

An Account of Virtual and Augmented Reality in Educational Institutions

Sami Ben Shamlan Bakhit Al-Salami

sssulami@uqu.edu.sa

Assistant Professor of Educational Technologies,
Faculty of Education, Umm Al-Qura University

Abstract

This paper argues for modern technologies in the educational process. It specifically outlines issues germane to virtual and augmented reality. It begins with an account on virtual reality and augmented reality, and touches on their characteristics, the advantages, obstacles and applications. It also discusses some relevant studies that emphasized the role of virtual and augmented reality in education, the difference between two terms. The paper ends with a note of vision on how to activate them in educational institutions.

Keywords:

augmented reality, educational technology, virtual reality

1. Virtual Reality

The current era has witnessed great changes resulting from the rapid developments in the field of information and communication technologies, through the entry of computers and the Internet in various fields, and the educational field and its various institutions were affected by those developments that contributed to the provision of e-learning and which brought about changes in the roles of workers and beneficiaries in education.

Virtual Reality is one of the areas that contributed to the development of information and communication technology in terms of providing virtual educational environments that are very similar to real education environments in terms of making the learner interact with an artificial environment that uses multimedia. The Internet represents the backbone of virtual reality.

[1] asserted that the American Myron Krueger was the first to use virtual reality in the industry in 1975 by talking about that the individual lives in an artificial three-dimensional world that is produced by the computer and through which the individual feels the physical presence with that world. And the American thinker *Arthur Clarke* issued a book about science fiction in the name of reality and stars, in which he talked about virtual reality through the existence of a future city that wants to communicate with each other and consult and discuss their issues through advanced electronic devices that do not require their presence in the same geographical place despite their distant

places. The name Virtual Reality was first introduced in 1989. Similar names were introduced, such as Artificial Reality in the 1970s, Cyberspace in the 1980s, Virtual Worlds, and Virtual Environments in the 1990s. This leads to the concept of virtual reality.

The Concept of Virtual Reality

There are several definitions of virtual reality, including the definition provided by [2] according to which a simulation of the real reality electronically, which enables the learner to interact, immerse, control and navigate within this electronic environment, using the senses using tools and devices for this, and according to specific steps. One more definition by [3] that conceptualized it as an imaginary electronic, visual and tangible reality that the individual lives in with all its features and characteristics and as a fictional reality that simulates the real reality, embodied in the science of imitation and simulation, and based on two main pillars, namely: computer science and optics and visuals.

Features of Virtual Reality

Virtual reality has multiple characteristics that contributed to its spread and usage in various fields, including the educational field.

1. **Coexistence:** It refers to user's feeling that he is physically present within the virtual reality environment.
2. **Immersion:** It means containing the user and his ability to interact with the environment through the stimuli it offers that make him enjoy and spend more time while interacting with the environment.
3. **Correlation:** It refers to user's concentration of his energies during his interaction with the environment and the activities it offers.
4. **Navigation:** It is the method by which the users discover the environment, navigate through its various components, and determine the appropriate method for them.
5. **Scale:** It is the percentage of the representation of the elements that make up the virtual environment, whether it is the percentage of representation of a real environment that is converted into a three-dimensional virtual environment or the percentage of representation between the elements of the virtual environment and each other.

6. **Interaction:** User's ability to navigate the environment, process its contents, and other events that may occur within the environment.
7. **Vision position:** The ability of the user to control the change of the point or angle through which he can see the environment and explore its components.
8. **Control:** The operations carried out by the user within the environment to help him meet his needs within the environment with different users.
9. **Simulation:** The ability of the environment to simulate reality so that the user feels as if he is in the real environment.

Advantages of virtual reality in education

Virtual reality helps to bring actual reality to a large extent by transferring the user's senses to an artificial environment similar to reality. Among the advantages of using it in education is what was indicated by [4] as follows:

1. Virtual reality contributes to the effectiveness of learners' learning by designing and representing three-dimensional information.
2. Assists learners in carrying out various educational experiments and projects.
3. Presenting education in an attractive way that contains fun and entertainment.
4. It enables the learner to interact with other users and encourages them to learn cooperatively.
5. It provides alternative experiences that are difficult to present in the real world, either because of their danger, cost, or occurrence in the past.

As such, [5] confirms that the advantages of virtual reality technology are the following:

1. The user's feeling of actual presence in the virtual world and his responsibility for it through total immersion in his virtual environment.
2. The possibility of creating any educational environment, no matter how imaginary or challenging to achieve in reality.
3. It helps simulate different educational systems and allows the learner to practice repetition without financial losses and to maintain safety.
4. Abolishing the concept of passive reception in education and making the learner a participant in the educational process.

[6] adds some other advantages, namely:

1. Encouraging creativity and innovation among learners in programs that depend on construction and manufacturing.
2. Financial savings, in terms of its ability to absorb more learners than traditional universities and schools.
3. Providing an atmosphere of fun, excitement and suspense, which is an attractive element in the school of the future.

Obstacles to Virtual Reality in education

Despite advantages of virtual reality, there are several obstacles that limit its use in education, including what [6] mentioned:

1. Virtual reality requires the presence of devices and equipment with particular specifications.
2. Its design and production needs a team of specialists, including programmers, teachers, curriculum experts and psychologists.
3. The limited influence of the five senses in virtual reality technology, whose use depends on the sense of hearing, sight and touch only.
4. The negative health impact of excessive use of virtual reality programs through prolonged sitting.

Virtual Reality applications in education

The applications of virtual reality in the educational field vary take several forms, and among those applications are:

1- Virtual University

[7] defined virtual university as an institution that provides an indirect educational service that meets the needs of learners who are eager to learn in environments that simulate traditional universities due to certain circumstances that did not allow them to enroll in traditional universities through a technological structure that is transmitted over the Internet and transcends the limits of place and time. [6] indicates that the difference between the virtual university and the traditional university is that the virtual university does not need classrooms inside buildings or direct teaching from the teacher to the learner or other procedures required by traditional universities to perform their educational roles, but this can be achieved through Using the Internet and building a virtual learning environment. This does not mean that the virtual university is considered an actual alternative to traditional universities but rather a complement to it in response to the needs and conditions of the learners who attend it.

2. Virtual School

[8] defined virtual school as a school that relies on the Internet for its education without the need for a real and direct situation between the teacher and the learner and allows the learner to attend it from home to learn curricula approved by a specialized teacher and possesses skills that enable him to manage to learn.

[6] confirms that the virtual school is a modern trend in schools by providing education and learning at any time and time by making use of communication and information technology, and this means that the virtual school seeks to take advantage of special hardware and software to organize the learning processes in the classroom Virtual Classes.

3. Virtual Class

[9] define Virtual Class as one of the advanced technologies of distance education systems, which are interactive, cooperative and participatory classes. They

represent traditional classes with all their elements and various means. Still, they transcend time and space limits through means of communication, programs and auxiliary tools needed by both the teacher and the learner.

[6] adds that the virtual classes have two types, namely:

- **Asynchronous virtual classrooms:** Some are called self-learning virtual systems because they are not bound by time or place and use asynchronous software and electronic tools.
- **Synchronous virtual classes:** They are similar to traditional courses, but the teacher and learner use tools and software related to a specific time and event, such as:
 - **The whiteboard:** it helps the teacher and the learner participate by writing on it.
 - **Video conferencing:** It helps to communicate between the teacher and the learner through audio, image and text.
 - **Chat room:** It allows written communication between the teacher and the learner.

4 Virtual Laboratory

[10] expressed virtual laboratory as an electronic learning environment in which pre-prepared websites or computer programs are used so the learner can simulate practical experiences and apply them as they are in reality with minimal effort and cost and without risk exposure. In this context, [6] indicated that virtual laboratories are distinguished by helping the learner to conduct experiments that are difficult to apply in reality, either because of their danger to the learner through, for example, the emission of toxic and dangerous gases, or because of the high cost of devices, or if their results are dangerous if an error occurs during their application Ex: risky surgeries.

Studies confirming the effectiveness of virtual reality in education include studies of virtual reality have been applied in education, and many of them have proven the effectiveness of virtual reality technology in education, these studies include [9] who confirmed that the virtual classrooms of the Madrasati platform contributed to increasing the academic achievement of first-grade students in the city of Khamis Mushait in mathematics and also led to the formation of positive attitudes towards mathematics.

[10] found the effectiveness of virtual laboratories in developing the academic achievement of secondary school students in Jeddah in the physics course. [11] confirmed the impact of virtual reality technology in helping second-grade secondary school students in Makkah to develop reflective thinking and academic achievement in the biology course. [12] revealed the effectiveness of virtual reality technology in developing visual thinking among sixth-grade students in the Gaza City.

2. Augmented Reality

Information and communication technology is increasing and developing at present, with the desire of its developers to take advantage of its capabilities in the development of various fields. With information, videos and sounds through virtual digital environments, which makes it more enjoyable for its user, and [13] confirms that through augmented reality, it is possible to build and design educational environments that make it easier for learners to perceive different information visually, better and easier than reading it from a paper book only. This leads us to know what is meant by augmented reality technology.

Concept of Augmented Reality

Recently, researchers have increased interest in augmented reality due to its novelty in the educational field. By reviewing the literature that has been interested in it, we find several terms synonymous with this concept. The reason is the difference in translation, which indicates augmented reality technology. There are many definitions of augmented reality technology in the literature. [14] viewed it as the technology that allows mixing actual reality with a simultaneous reality of digital content. [6] defined it as transforming reality in the real world into digital data and installing and photographing it using digital display methods that reflect the reality of the surrounding environment. [15] described it as a higher digital cover for the real world, including graphics, text, and sound that are interactive in real-time, and the experience is done using a tablet, smartphone, computer, or augmented reality glasses, which include a camera and software.

These definitions share the fact that augmented reality technology teaches the integration between real reality and the virtual world, to which virtual digital data such as images, videos, sounds and texts are added, and that advanced portable and wearable devices are used that were previously expensive and in our time. It became available to everyone.

Features of Augmented Reality

There is a set of characteristics of augmented reality, some of which were mentioned by [22], [6] and [15] and [16] as follows:

1. It mixes virtual reality with an actual environment.
2. It is 3D and allows adding and removing objects to and from the real environment.
3. Real-time interaction about its use.
4. Cost effective and easily scalable.

Advantages of Augmented Reality

[17] and [18] indicate that augmented reality has many advantages, including:

1. Providing an appropriate learning environment and various methods for different ages.
2. Motivating learners to discover information on their own.

3. Increasing learners’ understanding of the educational content.
4. Helping to retain information for a more extended period.
5. Encouraging learners and increases their creativity and imagination.
6. Increasing learners' motivation towards learning and their sense of pleasure and satisfaction

4. Difference between Virtual and Augmented Reality

[19] asserted that there are clear differences between virtual reality and augmented reality through the dimensions outlined in the following table.

Aspects of comparison	Virtual Reality	Augmented reality
Description	Simulation process to watch from actual or fictitious	It requires a mechanism to combine the real world and the virtual world
Feeling	The user feels like they are part of this virtual world	Enhances the feeling of the real world with some additional information.
Content	3D environment simulating physical reality	3D shapes, sounds, video, and more.
tools	#Headgear, input devices, such as a 3D mouse, smartphone, tablet, or mobile device, joystick, touch gloves#	Smartphone, tablet, or mobile device, augmented reality glasses
Software	<ul style="list-style-type: none"> o Programs for designing virtual reality, the most famous of which are: 3D Max. o Programs for displaying and playing virtual reality, such as flash drivers, and multimedia players. 	<ul style="list-style-type: none"> o Programs for designing augmented reality, the most famous of which are: 3: D Shape Makers (3D Max, Maya o 2.2 D Photo Maker (adobe photoshop) .3 o video editing software (after Effects, Sony Vegas o The most famous applications on devices and smartphones are (Augment, Layer, and Aurasma).
Availability	It can be built around places that don't even exist; That is, it needs a virtual environment.	It cannot deal with worlds that do not exist; That is, it does not need a virtual environment, and reflects reality.
Areas of use	Virtual medical operations, virtual world, virtual educational environments, virtual entertainment.	Education, industry, entertainment, tourism and travel, medicine, military, advertising and marketing, architecture and construction, daily life.

Obstacles to Augmented Reality

Despite the many advantages of augmented reality technology that were mentioned, several obstacles limit its use in education, including what was mentioned [23] as follows:

1. Financial obstacles:

- Infrastructure and its cost.
- Providing computers and smart devices.
- Internet speed.

2. Human obstacles:

- Specialized cadres.
- Leaders’ convictions.
- The teacher's conviction and readiness.
- The student's conviction and readiness.

3. Technical and technical obstacles:

- Digital content, linking and visibility.
- Efficiency of devices and applications.

Studies confirming the effectiveness of augmented reality in education. Many studies have been applied to augmented reality in education, and many of them have proven the effectiveness of augmented reality technology in education; and these studies include [20] showed the effect of augmented reality technology in developing mathematical concepts for primary school students in the city of Makkah. [21] found the effectiveness of augmented reality technology in developing the cognitive and performance aspects of the skills of using e-learning applications for second-stage teachers in Al-Farwaniyah Governorate in the State of Kuwait.

[19] confirmed the educational environment's effectiveness based on augmented reality in developing the skills of producing three-dimensional environments and the motivation for achievement among female students of the University of Jeddah. [23] found the effectiveness of augmented reality technology in developing critical thinking skills and achievement motivation among sixth-level secondary students in the physics course.

Through the previous review in the scientific paper of the concept and dimensions of virtual reality technology and augmented reality in the educational process, and what was proven by the studies that were conducted on different samples of learners and in many educational stages starting from the primary stage to the university stage, and in various courses, all confirmed the role of virtual reality technology And augmented reality in bringing about a successful learning experience.

4. Conclusion

Based on the discussion above, educational institutions can benefit from virtual and augmented reality in the following ways:

1. The curriculum developers and planners could integrate such technology in the textbook to increase its effectiveness in the educational process.
2. Inclusion foundations and procedures for how to use modern technologies in education (including virtual and augmented reality)in the courses that pre-service teachers take in their training program.
3. Organizing training courses for teachers in different disciplines to develop their technical skills on how to employ virtual and augmented reality in education.
4. Equipping laboratories in educational institutions with computers, the Internet, and intelligent devices.
5. Encouraging learners to use virtual reality and augmented reality in their learning.

References

- [1] Al-Juaid, A. (2016). *The effectiveness of a proposed training program based on integrating social communication programs through mobile learning and cloud computing technology in developing the skills of employing virtual reality in teaching among science teachers*. Ph.D dissertation. Faculty of Education. Umm Al Qura University. Mecca.
- [2] Ahmed, H. (2017). Digital design of virtual reality technology in light of e-learning quality standards. *The Palestinian Journal of Open Education*, 6, 11.
- [3] Al-Saei, Ahmed. (2019). The extent of the effectiveness of virtual reality (interactive cube I-Cube) in the educational process from the point of view of students of the College of Education at Qatar University. *Journal of Educational Sciences*, 14. Qatar University.
- [4] Mazuryk, T. & Gervautz, M. (1999). *Virtual Reality History, Applications, Technology and Future*. Master's thesis. Vienna University of Technology, Austria.
- [5] Al-Juhani, F.(2013). *Virtual reality and its technologies in future education*. College of Education conference. King Saud University. Riyadh.
- [6] Attar, A. & Kansara, I. (2015). Educational Objects and Nanotechnology. Mecca.
- [7] Ayyad, H. (2020). Virtual universities: their pros and cons. *The Arab Journal of Measurement and Evaluation*, 2.
- [8] Al-Saadoun, N.& Al-Bazai, H. (2021). The roles of the secondary school teacher in light of the requirements of the virtual school in Hafr Al-Batin Governorate. *Journal of Arts, Literature, Humanities and Sociology*, 64.
- [9] Al-Shahrani, H., Al-Shahrani, A., Al Talhan, M. & Asiri, K. (2021). The effect of the virtual classes of the Madrasati platform on the achievement and the trend towards it in mathematics for first-grade intermediate students. *Young Researchers Journal. Sohag University*, 9.
- [10] Hazza, H. & Mabrouk, I. (2020). The effectiveness of using virtual laboratories in the academic achievement of secondary school students in a physics course in Jeddah, Saudi Arabia. *Al-Madinah International University Journal*, 33.
- [11] Al Qasimi, M. (2017). *The effect of using virtual reality technology on developing reflective thinking and academic achievement in the biology course for second-grade female students in the city of Makkah Al-Mukarramah* (Master's Thesis). Faculty of Education. Umm Al Qura University. Mecca.
- [12] Agha, M. (2015). *Virtual reality technology in developing visual thinking for ninth-grade students in Gaza* (Master's Thesis). Islamic University. Gaza.
- [13] Khamis, M. (2015). Virtual reality technology, augmented reality technology, and blended reality technology. *Education Technology Journal. Egyptian Association for Educational Technology*, 25.
- [14] Dunleavy, M., & Dede, C. (2014). Augmented reality teaching and learning. In *Handbook of research on educational communications and technology* (pp. 735-745). Springer, New York, NY.
- [15] Papagiannis, H. (2017). Augmented human: How technology is Shaping the new reality. " O'Reilly Media, Inc.
- [16] Sadiq, F. (2019). *The effect of Augmented Reality technology in science teaching on the achievement level of fifth-grade pupils* (Master's Thesis). Kuwait University. Kuwait.
- [17] Yuen, S., Yaoyuneyong, G., & Johnson, E. (2011). Augmented reality: An overview and five directions for AR in education *Journal of Educational Technology Development and Exchange (JETDE)*, 4(1), 11.
- [18] Radu, I. (2012). Why should my students use AR? A comparative review of the educational impacts of augmented-reality. [IEEE International Symposium on Mixed and Augmented Reality (ISMAR)], 313-314.

- [19] Assuhaim, A. (2020). *The effectiveness of an educational environment based on Augmented Reality in developing the skills of producing three-dimensional environments and the motivation for achievement among female students of the University of Jeddah* (Ph.D dissertation). Faculty of Education. Umm Al Qura University. Mecca.
- [20] Al-Otaibi, N. (2022). *The effect of using augmented reality technology in developing mathematical concepts for primary school students in the city of Makkah* (Master's Thesis). Faculty of Education. Umm Al Qura University. Mecca.
- [21] Al-Anazi, F.(2021). The relationship between augmented reality technology and the method of teaching in virtual environments and their impact on developing the skills of using e-learning applications among secondary education teachers. *Journal of Specific Education Research*, Mansoura University. Issue 61.
- [22] Azuma, R., Baillet, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. (2001). Recent advances in augmented reality. *IEEE computer graphics and applications*, 21(6), 34-47.
- [23] Abu Hikma, Y. (2018). *The effectiveness of using Augmented Reality technology in developing critical thinking skills and achievement motivation in physics for sixth-level secondary students with different brain control patterns in Jeddah Governorate* (Ph.D. dissertation). Faculty of Education. Umm Al Qura University. Mecca.

Sami Shamlan Al-Salami holds an MA and Ph.D. in educational technologies, obtained from Umm Al-Qura University in 2013 and 2020. He is currently working as a lecturer at Umm Al-Qura University in the field of educational technologies. He has taught several courses in educational technology. He has also mentored a group of postgraduate students. His research areas include educational technologies and e-learning.