Artificial Intelligence in Education as a Mean to Achieve Sustainable Development in Accordance with the Pillars of the Kingdom's Vision 2030—A Systematic Review

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Abstract

In this study, we aimed to review scientific studies and research to present a view of artificial intelligence in education to achieve sustainable development in accordance with the foundations of the Kingdom's Vision 2030. We conducted a systematic review of previous literature by extrapolating and analyzing 17 previous studies published from 2018 to 2020. We found that the application of artificial intelligence has proven effective in improving and developing education, simplifying basic teaching tasks, assisting managers of educational institutions, and contributing to solving problems and challenges faced by the education sector.

Keywords: artificial intelligence, sustainable development, education, Kingdom vision

1. Introduction

In the current era, the world is witnessing rapid changes in the field of scientific development as a result of the technological revolution that has swept through all fields and sectors. This has been reflected in the lives of individuals, their cultures, and the prevailing systems in a way that may be positive or negative, especially with the emergence of the Industrial Revolution that has produced many applications, the most important of which is artificial intelligence. It is one of the most important challenges facing this era, as it has become an integral part of our lives. Artificial intelligence has affected all fields, starting with simple computers and culminating (so far) in smart phones and robots (Di Vaio et al., 2020). Intelligence has contributed to the prosperity of all fields of life that were not satisfied only by scientific and technical fields or even human and social sciences. Accordingly, artificial intelligence appeared in two main scientific fields, namely, behavioral and neurotransmitter science and computer science. It has been defined as a science that includes all the algorithms and theoretical and practical methods concerned with automating decision-making processes. The place of man, whether in a complete or partial way, with the human body with the ability to adapt, quote and predict (How et al., 2020), it is a part of computer science that aims to design intelligent systems that give the same characteristics that we know as intelligence in human behavior, and it deliberately works on the principle of matching configurations by which objects, events, and processes can be described using their qualitative properties and their logical and computational relationship (Mrówczyńska et al., 2019).

The development of contemporary societies has been affected by the degree to which they employ technological resources and artificial intelligence. This is considered one of the pillars of educational development. Therefore, many countries have employed artificial intelligence applications in their educational systems, which allow them to discover new learning frontiers through artificial intelligence in digital systems. This adds to the work of algorithms, saves time and effort, and contributes to providing an alternative reality for students. It allows students to grow accustomed to confrontation and keep up with modern technology (Chiu & Chai, 2020).

Employing artificial intelligence in education helps improve students' enjoyment during classes and raises their grades at the same time. Well-trained robots can complement the role of experienced teachers in providing private lessons and additional classes to strengthen and develop students' skills. This technology can also solve teachers' problems or respond to the scarcity of qualified teachers in some fields; however, artificial intelligence is not supposed to replace innate or natural intelligence. The purpose of it is not to replace teachers in the classroom or dispose of them altogether, but for the human mind to work side by side with the artificial mind in an elaborately

calculated combination (Sonetti et al., 2019).

Artificial intelligence aims to understand the nature of human intelligence through the work of computer programs that are able to simulate intelligent human behavior, solve problems, and make decisions based on the description of a situation (Panigrahi, 2020). Artificial intelligence has applications in various fields, the most prominent of which are expert systems, speech recognition, speech-making, education, and learning. Among the tasks that artificial intelligence performs in the teaching process are correcting exams and evaluating assignments. It reduces the time required for such tasks so that teachers can devote more time to students and classes. Special service options provided by artificial intelligence can help improve students' listening skills during lessons and improve their grades at the same time. They may also help teachers develop their capabilities and remedy any classroom deficiencies (Chen et al., 2020).

The Kingdom of Saudi Arabia is one of the first Arab countries keen to adopt the latest contemporary technological revolutions in all sectors, especially the education sector. Employing artificial intelligence in education was an integral part of the Kingdom's Vision 2030 to achieve sustainable development and anticipate future prospects. The vision's most important pillars are employing technology in the education process, particularly artificial intelligence, while considering learners' abilities and needs and fixing existing issues in education (Elhajji et al., 2020).

Our study aims to review scientific studies and research to explore artificial intelligence in education that achieves sustainable development goals in accordance with the Kingdom's Vision 2030. Identifying the most important findings of studies in this area—and analyzing their implications for education in the Kingdom and for the Kingdom's Vision 2030—is significant for several reasons. First, the use of artificial intelligence and its role in managing and evaluating education is important. Second, artificial intelligence is a modern technology that has become imperative for improving efficiency, introducing new opportunities to empower teachers, and developing necessary values and skills. Modern applications of information technologies are moving toward the use of artificial intelligence in education, especially in light of the push toward virtual classrooms and the systematic integration of artificial intelligence.

2. Method

We used an inductive approach by extrapolating and analyzing 17 relevant studies conducted between 2018 and 2020. We aimed to identify the theoretical basis for applications of artificial intelligence in education in order to achieve sustainable development in accordance with the pillars of the Kingdom's Vision 2030. The studies are listed in the table below:

Table 1. Studies from years 2018 to 2020 related to the field of study

No.	Study title	Year of publication	Author/s
1.	Artificial intelligence in education. Boston.	2019	Holmes et al.
2.	Sustainable Curriculum Planning for Artificial Intelligence Education: A Self-Determination Theory Perspective.	2020	Chiu & Chai
3.	Analyzing the effects of artificial intelligence (AI) education program based on design thinking process.	2020	Lee
4.	Use of Artificial Intelligence in education.	2020	Panigrahi
5.	Application and theory gaps during the rise of Artificial Intelligence in Education	2020	Chen et al.
6.	Artificial intelligence: A Better and innovative technology for enhancement and sustainable evolution in education system.	2020	Tilak
7.	Governing Artificial Intelligence to benefit the UN Sustainable Development Goals.	2020	Truby
8.	The role of artificial intelligence in achieving the Sustainable Development Goals.	2020	Vinuesa et al.
9.	Vision, challenges, roles and research issues of Artificial Intelligence in Education.	2020	Hwang et al.
10.	Towards an artificial intelligence strategy for higher education in Saudi Arabia.	2020	Elhajji et al.
11.	Constructivism-Based Methodology for Teaching Artificial Intelligence Topics Focused on Sustainable Development.	2019	Mota-Valtierra et al.
12.	Analyzing sustainability awareness among higher education faculty members: A case study in Saudi Arabia.	2019	Alkhayyal et al.
13.	The Future of Higher Education in the Light of Artificial Intelligence Transformations.	2020	Aldosari
14.	Artificial Intelligence as a Disruptive Technology in Education	2019	Zovko & Gudlin
15.	The Application and Development Research of Artificial Intelligence Education in Wisdom Education Era.	2018	Liu
16.	The need for a fundamental shift in the Saudi education system: Implementing the Saudi Arabian economic vision 2030	2020	Allmnakrah & Evers
17.	Artificial Intelligence (AI) and the Educational Process: Using AI to Enhance Student Performance in Content Skills.	2019	Aljohani

3. Theory

Artificial intelligence has received the attention of many researchers, resulting in many definitions of the term. One of the most prominent definitions was provided by Chiu and Chai (2020), who stated that the concept of artificial intelligence is "a field of computer science interested in designing intelligent computer systems that display the characteristics of intelligence in human behavior" (p. x). Similarly, Panigrahi (2020) defined it as "the science that enables machines to implement things that require intelligence if they are executed by humans." (p. x). Alternatively, Chen et al. (2020) defined it as "a branch of computer science concerned with the study and manufacture of computer systems that display some formulas of intelligence in the sense of systems that learn new concepts and

tasks, systems that can think and draw useful conclusions about the world in which we live, systems that accommodate natural languages, notice and understand visual landscapes, and systems that can accomplish actions that require human intelligence. Regarding the representation of computer models in a field of life and the identification of the basic relationships between its elements, and then the creation of reactions that are commensurate with the events and situations of this field.

Artificial intelligence includes all algorithms and methods, both theoretical and applied, which means that it can complete the decision-making process in place of a human being, whether totally or partially, due to its ability to adapt, predict, and quote (Truby, 2020). Some of the most important characteristics of artificial intelligence are its ability to solve problems, to think and perceive, to acquire knowledge, and to apply its learning and understanding from previous experiences to new situations. It can respond quickly to new circumstances, deal with difficult and complex cases, handle ambiguous situations with incomplete information, and distinguish the relative importance of the elements of known cases (Vinuesa et al., 2020).

Hwang et al. (2020) added that artificial intelligence creates a mechanism for solving problems that relies on objective judgment and the accurate evaluation of solutions. It raises the level of knowledge of an organization's officials by providing solutions to many problems that are difficult to analyze by the human element during a short period. It includes studying the logical thinking processes of humans and then trying to implement those processes through computers. Thus the most important characteristic is its relative stability, as it is not exposed to what humans are exposed to in terms of factors affecting abilities, such as forgetfulness. The basic principle upon which artificial intelligence science is based is not to solve problems quickly.

The largest, or in processing more data, or preserving the largest number of information derived from the human mind, but the correct principle on which this field is based is in fact the principle of processing information, whatever its nature and size, in an automatic or semiautomatic manner, and in a manner consistent with a certain goal (Elhajji, 2020).

Artificial intelligence, as a new science, seeks to understand the queen of intelligence in humans. To enable the computer to comprehend human knowledge and information, Mota-Valtierra et al. (2019) carried out a study in which they were able to extrapolate the objective of artificial intelligence, which is to understand the nature of human intelligence by creating computer programs capable of simulating intelligent human behavior so that the program can solve a problem or make a decision. Artificial intelligence also aims to understand the complex mental processes that the human mind uses during the thinking process and to translate these mental processes into equivalent operations that increase the computer's ability to solve complex problems. This has the potential to improve educational opportunities and access to learners all over the world, as well as to improve human–human, human–computer, and computer–computer communications and to create intelligent communication between perception and action.

Liu (2018) confirmed that one of the goals of artificial intelligence is to carry out tasks such as scheduling and movement, analyzing students' food systems, conducting training programs, and monitoring students. Doing such tasks would save time and effort and allow teachers to allocate more time to students. To enhance creativity and build relationships with students, artificial intelligence also aims to build software capable of performing behaviors described as intelligent when a person performs them. The ability of the machine to carry out tasks that require human intelligence (such as logical conclusions) makes the machine more intelligent and makes devices more useful.

Artificial intelligence and its applications have an important and clear role in improving and developing all areas of life, from the development of computer systems to working with super efficiency similar to that of an expert human being. With its various uses and applications as an applied science, artificial intelligence has become the backbone of daily life, enhancing the human race in its present and future. It becomes not only a tangible reality but also an indispensable reality in light of the tremendous technical development that the world is witnessing today and what this development represents in terms of the complete dependence of humanity on computers, through the information revolution, and the technical trends of the word from an implicit reference to cultural and technical contact between humans in various parts of the world (Holmes et al., 2019).

Panigrahi (2020) stressed artificial intelligence's great contribution to the field of education. Educational institutions are considered a rich source of data, where systems capable of managing educational institutions' and students' data can be created simultaneously and saved in the form of huge databases. Big data can be used to train huge neural networks that can predict vulnerability on an individual student level and shortages in material and human resources before they occur. Such systems will help educational institutions by reducing their costs and increasing the quality of their educational outputs. Examples include automatic teaching and automated systems for evaluating answer

sheets. With artificial intelligence technology, we can ask questions based on learners' weaknesses because the technology is able to study learners' behaviors. Students may tend to resort to information systems rather than to the teacher in asking questions. This is because they may be too shy to ask questions in front of the class or worried about disturbing the teacher, thereby negatively affecting their future evaluations.

3.1 The Most Important Applications of Artificial Intelligence in Education

Artificial intelligence is no longer a luxury in the field of education as it has become one of the pillars of educational development in developed countries. One of the most important means of developing school materials and digital systems for schools is applying artificial intelligence in education to establish interconnected data networks. Its method is to establish large-scale neural networks that can anticipate weaknesses and how to treat them, as well as to contribute to information management and address problems, the most important of which is Class Ara (Chen et al., 2020), where applications of artificial intelligence have surpassed in the field of artificial intelligence in education is characterized by an innovative derivative that derives from multiple theories and fields. The reformulation and crystallization of educational curricula in line with students' interests allow us to reach the shortest paths to deliver study materials and develop students' abilities to communicate with systems similar to humans. It is prepared and equipped to deal immediately with humans in all linguistic and social situations in a way that enhances communication and improves social skills.

Artificial intelligence in education is characterized by using non-digital coding, meaning that it is more complex. It relies on "only one and zero," which means that it can make complex decisions, be used in different fields of study, and solve problems even with incomplete data (Hwang et al., 2020). The use of artificial intelligence in education saves time and effort and provides an alternative reality for students as it allows students to grow accustomed to confrontation and to keep up with modern technology. Artificial intelligence also presents questions to students in a way that reveals the weaknesses of each learner and prepares their mental outlook. It explores how students learn and helps them choose the right questions. It is also provided a catharsis for them; experiences have shown that students are more able to engage in dialogue without the teacher.

A study by Zovko and Gudlin (2019) explained the most important applications of artificial intelligence in education. (1) Smart content is when educational robots can create digital content with the same degree of ingenuity as their human counterparts, and artificial intelligence can help in digitizing textbooks or creating applicable digital interfaces for learning. (2) Characterizing learners and predicting their performance (profiling and prediction) includes determining enrollment decisions, course scheduling, dropout rates, and school attendance, as well as identifying student models and academic achievements to support learners in a timely manner. (3) Intelligent educational robots perform learning tasks better than humans can because they are able to employ and integrate human knowledge in various fields through machine learning by borrowing from advanced technologies. At the same time, the capabilities of independent teaching, assistant teaching, and teaching management available with artificial intelligence via educational robots add intelligence and interest. For learners' activities and to become an excellent platform for training learners on abilities and comprehensive knowledge (4) Intelligent tutoring systems include teaching course content and diagnosing strengths and weaknesses, providing automatic feedback, and determining appropriate educational materials for learners according to their needs. (5) Assessment and evaluation involve evaluating tasks with high levels of accuracy and competence. It includes the correction and automatic monitoring of grades, providing feedback, assessing students' understanding and judging the extent of their academic integration, and evaluating teaching.

Studies by Aljohani (2019) and Holmes et al. (2019) have clarified the most prominent uses of artificial intelligence technologies and systems in education, particularly for individual learning. The current education system adopts the principle of equality in education so that all students attend the same subject, listen to the same lecture, and take the same standardized test to determine their proficiency, regardless of understanding or future application of concepts if a large group of data is collected for each student or group of students. This data is linked to background data for the students and their orientation. It is possible to recommend a system that can predict the type of material that the students will absorb and lead to maximum learning. Each student could have a separate curriculum and separate tests, and there are attempts on a small scale to implement such systems. An American company, Aleks, acquired from the publisher McGraw Hill, has used artificial intelligence to determine the extent to which each student understands a certain mathematical concept, and it proposes a learning path for each student. It uses artificial intelligence to understand the stages of learning, which is one of the most important goals of behavioral psychology through which theories of education are developed.

Learning can be studied from the angle of machine learning or, alternatively, new theories of education can be

developed that may completely reconsider the current educational system and the technology of artificial neural networks. Artificial neural networks are similar to the neural synapse in the brain, so training these networks on a specific task and observing the effect of training on performance and its quality may reveal information about the learning process itself. Training neural networks is the cost and can be repeated thousands of times and can reveal the quality of learning and its measurement. By comparing these experiences with behavioral experiences and their results, a new framework for learning theories can be built, upon which learning methods and educational curricula can be developed. These new theories may result in an educational system completely different from what we currently know.

Regarding visual linguistic interactions with children, robots can now work with a child, understanding a child's interactions and making movements and gestures. Automation is still in its infancy, but it may produce a generation of children that can learn faster than previous ones. Artificial intelligence is used in the work of digital school systems capable of managing school and student data at the same time and saving them in the form of huge databases. Big data can be used to train huge neural networks that can predict vulnerability on an individual student level and shortages in material and human resources before they occur.

3.2 The Role of AI in Education in Achieving Sustainable Development

Interest in sustainable development has increased in all countries around the world. Efforts have been made to achieve its economic, social, and environmental dimensions, and the proposed approaches have multiplied to raise its efficiency in this regard. Artificial intelligence in education has emerged as a successful tool because it is the focus of the human element in terms of providing knowledge. Artificial intelligence in education for sustainability is more than just a knowledge base and applications related to the environment, the economy, and society. It also includes training, raising awareness levels, and learning skills, trends, and values that guide and motivate individuals to adopt different perspectives. Seek sustainable livelihoods, participate in a democratic society, and live in a sustainable way, and it also includes the study of local and global issues (Vinuesa et al., 2020). Elhajji et al. (2020) explained that education for sustainable development is educating a comprehensive and transformative capacity that addresses the contents and outcomes of learning, the educational approach, and the learning environment; it achieves its goal by transforming society. Education enables citizens of a country to deal with complexities, inequality, natural heritage, culture, society, and economy. Artificial intelligence in education prepares individuals for the future and enables education for everyone everywhere. It is also effective for a successful transition toward societies and economies that are sensitive to the environment.

Artificial intelligence in education has many characteristics that enable it to achieve sustainable development because it is based on four basic pillars: knowledge, living, working, and transfer of knowledge. It is consistent with achieving a just, fair, and peaceful world. Ensuring the sustainability of cultural, social, and economic resources encourages the diagnosis of individuals' requirements to meet their education and learning goals. The implementation of strategies to evaluate educational results recognizes that meeting local needs often has international impacts and that artificial intelligence in education involves the three basic dimensions of sustainable development. It is designed to keep pace with the evolving nature of sustainable development, take into account problems based on the principle of teamwork, and improve quality of life in order to achieve sustainable development. This is achieved via the use of a variety of educational technologies that enhance participatory education and thinking skills. Students benefit from fun education, which allows for the transformation of societies toward sustainability. It is based on performance and the desire to achieve societal success, development, and well-being (Alkhayyal et al., 2019). Aldosari (2020) noted that the role of artificial intelligence in education is to achieve sustainable development by developing a sense of family, community, and institution participation. This expands the margin of democratic participation and develops a sense of citizenship that allows people to recognize others and their right to differences, as guaranteed by international human rights covenants on freedom of speech and action. It also secures freedom of expressing opinions; freedom of movement; developing a sense of belonging to the future; adopting future planning as a life strategy for individuals and groups; developing feelings of justice and fairness; developing nonviolent behavior; rearranging priorities; and ensuring ethical, transparent, and auditable use of educational data and software, monitoring, evaluation, and research.

3.3 The Reality of Applying Artificial Intelligence in the Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia, with its ambitious vision, has tended to form a knowledge society, with digital transformation and comprehensive utilization of technology in all fields, including artificial intelligence in all sectors, the most important of which is education. Perhaps the NEOM project is one of the most important features of the Kingdom's application of artificial intelligence. This project will transform the Kingdom into a leading global center

in innovation and trade based on modern technologies. Artificial intelligence is the main pillar on which this project is based, which will work to establish NEOM as a smart city that includes all smart services (including smart schools) and artificial intelligence in education. The National Center for Robot Technology and Smart Systems in the King Abdulaziz City for Science and Technology aims to develop a knowledge system that creates an umbrella of research and development that benefits from technology transfer and localization projects. The first technical robot was employed in the Ministry of Education for customer service purposes and communication with visitors about exhibitions and activities. The General Organization for Technical and Vocational Training, as well as the Saudi Conference and Exhibition of Robotics held in March 2019 was attended by experts and researchers in artificial intelligence, and it included sessions on the future of robotics in the Middle East, innovation, and smart manufacturing to support Vision 2030 (Allmnakrah & Evers, 2020).

There is a tremendous technological movement in the Kingdom of Saudi Arabia in the field of artificial intelligence involving the establishment of the Saudi Authority for Data and Artificial Intelligence, as well as the establishment of a leading company in the field of artificial intelligence and information technology in Riyadh. The applications and services it provides are among the most important applications of artificial intelligence in education in the entire Kingdom. The Robot Olympiad competitions aim to achieve the Kingdom's plans to transform toward an innovative knowledge society. The most important is the "First LEGO" competition, which focuses on enabling students to use their knowledge to design and build robots as tools at various educational stages (Aldosari, 2020).

3.4 The Pillars of the Kingdom's Vision 2030 in Education

The Kingdom of Saudi Arabia attaches great importance to the development and promotion of education to build a promising generation with diverse cultures. Through Vision 2030, the Kingdom has begun its advancements in developing education through its various stages, approaches, and methods. The Kingdom has paid attention to all stages of education, such as general education, higher education, vocational education, and inclusive education. It has worked to develop curricula according to a pioneering educational philosophy. Vision 2030 aims to prepare teachers and their professional development in line with the requirements of the twenty-first century and with what is needed to develop necessary skills to keep pace with intellectual, technological, and industrial developments (Alkhayyal et al., 2019).

Vision 2030 is characterized by its comprehensiveness. Education is available to all members of society, both male and female, from nursery to postgraduate studies. The diversity in educational curricula also includes different age levels in harmony with Islamic belief and Arab thought. According to the increasing knowledge and technological revolution developments. Vision 2030 also gives special importance to people with special needs, providing them with appropriate support and facilitating various means to provide education to them.

Vision 2030 seeks to keep the curricula in line with scientific and cultural developments. To ensure that students be in constant contact with any scientific and cognitive developments, Vision 2030 pays special attention to developing teachers in the form of distinguished courses that inform them of everything new in curricula and teaching methods, enriching their knowledge with educational activities and workshops and granting them scholarship opportunities. Vision 2030 has worked to make students the center of the educational process, aiming to raise children with a scientific background without giving them duties and tasks they cannot perform. This has led to an increase in educational activities within the school environment, which has developed the skills of students enough to meet the requirements of modern life. Regarding teaching, Vision 2030 urges the use of modern teaching methods and promotes teaching through computers and iPads. Vision 2030 has also worked to support schools by providing necessary computer equipment and display devices to urge diversity in the teaching process and by equipping scientific laboratories with necessary devices and tools. It has also provided smart boards, which have become a necessity in modern education (Vinuesa et al., 2020).

Vision 2030 has worked to improve teaching methods that make the learner the focus of the process by emphasizing building skills, refining personality, instilling confidence, and building creativity. Vision 2030 seeks to build a stimulating, attractive, and desirable school environment linked to a system of supportive and integrated services. It also considers the health of students by assessing the quality of food provided to students and calculating calories. Vision 2030 works to re-conceptualize the school as an educational institution that sharpens talents, provides skills, and produces a generation of ambitious adults who are motivated by challenge, competition, love of work, and productivity. It urges schools to increase discipline and seriousness in educational practice via organizing activities and attending forums and events (Elhajji et al., 2020).

Vision 2030 also aims to restructure the education sector by modernizing the system of regulations and instructions, by implementing rules that govern curriculum development and the recruitment of teachers, by organizing the

process of educational supervision, and by continuously monitoring the effectiveness of professional development and training. It also emphasizes harmonizing education with the various interests of society, including developing the national economy by transforming the economy from relying on a single source of income to an economy that relies on highly skilled minds and creative human energy. Moreover, Vision 2030 strengthens the education system by relying on safe and reliable sources, programs, and projects that enhance investment opportunities and generate job opportunities through education's contribution to developing human capital and meeting the requirements of the labor market (Alkhayyal et al., 2019).

4. Results and Discussion

Our study aimed to identify the role of artificial intelligence in education to achieve sustainable development in accordance with the pillars of the Kingdom's Vision 2030. We achieved this by extrapolating literature from 2018 to 2020. The following is a review of the results of these studies.

Holmes et al. (2019) concluded that the applications of artificial intelligence in learning have proven their effectiveness, overcome challenges, formed a direction of development for education, and changed the rules of the educational process. Artificial intelligence in education has been characterized as derivative and innovative as it has been derived from multiple theories and fields. These include artificial intelligence, information and communication technology, and cognitive science. It also generates its own knowledge and answers questions such as "what is the nature of knowledge?"; "how can it be represented?"; and "how can artificial intelligence help students to learn?" Artificial intelligence seeks to understand the nature of human intelligence by creating computer programs capable of simulating intelligent human behavior.

This idea is consistent with Aljohani's study (2019), which concluded that artificial intelligence is important in education due to its inherent power to meet the learning needs of students in the classroom. Artificial intelligence systems provide flexibility in presenting scientific materials and responding to students' interests and needs. They also benefit students through their ability to support the collection and processing of information, which allows for greater diversity in responses. This is confirmed by Chen et al. (2020), who concluded that there is great and continuous interest in artificial intelligence research and its impact on the educational process. Chen et al. also found that there was relatively little demand for the application of deep e-learning in the educational system, while traditional artificial intelligence techniques such as natural language processing are widely adopted. They found a lack of studies that use artificial intelligence techniques and interact deeply with educational theories. Due to the modernity of artificial intelligence techniques, it has become a goal for researchers to verify their effectiveness, areas of use, and what they can achieve. The lack of deep application of artificial intelligence techniques is due to the need for both teachers and students to acquire skills to use artificial intelligence techniques and highlight their importance and positive impact.

Hwang et al. (2020) found that artificial intelligence techniques can provide personal guidance, support, or feedback to students. They can also help teachers or policymakers during decision-making processes. The integration of artificial intelligence in education leads to new opportunities to significantly improve the quality of teaching and learning. Teachers can benefit from smart systems that help in assessments, collect data, enhance learning progress, and develop new strategies that benefit students. From intelligent teachers and asynchronous learning in enhancing learning outcomes, this indicates the advantages of artificial intelligence in providing personalized education to teachers and learners alike according to their individual needs based on evaluations. Of the many advantages, and presenting new ways to interact with information, and this is consistent with the results of this study.

Lee (2020) indicated that artificial intelligence has an impact on the effectiveness of problem-solving regarding programming languages, and that learners' attitudes toward artificial intelligence applications were positive, especially for students who frequently used programming languages. Panigrahi (2020) showed that artificial intelligence has evolved from systems based on simple rules to systems based on data, resulting in context-driven systems with advanced capabilities. The use of artificial intelligence in education will lead to changes in the "learning experience" by providing an adjustable learning environment that creates an "educational experience" (p. xx). Artificial intelligence technology in the education sector aims to improve the learning experience and the quality of learning. The results of our study confirm these observations. The importance of employing artificial intelligence applications in education is in raising the level of education and achieving the goals of sustainable development.

Vinuesa et al. (2020) confirmed that artificial intelligence can enable the achievement of 134 goals but may also prevent the achievement of 59. However, the current research ignores some important aspects. The rapid development of artificial intelligence needs to be supported by the necessary regulatory vision and oversight of artificial intelligence-based technologies to enable sustainable development. Failure to do this may lead to gaps in

transparency, safety, and ethical standards. The results of this study clarify all of the vision's positive and negative aspects regarding artificial intelligence in education. Artificial intelligence contributes to achieving the sustainable development goals if its effects are controlled in line with said goals. Neglecting this would cause negative results and violate rights and ethical standards.

Regarding the requirements for applying artificial intelligence in education to achieve sustainable development, Chiu and Chai (2020) conducted a study in which teachers demonstrated the need for qualification courses that would enable them to acquire skills to use artificial intelligence techniques. This confirms the recent trend toward artificial intelligence in education. After the establishment of an infrastructure for this new system, which depends on the virtual system, there are many requirements that must be met to reach the desired results, such as training both students and teachers, providing the necessary tools and means, preparing the educational environment, and strengthening the orientation. Both students and teachers use artificial intelligence techniques.

Liu (2018) highlights the importance of teaching with artificial intelligence techniques: it is located at the intersection of knowledge economy, knowledge engineering, knowledge innovation, science, education, and the rejuvenation of the nation to keep up with developmental goals. Artificial intelligence will increase the effectiveness of the learning process and help remedy the problems of education. This agrees with the findings of Mota-Valtierra et al. (2019), who noted the effectiveness of artificial intelligence in measuring the interaction between university students and in the theoretical mathematics of artificial intelligence.

Tilak (2020) explored the effectiveness of artificial intelligence in education as well as its impact on development. The sustainable education system, where the study clearly demonstrated the development of teaching methods for students and teachers. Teaching methods around the world are becoming more structured to improve and update results. Furthermore, teaching methods and the relationship between learners and teachers have substantially developed, and many educational institutions are aware of the benefits of artificial intelligence in the education system. However, the percentage of institutions using artificial intelligence in this sector is still much lower. There are many reasons behind the lack of adaptation to artificial intelligence in the education system, including the lack of awareness, the current infrastructure, lack of government support, and the cost associated with applications and tools. Teachers are now ready to adopt and implement artificial intelligence in their institutions because they believe that it is an innovative technology that can promote sustainable development.

However, this effort may have limitations. Truby (2020) stated that, just as there are advantages to artificial intelligence regarding sustainable development, there are also disadvantages that are dangerous to sustainable development goals. The study suggested some effective preventive regulatory options to reduce scenarios in which artificial intelligence harms sustainable development goals. It reviewed internationally accepted principles for the governance of artificial intelligence and defended their implementation as regulatory requirements that control artificial intelligence developers and programmers. Zovko and Gudlin (2019) indicated that the development of the educational system is in light of the spread of intelligence applications.

In light of the Kingdom of Saudi Arabia's keenness to keep pace with digital progress and development and to integrate artificial intelligence applications in education to achieve the sustainable development goals, Elhajji et al. (2020) indicated that to see the advantages of artificial intelligence in education, a lot of work is required from the government, education institutions, and even teachers and students to ensure the success of this new technology and of Vision 2030. Therefore, it is necessary to make people aware of the importance of employing artificial intelligence techniques that help to achieve sustainable development within the framework of developing education in the Kingdom of Saudi Arabia.

Alkhayyal et al. (2019) observed that according to Saudi Vision 2030, which was developed in accordance with the requirements of the United Nations, the Saudi government expects companies to be more responsible toward society and the sustainable economy. Increasing the understanding of sustainability among faculty members is beneficial for young people to build their careers in a sustainable environment, taking into account environmental, social, and economic impacts. The role of faculty members is crucial to enhancing awareness and knowledge about sustainability in higher education among young people. This confirms the Kingdom's keenness to keep pace with sustainable development goals. According to Aldosari (2020), there has been a decrease in the level of awareness of the mechanisms for applying artificial intelligence, and Saudi educational environments should raise more awareness about the possibilities of using artificial intelligence applications in education. This lack of awareness indicates the weakness of artificial intelligence in education in the Kingdom of Saudi Arabia. Allmnakrah and Evers (2020) confirmed the need for teachers to be equipped with the necessary teaching tools to move toward a transformation in the Saudi education system in line with Vision 2030. The Kingdom of Saudi Arabia is still employing artificial

intelligence applications compared to the current applications and investment in advanced rates for artificial intelligence systems in education compared with other countries. To achieve sustainable development goals in accordance with Vision 2030, the Kingdom must raise awareness among artificial intelligence specialists in education and pay attention to the challenges arising from the application of artificial intelligence to jobs and to the roles of academics in various educational institutions. Academy on all issues of artificial intelligence, creating community cooperation with companies specialized in the field of artificial intelligence.

5. Conclusions

After conducting a systematic review of previous studies, we conclude the following:

1. The applications of artificial intelligence have proven effective in improving and developing education, simplifying basic teaching tasks, assisting managers of educational institutions, and contributing to solving problems facing the education sector, such as teachers' lack of efficiency and failure to meet learner requirements.

2. There are positive trends for both students and teachers regarding the use of artificial intelligence in education.

3. Among the most important applications of artificial intelligence used in education are smart content, smart education systems, and augmented or virtual reality technology.

4. The Kingdom of Saudi Arabia is keen on employing artificial intelligence applications in education in order to achieve sustainable development.

5. The Kingdom of Saudi Arabia is still in the early stages of implementing artificial intelligence applications compared to its implementation of advanced applications and investments in artificial intelligence systems.

6. In order to achieve sustainable development goals in accordance with the pillars of the Kingdom's Vision 2030, the Kingdom must raise awareness among specialists for applying artificial intelligence in education.

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