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Green Education and Digital Transformation as Catalysts for Growth in Iraq: An Economic Analysis of Available Opportunities

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Abstract

General Background Sustainable economic growth requires the integration of environmental sustainability and digital innovation. **Specific Background** Iraq's economy is characterized by oil dependence, limited diversification, and underdeveloped education and digital systems.**Knowledge Gap** Limited studies have examined the combined role of green education and digital transformation in addressing these structural challenges. **Aims** This study analyzes their joint role in supporting sustainable economic growth in Iraq. **Results** Green education develops environmentally skilled human capital and supports green sector innovation, while digital transformation improves efficiency, productivity, and market access. Their integration promotes economic diversification, reduces oil reliance, and aligns with Iraq Vision 2030, although constrained by weak infrastructure and limited investment. **Novelty** The study offers an integrated framework linking green education and digital transformation as complementary drivers of structural reform. **Implications** The findings highlight the need for coordinated policies, increased digital investment, and stronger international collaboration to support a sustainable and diversified economy.

Highlights:
- Integration of Environmental Learning and Technology Fosters Diversification Beyond Oil Sectors
- Infrastructure Gaps and Limited Funding Constrain Progress in Education and Digital Systems
- Policy Coordination and International Collaboration Support Transition Toward Sustainability

Keywords: Green Education, Digital Transformation, Sustainable Economic Growth, Iraq Economy, Economic Diversification.

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Introduction

Over the past few decades, the world economy has experienced dramatic structural changes due to the development of new technologies and environmental trends that became one of the basic foundations in developing modern economic policies. In this scenario, green education and digital transformation become two key tools to attain sustainable development and improve the competitiveness of the national economies. With human potential and a rich source of natural and economic resources ahead of it, Iraq is in one of the key chances to embrace these catalysts as a strategic point of entry in transforming its economy and attaining the desired diversification that is not overly dependent on oil reserves.

Green education is not a simple environmental strategy but an investment in the human capital by coming up with environmental and technological values in the educational programs and, hence, equip individuals with the ability to answer the demands of the green economy. Simultaneously, the digital transformation offers modernized infrastructure that allows building productive and service sectors and minimizes the efficiency gap between the Iraqi economy and the regional and global ones. Therefore, the significance of this study is in examining how the two concepts of green education and digital transformation play a dual role in economic growth in Iraq, by evaluating the possibilities of integrating the two, the obstacles which impede their activation and finally building an analytical framework that explains their implications to the realization of sustainable growth as part of the Iraq Vision 2030. The paper presents a critique approach in the development of a sustainable economic approach, through the review of the preceding scientific body of research, hence it is an effort to create a basic instrument of planners and policy makers tasked with the responsibility of devising economic policies in Iraq.

Research Problem

Iraqi economy experiences structural imbalances due to overreliance on oil and a lack of diversification and economic activities, as well as environmental and technological problems like the deterioration of natural resources and the lack of digital infrastructure. In such circumstances, the necessity to implement new impetuses of sustainable development becomes apparent, first of them being green education and digital transformation. Nevertheless, the activation of the two elements is hampered by structural and institutional challenges associated with poor economic policies of the people, poor investment, and lack of necessary skills. Based on it, the research problem will be as follows: Can green education and digital transformation be considered effective drivers of sustainable economic development in Iraq and how the upcoming challenges and barriers that disrupt the process may be addressed?

Research Objectives

The study aims to:

1. Compare the stimulating nature of green education and digital transformation in stimulating sustainable economic development in Iraq.
2. Discover the economic possibilities of the combination of green education and the digital transformation.
3. Identify the institutional and technological barriers to the digital transformation and embracing green education in the Iraqi economy.
4. Suggest a feasible action plan to help attain sustainable development as per the Iraq Vision 2030.

Research Hypothesis

The hypothesis of the study is that the integration of green education and digital transformation in the economy of Iraq can achieve sustainable growth due to the contribution to the economic diversification, the development of human capital, and the increase in the level of environmental and digital performance, that is, it is suggested to reach the Sustainable Development Goals and Iraq Vision 2030.

2. Literature Review

The economic literature deals with the issues confronting the rentier economies like the Iraqi economy, the most important being overdependence on production and export of a sole commodity that is the oil as the main source of income, proliferation of corruption in certain institutions of government, and the political and security instability around the economy. All these are manifested in an evident disregard of non-oil industries, particularly productive ones, as well as the poor development of green and digital industries. This, in its turn, consolidates and undermines the process of orientation to sustainable development and economic growth, even though the local economy has huge and varied opportunities and capabilities.

On the contrary, green education and digital transformation are offered as the possible solutions to these problems. Aggarwal mentioned that green education is critical to action to address challenges as it motivates people to engage in sustainable practices and take part in the activities that can positively impact the economy and society and shape policy change at the micro and macro levels through environmentally friendly decisions [1]. Green education in many cases is connected with the community organizations, governmental and non-governmental (civil), and companies that are actively involved in the environmental conservation and sustainability activities. Based on this, educational programs are designed to incorporate issues and themes concerning the sustainability of economic resources to make people appreciate the relevance of being sustainable in their activities, i.e. conserving energy, reducing wastage and recycling, and utilizing natural

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resources. This will result in a higher social and economic welfare, lessened environmental hazards and shortage of resources, and helped in the generation of new employment opportunities, as well as led to diversification of the economy.

Radhi discussed the importance of adopting green economy approaches as a catalyst of economic growth in Iraq for the coming decade and examined the experiences of countries that have successfully implemented green economy strategies to achieve sustainable development [2]. Masdar City in the United Arab Emirates, for example, adopted one of the first projects based on renewable energy sources (solar energy), emulating Tsukuba Science City in Japan. In Masdar City, an institute specializing in alternative energy and clean technology was established to undertake scientific research and development activities in digital technologies. This led to a reduction in electricity consumption by 51% and drinking water consumption by 54%, as well as support for innovative designs to enhance agricultural production and fisheries, and encouragement of students to cultivate plants tolerant to seawater salinity.

In the same vein, the strategic energy plan prepared in 2008 by Jordan aimed at the years 2008-2020 embraced green tactics which saw 50,000 job opportunities being created, the people guided towards diversified activities of resource management so as to produce renewable energy at a rate of 10 percent, it oriented on transforming oil consumption to 40 percent rather than 60 percent and 5 percent of farm numbers were to be transformed into producing organic products in collaboration with Jordanian universities and cooperative associations. Another policy that the country used was the use of academically specialized and scientifically qualified experts and the allocation of 0.05% of the budget in the country towards environmental issues.

The future vision of green transformation was also introduced by Radhi as it concerns the period between 2025 and 2035 to meet the sustainable development in Iraq [2]. This vision aimed at the adoption of local programs that alleviate poverty and elevate income levels, boosting educational abilities in various levels through creation of curricula and skills that support the green economy, adopting programs that raise awareness of the individual on the significance of sustainability and incorporating environmental sustainability into studies. The vision also emphasized stimulating green foreign investment, adopting plans that support green transformation to achieve optimal use of natural resources, meet health and environmental requirements, and facilitate the transfer of technological techniques and digital applications that increase project productivity in a safe and environmentally friendly manner.

All these would eventually translate to the increased sustainable economic growth. When it comes to digital transformation, it is also the process of applying digital technologies to the work of economic units. The transformation is also considered to be instrumental in influencing the policies of the populace and the partaking to the alleviation and control of issues of the local economy. Contrary to what is commonly believed and as demonstrated by Al-Bahr the diffusion of digital technologies results in radical changes in the production processes and the service activities as it saves time and efforts in accomplishing the tasks, boosts economic growth with a higher output and productivity, raises economic efficiency in the use of resources and provides access to the markets [3]. Connecting the particular context of developing countries, Al-Lami showed the eminence of the digital transformation to avoid the traditional steps of the development and reach the qualitative leap in the economic performance [4]. In this connection, those countries, including Iraq, must introduce their development strategies on the foundations of digitalization by increasing the rates of digital education and investing in digital infrastructure.

As a result, Wafaa has recommended the allocation of a high-profile position to the digital transformation in promoting the higher education sector, in general, and in Algeria, in particular, by updating the educational programs in terms of changing the qualitative level of the provision of university services to students as well as the Algerian Scientific Journal Platform (ASJP) and the PROGRES platform, among others [5]. This leads to modernization of higher education, enhancement of its quality as well as making the educational process more effective and efficient. The research also promoted the conversion of educational content in traditional forms to digital ones, which would help achieve sustainable economic development through embracing modernized implications such as green digital education thus positively impacting on the performance of the students, the quality of their level of education, and their view of the environment around them.

Hence, the research by Abu Bakr attempted to elucidate the role of green digital education in sustainable environmental development by means of a group of digital technologies that help to address the issues of environmental balance, eliminate pollution problems, and steer the economic development with sustainable natural resource reserves in the present and the future [6]. To that effect, the analyzed literature highlights the role of education in facilitating such economic changes. Green education aims at preparing people with knowledge, skills and values needed to live sustainable lifestyles and work towards a green economy, whereas digital education aims at preparing people with the digital competencies needed to meet the challenges and opportunities of the digital age. Therefore, the researcher claims that with green education, combined with digital transformation, the concept of strong complementarity and synergy in providing sustainable development is possible, as well as providing new and more modern horizons to stimulate and improve economic development.

2. Theoretical and Conceptual Framework

1. Definition of Green Education and Its Importance

Green Education is a term that has gained a high profile in scholarly articles, as well as environmental policy in recent decades, but in intellectual terms, it can be said that the concept has its origins in the environmental education movement that arose in the 1960s and 1970s. The United Nations, in 1972, conducted the Stockholm Conference on the Human Environment to emphasize the role of education in ensuring environmental awareness [7]. Then the Earth Summit in Rio de Janeiro in 1992 highlighted the significance of education in realizing sustainable development which resulted in the concept of Education for Sustainable Development (ESD) forming the intellectual core of green education.

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Formalization of the term green education came about in 2005 when UNESCO in its report on the International Decade of Education for Sustainable Development (2005-2014) put green education as a central pillar of the current educational policy [8]. In turn, the term started to be more often applied in the framework of global conferences and scientific publications to describe the efforts of the attempts to introduce the concerns of environmental sustainability into the curricula and educational systems. The idea was also incorporated into the Sustainable Development Goals (SDGs) of 2015 and became part of Goal 4: Quality Education, or Goal 13: Climate Action [9]. According to the definition of green education by the UNESCO, green education attempts to educate students on the environmental awareness and to encourage sustainable practices through inclusion of the environmental and sustainable development in the curricula and educational activities [10]. It has further been defined as a holistic approach which aims at developing the knowledge, skills and value on the part of the learners which is expected to enable them to comprehend environmental issues and take appropriate action to attain environmental sustainability. This understanding makes green education a process aimed at empowering the individual to learn more about global and local environmental issues, including climate change, the significance of natural resources conservation, and the need to reduce pollution through the stimulation of sustainable behaviors and the provision of solutions and plans using science and innovation [11].

Digital technology also supplements green education by using digital instruments and methods in the implementation of learning programs, which allows electronic communication between the educator and the learner through the internet. This enables institutions that embrace this kind of education to experiment with the emerging technologies and create exciting digital programs of courses and lectures [12]. These digital advances play a role in sustainable development as they enhance the effectiveness of the education sector in accordance with the environmentally friendly principles and train human resources that may discover environmental problems and challenges and become a part of their solutions. Furthermore, the prevailing trends adopt the smart digital information revolution, and in this regard, the education sector is shifting towards the use of artificial intelligence in education programs across the world. It is done through creating future-oriented roles of curricula through the help of educational institutions and their staff, applying applications, technologies, behaviors, and tools that improve individual performance and train the learners to act as the active participants of environmental preservation. Finally, this strategy helps the realization of sustainable economic development [6].

Green education is also singled out as an efficient instrument to establish sustainable societies with green economies since it improves skills of people and their capacity to join the green labor market, which consists of renewable energy, sustainable agriculture, and waste management [13]. In addition, green education is a strategic requirement towards ensuring balanced economic, social, and environmental development. In line with this, green education is crucial in developing a green economy since it prepares a green job-ready workforce with abilities that alleviate green job demands hence leading to an increased economic growth through a sustainable process [14]. It assists with the reduction of carbon emissions, as well, enhancing the level of awareness of society about the necessity of sustainability within the framework of managing economic and natural resources [15]. Green education in the context of the Iraqi economy helps in solving issues of environmental challenges caused by reliance on crude oil mining and deterioration of natural resources, hence economic diversity and sustainability. On the basis of the aforementioned, the relevance of green education can be summarized as follows:

1. Green education assists in developing environmental consciousness in individuals and communities, which allows the individuals and communities to be aware of the environmental issues.
2. It provides the economy with human resource with skills needed in green jobs and realises real growth in sustainable economic growth through decreasing the dependency on the traditional industry that is environmentally polluting to the production process.
3. It promotes environmental friendly practices which reduce carbon emission and improve sustainability of resources.
4. Such education encourages creativity in thoughts that come up with novel ways of solving environmental issues like sustainable technologies [16].
5. It enhances the ability of the society and the economy to utilize effectiveness in using natural resources and meet the environmental challenge [17].
6. It enhances better education as it embraces holistic curricula that connects environmental sciences to the economic and society so that education is more comprehensive.

2.2 The Concept of Digital Transformation and Its Economic Impacts

One of the main characteristics of the modern world is digital transformation, which is focused on the extensive distribution of new technologies and communication tools due to the active use of the internet and the high dependence on digital applications on smartphones. These applications work using highly sophisticated technological processors that have immense data processing, collection, storage and analysis capabilities besides transmitting and exchanging information in all the social and economic sectors. Over the past few years, the amount of information transfer and communication via the various digital platforms has outpaced the population of the entire world and it is estimated that about fifty percent of the entire world population has grown to be dependent on the use of internet services and smartphone applications. These services work on an international platform controlled and overseen by the GSM Association (GSMA), representing approximately one thousand mobile network operators, and 90 percent of them work in compliance with the international standards accepted by the Association. This framework is expected to enhance the coordination of the countries, share modern digital advances, empower and enhance digital services and their quality, and enhance the velocity and connectedness of digital communications between national economies, which eventually leads to the worldwide economic integration [18]. Based on this, it may be said that digital transformation is a framework reshaping the lifestyles, work, thought, and interaction patterns of individuals as they engage in communication using available digital technologies through constant planning and continuous endeavors to redefine their experiences and practical skills. This process leads to the provision of vast capabilities that effectively and competitively support the building of society and the economy in a

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sustainable manner, by bringing about radical changes in services for various stakeholders, consumers, producers, and users, while improving their experiences and productivity through a series of coordinated processes accompanied by the necessary procedures for activating and implementing productive and economic plans. Thus, digital transformation represents “a tool for improving efficiency, reducing expenditure, and rapidly and flexibly introducing new services that enhance the efficiency of using economic and human resources” [19].

Digital transformation also refers to an applied process of digital technologies that assists in revitalizing businesses, creating new value, and producing it (including value in terms of economic activities). It is also defined as the process that involves using digital technologies to create a radical change in economic activities resulting in the growth of production and the supply of services along with the subsequent implementation of these tasks and activities using digital tools and software, including artificial intelligence in the virtual world, thus making the work and operations performed as efficient and effortless as possible [3].

Therefore, the concept of digital transformation has a major economic value, as it results in the following consequences [20]:

1. Saving on expenditure and time taken to get things done using less effort.
2. Enhancing and coordinating the efficiency of operations that is indicated by increased output and productivity at both firm and individual level.
3. Increasing the level of product quality and streamlining processes to provide and access services.
4. Delivering and producing innovative and imaginative services, leaving traditional ways of doing business and other services.
5. Helping economic units, e.g. companies and banks to extend their activities and operations to a broader scale and providing their products and services to a larger audience of consumers and clients. Digital transformation, in turn, has a number of economic effects that can be summarized in the following way:

A. Modern innovation adoption will lead to a greater capacity to satisfy the consumer demand and competitive advantage of goods and financial products due to technologies affiliated with modern digital technologies including the internet. Digital transformation is also involved in creating new and more skilled jobs with increased productive capacity, and increases the export and import capabilities of the products and raw materials due to digitally mediated trade openness. Therefore, the connection between the digital transformation and economic development is positive: when more funds are invested in information and communication technologies, the output and productivity rise which can be translated into the actual economic growth [21].

B. Production and usages Manufacturing is a major accelerator of production and consumption that affects the level of income and aggregate demand by increasing individual and national expenditures. Modern technologies related to the digital world bring advancement in the production of goods and services, leading to the need to employ labor, and the employees with high technical and programming skills are in high demand. This causes radical transformation in the manufacturing and productive power, enhances division of labor due to a change of technology and creates economies of scale, which results in increased returns by the economic units due to better utilization of human and economic resources [22].

C. Digital transformation assists in drawing foreign capital to the local economy with the aim of introducing modern digital technologies, which increases the level of technological application in producing goods and delivering a service. This improves international as well as domestic competitiveness as witnessed in the Asian Tiger economies which have been channelling foreign investment into the technology intensive productive sectors. The strategy added value, improved knowledge, skills and expertise on digital related issues, and helped in the creation of infrastructure that was appropriate in the new digital environment [23].

D. The transition to the implementation of digital technologies causes the alteration of the production structure and promotes a new model of international trade. This is because economies get comparative advantages that are associated with digital transformation, despite not having natural resources that have long been used to make trade alliances. This enables local economies to manufacture high value-added goods and services related to the advances in digital technologies, and therefore changes the trade balance to their benefit as they begin to export higher-value goods and import those with lower value [24].

Research Methodology

This study employs an applied descriptive–analytical research method with an inductive approach to investigate the role of green education and digital transformation as indicators of sustainable economic growth in Iraq. This methodology is based on a systematic review of the economic literature, policy documents, and prior quantitative studies on green education, digital transformation, and sustainable development, with special focus on the structural features of rentier economies. To evaluate the state of education investment, digital infrastructure, human capital, and public expenditure in Iraq on a long-term horizon, quantitative secondary data are used. These data come from official national sources, including reports published by the Central Bank of Iraq, and the Ministry of Planning, and the Central Organization for Statistics, as well as international institutions such as the World Bank and UNDP. The focus is placed on it utilizing an analysis of key economic indicators—investment expenditure in education, digital transformation indices, GDP growth, public spending ratios—to reveal trends, fluctuations, and structural gaps that limit sustainable growth. Through comparative analytical techniques that correlate Iraq to regional and international standards, this presents areas in which Iraq hurdles behind regional and

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global averages, and where policies could be leveraged. Furthermore, the methodology combines conceptual analysis to create an interpretive scheme illustrating the way and dynamics of green education-digital transformation nexus enhances economic diversification, productivity and environmental sustainability. The study analyzes opportunities, challenges and institutional constraints through analytical synthesis and develops policy-relevant recommendations consistent with Iraq Vision 2030. This methodological approach to combining theory with empirics consolidates the background needed to provide an integrated framework for evaluating sustainable growth pathways for the Iraqi economy.

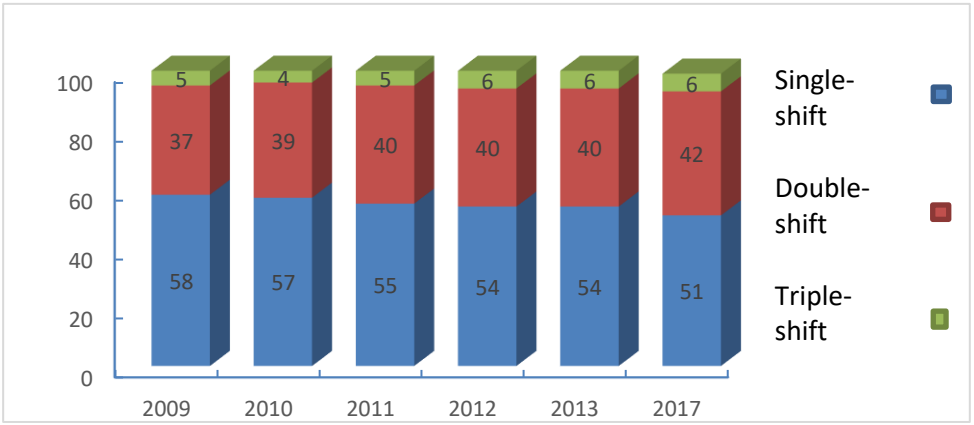
Result and Discussion

3. Analytical Section

3.1 The State of Investment in Greening Education in Iraq

Investment in green education in Iraq faces significant challenges due to insufficient allocated funding and the limited emphasis on integrating environmental sustainability into educational curricula. Green education aims to enhance societal awareness among students and pupils regarding the importance of the surrounding environment and to develop skills that support environmentally oriented education. However, Iraqi educational policies have not given clear priority to this type of education. Most spending directed toward the education sector has been concentrated on operational expenditures (such as salaries and wages), with part of it allocated to the construction of traditional school buildings that lack green environmental considerations in both their planning and implementation. This has occurred instead of developing educational curricula that support sustainability or specialized training programs to prepare cadres capable of applying green education approaches and fostering generations that embrace environmentally supportive ideas [10].

Figure (1) illustrates the share of traditional school buildings according to their attendance systems over the academic periods from 2009/2010 to 2017/2018, as follows:



Source: The figure was made by the researcher based on the Iraqi Council of Ministers (2023). *The National Strategy for Education in Iraq (2022–2031)*, pp. 39–40.

* Data on the number of schools for the years 2014, 2015, and 2016 were not included due to their unavailability as a result of the control of terrorist groups (ISIS) over parts of Iraqi territory.

Figure (1) indicates a significant gap in school infrastructure, which has led to the emergence of double- and triple-shift systems for students within the same schools, many of which are old, deteriorated, and not compliant with environments conducive to promoting green education. The percentage of double-shift systems in an individual school was 37 to 42 with the triple-shift systems being 4 to 6. Conversely, share of single-shift school reduced by 58 to 51% of conventional school buildings. Such a state of affairs could be explained by a complex of factors, such as the boom rate of population growth, the lack of economical development of educational infrastructure, including schools, the devastation of some schools since 2014 under the control of the terrorist organizations (ISIS), and the military actions to free the situation. According to an Iraqi Ministry of Education, 15.5 percent of schools in those governorates were destroyed or partially destroyed.

Statistics from the Iraqi Ministry of Education in 2020 also indicated that internally displaced persons from those governorates occupied approximately 400 schools across six governorates in secure areas (Iraqi Council of Ministers, 2023), which hindered the educational process and the development of curricula toward adopting environmentally supportive and sustainable approaches. Based on the above, it becomes evident that there is a need to increase investment expenditures directed to the education sector in Iraq. Most of the current investment spending is channeled in ways that serve traditional education, without a clear orientation toward greening educational curricula to support environmental sustainability. Investment expenditures at constant prices (2012 = 100) in Iraq's education sector, and their relative importance with respect to total public expenditures and real GDP for the period 2009–2024, are presented in Table (1) below.

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Table (1): Development of Investment Expenditures at Constant Prices (2012 = 100) in Iraq's Education Sector and Their Relative Importance for the Period 2009–2024

Year	Real GDP (billion IQD)	Annual Growth Rate (%)	Total Public Expenditure (billion IQD)	Investment Expenditure (billion IQD)	Annual Growth Rate (%)	Investment Expenditure / GDP (%)	Investment Expenditure / Total Expenditure (%)
2009	149,906	—	60,318	12,064	—	8.0	20.0
2010	181,504	21.1	78,546	26,518	119.8	14.6	33.8
2011	230,488	27.0	83,527	18,912	-28.7	8.2	22.6
2012	254,225	10.3	105,140	29,351	55.2	11.5	27.9
2013	268,592	5.7	116,952	20,833	-29.0	7.8	17.8
2014	255,745	-4.8	111,329	23,940	14.9	9.4	21.5
2015	185,764	-27.4	79,021	16,594	-30.7	8.9	21.0
2016	189,350	1.9	64,488	13,542	-18.4	7.2	21.0
2017	211,102	11.5	71,895	15,680	15.8	7.4	21.8
2018	256,847	21.5	77,243	13,200	-15.8	5.1	17.1
2019	264,266	2.9	106,913	23,371	77.1	8.8	21.9
2020	209,104	-20.9	72,390	30,532	30.6	14.6	42.2
2021	270,335	29.3	92,242	11,949	-60.9	4.4	13.0
2022	323,261	19.6	98,700	10,142	-15.1	3.1	10.3
*2023	307,200	-5.0	142,436	14,106	39.1	4.6	9.9
*2024	311,906	1.5	171,436	19,341	37.1	6.2	11.3
Compound growth rate (%)	4.7	----	6.8	3.0	----	----	----
Average (%)	----	----	----	----	----	8.1	20.8

Source: The table was prepared by the researcher based on the Central Organization for Statistics and Information Technology (2009–2023). Annual Statistical Abstract (2009–2023), National Accounts Directorate, various pages. Central Bank of Iraq (2009–2024) [25]. Annual Statistical and Economic Reports (2009–2024), Statistics Department, various pages. Percentages in the table were calculated by the researcher. Data for output and expenditures for 2023 and 2024 are preliminary estimates.

It can be observed from Table (1) that investment expenditures in Iraq's education sector over the period 2014–2024 were largely directed toward traditional education, and these expenditures experienced significant fluctuations in their annual growth rates. The investment spending fluctuated significantly during the period 2009-2014. The investment expenditure increased significantly in 2010 to 26.518 billion dinars with an annual growth rate of 119.8 as an effort was made to enhance the investment in the educational sector and build the sector due to the comparative gain in oil revenues. This has been observed in terms of the rate of growth of real GDP, which rose to 21.1, with the majority of the growth being contributed by the oil sector in Iraq. Nevertheless, investment spending decreased in 2011 and 2013, and its rates are 28.7% and 29 percent/year, which means that economic and political crises adversely affected the education sector of Iraq, including the decrease of oil prices and security crises. Increment in investment expenditures strengthened in 2014 with the annual growth of 14.9 with a little rise in the public budget of Iraq and increasing oil prices that were replicated in GDP growth in 2011 and 2013.

Investment expenditures show a decree at 201518, including the minimum in 2018 and the annual rate of negative growth of -15.8, as a result of the financial crisis of the falling oil prices as well as the war against ISIS. The 20192024 had experienced a relative recovery in investment spending. The growth rates remained quite high in 2019 and 2020, at 77.1 and 30.6, respectively, which were the highest levels of investment spending during the years. This recovery was, however, not sustained and the expenditure decreased significantly in 2021 with an annual rate of -60.9 since the effects of the COVID-19 pandemic took its toll. During 2023 and 2024, investment expenditures increased once more, increasing 39.1 percent and 37.1 percent per year, and signifying efforts to rejuvenate investment in education in the 2023-2025 budgets.

As far as the ratio of investment expenditures to GDP is concerned, the ratio over the period of 2009-2024 was 8.1 but with enormous variation that influenced the growth of the education sector in Iraq. Concerning the ratio of the investment expenditures to the total public expenditure, the average of the same time was 20.8% which means a relatively high amount of allocation of the educational investment in the total amount of public expenditure. The compound growth rate of investment expenditures during the study period is lower than that of GDP growth rate (4.7) and the overall growth rate of the total public expenditure (6.8) (3%). This implies that the rate of investment in education was not in line with the real

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economic growth in Iraq whose annual growth rates ranged widely between -27.4 and 29.3 in the course of the research because of the rentier characteristic of the Iraqi economy. The comparatively fluctuating growth in investment spending is indicative of the failure in the distribution of economic and financial resources to the building of the Iraq education sector especially in the fields like green education where the traditional curriculum still prevails.

3.2 The State of Digital Transformation in Iraq

The structural challenges facing digital transformation in Iraq include are poor infrastructure, lack of digital skills, and proliferation of corruption in certain government agencies, which impact the capacity of the Egyptian nation to harness the benefits of going digital. Thus, there exist indicators of the digital transformation in Iraq that need to be studied and analyzed to reflect the advancement made in this sphere and the issues it encounters. Besides, the analysis of these indicators can help determine the level of digital transformation in Iraq and the gaps that can slow down the realization of digital transformation, as Iraq is trying to build a high-level digital economy. In line with this, Table (2) is prepared in accordance with the development of the chosen digital transformation indicators in Iraq between the year 2009 and 2022 as follows:

Table (2): Development of Selected Digital Transformation Indicators in Iraq (2009–2022)

Year	E-Services	Annual Change (%)	Telecommunications Infrastructure	Annual Change (%)	Human Capital	Annual Change (%)	E-Government	Annual Change (%)
2009	0.13	—	0.02	—	0.72	—	0.27	—
2010	0.15	15.4	0.05	150.0	0.69	-4.2	0.29	7.4
2011	0.17	13.3	0.08	60.0	0.74	7.2	0.33	13.8
2012	0.28	64.7	0.12	50.0	0.61	-17.6	0.34	3.0
2013	0.31	10.7	0.09	-25.0	0.63	3.3	0.37	8.8
2014	0.19	-38.7	0.22	144.4	0.52	-17.5	0.31	-16.2
2015	0.21	10.5	0.23	4.5	0.55	5.8	0.34	9.7
2016	0.34	61.9	0.16	-30.4	0.48	-12.7	0.33	-2.9
2017	0.21	-38.2	0.18	12.5	0.51	6.3	0.35	6.1
2018	0.45	114.3	0.19	5.6	0.53	3.9	0.37	5.7
2019	0.47	4.4	0.21	10.5	0.55	3.8	0.39	5.4
2020	0.33	-29.8	0.53	152.4	0.43	-21.8	0.43	10.3
2021	0.36	9.1	0.55	3.8	0.46	7.0	0.45	4.7
2022	0.38	5.6	0.58	5.5	0.48	4.3	0.47	4.4
Compound Growth Rate (%)	**6.6**	—	**25.3**	—	**–3.6**	—	**1.5**	—

Source: Table prepared by the researcher based on (World Bank (2009–2022) [26]. *Digital Economy Indicators (2009–2022)*, available at the World Bank DataBank. Arab Monetary Fund (2009–2022). *Annual Reports (2009–2022)*, various pages.

It can be observed from Table (2) that the e-services index increased over the period 2009–2022 from 0.13 to 0.38, with a compound growth rate of 6.6%. The index, however, exhibited significant volatility, reaching a peak in 2018 at 0.45, with a high annual growth rate of 114.3%, and experiencing sharp declines in 2014 and 2020, when it fell to 0.19 and 0.33, respectively, with negative annual growth rates (compared to the previous year) of –38.7% and –29.8%. This volatility reflects the impact of economic and security crises on the provision of electronic services. In general, the incremental development is a slow rise in the supply of e-services to consumers including e-commerce and online banking. However, the low scores of some years indicate how Iraq lags behind the provision of the electronic services, both in terms of the lack of digital infrastructure, and the deficit of digital skills of some segments of the labor force, and the derailment of some of the projects of the digital transformation.

In terms of the telecommunications infrastructure index, it increased within the study period by 0.02 to 0.58 registering a rather high compound growth rate of 25.3, the highest of all the indicators, which are given in Table (2). The period was marked by high peak especially in 2010 and 2020 with annual growth rates of 150% and 152.4, respectively. Simultaneously, there were downs in 2013 and 2016 with a negative annual growth rate of -25 and -30.4, respectively.

Overall, the high development of this indicator indicates increased investment into telecommunication systems, including the expansion of the internet and the mobile phone network. Nevertheless, the absolute values are rather low, indicating that high-speed internet penetration is still at a low level, which may be caused by the unpredictability in investment by economic and security crisis, as well as the absence of long-term financing of it. In terms of human capital index, the index

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decreased in the study period of 0.72 to 0.48 and a negative growth rate of the compound was experienced in the form of compound -3.6. The index has recorded deep drops in 2012, 2014 and 2020 when the annual growth rates dropped to -17.6, -17.5 and -21.8, respectively with slight improvements in 2011 and 2021 with annual growth rates of 7.2 and 7, respectively.

This indicator showed continuous deterioration indicating a poor development of digital skills among the labor force which prevents digital transformation in Iraq. This is indicative of gaps in the training and capacity-building programs, the shortcomings of the digital education system, and the outcomes of economic, social, and political crises. The human capital is, therefore, the least developed aspect of digital transformation in Iraq, as it would have to invest a lot in education and training to be able to follow technological advances. In the case of e-government index, it had grown by 0.27 to 0.47 during the period of study and the growth rate of the compound was relatively low, 1.5. Table (2) indicates that the index has recorded significant improvement in 2011 and 2020 with an annual growth rate of 13.8% and 10.3, respectively, and negative growth rates of -16.2 and -2.9 in 2014 and 2016, respectively. Nevertheless, the report by the United Nations Economic and Social Commission for Western Asia (ESCWA) suggested that e-government services became relatively more mature in 2023, and a total of 37 services were offered by ten government institutions [27].

On the whole, the gradual increase in this indicator can be attributed to the little done to establish e-government in Iraq e.g. electronic payment and electronic public services. The low scores also reflect that there are few institutions of the Iraqi government that use up to date electronic management systems. This can be explained by administrative and financial corruption, lack of digital infrastructure, and even digital skills, which are limiting the establishment of e-government in Iraq.

3.3. The Stimulative Role of Green Education and Digital Transformation in Iraq's Economic Growth

Green learning and digitalization has a decisive stimulative impact when it comes to improving the economic growth in Iraq. There is the complexity and complementarity between them, as they affect each other in a variety of ways. Green education (along with digital transformation) will help to create the sustainable and diversified economy without over-reliance on oil, where the sustainability of the environment and efficiency of technology will be prioritized. Furthermore, the combination of the two results in the successful attainment of sustainable economic growth grounded on environmental and digital innovation, thus, bridging structural gaps and proceeding with the agenda of Iraq Vision 2030, that is, diversification and sustainability.

3.3.1Green Education as a Catalyst of Growth.

Green education also helps in developing the human abilities that can be used in innovation and adaptation to the needs of green economy that promotes sustainability of the local economic resources. Equipped with knowledge and skills concerning sustainability, the individuals can come up with innovative solutions to the environmental issues and can create new economic units within green sectors of renewable energy, waste management, and sustainable agriculture. This consequently results in employment generation, higher productivity, as well as inflation of national income streams hence triggering economic growth.

Green education is also used to minimize the adverse effects of the environment and provide the youth with employment opportunities. This can be seen in the project titled: Green and Digital Vocational Education for Employment Promotion in Iraq initiated by UNESCO with the help of European Union. The project will involve over 5,000 university students and students in vocational institutions and schools, with a budget amount of USD 10.5 million, positively impacting the enhancement of green and digital vocational education in order to decrease the disparity in skills, assist in the diversification of the economy and enhance sustainable development [28]. Moreover, green education increases environmental awareness in the individual and community which results into more sustainable consumption and production activities, less environmental cost in the long term, and better quality of life. It is however observable that financial resources are still channeled to conventional education yet there is not adequate focus on environmental sustainability when developing plans on how to develop the education sector in Iraq. In 2023, the government introduced the National Strategy of Education in Iraq (2022–2031) that makes no direct mention of green education or the plans of its implementation and the development of sustainable practices in the educational segment. As illustrated below, table (3) represents the economic and financial criterion embraced by the national strategy in developing the education sector in Iraq.

Table (3): Economic and Financial Criteria According to the National Strategy for Developing the Education Sector in Iraq (2025–2031)

Items \ Year	2025	2026	2027	2028	2029	2030	2031	Average (%)
Real GDP (2019 = 100) (billion IQD)	283,650	291,988	301,635	311,600	321,893	332,529	343,514	—
GDP growth rate (%)	3.2	2.9	3.3	3.3	3.3	3.3	3.3	—
Total public expenditure / GDP (%)	33.3	33.6	33.9	34.2	34.4	34.7	35.0	34.2
Total education expenditure (2019 = 100) (billion IQD)	12,280	13,269	14,321	15,440	16,629	17,894	19,237	—
Education expenditure / total public	13.0	13.5	14.0	14.5	15.0	15.5	16.0	14.5

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expenditure (%)								
Education expenditure / GDP (%)	4.3	4.5	4.7	5.0	5.2	5.4	5.6	5.0
Educational investment expenditure (billion IQD)	1,285	1,310	1,351	1,403	1,476	1,557	1,644	—
Educational investment expenditure / total public expenditure (%)	10.5	9.9	9.4	9.1	8.9	8.7	8.5	9.3
Educational investment expenditure / GDP (%)	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5

Source: Table prepared by the researcher based on the Iraqi Council of Ministers (2023). *National Strategy of Education in Iraq (2022-2031), pp. 8187. The researcher has calculated percentages in the table.*

The Table (3) shows that the National Strategy is expected to drive the growth of real GDP (2019=100) to 343.514 billion dinars in 2025-2031, which represents a smooth economic increase. The growth rate is set to be between 2.9 and 3.3 percent per annum at an average of about 3.2 percent. This is a pointer of consistent economic forecasts although at small levels as the National Strategy is implemented. The low economic growth could limit the government to more spending on the education sector especially since it is largely dependent on revenues earned in the oil sector.

In Table (3) we also note that the proportion of public expenditure against GDP is increasing, i.e. 33.3 percent in 2025 to 35 percent in 2031 and average is 34.2. This indicates that there has been a progressive growth in the role of the government in the public expenditure in accordance with the objectives of the National Strategy to empower critical sectors like education. The growth in the social spending shows that some attempts to benefit the social sectors are made, but these figures are insignificant compared to the developed world, where the state spending can be 40-50% [10]. This brings to the fore financial constraint that has a bearing on the direction of the fiscal policy hence on the National Education Strategy and the move towards greening education in accordance with the sustainable development goals of the nation of Iraq. The expenditure on education will increase by 12.280 billion dinars to 19.237 billion dinars between 2025 and 2031 which can be summed up as a total increase of 56.6 percent during the period of the National Strategy. The rates of annual spending are expected to flow up between 13-16 percent in the process with an average of 14.5. Also, the education expenditure as a percentage of GDP will increase to 5.6 percent with an average of 5.3. It is near the international guidelines of 46% proposed by UNESCO, which depicts a trend in solving priorities in the education sector in Iraq in the future, but it is not yet enough to make a shift to environmentally sustainable (green) education [10].

The upward trend in spending on education is an indicator of the scope and dream of the National Strategy of enhancing the education sector in Iraq, however, there are challenges that the sector faces which include the allocation of the highest percentage of the expenditure towards the salaries instead of actual development. The amount of money to be invested in education is likely to increase by 28% in the strategy period with the expenditure to be 1.285 billion dinars and 1.644 billion dinars respectively. Nevertheless, it is estimated that the ratio of investment spending to total government spending will decline to 8.5 percent in 2031 with an average of 9.3 percent. This decrease is a relative sign of failing to pay special attention to the actual investment in education as opposed to operational expenditures (e.g., salaries). In terms of the education investment percentage against the GDP over the strategy period, it is relatively constant at 0.5 which is very low in comparison to the investment necessary to build the education sector especially green education. The low level of investment expenditure (0.5% of GDP) is an indication of difficulties in investing in the projects related to educational infrastructure and sustainable curriculums, which could be a hitch in meeting the goals of the National Strategy.

3.3.2. The Digital Transformation as a Growth Catalyst .

Digital transformation is one of the key drivers of economic growth owing to the improvement of efficiency and productivity, market expansion, and innovation. The use of digital technologies in different sectors of the economy results in the automation of production and economic processes, the introduction of digital payment systems, better resource management, and the delivery of various and innovative digital services. This saves on expenses, increases transparency and access to new markets within and outside the country. The shift to a digital economy has the potential to boost the economy by up to 5% due to enhanced output and productivity and development of new job opportunities [29]. Digital transformation also contributes to accommodating the rapid growth in digital payments in Iraq, which increased from 2.6 trillion dinars in 2023 to 7.6 trillion dinars in 2024, ensuring more transparency and reducing forms of corruption [30]. Furthermore, reports from the UNDP and the World Bank confirm that digital transformation supports diversification of public revenues and can increase GDP growth by up to 40% through rising demand for digital skills [26]. An example is that e-commerce has the potential to introduce new markets to the local products, e-finance can increase financial inclusion, and big data and artificial intelligence can offer valuable information to make economic decisions. The developments assist in attracting investments, improving corporate competitiveness, and establishing a more dynamic business environment, which affects micro- and macroeconomic growth positively. Nevertheless, the assessment of the indicators of the digital transformation development in Iraq shows unequal aspects. In spite of the positive moves to build the digital infrastructure and acquire digital skills, the data presented in Table (2) indicate that the current developments are not enough to realize the objectives without substantial investments in human capital and e-government.

The Iraqi government has therefore sought to streamline the administrative processes and utilize digital communication within the government institutions to provide and secure services to make sure that accuracy and objectivity of transactions is observed, lessen bureaucratic processes and engender confidence of the government institutions by the citizens. These are of the target to have the digital transformation under the National Development Plan (2024-2028) to have the high-

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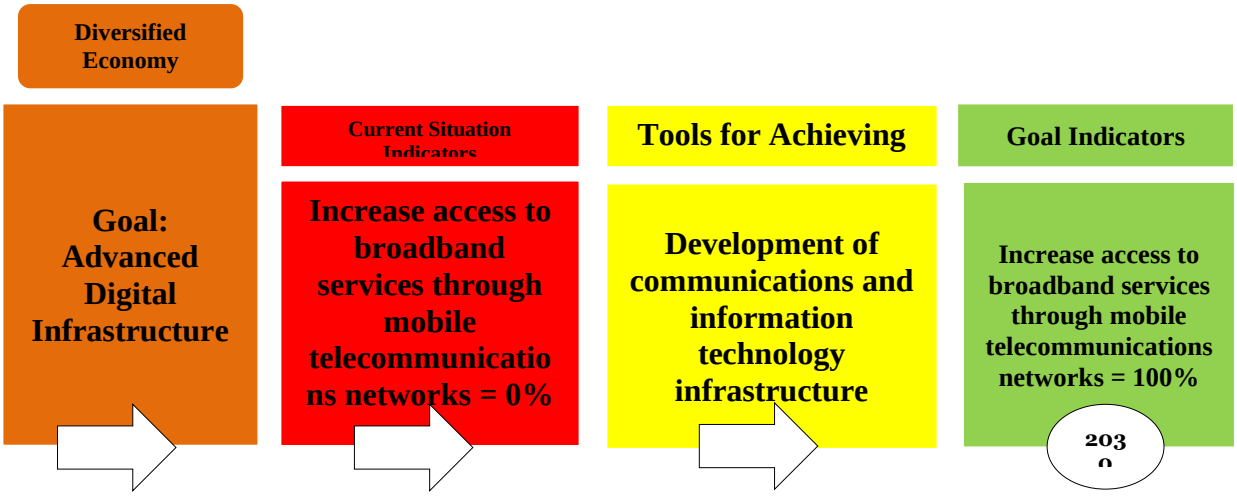
access digital government services to all the segments of Iraqi society, in line with Sustainable Development Goal 16 [27].

In Vision 2030, Iraq, in collaboration with the UNDP, the World Bank, and other international organizations, aims to achieve economic diversification and stimulate real economic growth through infrastructure development. The vision specifically targets digital transformation by developing information and communications technology (ICT) infrastructure, expanding access to digital technologies, increasing internet speeds, and developing a national digital storage infrastructure effectively connected to the internet [31].

The goal of Iraq's Vision 2030 for developing digital infrastructure can be illustrated in Diagram (1) as follows:

Diagram (1): Iraqi Vision 2030 for Developing Digital Infrastructure.



Source: the diagram was made by the researcher based on: UNDP. (2023). Iraq Vision 2030. United Nations Development Programme, p. 42 [31].

In order to achieve the goal of digital transformation in Iraq, the development of the following indicators will be targeted (Republic of Iraq, 2024):

a. National Data Center: This center, as one of the core components of digital infrastructure, is responsible for hosting digital applications and platforms to deliver government services to both citizens and government institutions.

b. Ur Government Electronic Services Portal (Ur Portal): This portal represents the digital services platform for Iraq and its official institutions and constitutes the nucleus of the e-government project. During the years 2022 and 2023, the overall value of the Ur Portal services index increased from 18% to 25%, distributed as follows: Service delivery criterion increased from 27 to 37 points; Availability of digital services increased from 20.8% to 29.8%; Accessibility for Iraqi citizens increased from 17.2% to 23.9%; Availability of open data increased from 35% to 49.5%; The format for publishing open data improved from 33% to 48.9%.

c. Unified National Card: The government has strived to create an unified and centralized database of the personal and civil status of Iraq citizens by adopting an official document that is in line with the international standards, and, with that, involves information security needs and allows sharing of data and information electronically among governmental institutions. This has come about by digital transformation of most of the inner departments in the government and services that deal with consumers that need quicker digital transformation. It is also interesting to mention that the size of people that have already received the Unified National Card has already passed in 40 million Iraqis and this is a great achievement

in the digital transformation of the population digital documentation.

3.3.3 Integrating Green Education and Digital Transformation

When green education and digital transformation are applied in a complementary fashion, it makes them much more effective. These two factors when combined can help Iraq to enjoy sustainable economic growth through environmental and digital innovation and thus fulfill the objectives of economic diversification and sustainability through structural gap bridging. The synergy as a result of such integration facilitates inclusive and sustainable economic development and also helps in developing a more resilient economy that can be able to adapt to challenges in the future. Iraq Vision 2030 lays stress on the idea that long-term economic growth should be diversified in terms of earning sources, and innovation should be encouraged. Here, the contribution of green education can be seen in the context of environmental innovation, and digital transformation is an advanced technological environment that promotes e-commerce, e-government and online payment. Such drivers, when implemented in a transparent policy context are bound to contribute to the growth of the non-oil share in the GDP and decrease the unemployment rates by offering employment opportunities in the clean technologies and digital services, thus making the Iraqi economy more competitive in the region and globally. Digital technologies have the potential to improve the efficacy of green education by offering distance learning platforms, ecosystem simulation and analysis of environmental data. The patterns of energy consumption can be studied with the help of artificial intelligence and

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recommended to be more efficient in terms of the use of economic resources. Students can also be trained on how to practice sustainable agriculture using virtual reality.

On the other hand, green education offers the cognitive and value-based approach to steer the process of digital transformation towards the realization of sustainable development goals to enable the digital innovations to be environmentally and socially responsible. In line with this, green education and its application with the digital transformation enhance the capacity to meet sustainable economic development goals by emphasizing on the green jobs that offer sustainable economic growth and foster inclusive growth in the economic landscape of Iraq.

4. Identifying Opportunities, Challenges, and Solutions in the Context of Green Education and Digital Transformation

4.1. Opportunities Available to the Iraqi Economy

Iraq has huge opportunities which can be utilized to attain sustainable economic growth, they include:

a. Economic Diversification: The oil sector can be substituted with green and digital sectors to lower the economic risks and enhance economic resilience. As an example, one can refer to e-commerce and digital services in any field, such as green-minded education, software development, and artificial intelligence, which can introduce wide opportunities to diversify the Iraqi economy. This will generate thousands of new employment opportunities among the Iraqi young people, especially in areas that demand high levels of digitalization. Also, traditional and green sectors including industries and agriculture can be made more productive with the help of modern technologies that enhance the production processes and raise the output.

b. Tapping into Youth: Iraq has a very high rate of youth who can undergo training and qualification on green and digital technologies which can make them a growth force. Environmental and digital innovations enhance business environment and develop it, allowing Iraqi youth to use digital tools and opportunities to create new ideas and start ups. Such initiatives can also be beneficial to the Iraqi environment through innovative solution offerings, new job opportunities, innovation culture, and by making the Iraqi economy more dynamic and susceptible to the international changes.

c. Natural Resources: Iraq has tremendous solar and wind power capacities, agricultural land that can be exploited by using green technologies. The use of these resources is enabled through digital transformation that assists in supporting the Iraqi economy through creating a digital ecosystem and curricula that will sustain the resources. It also provides a conducive business environment which promotes investment, production and efficient utilization of resources. Digital platforms enable small and medium enterprises to access the local and global markets fast and without much difficulty, making them more competitive and leading to sustainable economic growth.

d. International Support: It is becoming more and more international to support sustainable development and digital transformation projects in Iraq, which can fund and experience the required expertise. The necessity to make use of the international experience in the area of green education and digital transformation is to form partnerships with the most advanced countries and organizations in the area to receive technical and financial assistance.

A deeper illustration of the interactive relationship between green education and digital transformation in achieving sustainable economic growth in Iraq can be presented in the following diagram (2):

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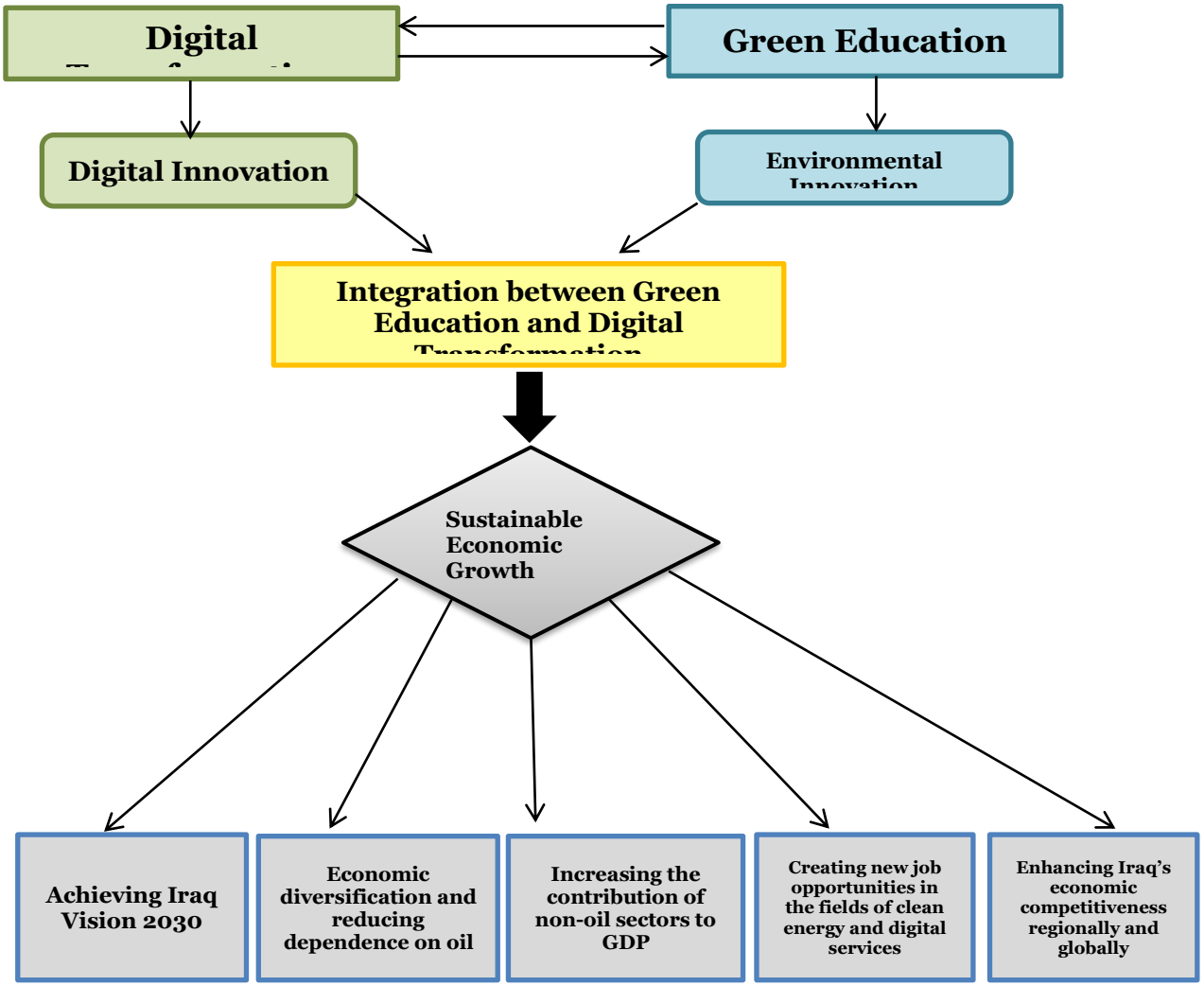
Diagram 2: The Interactive Relationship Between Green Education and Digital Transformation and Their Impact on Sustainable Economic Growth in Iraq



Source: The diagram was prepared by the researcher based on the preceding and following analysis.

Diagram (2) illustrates the interactive relationship between green education and digital transformation. This is not merely the addition of new elements to the economy, but rather a structural transformation aimed at building a more resilient and competitive economy. Environmental innovation takes place through green education. It is not merely about introducing environmental courses or studying it is a whole education methodology and it involves making environmental awareness and social responsibility in people to be able to participate actively in the creation of a sustainable economy. Such training will empower the young people to come up with creative solutions to the current environmental issues affecting Iraq, like water shortage, pollution and garbage disposal. As an illustration, the students of engineering can study to create energy saving buildings, and agriculture students can acquire sustainable farming methods. This gives way to environmental innovation which is the foundation of a diversified green economy.

Digital transformation as a driver of digital innovation is not just the application of computers and the internet, but a wholesome process of re-organizing the economic and social processes through digital technologies. Digital transformation can be used in the Iraqi situation to solve numerous structural problems. To give an example, e-government may lessen the bureaucracy and corruption, ease the establishment of businesses. Digital payments and e-commerce facilitate the inclusion of the informal economy in the formal economy and enhance transparency and enlarging tax base. This will provide a fertile ground on digital innovation which entails creation of smart applications, solutions that are fuelled by big data and application of artificial intelligence to enhance productivity and efficiency in different sectors.

The response of green education and digital technology provide an important driver of sustainable economic development. Both green education and digital transformation are worth the money, but it can be realized better when it is combined together. Such integration produces a strong synergy: digital technologies may become potent instruments to support green education, e.g., the virtual and augmented reality may be used to teach students the specifics of sustainable agriculture or to recreate the effects of environmental pollution. On the other hand, green education makes sure that digital innovations are used in a responsible manner not only in the environmental sense, but also in the social sense. The result of this interaction

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is the creation of the sustainable economic development that depends on the effective use of both natural and economic resources with the help of digital technologies and AI to examine the energy consumption patterns and make recommendations to enhance this efficiency. Dual innovation is also used to build products and services that integrate environmental sustainability with the digital technology and establish new sectors, including clean technology, environmental data management, and smart agriculture. In turn, this interaction will be directly related to the realization of Iraq Vision 2030 as it is central to the implementation of the vision goals, which are directed at the economic diversification. Iraq is able to through this synergy:

1. Less dependence on oil: Green and digital sectors are integrated so that the focus is not on oil sectors but on non-oil sectors, i. e. technology, sustainable agriculture, and renewable energy.
2. Expand the role of non-oil sectors in the GDP: The expansion of other sectors in an economy makes it depend less on the global oil prices hence it becomes less susceptible to global market fluctuations.
3. Provide jobs: The result of this integration is the appearance of new jobs that require high-level skills in IT, clean energy and digital services, which will reduce youth unemployment.
4. Bring efficiency and transparency to the government: The performance of the Iraqi state can be transformed by the digital technologies and lead to e-government through which individuals and businesses receive government services using modern digital applications. The process of requests and payment of fees can be carried out online, which saves time, minimizes effort, lowers risks of corruption, and enhances investor confidence, both local and foreign, hence boosting local and foreign investments.
5. Increase the competitiveness of the region and the international market: The innovative and sustainable environment of Iraq makes the country more appealing to foreign investment.

The attainment of the Iraq Vision 2030 depends on local initiatives with the contribution of international organizations like World Bank and UNDP. To expand the development gap and improve economic stability, Iraq can use the available opportunities to ensure an inclusive and sustainable economic growth.

2.Challenges and Obstacles to Sustainable Economic Growth in Iraq.

The Iraqi economy is characterized by diverse challenges and barriers that make it hard to follow the way of sustainable development and the extensive development. The most notable of these issues may be summed up as follows:

a. Overreliance on oil: This is the biggest threat to the Iraqi economy, total reliance on oil revenues. The oil has been over fifty percent of GDP, eighty-eight percent of all public revenues, and ninety-nine percent of Iraqi total exports during the period 2009-2024 [25]. Such a reliance renders the economy extremely sensitive to the changes in the world oil prices and results in the instability of the state budget and trade balance and reduces the chances of participating in long-term economic planning. It also increases the decline of motivation to diversify the sources of income and to develop alternative sectors of the economy like agriculture, industry and tourism which has adverse impacts on realization of sustainable economic growth.

b. Political and security instability: The years of conflict and political and security instability have severely hit the economy of Iraq. The security threats index showed a high of 10.9 in the years 2009 to 2024 whereas the Global Peace Index ranked Iraq at an average of 157th globally with an index of 3.2 [32]. The Fragile States Index scored 102.2 on average with Iraq being placed 13th among 12 indicators of fragility in the sub-indicators [33]. The persistence of political unrest, internal strife as well as security dilemma provide a climate that discourages local and foreign investment. They also interfere with the realization of significant development projects, cause the departure of capital and talents, and make it difficult to implement the policy on green education and digital transformation, which undermines the productive background of the economy.

c. Administrative and financial corruption : Corruption is prevalent in various areas of the Iraqi state and one of the biggest impediments to sustainable economic growth and has resulted in the loss of capacity and resources to execute economic development policies, such as green education curriculum and digital transformation systems that would enable sustainable economic resources exploitation to benefit the current and future generations. The administrative and financial corruption has been one of the primary factors that have contributed to poor economic performance in Iraq. Iraq was between 140th and 175th out of 180 in the corruption indices between 2009 and 2024 [34]. Corruption leads to miscare of economic resources undermining governance. In 2021, Iraq's governance index averaged 47% of its economic resources, distributed as 40% in public budget management and 54% in national oil revenue sharing. Iraq ranked 61st out of 89 international evaluations according to the governance index.

The Value for Money (VfM) index, which measures the economic, social, and environmental benefits derived from natural resource utilization (e.g., oil, gas, and minerals) through effective and transparent management, averaged 52% in Iraq. This was distributed as 35% in licensing, 73% in taxation, 33% in local impact, and 66% in state-owned enterprises. Such aspects saw the collapse of the enabling environment of economic sectors in Iraq. The enabling environment in 2021 had an average of 16 but it was further broken down as; 26% transparency and accountability, 15% governance effectiveness, 17% regulatory quality, 7% rule of law, 9% anti-corruption, 5% political stability and absence of violence, and 31% other indicators. This made Iraq be ranked 81 st of 89 countries assessed internationally on the enabling environment index [35].

d. Poor infrastructure: The infrastructure in Iraq is plagued by extremely poor infrastructure that is in poor conditions in most of the key sectors of infrastructures such as electricity, water, sanitation, roads, ports and communications. This drawback has adverse impacts on production and productivity, the rise in business costs, the inability to develop and achieve growth and expansion of the private sector, and the inability to implement green education methods and digital transformation processes. Weak investment in infrastructure is a hindering factor to economic integration and makes Iraq

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less appealing as an investment destination. In 2023, the World Bank projected that it will take $1 billion a year to modernize the productive sector in Iraq, and in the long run, an estimate of 100 billion to modernize the national infrastructure [26].

e. Lack of strong contribution of the private sector: Although the potential of the Iraqi private sector is great, it is still weak and encounters various challenges including bureaucracy of administration, challenges of getting finance, unfair competition with the state sector and lack of legal security. The majority of the activities in the private sector are oriented to the traditional business and services, which is not related to green investment and digital technologies. This has been a weakness resulting in a low contribution of the private sector to the GDP and creation of jobs. The contribution of the privates to the industrial sector and agricultural sector during 2009-2024 amount less than 2.1% and 3 respectively which puts pressure on the public sector (Iraqi Ministry of Planning, 2009-2024).

f. Social constraints: Regardless of the huge oil reserves in Iraq, unemployment rate is high in the nation especially among the youth and graduates. The unemployment was increased to 15.6 percent in 2023 against 8.2 percent in 2009 (Iraqi Ministry of Labor and Social Affairs, 200915.6). Also, the poverty levels were between 18.9% and 30%. Over the same periods of time, the poverty levels were at 18.9% to 30% (Iraqi Ministry of Planning, 2009-2023). These problems can be attributed to the fact that economic sectors are not able to accommodate the influx of new women in their employment sector, dependence on government employment, inadequate skills in the labor market, and the inappropriateness of sustainable development plans and programs in Iraq.

g. Environmental issues and climate change: Iraq has a very serious environmental problem, including lack of water, desertification, air and soil pollution, and effects of climate change. Irrigation and agricultural problems were aggravated as the flow of rivers Tigris and Euphrates was reduced by 30-40 percent between 2009 and 2020 (Iraqi Ministry of Planning, 2009-2024) as a result of drought and dam construction in Turkey. Desertification in the country took place in 2022 when 39% of the total territory of Iraq was desertified, and 60,000 acres of arable land were lost annually [36]. Sand and dust storms were even more intense in the same year with 270 storms per year [37]. These issues adversely affect the key economic industries like the agricultural sector, impede the use of digital technologies, and raise the health and social costs, which would demand colossal green investments to adjust to and reduce the effects of climate change.

4.3. The strategy for Addressing Iraq's Economic Situation.

To make Iraq experience sustainable and inclusive economic growth, it is necessary to take a strategy that will improve on the challenges and exploit opportunities available, but more specifically, one should consider incorporating green education and digital transformation as the drivers of economic growth in Iraq. The approach is developed on the comprehensive research of the economic status of Iraq, structural issues, and opportunities, and the critical role of green education and digital revolution. Simultaneously, it offers a bold green and digital outline that is in line with the Vision 2030 of Iraq. The vision of the strategy is the diversification and maintenance of the Iraqi economy which is based on the green and digital knowledge. It is also designed to turn the Iraqi economy to be a strong model that can resist fluctuations and changes to guarantee the social and economic well-being alongside fostering innovation, inclusivity, and responsiveness to global changes.

3.1. Strategy Objectives:

a. Income resource diversification: By 2030, share of non-oil sources in GDP should rise to 20 per cent, aiming to reduce the level of dependence on oil, which made 88 per cent of total public revenues in 2022, and an even smaller portion of GDP in agriculture and industry, which stood at less than 4 per cent and 2 per cent, respectively, in 2022 [31].

b. Developing a knowledge based economy: Investment in human capital, innovation and research and development to increase Human Capital Index of 0.48 in 2022 (see Table 2) to 0.6 and increase allocation to R&D to 2% of GDP [31].

c. Sustainable development: Incorporate good environmental actions in all sectors of the economy to avoid carbon emission by 15 percent by 2030, and integrate contemporary digital technologies to offer high-speed internet services to 70 percent of the population [31].

d. Improving economic, social inclusion: Equal opportunities help to reduce unemployment to 10 percent and to emphasize women and youth empowerment. Enhance the quality of life by making access to clean and continuous water, which in 2024 appeared to 98.4 per cent of the Iraqi population, and which continues to increase its quality [38].

e. Enhancing the business environment: Attract foreign and local investment, ease business operations by various units of the economy and enhance the business preparedness indicators where Iraq stands at the last quartile with a score of 49.4 in 2024. Minimize difficulties of the private sector caused by poor digital systems, and the service index score was 21.5 in the same year, and solve problems such as lack of adequate provision of the public services, with a score of 46.8 [39] [40][41][42][43][44][45].

4.3.2. Pillars of the Strategy:

Pillar One: Enhancing Governance and Institutional reform.

a. Fighting corruption: Strict implementation of anti-corruption laws and regulations (including the Integrity Commission Law of 2011), and improved independence and effectiveness of oversight institutions and anti-corruption institutions. Create online services to report corruption and track financial operations of people based on blockchain technology to minimize manipulation, raise transparency, and accountability of all governmental and financial processes, which will eliminate losses

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caused by corruption.

b. Administrative reform: Streamline bureaucracy, making more of the government services, including the granting of licenses and permits, digital (through electronic portals). Digitization of train personnel through international courses will enhance the level of effectiveness and productivity of the employees, as well as raise the satisfaction of citizens with the services rendered by the government.

c. Political and security stability: Have a national economic council with the civil society representatives to give a long term developmental outlook out of the political wrangles. Improve security through modernization of security agencies and application of AI surveillance technologies to ensure stability in the whole country and also establish an investment-friendly atmosphere. Use foreign assistance to enhance reconstruction, development, and stability initiatives, which will result in a possible 30 percent growth in foreign investment because of better security and stability.

Pillar Two: Economic Diversification and Investment in Real Productive Sectors

a. Boosting up agricultural sector: Invest in the modern technologies of drip irrigation to minimize the usage of water and maximize the productivity of land. Adopt a program of training farmers to become climate-smart and organic farmers to boost production and limit rural-urban migration. Provide funds to the farmers with the help of financing and new technology in the form of low-interest or even zero-interest loans.

b. Industrial sector development: concentrate on high value added manufacturing industries i.e. petrochemicals and food with investments of up to 5 billion USD by the year 2030 harnessing on locally available raw materials. Offer tax exemptions to green industries within a period of five years such as the production of solar panels. The creation of green industrial areas in Baghdad and Basra together with WTO in collaboration with the World Bank to stimulate local and foreign investment, hence contributing to the GDP of the industrial sector.

c. Revitalizing the tourism sector : This will allocate 50 billion IQD annually to build tourism infrastructure e.g. hotels in Baghdad, Karbala, and Najaf and to enhance roads and services. Market archaeological and religious and natural sites in Iraq to the rest of the world with international marketing and develop human capability in the tourism and hospitality sector.

d. Helping the small and medium-sized businesses : Have a 1-trillion-IQD fund to finance small and medium enterprises with interest-free loans. Introduce investor protection laws based on the Singapore investment laws. Promote the joint ventures between the government and the business sector in the development of infrastructure like renewable energy ventures. These will make the contribution of the private sector to GDP 35.

Pillar Three: Moving Green Education and Digital Transformation.

a. Green Education:

- **Introducing concepts of sustainability**: Set up the curricula to include the concept of green economy, sustainable development, and environmental protection at any level of education, starting with early education and ending with university, and including at least 10% of the courses.

- **Creating green skills**: Build 50 professional training centers to train young people in new green economies including renewable energy, waste management and sustainable agriculture, with the European Union.

- **Green scientific research**: Favor research and studies in green technologies, environmental solutions, and circular economy efforts by reserving 1 percent of the budget to green education education programs and other related digital technologies.

- **Green universities**: Turn five Iraqi universities into sustainability model, through administration and operational environmentally friendly practices, and generate graduates who are fit in the green sector.

b. Digital Transformation:

Digital infrastructures: Spend more in order to develop and modernise internet and communications infrastructure in Iraq to increase coverage of the internet speed and quality of service and lower prices in collaboration with other international bodies with an aim of increasing the internet speed coverage to 70 percent.

- **Digital government**: By 2030, digitalize more than 80 per cent government services to make them easier and more transparent to the citizen and business, and to fight corruption.

- **Digital inclusion**: Train 300,000 individuals in the Iraqi society, especially youth and women, in digital skills, so that they can gain access to the digital economy.

Supporting digital innovation: Have business incubators and innovation centers in order to promote startups in the digital technology sector.

Cybersecurity: Prepare a fully developed legal and institutional structure to secure data and guarantee cybersecurity.

Pillar Four: Investing in Human Capital:

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- **Education reform:** Alter the curricula to reflect labor market demands at the present and in the future, enhance the quality of education, educate the teachers, and match the desired results of the educational system to the needs of the private sector.
- **Vocational training:** Implement specific work-based vocational training programs depending on the needs of different sectors, such as green and digital ones, and encourage the collaboration of educational institutions at the state level with the non-governmental sector in terms of practical training.
- **Entrepreneurship:** Promote entrepreneurship culture and motivate youth to establish their own business, mentor and support start-ups, green and digital ones.

Conclusion

Economic analysis highlights multiple opportunities for Iraq's economy, with green education and digital transformation serving as strategic enablers for sustainable and inclusive economic growth, addressing structural challenges while leveraging available opportunities. Iraq faces significant challenges, such as excessive reliance on oil (88% of total revenues), weak digital infrastructure with high-speed internet coverage at 30% in 2022, environmental degradation with desertification affecting 39% of land, and reduced flows of the Tigris and Euphrates rivers by 30%-40%. However, green education offers chances to produce the qualified workforce in green industries including renewable energy and sustainable agriculture so that carbon emission can be decreased and diversification of economy can be encouraged. Digital transformation contributes to the efficiency of the economy through the digitalization of government services and the contribution of the digital economy to the GDP, which is anticipated to reach 5 percent in 2030. To have these opportunities, it is important to incorporate green education and digital transformation into a broader strategy that is based on the economic diversification, better governance, and the human capital investment. This strategy supports the goals of Iraq Vision 2030, aiming to build a knowledge-based, diversified economy while reducing dependence on oil and enhancing economic and social inclusion.

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