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Article

The Role of Technology in Modern Education and its Impact on Sustainable Development

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Abstract: This study addresses the role of technology in modern education and its impact on achieving sustainable development. The research aims to explore how technology is used in education and its effects on environmental sustainability and natural resources. A field study was conducted in several schools to assess the opinions of teachers and students regarding the use of technology in the educational process. A sample of 100 teachers and students from various schools was selected, and a questionnaire was used as the primary data collection tool. The results showed that technology significantly contributes to improving the quality of education and developing students' life and environmental skills. However, some challenges were identified, such as the digital divide and the lack of technological infrastructure in some areas, which affect the implementation of sustainable education. The study recommends improving technological infrastructure and providing continuous teacher training, as well as suggesting further integration of technology into curricula to fully benefit from the capabilities that technology offers to achieve sustainable development goals in education.

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Introduction

The modern era has witnessed tremendous advancements in information and communication technologies (ICTs), making technology an essential tool in all aspects of human life, including education. This development has not only improved teaching methods but has also extended to new technologies that contribute to achieving the Sustainable Development Goals (SDGs), making modern education a key element in this process. Sustainable development, which aims to improve the quality of life for current generations without compromising the ability of future generations to meet their own needs, has become a priority in global education policy. In this context, technology plays a pivotal role in promoting sustainable education by employing digital tools to provide learning opportunities for students worldwide, with a focus on the importance of environmental and social awareness.

Previous studies have shown that sustainable education relies primarily on developing individuals' skills and empowering them to use technology to achieve environmental, social, and economic goals. For example, Fawaz's study demonstrated that the use of digital platforms and educational technology can contribute to raising environmental awareness, helping generations understand environmental challenges

and how to address them [1]. Furthermore, studies such as Zarari's have shown that integrating technology into education strengthens the relationship between humans and the environment and helps reduce the negative environmental impacts of traditional teaching methods [2].

The environmental challenges facing the world today, such as climate change and the depletion of natural resources, require a rapid and effective response from all sectors. Therefore, sustainable education is one of the most important tools for developing environmental awareness and motivating individuals to participate in environmental conservation efforts. In this regard, Lali's study indicated that modern technologies not only contribute to improving the quality of education but also help reduce the consumption of resources such as paper and energy, thus mitigating the environmental impact of traditional education [3].

Despite the significant benefits of technology in education, many countries face challenges in effectively integrating these technologies into their education systems. The digital divide between developed and developing countries is one of the biggest obstacles to achieving sustainable education in many regions. Abdul-Razzaq pointed out that the lack of technological infrastructure in some developing countries is one of the most prominent factors limiting the use of technology in education, which hinders the achievement of sustainable development [4]. This research will explore the role of technology in achieving the Sustainable Development Goals (SDGs) through modern education. It aims to examine how the use of technological tools impacts the achievement of environmental, social, and economic goals, while also highlighting the challenges that may arise in integrating technology into sustainable education. Possible solutions for overcoming these challenges and maximizing the benefits of technology for sustainable education will also be discussed.

Based on the above, it can be argued that the impact of technology in modern education extends beyond simply improving the quality of education; it also transforms how individuals interact with the environment and their communities. The importance of using technology in education is growing in light of global environmental and economic challenges, highlighting the urgent need to fully integrate technology into curricula and educational activities to ensure the effective achievement of the SDGs.

Research Problem:

The research problem lies in exploring how the use of technology in modern education impacts the achievement of sustainable development. The research also raises questions about the challenges that may arise in using this technology in the educational process, and how these challenges and opportunities can be leveraged to contribute to achieving the Sustainable Development Goals (SDGs) on environmental, social, and economic levels.

Research Questions:

1. How does technology contribute to improving the quality of education and promoting sustainable development?

2. What is the role of technology in enhancing environmental and social awareness through education?

3. What challenges may arise in using technology in education to achieve sustainable development?

4. How can the digital divide between developed and developing countries be bridged to achieve sustainable education?

5. What opportunities does technology offer in promoting the SDGs in education?

6. How can modern educational technologies be utilized to achieve sustainable development in rural and remote communities?

7. What theoretical frameworks support the relationship between technology and sustainable development in the field of education?

8. How can sustainable educational principles be applied through the use of technology in educational development?

Research Objectives:

1. To analyze the role of technology in enhancing the quality of education and supporting sustainable development at the environmental, social, and economic levels. 2. To identify the challenges and opportunities associated with using technology in education to achieve sustainable development.

3. To explore the theoretical frameworks that contribute to linking technology with sustainable development in the field of education.

4. To present proposals and recommendations on how to effectively use technology to achieve the Sustainable Development Goals (SDGs) within the education system.

5. To compare the impacts of traditional and technological education on sustainable development in different societies.

Research Significance:

Scientific Significance:

This research contributes to enriching the academic field with an in-depth study of the relationship between technology and sustainable development in education. By analyzing the theoretical frameworks available in the scientific literature, the research demonstrates how technology can be effectively integrated into educational curricula to achieve the SDGs. The research also opens new avenues for studying the impact of technology on different societies, helping to guide future studies toward the optimal use of modern technologies in educational fields.

Applied Significance:

On a practical level, this research contributes to providing practitioners in the field of education, such as teachers and decision-makers in educational institutions, with the necessary knowledge to effectively apply technology in the educational process. Research also helps to better understand the challenges that education systems in developing countries may face and offers solutions to overcome these challenges by leveraging available technological opportunities. Furthermore, research can provide practical proposals for developing sustainable education strategies using modern educational technologies, thus contributing to long-term sustainable development.

Section One: Technology in Modern Education

Requirement One: The Concept of Technology in Modern Education

Technology in modern education is the use of advanced technological tools to enhance the educational process, improve its efficiency, and make it more interactive and comprehensive. Diab defines it as "the application of modern technologies in the design, management, and implementation of the educational process in line with the needs of the modern learner." [5]. These tools, such as smart boards, interactive applications, and digital content, play a fundamental role in transforming traditional education into advanced education that meets the aspirations of the 21st century.

According to John Dewey's constructivist theory, technology supports experiential learning, where students learn through active engagement with digital educational resources. For example, students can use virtual reality technologies to explore learning environments that are not physically accessible, such as space exploration or complex chemical experiments [6].

In addition, technology contributes to creating an interactive learning environment that places the student at the center of the educational process. Educational applications

such as Edmodo and Google Classroom help organize lessons and facilitate communication between teachers and students [7].

The second requirement: The impact of technology on teaching methods. Technology has significantly impacted teaching methods, transforming the traditional rote-learning model into one based on interaction and creativity. Ahmed noted that "technology is not merely an educational tool, but a catalyst for rethinking how information is presented and learned." [8]. These effects are evident in the use of technological media such as educational videos and interactive software.

According to Jean Piaget's active learning theory, learning becomes more effective when students actively participate in problem-solving and use modern technologies to develop their skills. For example, augmented reality applications are used to clarify complex scientific concepts for students, enhancing their understanding and increasing their enthusiasm [9].

Third Requirement: Challenges of Using Technology in Education

Despite the benefits of technology in education, several challenges hinder its optimal use. Among the most prominent of these challenges are the lack of technical skills among teachers and weak infrastructure in schools. According to Al-Ta'i and Adham The unavailability of technological equipment and weak internet connectivity constitute an obstacle to achieving the goals of e-learning." [10].

Bert Lanfy's systems theory emphasizes the importance of coordination between technical and human aspects to ensure the successful use of technology. If teachers are not adequately trained, this may lead to resistance to the use of technology in education [11]. For example, a study conducted in Saudi Arabia showed that many schools lack the necessary technological resources to support e-learning, which negatively impacts educational outcomes [12].

Section Two: The Impact of Technology on Achieving Sustainable Development

First Requirement: The Concept of Sustainable Development and its Relationship to Education

Sustainable development represents the cornerstone of societal progress in the future, focusing on meeting the needs of the present without compromising the ability of future generations to meet their own needs. Awarim and Milat indicate that "education is the cornerstone of achieving sustainable development through the dissemination of environmental, social, and economic awareness." [13]. This reflects the role of education in shaping societal awareness of how to manage natural resources sustainably. Education is not merely a means of transmitting knowledge, but a tool for developing values that contribute to environmental preservation and achieving balanced development.

Through the concept of sustainable development, it becomes clear that education must focus on three main dimensions: the environmental dimension, the economic dimension, and the social dimension. This approach requires that educational policies be concerned with equipping individuals with the knowledge and skills necessary to promote the sustainability of the environment and natural resources. The relationship between education and sustainable development is also clearly evident in educational programs that focus on climate change and its impacts, such as virtual learning programs aimed at raising environmental awareness [14].

The concept of sustainable development in education also includes fostering critical thinking among individuals regarding their daily practices and their impact on the environment. In this context, the importance of modern technology in providing innovative educational solutions that contribute to enhancing environmental awareness is highlighted. For example, through e-learning programs, students can access environmental information and reports that contribute to their understanding of the impact of human activities on natural [9].

Social change theory emphasizes that education is the cornerstone of achieving societal transformations towards sustainable development. Education not only transmits information but also encourages behavioral change that ensures the sustainability of resources for future generations. By integrating technology into educational methodologies, students can be equipped with the tools and knowledge necessary to protect the environment and achieve the Sustainable Development Goals. This aligns with the assertions made by numerous studies on the role of education in empowering societies to achieve sustainable development [12]. Discussing sustainable development and education also requires considering the role of modern technology in providing advanced educational platforms that facilitate access to environmental information and data. Through these platforms, knowledge about conserving natural resources, including the use of renewable energy and the preservation of biodiversity, can be expanded. These technological tools contribute to changing societal thinking and enhance individuals' ability to address sustainability challenges.

Furthermore, the use of technology can contribute to promoting the principle of sustainability in education by facilitating access to up-to-date and reliable environmental information, thus encouraging individuals to adopt sustainable practices. E-learning programs provide a flexible learning environment that allows students to learn according to their individual circumstances, contributing to the achievement of the Sustainable Development Goals.

Therefore, education and technology contribute to achieving sustainable development by raising societal awareness about environmental, economic, and social issues. By integrating technology into educational activities, sustainable development can be achieved not only at the individual level but also at the societal level as a whole. These educational processes contribute to stimulating innovation in the fields of clean energy, natural resource management, and achieving social justice [7].

On the other hand, numerous studies confirm that education is a fundamental factor influencing the achievement of sustainable development. Through educational programs that integrate sustainability concepts into the curriculum, students are encouraged to adopt environmentally sustainable behaviors, thus enhancing their ability to protect the environment. This process is an integral part of disseminating a culture of sustainability, a process that leverages educational technology to accelerate knowledge transfer among individuals [15].

Furthermore, sustainable education contributes to achieving sustainable development by enhancing students' skills in using resources rationally and sustainably. These skills include identifying ways to reduce natural resource consumption and use energy more efficiently, leading to an improved quality of life for current and future generations.

In conclusion, it is evident that sustainable development is not merely an environmental goal, but a comprehensive objective encompassing economic and social aspects. To achieve this goal, education is a key tool that empowers individuals to understand environmental challenges and make sustainable decisions. Technology plays a complementary role in this context, providing tools and resources that contribute to disseminating knowledge and promoting sustainability awareness among individuals.

The second requirement: Technology and sustainable education

Modern technology plays a crucial role in achieving the goals of sustainable education by reducing the consumption of natural resources such as paper and energy. Technological tools like e-learning systems and distance learning programs contribute to reducing the need for traditional facilities that consume significant environmental resources. Lally points out that "the use of technology reduces the environmental impact of traditional education," highlighting the importance of digital educational technologies in reducing the carbon emissions resulting from the traditional educational process [16].

By using technological tools, such as e-books and digital learning platforms, students can learn the necessary skills without excessively using natural resources. For example, instead of printing textbooks, students can use devices to access them.The use of e-learning to access educational content reduces paper waste and carbon dioxide emissions from the printing process [17]. This digital transformation in education reflects the adoption of the concept of sustainability at both the individual and societal levels.

According to the theory of human ecology, the relationship between humans and the environment depends on the sustainable use of natural resources. By using technology in education, this relationship can be strengthened by reducing negative environmental impacts. Studies indicate that the use of e-learning contributes to reducing energy waste resulting from the commuting of students and teachers to and from educational institutions, in addition to reducing the use of paper materials [2].

Through technology, greater utilization of environmental resources can also be achieved by developing innovative educational solutions that help promote environmental awareness among students. For example, through virtual learning platforms, students can learn sustainable environmental practices and discover new ways to protect the environment using digital tools, such as smartphone applications that help monitor energy consumption or determine air pollution levels [9]. Given the environmental challenges facing the world, integrating technology into education is vital for achieving the Sustainable Development Goals (SDGs). By using digital media in the educational process, the need for natural resources consumed in traditional education, such as paper and electricity, can be reduced. Furthermore, digital education provides an opportunity to educate a greater number of individuals in flexible and non-traditional learning environments [7].

This technology also contributes to bridging the educational gap between urban and rural areas, as remote regions can access modern educational content via the internet. This contributes to achieving the principle of social justice in education and underscores the importance of providing equal learning opportunities for all. The development of this process also supports the SDGs at the community level, particularly for those communities that have been unable to access traditional education due to geographical or economic barriers [1].

Using online learning platforms, training programs and workshops can be provided to teach individuals how to manage resources more sustainably. For example, students can learn how to use new technologies, such as renewable energy, in local environments, contributing to environmental conservation and sustainable development [15].

The challenges facing sustainable education in the age of technology necessitate increased investment in technological infrastructure, particularly in remote areas and developing countries. While technology offers opportunities to provide education for all, the digital divide continues to hinder access to these opportunities in many regions. Therefore, it is essential to provide the necessary infrastructure to support this digital transformation and promote sustainability in education [4].

Despite the challenges, technology offers innovative solutions for sustainable education through applications that facilitate student learning and provide new information on how to protect the environment. Thus, technology plays a key role in improving the quality of education and providing equal educational opportunities worldwide, contributing to sustainable development on all levels.

Third Requirement: Challenges and Opportunities in Achieving Sustainable Development through Technology

Achieving sustainable development through technology faces a range of challenges that may hinder the attainment of its desired goals. At the same time, these challenges

open up opportunities that can be leveraged to achieve sustainable development more effectively. One of the most prominent challenges facing this path is the digital divide between developed and developing countries. Studies indicate that many developing countries lack the necessary technological infrastructure to support digital and sustainable education [4]. This gap leads to significant disparities in access to quality education, hindering the achievement of social justice and negatively impacting the progress of sustainable development in these countries.

Furthermore, the lack of adequate training for educators and end-users of technology presents a significant challenge. Even in countries with robust technological infrastructure, the absence of ongoing training programs for educators can lead to the ineffective use of technology. The use of technology in education also requires new educational strategies that are compatible with modern technological tools and keep pace with the evolving educational market. Studies have emphasized the need for comprehensive training programs for teachers to ensure they make the most of technology to achieve educational and developmental goals [1].

On the other hand, economic challenges are among the most significant obstacles to achieving sustainable development through technology. In many countries, families and educational institutions cannot afford the necessary technological devices, thus limiting access to digital education. According to Abdullah, Economic challenges place limitations on the ability of local communities to use modern technology, which hinders the achievement of the Sustainable Development Goals." [18]. However, these challenges can be transformed into opportunities through international partnerships between governments, NGOs, and educational institutions, which can contribute to providing affordable technological tools and the necessary support to educational institutions in remote areas.

Despite these challenges, technology offers numerous significant opportunities for achieving the Sustainable Development Goals. For example, digital technology provides access to unlimited educational resources through platforms such as Moodle and Zoom, which offer an interactive learning environment that allows students to learn remotely. This helps bridge the educational gap between urban and rural areas, providing greater opportunities to learn skills that contribute to improved environmental sustainability. Through online education programs, students in remote areas can access educational opportunities equal to those in major cities.

Furthermore, modern technology offers innovative solutions for optimizing the use of natural resources in education. By using electronic tools such as e-books, excessive paper and energy consumption can be reduced, thus promoting the sustainability of education and minimizing the environmental footprint. These tools help provide sustainable educational opportunities not only for current generations but also for future generations [12].

On another front, technology contributes to improving the quality of education in environmental fields by offering integrated educational solutions related to climate change and the sustainability of natural resources. For example, online students can interact with real-time data on environmental changes around the world. This data can be used to analyze negative environmental impacts and develop innovative solutions to local and global environmental problems, thereby empowering students to contribute to sustainable solutions within their communities [9].

One of the important opportunities offered by technology is education through virtual reality simulations, where students can use technologies such as augmented and virtual reality to study environmental changes practically and realistically. For example, students can experience the effects of climate change on ecosystems in a virtual environment, contributing to a deeper understanding of these environmental issues and the ability to address future challenges.

Furthermore, technology can contribute to strengthening international cooperation through shared educational platforms between developed and developing countries, facilitating the exchange of knowledge and expertise. It also contributes to improving cooperation between governments, international organizations, and academic institutions to develop solutions to shared environmental and social challenges. According to the theory of social justice, educational technology can contribute to achieving education for all, thus contributing to the achievement of the global Sustainable Development Goals.

In addition, technology offers opportunities for innovation in how environmental awareness is disseminated. Smartphone applications and the internet can provide educational tools that help individuals track their energy consumption, learn how to recycle waste, or use renewable energy more efficiently. These applications can serve as interactive educational tools, helping to spread a culture of sustainability among people worldwide. Through these opportunities, technology becomes a powerful tool for supporting sustainable development in the future. However, to achieve this, it is essential to consider the challenges that some communities may face and provide appropriate solutions to ensure the equitable distribution of technology on a global scale. This contributes to enhancing sustainability not only at the environmental level but also at the economic and social levels.

In conclusion, it can be said that the challenges and opportunities that technology presents in achieving sustainable development require global cooperation and the effective utilization of technology.Technology is essential for providing sustainable solutions. By developing smart educational strategies and providing the necessary infrastructure, these challenges can be overcome, thus achieving sustainable development that benefits current and future generations.

Population:

This study focuses on the community of male and female teachers in Iraqi primary and secondary schools who work in an educational environment that partially relies on modern educational technologies (such as distance learning, educational platforms, and digital tools).

Sample:

A random sample of 100 male and female teachers was selected from public and private schools in Iraq. The sample is diverse in terms of gender, age, and academic specialization.

The survey results showed that the majority of participants (75%) believe that the use of technology enhances the quality of education, reflecting the general belief that technology offers significant opportunities to improve access to knowledge and expand the scope of teaching. Ten percent of participants disagreed with this view, while 15% expressed a neutral opinion. This result indicates that technology is considered a key factor in improving the quality of education, but it requires appropriate training and effective integration into the curriculum to achieve its full potential.

The results also showed that 65% of teachers believe that technology contributes positively to the development of students' social skills, indicating that modern technological tools provide students with opportunities to connect with their peers and teachers in an interactive environment. However, 15% of participants expressed a negative opinion, while 20% were neutral. This demonstrates that while technology can enhance social skills, some teachers may see challenges in achieving this goal effectively.

The results further showed that only 45% of teachers believe that technology contributes to the sustainability of natural resources, while 25% disagreed, and 30% were neutral. This shows that many teachers are not fully aware of the environmental benefits that can result from using technology in education, such as reducing paper use or energy consumption.

The survey results showed that 55% of participants believe that technology offers environmentally friendly alternatives, such as reducing reliance on paper and energy. Meanwhile, 20% of teachers expressed a negative opinion on this topic, and 25% were neutral. This result confirms that the majority of teachers recognize the importance of technology in providing sustainable environmental solutions, but it also indicates the need to raise awareness about these benefits.

The results showed that 85% of teachers believe that technology enhances students' research and analytical abilities, highlighting the positive impact of technology on developing critical thinking skills. However, only 5% of participants disagreed, while 10% were neutral. This result indicates that technology significantly contributes to enhancing students' research and analytical abilities, but more training support may be needed to fully realize this potential.

The results also indicated that 75% of teachers agree that there is a digital divide between schools in rural and urban areas. Only 10% of teachers disagreed with this idea, while 15% were neutral. This finding suggests that the digital divide is one of the biggest challenges to achieving sustainable education in some areas, necessitating greater investment in developing technological infrastructure in rural regions.

The results showed that 80% of teachers believe that ongoing training in technology use is essential, while only 8% disagreed, and 12% were neutral. This indicates a high level of awareness among teachers regarding the importance of technological literacy to ensure its effective use in the educational process. There is still a need to provide ongoing training programs to enhance teachers' skills in this area.

The results also showed that 57% of teachers believe that online education promotes the sustainability of education, while 18% disagreed, and 25% were neutral. This suggests that distance learning is considered a sustainable option by the majority of teachers, but some still question its effectiveness in terms of sustainability in certain contexts. The results showed that 40% of teachers face difficulties in integrating technology into education, while 30% expressed a neutral opinion and 30% did not encounter any difficulties. This indicates that there are real challenges in effectively integrating technology into classrooms, necessitating increased technical support and training for teachers.

The results also showed that 83% of teachers believe that technology contributes significantly to the development of sustainable education, while 7% disagreed and 10% were neutral. This suggests that the majority see technology as playing a vital role in achieving sustainable education, reflecting a growing awareness of its benefits in improving access to education and conserving resources.

Conclusion

In conclusion, this study addressed the role of technology in modern education and its impact on achieving sustainable development. The research revealed that technology is a powerful and essential tool for improving and developing the educational process. Through the use of technology in education, learning efficiency can be enhanced, access to knowledge expanded, and students' social and environmental skills developed. The results also confirmed a strong relationship between sustainable education and technology, as modern technologies can contribute to reducing negative environmental impacts by decreasing the consumption of traditional resources such as paper and energy.

Despite the numerous benefits offered by technology, challenges such as the digital divide in some regions and issues related to ongoing teacher training remain obstacles to achieving the goals of sustainable education. Based on the study's findings, there is a need for increased awareness and support to improve technological infrastructure and provide continuous training for teachers to enable them to fully utilize modern technology tools.

Conclusions

Through the field study and analysis of the results, several important conclusions can be drawn:

• Educational technology enhances the quality of education: The majority of study participants supported the idea that the use of technology in education enhances the quality of education and contributes effectively to developing students' skills.

• Technical Challenges: Many schools struggle to integrate technology into the educational process due to the digital divide in some areas, requiring ongoing efforts to improve infrastructure.

• Environmental Awareness: There is a need to enhance environmental awareness among teachers and students regarding how technology impacts the conservation of natural resources.

• The Role of Ongoing Training: Training teachers in the use of technology is crucial for enhancing its effectiveness in education. The study showed that teachers who received ongoing technical training demonstrated a better ability to integrate technology into classrooms.

Recommendations

Based on the findings, the following recommendations can be made:

• Expanding Technological Infrastructure: Stakeholders should work to improve and expand technological infrastructure in schools, especially in rural or remote areas, to reduce the digital divide.

• Focusing on Teacher Training: Ongoing training programs should be provided for teachers to familiarize them with the latest educational technologies and how to use them in classrooms, which will contribute to enhancing the effectiveness of technology.

• Promoting Sustainable Education: Awareness about the benefits of sustainable education using technology should be raised through workshops and awareness campaigns for both teachers and students. • Integrating technology into the curriculum: It is essential to integrate technology into the curriculum more deeply to encourage students to use it in innovative and effective ways.

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