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Aligning Education with Vision 2030 Using Augmented Reality

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Abstract: Vision 2030 requires a new generation of people with a wide variety of abilities, talents, and skills. The adoption of augmented reality (AR) and virtual reality is one possible way to align education with Vision 2030. Immersive technologies like AR are rapidly becoming powerful and versatile enough to be adopted in education to achieve this goal. Technologies such as AR could be beneficial tools to enhance maintainable growth in education. We reviewed the most recent studies in augmented reality to check its appropriateness in aligning with the educational goals of Vision 2030. First, the various definitions, terminologies, and technologies of AR are described briefly. Then, the specific characteristics and benefits of AR systems are determined. There may be a significance of the pedagogical method used by adapting the AR scheme and the consistency of the equipment and learning experiences. Therefore, three kinds of instructional methods that stress roles, location, and tasks were evaluated. The kind of learning that is offered by the distinct kinds of AR approaches is elaborated upon. The technological, pedagogical, learning problems experienced with AR are described. The potential solutions for a few of the issues experienced and the topics for subsequent research are presented in this article.

Keywords: Augmented reality; AR; VR; 2030 vision; education

1 Introduction

Vision 2030 expresses the prosperity that results from the determination of the people and the efforts of an earlier generation. Achieving its goals will necessitate the renovation of the current modes of education and preparation of the younger generation with the required skills. Vision 2030 indicates that younger generations can become the drivers of a robust and expanding economy. The changes will be attained by leveraging a wide variety of abilities, talents, and skills. Accomplishing the Vision's goal is contingent on the implementation of the required instruction at all grade levels, from kindergarten to post-graduate study. All instructors and leaders of learning organizations have a serious role in the construction of this future.

Traditional education methods and models can no longer meet the demands of the rapidly changing work climate. It is essential to form a learning scheme that ensures graduates have the abilities to familiarize themselves with ways to adapt to change.

Educational leaders are conscious of the numerous novel opportunities offered by the immersive experience of augmented reality (AR) [1]. AR brings together virtual and real worlds, thus developing an improved form of reality and providing a sensible education [2,3]. AR offers new learning and teaching opportunities in the field of education that aligns with Vision 2030 [4]. As virtual elements and actual surroundings exist together, students can create a visualization of intricate spatial associations and abstract ideas [5–7] and perform tasks that are not possible in other technology-rich learning contexts [8].

The development of AR could be carried out using and connecting different innovative technologies (such as wearable computers, mobile devices, and involvement tools). The scholastic benefits of AR are linked to the way AR is considered, used, and included in the educational environment.

This paper elaborates on the existing status, benefits, and difficulties of AR in the area of education to achieve the Vision 2030 goals in education. To accomplish the objective of this study, it was imperative to find empirical and theoretical studies that dealt with issues like how AR could be developed for educational objectives and integrated into educational contexts. We incorporated articles from journals, conferences, and books issued between 2000 and 2020. We chose about 60 of these studies that concentrated on AR and relevant educational issues.

This paper answers the following questions.

1. How is augmented reality described in the context of education?
2. What roles of AR in teaching are recognized in the study?
3. Does the research provide any prototype or standard that guides the AR enterprise?
4. How does the integration of AR into learning and teaching take place?
5. What learning outcomes does AR support in education?

We discovered various provisional themes. The statements and assertions presented in this paper were evaluated in light of the Vision 2030 objectives.

We discuss the definitions, classifications, and technologies of AR in the subsequent sections. The characteristics and opportunities of AR systems and applications are also evaluated. Creating consistency between the AR usage, instruction methods, and education involvements may be more significant when AR is adopted in classrooms. Hence, three main kinds of pedagogical methods were examined that have been used in AR situations. Despite offering new learning opportunities, AR also presents significant challenges. The technological, educational, and learning problems pertinent to the use of AR in learning are presented as well as potential solutions for a few of them. Lastly, recommendations are made for subsequent studies based on our analyses and discussions on AR research.

2 Definitions, Categories, and Technologies

2.1 Definition of Augmented Reality

AR uses a wide-ranging method and a controlled method [1]. In the wide-ranging approach, AR means utilizing simulated cues to augment a natural environment to the operator. In contrast, the technology element is stressed in the controlled approach, where AR is described as a kind of virtual reality in which part is see-through, which represents the real world. AR was also described by researchers based on its characteristics. AR has three fundamental structures: a mix of virtual and real domains, immediate collaboration, and precise 3D action [8,9].

In one study [10], the authors noted the definition of AR should not be restrictive since it may be used in any technology that combines virtual and real information. AR may be explained more extensively as a “situation in which the real-world context is dynamically covered with logical location or context-sensitive virtual information" [10]. AR may offer technology-mediated immersive experiences to users that combine actual and simulated worlds [11] and enhances the involvement of users [12].

Developers and educators may benefit from a broader definition of AR, which implies that different technologies may use AR, such as desktop computers, head-mounted displays, and handheld devices [13–15]. The possibilities of the real-world use of AR can be further visualized by proposing supplementary and appropriate evidence that improves the way learners experience reality [16,17]. Though the basis of AR may be technology, it should be conceptualized further than just being a technology.

2.2 Categories of Augmented Reality

AR performs a complementary role to reality instead of a substitutive one [18,19]. Various definitions of AR have been formulated to explain the degree to which reality is complemented or augmented. A reality-virtuality continuum has been put forward in the literature that spreads from an entirely real environment to a completely virtual one [20]. Mixed reality in this continuum refers to a situation in which there is an arrangement of real and virtual objects. Two key ideas are part of mixed reality: Augmented reality and augmented virtuality. Some researchers indicated that AR includes more of the actual world than the simulated world, while in AV, aspects of reality are included in a virtual environment, consisting of a greater amount of virtual information [15]. The difference between them is determined by whether virtuality or reality is being augmented [21,22]. There is some support for the usefulness of an immersive learning environment, where there is a seamless coexistence of virtual and real objects; however, it is still important to examine the differences between AV and AR.

A spectrum was used in the literature [10–23] to stress the amplification offered in augmented reality, which is determined by the amount of simulated information offered to the consumers. When consumers use a lot of materials and objects from the actual domain and take limited admission to simulated material, a lightly augmented reality is developed. In contrast, when virtual information is used to a greater extent, a heavily augmented reality is developed.

A 3D model was presented in the literature to present the features of AR, comprising immersion, ubiquity, and multiplicity [13]. The reality-virtuality continuum was represented by the immersion dimension [20], and the issues of how and where the system may be used were represented by the ubiquity, and the extent of use by coexisting users is part of the multiplicity dimension. AR can be present at the midpoint of each dimension.

2.3 AR Technologies in Education

A few studies used the term "technology" to define AR. For instance, AR was described as a technology in which the actual and simulated world experiences are merged [6,11,24]. Technology is rapidly developing, so a greater number of hardware and software devices are being used to develop augmented reality; hence, it may be possible to extend the concept of AR. For example, novel opportunities for augmented reality have been brought about by the developments in handheld computing [15,25–27], which also gave rise to mobile-AR [28]. Since handheld devices offer mobility, they may enhance the interactions between learners [11,18]. These devices also give rise to universal AR systems [13] that run on handheld computers using technology based on location, such as the Global Positioning System (GPS). Ubiquitous AR methods are not very conspicuous and concentrate on actual settings. The integration of mixed realities and remote laboratories is another use of AR [29]. When students overlay virtual aspects on the remote device, they may be able to remotely use and interact with both actual and simulated devices. These technologies offer universal learning enriched by remote laboratories, computer models, and virtual or 3D entities [12]. There are different ways in which AR tools can be utilized for learning objectives. First, they allow students to become involved in the reliable examination of the real world, and virtual objects like videos, manuscripts, and images function as complementary elements that learners use to examine the real-world settings [7,30]. AR technologies can also be used to integrate real-world information with digital learning resources. When learners use AR, they can experience scientific events that are impossible in the real world (such as chemical reactions) [10,24]. In one study [31], the authors introduced a 3D energetic geometry scheme (Construct 3D) that had the objective of supporting geometry and mathematics education. Construct 3D not only offered a real-world environment to students but also displayed 3D items for learners to work on, extend, and use to comprehend spatial relationships.

Despite highly advanced tools and electronics, AR technologies themselves are not important to educational researchers [8,32]. However, the way these technologies support and provide valuable learning is critical. Hence, it would be useful to use AR as a model instead of technology.

3 AR Aspects in Education

There are five elements of AR schemes based on earlier studies that use AR in education. AR has the potential to bring about (1) education achievements in 3D, (2) collaborative, universal, and local learning, (3) learners' feeling of attendance, (4) envisaging the unseen, and (5) bringing together formal and informal learning. The following paragraphs elaborate on each aspect individually.

AR improves the learning experiences of students by allowing them to utilize 3D artificial items to obtain an enhanced graphical awareness of the objective model or situation [15]. The 3D object can be viewed from different perspectives, which provides a better understanding to students [16,24,33]. The use of 3D augmented reality in astronomy learning was demonstrated by using both AR and conventional teaching sessions [34]. For example, to obtain knowledge about the sun, earth, day, and night, different technologies in the AR session were used to rotate a virtual 3D spinning earth, including a projector, whiteboard, AR tile, web camera, and virtual 3D modeling package. The traditional teaching session involved textbook reading, a lecture on the astral scheme, and the use of 3D physical items for demonstration. The questions asked by teachers in the two meetings and their discussions following the meetings were examined by the authors. It was found that the teachers acknowledged that 3D visualization and AR enabled students to view inaccessible objects. However, it was not determined if the 3D learning experiences that AR generated provided substantially higher benefits to students than using real-world 3D physical models. Significantly better performance was shown by scholars in a group consuming both physical and computer representations in comparison to the groups employing one of the models [35,36]. Therefore, further evidence from research is required to provide the usage of AR-based 3D virtual systems in the place of real-world 3D systems.

The next feature is the use of handheld computers in AR. Pervasive or mobile AR systems use mobile devices, location-registered technology, and wireless communication to allow for collaborative, ubiquitous, and self-paced learning with games, program simulations, and virtual entities [16,12]. This kind of system may have features like social interactivity, context sensitivity, portability, individuality, and connectivity [10,24,27]. For instance, to support learning apart from classrooms, various mobile AR-games were developed, like Environmental Detectives [15]. When students are involved in live virtual competitions in actual places, their context-sensitivity may increase, which allows them to make more informed decisions after taking into account all relevant contextual factors [37]. There are attention-aware features inherent in an AR system that allow it to determine the locations and work progress of students, give task reminders, and provide options to restore their attention, which may reduce task disruptions [38]. There can be an increase in social interactivity when students work together across networked mobile devices and in a live setting [15].

According to one study [32], the features of immediacy, presence, and immersion are provided when AR and other immersive media like virtual worlds and serious games are used for learning. A mediated space is offered by AR, which provides a sense of being together with others to the learners, and this may improve the students' acknowledgment of other students [37]. An AR scheme could also provide a real-time response and offer spoken and non-spoken signals to encourage the feeling of closeness in students [39]. In addition, AR utilizes collected simulated entities or material for learners in a live setting, which is capable of enhancing immediacy. Lastly, learners feel a sense of immersion in AR, which refers to the subjective impression that one is involved in a comprehensive and realistic experience [30].

The fourth feature is that when AR superimposes simulated entities or material over physical entities or settings, it becomes possible to envisage invisible phenomena [24]. Learners may use AR models to observe intangible knowledge, ideas, or invisible events, like magnetic fields or airflow through employing simulated entities like vectors, symbols, and fragments. New visualizations are generated by these augmented real objects that are capable of improving the students' comprehension of intangible and unobservable phenomena.

The final aspect is that AR is capable of decreasing the gaps in education in official and comfortable contexts. For instance, AR and other technologies were used in the CONNECT project to establish a simulated knowledge thematic common setting [40] that needed two approaches: The museum mode and university mode. This project connected the disciplined education at a university to knowledge involvements of the simulated and customary visits to museums, using AR to enhance the visualization, models, and experiments for students. It was suggested that there was a positive impact of the environment on the students' essential inspiration for learning knowledge and conceptually comprehending an idea [40].

The important characteristics and aspects of AR in this section are not just pertinent to augmented reality, as a few of them may also be present in other contexts using similar technologies. Therefore, to effectively use AR, we now examine how to use it in various educational methodologies to accomplish learning.

4 Educational Methodologies

The design of AR learning environments encompasses various instructional and learning methods, such as game-based learning [1], learner-based models [11], role-playing [27], place-based learning [10,41], studio-based pedagogy [41], and problem-based education [17,42]. Distinct affordances are provided by the distinct subsets of AR (such as game-based augmented reality and mobile-based augmented reality) to facilitate the use of these approaches. The instructional approaches are grouped into three main categories: those that stress integrating learners into "roles", those that stress how learners interact with physical "locations", and those that stress on developing learning "tasks". These are described in detail below.

4.1 Learner-Based Method

The approaches that focus on integrating learners into various roles in an AR context consist of role-playing, participatory simulations, and the jigsaw approach. Interactions and cooperation between students are stressed in these approaches; they are typically linked to multiple AR, mobile AR, or game-based AR devices. In involved models, "different players have to function as interacting constituents of a dynamic system," and hence the outcomes of the system are influenced by student interactions [10]. For example, in the Worm game, learners adopted the part of viruses during the transmission of infectious diseases [43]. Information was transmitted by students using handheld procedures to mimic the procedure of contaminating something. Students also perform different roles in certain AR environments to comprehend a topic. For example, in one scenario, students have to adopt the identities of scientists, environmental scientists, and activists to comprehend the social situation involved in the scientific studies [17]. Another approach concentrates on how the different roles work together to allow students to accomplish tasks using role-playing. Exclusive information is provided to students taking up different roles in this approach, who then work in collaboration to attain solutions to a problem [12].

4.2 Location-Based Method

A typical subset that this approach uses is mobile-AR with location-registered technology because location-based learning stresses the way learners interact with the physical environment. The benefits of mobile technology are utilized by AR environments as they allow mobile devices to track the precise geographic location of the learners [44]. Mobile devices and geographical position systems also provide pertinent information to learners [10]. Place-based learning offers a sense of authenticity to students. Students have a greater sense of "reality" when working in a physical area [27]. Additionally, gaining familiarity with the situation and making knowledgeable conclusions regarding ecological problems are crucial education objectives, which may be attained when learners gather information or examine problems at various locations of the environment. Nonetheless, a common issue facing placed-based learning is that the limitations of the actual environment need to be managed by students [10].

4.3 Task-Based Method

The development of learning tasks in AR contexts is the third category. Different approaches are part of this category, including problem-based, game-based, and studio-based learning. The tasks are carried out in various environments; hence, the use of these methods is not dependent on a particular subgroup of AR tools. Game-based education is the most well-known approach in AR, which refers to the "games played in the real world using digital devices that produce an imaginary layer over the real-world context" [37]. Game-based education consists of characters, actions focusing on issues, areas for questioned challenges, and reliable tools included in the system [37]. Digital information is offered by games to one or more players, and it is altered after obtaining input from players. In an AR game known as *Outbreak at the Institute* [27], learners collaborate to stop an infectious disease from spreading by taking up various roles in the game, such as specialists, public health professionals, and medical technicians. Information is obtained by students by communicating with a virtual character and obtaining simulated information from reliable sources integrated into the system.

Problem-based learning is another task-based method that is used to encourage self-guided learning, issue-explaining services, self-motivation, and information-implementation abilities [42]. The education objectives of problem-based knowledge are distinct from those of game-based learning; however, the two approaches may be integrated into the way tasks are developed. For example, problem-solving features are part of the design of various AR games [27].

The features of educational tasks are also highlighted in studio-based learning, and learning by design is stressed, where students develop their individual AR games [41]. The project-based effort on open-ended issues is part of this approach, which then involves recurring repetitions of enterprise and analysis [45]. The basis of this form of education is that learners get to know about the strategy, concept, and abilities as they carry out the activities in the enterprise procedure. Often, more than one instructional approach is used in the development of AR learning environments. When the correct instructional approaches are used, AR environments may be able to utilize the features of augmented reality and align them with the desired learning objectives.

5 AR Learning Effects

Previous studies showed that AR systems and environments may help in more effectively developing the skills and knowledge of learners compared to other technology-augmented learning environments. AR systems have been used to explain lessons in a 3D format, which allowed them to virtually create various educational items and manage material uniquely and collaboratively [46]. AR portable games assisted students with establishing a goal, finding the necessary data, and analyzing the information and material [10].

AR learning environments can also help students develop new skills that are critical in an information-based economy [8,9]. AR environments may improve the motivation and interest of students, which may improve their investigation skills and help them acquire more accurate knowledge [40]. When students use immersive and collaborative AR applications, their spatial capabilities are particularly enhanced [21,47]. AR systems may also support different teacher-student interactions, which would ensure the highest transfer of knowledge to students [30,47]. Since AR employs visual signals in addition to haptic signals to improve users' experience, psychomotor-cognitive skills are also enhanced in AR [28]. Researchers created an AR system in a clinical setting in which touch sensors were installed in the physical setting, sensor data were collected to determine students' performance, and the performance data were then converted to the graphical reaction [39]. This AR system enabled learners to obtain real-time data and relevant responses, which enhanced their performance and their psychomotor skills while performing a cognitive task.

Students typically face problems in viewing invisible events like the earth's rotation [34]. Learners can use AR to form virtual objects or to view phenomena that are not possible to view in a natural setting (such as wetland ecosystems). Through these learning experiences, the thinking skills of learners and their understanding of invisible events may be enhanced [48], and their misconceptions may be removed [40]. Most of the AR systems focus on teaching mathematics and science topics, which require the visualization of the abstract concepts. However, some systems were also developed for students with learning difficulties. Some researchers developed an AR learning environment that had a context-conscious educational game to remove the knowledge obstacles of students and enhance their English communication and attention [48].

Unlike other technology-augmented learning environments, AR environments may support vital practices and literacies [17]. It has also been asserted that augmented reality games may stimulate the previous knowledge of learners, link previous knowledge with the physical domain, and involve learners in theoretical activities.

AR also has adverse effects on learning; for example, it creates less commitment [34]. According to one study [34], teachers sought greater power above the content in the method so that they may adjust according to the students' needs. Hence, AR may have offered some new education opportunities. However, it may also present significant challenges. The technical, educational, and learning concerns regarding the use of AR in learning are discussed in the next section.

6 AR Challenges

Introducing AR technology into education may result in some challenges. These challenges are categorized as technological, pedagogical, and learning challenges. The possible challenges are discussed here on the basis of earlier studies that used AR in education.

6.1 Technological Challenges

A head-mounted display is present in one kind of AR technology, which also includes additional computer equipment. Issues like discomfort and weak depth perception were caused by heavy and costly design [34]. Existing AR systems try to solve these issues by including mobile technologies that are not very conspicuous and improve a feeling of involvement and existence. However, since additional hardware and software devices are included in these systems, they can create problems with the interface and stability of the different devices [10,12,37]. When there is a lack of proper design of boundaries or procedures to control the engagements of learners, they may face problems in understanding signs within the strategies and the real-world situation, identifying the movement of information between devices, and shifting between reality and fantasy [37]. Furthermore, when a greater number of devices are used, the risk of device failure increases. However, the integration and stability of the devices could be resolved by the latest developments in the portable and wireless technologies.

Another challenge in technology design is a trade-off between position reliance and irradiance [11]. Location-specific skills provide context to the students' learning and create a link with a certain location. However, the location-independent design is portable and flexible and does not require the presence of teachers and students at particular locations. A balance between the two approaches may be achieved by developing a design that not only creates a link with the real-world locations but also consists of the significant features typically integrated in other positions [11].

6.2 Pedagogical Challenges

Similar to earlier educational innovations, using AR in schoolrooms may be limited by universities and instructors. Innovative methods, like involved imitations and studio-based pedagogies involved in the learning activities in AR, are distinct from the teacher-cantered, delivery-based focus of the traditional teaching approaches [34,37,49]. Implementing innovations can be challenging due to institutional limitations like encompassing a certain degree of content in a specified time limit [34]. A shortcoming may exist between the training and knowledge approaches presently being utilized in schoolrooms and the learner-centered and investigative approach of knowledge in AR systems. This gap needs to be acknowledged by the developers of AR learning environments to offer support to decrease this gap.

Instructional design is another issue, which pertains to how information should flow between two realities and between different devices. Educators and developers would benefit from a series of guidelines based on learning theories using empirical evidence. The content of AR systems may be inflexible [34], and teachers are unable to modify it to take into account the needs of students or to attain instructional goals. To solve this issue, authoring tools may be used through which instructors and students can modify AR tasks [50,10].

6.3 Learning Challenges

There are also issues regarding learners and their learning processes. Learners may experience reasoning overload due to the extensive material they come across, the different scientific devices they have to utilize, and the complicated responsibilities they have to perform. According to one study [12], learners frequently become perplexed and overwhelmed when participating in a multi-user AR simulation.

According to earlier studies, students experience learning difficulties in AR environments because they do not have the skills required to perform tasks in such environments, such as three-dimensional triangulation, association, technology, and scientific approximation [23]. Young students and beginners at carrying out flexible examinations may require further support to develop a relevant strategy of accomplishment, explore potential explanations to their problems, and comprehend the signs presented by technical devices and included in the real-world situation. The blend of reality and the imaginary world in AR may create confusion for students. This confusion is indicative of the authenticity of an AR system; however, not staying in touch with the real environment may influence learning and physically harm the students [12].

7 Research Findings

The use of AR to align with educational goals within Vision 2030 requires caution. The analyses of empirical studies in AR carried out in earlier sections show that several issues need to be considered when implementing AR in educational settings. Furthermore, there are limitations in these studies concerning the research design and validity. These limitations are identified in this section. Essential issues that require additional investigation are also presented.

The study on the use of AR in education is in its preliminary stages, and so AR has a limited influence on teaching. Previous studies have shown the efficiency of technologies in encouraging education consequences (e.g., [15,16]). The focus of most of the studies on AR continues to be on development, application, and initial adoption of AR tools [18,51,52]. Furthermore, it is also observed that these studies have a comparatively simple research design and a small sample size, occur for a short duration, and adopt an exploratory approach. Most studies were in the initial stages of development and depended on the learners' self-reports of efficiency and effectiveness to analyze learning, like the studies of Construct 3D [47].

A further indication of the learning benefits of AR can be attained when regulated and intensive studies consisting of bigger samples and valid instrumentation are carried out. Successful curricular and knowledge features that may be provided by AR should be determined by researchers to determine the educational values that are distinct to the context of AR learning. The empirical outcomes provided by these studies could help in the formation of instructional designs and principles of AR settings that may solve the problems inherent in instructional design. Double enterprise concepts for design-augmented reality actions in the study of behavior were presented [53], such as making use of play and participatory modeling to facilitate the scientific investigation and associating broad-minded symbolization in amusing semiotic ecologies to generate sense. Examples of other useful research topics are determining instructional factors that influence the success of an AR system [40] and identifying the impact of student differences when learning with AR [54].

Research that contains detailed analyses of the way AR settings facilitate learning allows investigators to develop hypotheses about significant concepts in learning, such as truthfulness and engagement. Learners are involved in distinct roles in an AR context in involved imitation. These approaches stress that when learners are involved in different approaches, their sense of presence, immersion, and immediacy may improve. For instance, role-playing in AR offers complete, accurate involvements that are possible in mixed reality and which would give rise to novel kinds of emotional, behavioral, and cognitive engagement [55], which should be documented and studied in educational research.

Location-based learning methods stress the way students interact with the physical environment. When location-based methods and portable technologies are used in AR, the gap between strict and casual learning may decrease while offering ubiquitous, situated, and collaborative learning. Aligning location-based educational methods with the features of AR could lead to a reconceptualization of contextualization, which means "the use of specific scenarios that take place outside the classroom and are particularly appealing to students" [56].

AR may also improve the features of task-based teaching methods, as it may decrease the intricacy of task responsibilities by depicting the tasks, comfort, or difficulties in distinct viewpoints, and enable the imperceptible to be viewed [57]. This may validate a false mission as a well-developed AR environment may allow learners to link the task with the actual world and generate new meanings.

Research subjects and problems with educational design and execution also need to be examined. Subsequent research should concentrate on creating significant educational content on AR for subjects other than science and mathematics. It is important to carry out further educational studies with powerful research design and an extensive analysis to assess the way AR influences learning. Due to the gap between traditional teaching approaches and the exploratory form of learning provided by AR, the potential benefits of including AR in regular school curricula should be examined. Teachers should be offered significant support to customize AR technologies to develop tailored learning tasks and to keep a check on the learning progress of students.

The use of AR can be further generalized as a technical computing approach applicable to many other teaching and training applications. This work is essential for assisting with dealing with the massive crowds and gatherings for the Hajj and Umrah-related activities, i.e., helping develop the proper AR education worldwide for those planning to visit Saudi Arabian holy cities, which also aligns with Vision 2030 [58–63].

8 Conclusion

The use of AR to meet educational goals in Vision 2030 vision requires caution, as the studies on the use of AR in education are in their preliminary stages, and there is limited evidence on the impact of AR on learning and teaching. This paper provided an analysis of the empirical studies in AR in educational settings. The various definitions, terminologies, and technologies of AR have been explained in the paper. The opportunities for AR systems in education were determined. The methodology of using AR in education has been identified. Three categories of instructional approaches that stress the learners, location, and tasks were developed. AR can create new learning opportunities as well as new challenges. The technological, educational, learning challenges experienced during the implementation of AR in education were described. The potential solutions for a few of the issues experienced and the topics for subsequent research were presented. It is important to carry out further educational studies with more data and a more extensive analysis to assess the way AR influences learning. Due to the gap between traditional teaching approaches and the exploratory form of learning provided by AR, the potential benefits of including AR in regular university curricula should be examined. Teachers should be offered significant support to modify AR and develop tailored educational tasks and monitor the learning progress of students.

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