

Educational Level	Bachelor's	Master's	Doctorate
Bachelor's	—	0.97*	0.83*
Master's	—	—	—
Doctorate	—	—	—

* Statistically significant at the 0.05 level.

Interpretation of Post-Hoc Results

The results in Table (13) show that:

There are statistically significant differences between the **Bachelor's** and **Master's** groups in favor of the **Master's** group.

There are also statistically significant differences between the **Bachelor's** and **Doctorate** groups in favor of the **Doctorate** group.

These findings indicate that **respondents with higher educational levels (Master's and Doctorate)** possess **greater knowledge** of the role of artificial intelligence in sustainable development compared to those with a Bachelor's degree.

CONCLUSION

The present study examined the role of artificial intelligence in achieving the Sustainable Development Goals (SDGs) and enhancing awareness of them, focusing on three core dimensions: respondents' knowledge of AI's role in sustainable development, the effectiveness of AI in promoting SDG awareness, and the potential opportunities AI can offer in advancing sustainable development efforts. The findings revealed consistently high levels of agreement across all dimensions, indicating that the research sample possesses substantial awareness of the importance of artificial intelligence in supporting sustainability initiatives.

The results demonstrated that respondents recognize AI as a powerful enabler of sustainable development—capable of improving environmental protection, enhancing economic growth, supporting social well-being, and fostering innovation. Moreover, the study found no statistically significant differences in perceptions based on gender, suggesting a shared understanding of AI's role across demographic groups. However, significant differences emerged across educational levels, with higher levels of education associated with greater knowledge of AI's contribution to sustainable development. This underscores the importance of educational attainment in shaping awareness and understanding of emerging technologies.

Overall, the study confirms that artificial intelligence represents a transformative tool with substantial potential to accelerate progress toward the SDGs, provided that institutions invest in capacity-building, strategic planning, and cross-sector collaboration.

RECOMMENDATIONS

Based on the study's findings, the following recommendations are proposed:

1. Strengthen Research and Development Efforts

Increase investment in research and development focused on integrating artificial intelligence into sustainable development initiatives, particularly in areas such as environmental protection, resource management, and smart community planning.

2. Enhance Cross-Sector Collaboration

Promote coordinated efforts among government agencies, private-sector organizations, academic institutions, and civil society to develop unified strategies for leveraging AI in sustainability programs.

3. Build Human Capacity and Digital Skills

Prioritize training and professional development programs that equip individuals—especially educators, policymakers, and sustainability practitioners—with the skills needed to effectively utilize AI tools in awareness-raising and decision-making.

4. Integrate AI into National Sustainability Strategies

Encourage policymakers to embed AI-driven solutions within national and regional sustainability frameworks, ensuring that technological innovation aligns with long-term development goals.

5. Promote Public Awareness and Community Engagement

Develop public awareness campaigns and community-based initiatives that highlight the benefits of artificial intelligence in achieving the SDGs, thereby fostering a culture of informed participation.

6. Support Innovation and Entrepreneurship in Sustainable AI

Encourage startups, innovators, and technology incubators to develop AI-based solutions that address sustainability challenges, particularly in developing communities.

7. Ensure Ethical and Responsible Use of AI

Adopt clear guidelines and ethical frameworks to ensure that AI applications in sustainable development are transparent, fair, and aligned with societal values.

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Study Appendices

The Role of Artificial Intelligence in Enhancing Awareness of Sustainable Development

A Survey Study

This questionnaire has been developed for the research titled *"The Role of Artificial Intelligence in Enhancing Awareness of Sustainable Development."* The purpose of this instrument is to collect the views and insights of participants regarding the contribution of artificial intelligence to promoting awareness of sustainable development.

We kindly request your valuable participation and a few moments of your time to support the success of this study and help achieve its objectives, which will ultimately benefit students and learners in the future. Please note that all participant data will be treated with strict confidentiality, will not be used for any purpose other than scientific research, and the questionnaire does not require any personal, identifying, or sensitive information.

Section 1: Participant Information

1. Gender

☐ Male

☐ Female

2. Educational Level

☐ Bachelor's Degree

☐ Master's Degree

☐ Doctoral Degree

SECTION 2: SURVEY STATEMENTS

Instructions: Please indicate your level of agreement with each statement.

Scale:

5 = Strongly Agree

4 = Agree

3 = Neutral

2 = Disagree

1 = Strongly Disagree

Dimension 1: Knowledge of the Role of AI in Sustainable Development

No.	Statement	1	2	3	4	5
1	Artificial intelligence plays an important role in enhancing awareness of sustainable development.	☐	☐	☐	☐	☐
2	The use of technology and artificial intelligence contributes to environmental protection.	☐	☐	☐	☐	☐
3	Directing efforts toward adopting technologies such as AI enhances awareness of the importance of sustainability.	☐	☐	☐	☐	☐
4	The use of AI helps improve planning for sustainable development projects.	☐	☐	☐	☐	☐
5	I am interested in learning more about how AI can support awareness of sustainable development.	☐	☐	☐	☐	☐

Dimension 2: Effectiveness of AI in Enhancing Awareness of Sustainable Development

No.	Statement	1	2	3	4	5
6	AI contributes to achieving the economic goals of sustainable development.	☐	☐	☐	☐	☐
7	The use of technologies such as AI improves the social and cultural life of communities.	☐	☐	☐	☐	☐
8	AI helps provide sustainable solutions to environmental and pollution challenges.	☐	☐	☐	☐	☐
9	Directing investments toward sustainable technologies such as AI supports sustainable development.	☐	☐	☐	☐	☐
10	AI plays a role in empowering communities to achieve sustainable development goals.	☐	☐	☐	☐	☐
11	AI contributes to promoting sustainable economic growth.	☐	☐	☐	☐	☐

Dimension 3: Potential Opportunities Provided by AI for Achieving and Expanding Awareness of SDGs

No.	Statement	1	2	3	4	5
12	AI technologies can improve the quality of life in sustainable communities.	☐	☐	☐	☐	☐
13	Adopting AI technologies can enhance employment opportunities in sustainable fields.	☐	☐	☐	☐	☐
14	AI can help provide sustainable solutions to health and well-being challenges.	☐	☐	☐	☐	☐
15	The adoption of AI can improve resource-use efficiency and reduce waste.	☐	☐	☐	☐	☐
16	Employing technologies such as AI can support sustainable development in developing communities.	☐	☐	☐	☐	☐
17	Investment in sustainable technologies such as clean energy and resource management can lead to sustainable economic growth.	☐	☐	☐	☐	☐
18	Reliance on smart technologies can improve quality of life and contribute to achieving SDGs.	☐	☐	☐	☐	☐
19	The application of smart technologies can enhance social inclusion in support of sustainable development.	☐	☐	☐	☐	☐
20	AI can play a role in fostering innovation and developing solutions to sustainable development challenges.	☐	☐	☐	☐	☐