

The Role of Augmented Reality in Solving Abstract Concepts Teaching Problems: A review article

Sayed Shaaban Abd-ul Aliem Younes

ssyounes@uqu.edu.sa

Professor of Educational Technologies, College of Education, Umm Al-Qura University

Professor of Educational Technologies, College of Education, Al-Azhar university

Abstract

To find research that concentrated on the use of augmented reality to address issues with teaching abstract concepts, several international databases were examined. Thirty research, published between the years (2013-2022), were analyzed to determine the many functions of augmented reality in resolving issues with abstract notions. These studies discovered numerous roles, which are listed below. The use of augmented reality in the following areas: the simplification of abstract ideas, the embodiment of abstract ideas, the enrichment of examples of abstract ideas, the resolution of conceptual misunderstandings, the stimulation of interest in learning abstract ideas, and more, and the research ended with the presentation of the conclusions.

Keywords:

Augmented Reality - Solving Abstract - Concepts Teaching-Problems - abstract ideas

1. Introduction

The educational environment is undergoing ongoing changes that are largely in line with technological advancements that aim to enhance the educational environment, raise the quality of its outputs, develop learners' technological cultures both inside and outside of the classroom, and prepare them to face the challenges and requirements of the technological revolution. One of the most significant of these advancements is Augmented Reality, as this technology has made it possible for more students than ever before to engage in a variety of different learning activities. With the intention of making the learning process more alluring and pleasurable for them, whether face-to-face or via distance learning.

There is no doubt that the education of our students faces several challenges, the most significant of which is their capacity to learn abstract concepts, particularly in the early stages of their education. Educational technology then comes to provide many solutions to these challenges, with augmented reality at the forefront of those technologies that embodied the abstract and helped in a great way to solve this problem.

Because it is one of the technologies that has become extensively used in a variety of educational settings and because its apps for smartphones and other smart devices have produced favorable outcomes for students, augmented reality technology plays a significant part in the educational process. As a result, they were frequently employed by educational institutions.

One of the most well-known contemporary technologies is augmented reality technology. Because it enables the blending of actual and virtual reality, as demonstrated to offer the student appropriate individualized learning; and to provide real support to the learner [1].

Moreover, augmented reality technology enhances learning and imparts knowledge in a more engaging and effective manner. The motivation, interest, comprehension, and depth of material learning among students are all increased by creating augmented reality settings. Enhancing both sorts of artistic athletic activity, mathematical concepts, and learner motivation could all be achieved using augmented reality technology in mathematics teaching [2].

In this study, the research on the application of this technology to address the issues with abstract conceptual education is reviewed.

2. Conceptual framework:

2.1 Augmented Reality:

In educational literature, augmented reality goes under many different names, including greater reality, augmented reality, enhanced reality, enlarged reality, and integrated reality. The most common and utilized term in Arabic research, studies, and translated literature is, it must be emphasized, and this difference in terminologies is due to the nature of translation from English into Arabic (augmented reality). In any event, the process of fusing actual and virtual reality that is created by this technology is what unites the various definitions of augmented reality.

2.1.1 The concept of augmented reality:

A definition of augmented reality is that it is a type of reality that exists between non-immersive and fully immersive systems, combining computer-generated content with the user's perception of the real world and inputs from a distance.

Augmented reality is the potential for fusing virtual information with the actual environment. Personal computers and mobile phones today use this technology, which was greatly aided in its development by technological advancement. After that, research facilities in big businesses had a monopoly [3].

Khamis (2015, 2) defined it "A three-dimensional technology that integrates real and virtual reality, between the real thing and the virtual object, and interacts with both in real time, while the individual accomplishes the real work" [4].

Augmented reality is "a system that creates a composite vision for the user, combines the real scene they are viewing with a virtual scene created by a computer, and enriches the real scene with additional information" [5].

Augmented reality is a technology that enables the fusion of the physical and digital worlds. This is accomplished through systems and devices that are backed by the virtualization of various media as well as the data that users interact with.

According to Abu Khater (2018), augmented reality is the merging of our physical world with virtual worlds and the transformation of two- and three-dimensional images and shapes on contemporary tablets [6].

In accordance with Al -Sarhani (2020), augmented reality technology is "the fusion of the virtual world with the real, tangible world through the use of a smartphone application, so that digital content such as video, audio, and 3D images appear on the surface of the mark, enabling interaction with digital content and overcoming the limitations of time and space" [7].

By combining and improving real world with still photos, video clips, or written materials, augmented reality as the progression of virtual reality. The actual truth is not presented to improve sensory perception.

There are varying points of view among some of them due to the nature of interacting with technology, even though they all agree that the foundation for augmented reality in education is that it is an interactive technology that integrates real and virtual reality. The type and shape of content that is engaged with to improve learning can vary between virtual, actual, and other environments.

As a result, augmented reality is a technology that enables the blending of actual and virtual learning settings.

To address the challenges of teaching abstract concepts, this is accomplished using tools and systems that are supported by virtualization of various media and information that the user interacts with.

2.1.2 Features of Augmented Reality:

In contrast to other technologies, augmented reality has several characteristics that have kept it in the forefront of people's attention for several years running. Perhaps one of the most significant features of augmented reality technology is that the user stays in his or her real world and that it is praised as one of the technologies that have positive effects on people of all ages. In other words, the person is nonetheless conscious of his physical presence in the outside world.

Some of the characteristics and benefits offered by augmented reality were represented in the following points from earlier literature and studies, including those: [8], [9], [10]

- Increases interaction in learning.
- Aids students in identifying and addressing scientific facts, concepts, and generalizations.
- Promotes students' active participation in the learning process. They are the ones who will get knowledge, comprehend it, and analyze it, which will hone their capacity for independent learning.
- Boosts students' academic achievement by increasing their activity and motivation.
- Improves concentration and aids in the information processing of students.
- It is simple to use and control; neither the teacher nor the student need has high levels of ability.
- It aids in the learners' skill development and aids in the simplification of the information that is taught to them.
- The use of augmented reality technology in education is a good fit for today's students' learning styles.
- It allows the teacher to impart more information to the student in less time.
- It removes obstacles, makes learning flexible, and is accessible anywhere, at any time.
- Enables students to investigate risky, extremely uncommon, and impossibly difficult situations in our physical world.
- explains a variety of topics that attract students' attention and improve their capacity to use knowledge to address difficulties.
- It increases the level of sensory perception among the students and provides a platform for conversation and debate between the teacher and the learner.

These qualities of augmented reality technology have made it appropriate for the needs of both adult and young learners as well as the accelerated time in which we live. Because of this, care must be taken to adapt it to the educational setting and take advantage of the qualities it

possesses, such as supplying students with a wealth of knowledge and information, educating them technologically, and inspiring them to explore the world of invention and creativity. Since this technology offers a variety of display options, including words, photos, graphics (animated and static), videos, and 3D objects, all these outcomes will be reflected on the various types of learners. This will improve the learning process.

Considering the aforementioned, it can be concluded that augmented reality technology has many benefits for the educational process. These benefits are particular to the instructor and are reflected in the teacher's increased digital abilities. In addition to allowing teachers to take students on a variety of visual journeys that enable them to learn many things immediately that may be difficult for the teacher to communicate to them in other ways, augmented reality technology also enables educators to design many educational materials based on it.

The fact that learner augmented reality technology takes individual learner variances into account is one of its benefits. It provides a range of instructional materials that are appropriate for all users and instructs learners on how to develop their visual and mental perceptions via the use of interactive tools and applications. Along with being appropriate for students with special needs, it provides safety for students when they interact with hazardous educational materials.

The capacity to repeat and recover educational information several times is one of the benefits of augmented reality technology related with the educational content. Also, it gives textbooks more appeal and enjoyment, and it provides students with a wealth of new material. Since augmented reality can be viewed without the learner being present in the classroom, it serves as a teaching strategy that encourages learning to continue outside of the formal classroom. Its technology can also be incorporated into a variety of educational materials and applied to a wide range of academic disciplines, and it offers the learner in-class flexibility, interaction, and control.

The fact that augmented reality technology combines fact and fiction in a real environment and is interactive in real time is one of the most significant characteristics of using AR technology in education and training, according to numerous studies like Anderson [11]. It is distinguished by being three-dimensional, giving the learner information that is clear and succinct, accessible, simple to use, affordable, and scalable. Also, it enhances perception over a longer period and enhances interaction with the teaching materials.

2.2: Abstract Concepts

Learning general and abstract concepts now has a specific position in the educational process because to

scientific and technological advancements. Since it gives the individual a new knowledge framework, it helps to transmit the impact of learning because it increases students' understanding of the subject matter and connects the various details and facts.

we develop abstract notions because of our experiences with a particular class of entities, whose members share some qualities and differ from one another in other characteristics.

An individual's idea of a group of things or events that have common characteristics with him or her, and this idea includes at the same time the distinction between that group of things or events and other groups that differ from it in some characteristics or characteristics" [12].

These are concepts that cannot be sensed by the senses but can be identified by shared qualities by giving the learner indirect or alternative experiences.

It is a group of items or symbols that come together based on their broad shared qualities, may be united into a closed category, and can be referred to by a specific name or symbol.

Abstract conceptions are made up of or produced from a group of stimuli that have similar qualities that set them apart from other stimuli. As a result, they are a collection of objects that do not exist in space [13].

It is described as "a mental abstraction of the common qualities of a group of things, events, phenomena, deeds, or arrangements" by Muhammad [14].

We can see from the definitions of abstract notions that were previously mentioned that they emphasized the following elements:

- Education must prepare every learner and offer him the essential experience since abstract notions are not supplied to the learner directly; rather, he must extract them from his own experiences and thoughts.
- The diversity and wealth of experience contribute to the development of broad applications and the deepening of the meanings of concepts. Abstract concepts are generated because of a continual growing process.
- If the abstract idea can be connected to the substantial overall structure that comprises its subject, it will be valuable and meaningful.
- Abstract ideas develop and broaden through varied experience rather than tedious repetition.
- If the student operates efficiently within his own surroundings, abstract concepts will be developed more effectively.
- Since they are wider and more thorough, abstract conceptions are founded on comprehending the relationships between several things, situations, or facts.

- Abstract notions promote productive thinking by encouraging inference because they help reorganize prior experiences or connect them in novel ways.
- Abstract conceptions are prone to development in line with the progression of a person's experiences and the occasions and circumstances he recognizes [15].

2.2.1 The Importance of Abstract Concepts:

The following are the reasons why abstract notions are important [16]:

- They aid in students' cognitive development.
- Improve the learner's capacity to comprehend and analyze a wider range of life occurrences and deal with everyday issues.
- By summarizing and categorizing the objects and circumstances in the environment, it lessens the environment's complexity.
- Learning it helps to get rid of repetition and verbal, instinctive retention of facts.
- It aids in overcoming learning challenges, misinterpretations of phenomena, events, and things, and clarifies their connections.
- It aids in structuring concept content so that the curriculum's paragraphs appear connected.
-

3. Learning theories related to augmented reality:

There has been significant progress in the educational process. Since the advent of technology-based learning theories, science and knowledge have flourished and developed because of the diversity in education and teaching methods, in addition to the services offered by educational institutions, the development of programs, teaching methods, and various teaching styles.

One of the many types of e-learning that uses augmented reality technology is education. This type of e-learning is based on several theories that represent models that provide realistic and empirical foundations for the variables that affect teaching and learning processes as well as explanations of how these effects can take place.

3.1 Behavioral Theory:

Abdel-Ghaffour [17] said that behavior is either learnt or the product of its alteration during the learning process in accordance with this idea. Consequently, behavioral theory focused on setting up the learning environment, supplying the learner with stimuli that induce a response, and then reinforcing that response.

The augmented reality environment presents a variety of two- and three-dimensional stimuli, and these stimuli cause responses from the learner. The augmented reality environment then modifies these responses and guides them down the right learning path, which allows it to address the challenges of teaching abstract concepts by presenting sensory stimuli. It teaches the augmented reality environment to encourage correct replies and steer the wrong reaction, bringing the notion closer to the learner's head and resulting in responses that indicate his awareness of it.

If we examine augmented reality technology attentively, we see that it supports the educational setting by presenting the student with stimuli that force him to respond to them by learning, which is congruent with behavioral theory. Learning occurred because of the proliferation of smart devices among students and the accessibility of augmented reality applications.

The study (Chen, 2019) with a procedure aimed at testing the impact of augmented reality technology in facilitating learning chemistry concepts divided them into three groups: a group that studied through books only, a group through augmented reality that depends on presenting stimuli and incentives for the learner during the learning process, and the results showed that the performance of the augmented reality group performed better than the group using only books [18].

3.2 The Constructivist Theory:

This theory holds that each person has their own unique originality in what they produce or compose from their educational experiences. Constructivism, which views knowledge as a construction of reality rather than an acquisition, was developed to help clarify this concept. According to constructivism, knowledge cannot exist outside of the learner's mind; rather, it is created by the learner through his experiences and cognitively organizing information [17].

Hence, e-learning generally and augmented reality technologies specifically have a close relationship with positive learning environments. When a topic is simply presented utilizing augmented reality, it enables for the development of concepts through individual activities and observation inside rich interactive environments, which improves learning. One of the tenets of constructivism is that understanding is the foundation upon which a learner can build knowledge of the task at hand.

Augmented reality technology is compatible with constructivist theory's ideas, allowing learners to take control of their learning processes and turn constructivism into a reality they can use to accomplish e-learning objectives by bridging the gap between theoretical and

practical education and incorporating the virtual environment. also, the genuine [19].

The learner can interact with the components and elements of the augmented reality environment without committing to specific steps, allowing him to perform the steps in any order consistent with his learning until he reaches the correct step that demonstrates the outcome of his learning, according to this theory, which can establish the use of augmented reality technology. Next, using the tools that the world offers to help bring the notion closer to his mind, he can construct his own experiences and establish his acquisition of abstract concepts by making the proper mental connections about them.

Because augmented reality can bridge the gap between theoretical and practical concepts and is interested in how the real and virtual worlds can be blended to achieve learning goals, learning in augmented reality is turned from an abstract reality into a tangible reality that can be implemented.

augmented reality stimuli can be a useful teaching tool to improve student learning outcomes, students will need to be able to assess and solve problems independently in the future. The cognitive theory underlies this technology as well, as what a learner acquires, He draws on the knowledge he already holds and processes it using the information and concepts made available by this technology. He acquired his knowledge by applying a variety of cognitive processes to the sensory data he gathers from his environment [20].

3.3 Connectivism Theory:

The theories—behavioral, constructive, and cognitive—concentrate on the internal learning process of the learner and ignore the role of the environment in fostering teaching and learning, especially considering the development of educational technology that emphasizes the process of learning rather than the quantity of information acquired.

The ability of the learner to categorize and sort knowledge into significant components is one of the associative theory's core ideas. Simens G. created this theory as a result. It examines networks with at least two nodes that have been constructed as nodes. Each node represents a source of knowledge that is linked to the others by links, and the learning process is facilitated by the learner's capacity to successfully access these links. This interdependence between the information nodes and what the learner already knows allows for the formation of new scientific concepts and the accumulation of knowledge [15].

Because smart gadgets can be carried or worn, as well as the applications they offer, augmented reality technology is based on one of the tenets of the associative theory, which holds that learning can occur using non-human tools and technologies.

Through the previous presentation, it can be inferred that the qualities and capabilities of augmented reality environments make them capable of realizing a variety of educational theory principles, the most significant of which are those of individual learning, participatory learning, and learning for mastery, as well as cognitive theory, constructivist theory, and theories pertaining to human behavior and communication. In order to create adaptable and user-friendly educational environments, he emphasizes the significance and necessity of taking these theories' guiding principles into account while using augmented reality apps in planning and constructing educational environments.

The relationship between augmented reality technology and various learning theories had a significant impact on the applications that were associated with it. These various theories also helped to make information more easily accessible while also advancing the use of augmented reality in conventional teaching techniques and spreading images of its potential uses. It is used frequently and, in many ways, to deliver different educational concepts in the educational setting. Positive consequences followed, which improved the quality of education efficiency overall and made the educational process simpler for students.

The studies [15], [21] are among those that used the relational theory in creating augmented reality. These studies relied on using augmented reality techniques through modeling tools, interactive computer applications, the use of networks, mobile and smart devices

4. The role of augmented reality in solving problems of teaching abstract concepts:

Via the assessment of numerous foreign databases by the researcher, including the Egyptian Knowledge Bank, the Saudi Digital Library, the Dar Al-Mandumah database, the EBSCO database, the ProQuest database, the Emerald database, the Springer database, and the Eric database.) The researcher was able to find 67 studies that concentrated on the role of augmented reality in resolving educational issues and by using the exclusion criteria to eliminate studies that weren't interested in teaching abstract concepts, was able to identify the studies that focused on the role of augmented reality in resolving problems of teaching abstract concepts. Thirty research on the various uses of augmented reality for resolving issues with abstract notions were published between (2013 AD) and (2022 AD), and these studies identified many roles, which will be presented as follows:

4.1 The role of augmented reality in simplifying abstract concepts:

According to Wijdenes, P., et al. [20] augmented reality technology makes abstract concepts easier to understand by

connecting knowledge content and user context, making learning more effective. Many augmented reality technologies have proven particularly successful in STEM subjects because they allowed users to visualize previously inaccessible representations and solve problems.

In addition, augmented reality apps that allow learners to see, hear, feel, touch, and interact with information on a computer through input devices like VR headsets, etc., can aid in improving conceptual understanding by reducing abstraction and moving closer to sensory observation. Where the student can view models that replicate reality, allowing him to feel as though he is living the reality. In addition, the learner will get as close to direct sensory experiences as possible, which are the most basic and long-lasting types of learning.

Augmented reality technology also contributes to simplifying abstract concepts by merging real reality with virtual reality and working to bridge the gap between theoretical and practical education by merging the real environment with virtual, which increases the effectiveness of the educational process and achieves positive results, by working to increase the learner's motivation to participate, and motivate them to explore the information.

Also, the use of augmented reality technology in the educational process helps the teacher to facilitate students' study of abstract concepts that are difficult for them when taught in the traditional way, and helps them develop these abstract concepts, bring them closer and clarify them [22].

The technology of augmented reality enables the learner to practice practices that were difficult to implement in the real environment, such as scientific experiments, and provides experiences for learners that were difficult to access such as space. Therefore, it increases social interaction between learners, and considers individual differences between them, so that learners can see three-dimensional and two-dimensional shapes. Dimensions on all sides, not as he had imagined.

Among the studies related to the role of augmented reality in simplifying abstract concepts is the study Al-Husayya. (2020) [23]. with designing a program based on augmented reality and revealing its impact on developing the cognitive achievement of some computer concepts among first-grade students. Al-Sarhani's study (2020) revealed the effect of using augmented reality technology on developing some mathematical concepts among sixth-grade female students in the Kingdom of Saudi Arabia [7], while Mansour's study (2021) identified the impact of using augmented reality technology on developing scientific concepts, and information search skills among ninth-grade students in the State of Kuwait [24]. The results of Al-Otaibi (2022) also found the effective impact of using augmented reality technology in developing knowledge. Mathematical

concepts among primary school students in Makkah Al-Mukarramah [25].

4.2 The role of augmented reality in embodying abstract concepts:

Different experiences must be provided for abstract notions to be learned. Because of their direct impact on the learner, his knowledge, interests, and inclinations, as well as the survival of the impact of learning and its transition from theorizing to application, modern educational trends and theories emphasize the importance of practical and applied activity in learning abstract concepts. Learners cannot effectively learn abstract concepts without engaging in practical and applied activity. Learning abstract concepts and understanding perceptions about them can be challenging, but augmented reality technology made it easier for learners to grasp the concept's visual representation.

As it works to transfer the human mind to an electronic virtual environment through which the learner works, relying on his mental effort and his various senses, augmented reality applications in which the student is not only linked to the learning environment but rather we immerse him in this environment until he becomes an integral part of the laboratory experience. The truth is that augmented reality is a set of technologies that allow students to experience life as if they were living it [26].

This supports the constructivist theory, which holds that learning occurs through interaction with the physical environment, social interaction, and responding to external stimuli using one's senses, playing, performing tasks, and understanding concepts in an intuitive way through construction. Augmented reality is effective in solving the problems of teaching abstract concepts as supported by this. Learning by doing is therefore a crucial activity for the learner since it allows information to be retained and applied. This, in turn, helps to modify the learner's knowledge structure because students' excitement and curiosity inspire them to participate more actively in class.

As the primary purpose of using augmented reality is to enhance already-existing knowledge, these technologies also make difficult-to-teach complex concepts like space, stars, and planets simpler, more approachable to learners, and moveable by simply shining the camera of tablets or smartphones on them. In fact, real content already exists, and the additional digital content strengthens and complements it. Using them together stimulates the senses of hearing, sight, and touch and makes it easier for the user to perceive new content that they interact with. This is because information is available in technological devices in various forms (images, videos, and animations). [27], [28].

Augmented reality technology works to embody abstract scientific concepts in a clear way that facilitates

understanding on [26]. This is because it is difficult to explain abstract ideas to students and instead necessitates a lot of work on the part of teachers. Moreover, by using augmented reality technology, it will be simple to bring those practical ideas closer.

4.3 The role of augmented reality in enriching examples of abstract concepts:

Estapa, A., & Nadolny, L. (2015) [2]; Chao, W., & Chang, R. (2018) [29]. that by presenting scientific concepts in many media including books, movies, and computer programs, augmented reality helps to boost learners' grasp of scientific concepts by giving them multiple examples of the subject. The pictures are both two-dimensional and three-dimensional, and this makes studying more engaging, satisfying, and enjoyable for students. It also helps them remember the knowledge they learned through augmented reality for a longer amount of time.

Using augmented reality technology enhances the educational process and all its components. As his responsibility is to direct the camera of the phone or smart device onto the QR code, so that it transforms into an animated educational video or a two-dimensional or three-dimensional animation, so that the student can repeat it numerous times or stop and navigate it until the understanding of the content is deepened, the teacher is better able to direct the educational process and make his explanation of the educational content specific.

4.4 The role of augmented reality in addressing the misunderstanding of abstract concepts:

The augmented reality techniques and applications provided a visualization of examples that are thought to be a misunderstanding of the concept. This confirms that augmented reality technology provides the opportunity to interact with real things and immerse themselves in them, to address the misunderstanding of these concepts, and that augmented reality has a positive. [23], [25], [30].

In addition to exploring uncommon experiences that are challenging to communicate to them during direct learning to address misconceptions of abstract concepts, augmented reality technology also combines learning and fun. Experiences that are challenging for learners to learn if they received them using traditional learning can be presented. For instance, investigation (volcanoes, predatory or rare animals, ... and others).

The Abdul Maqsood (2017) study [31], which sought to gauge how using augmented reality applications affected preschoolers' acquisition of scientific concepts as well as their retention of those concepts, according to Bayoumi. (2019) [32] research, augmented reality technology can be used to help second graders' conceptual knowledge of physics.

4.5 The role of augmented reality in increasing motivation to learn abstract concepts:

Students are more eager to learn through an augmented reality environment and engage in interactive learning activities because augmented reality creates an engaging and interesting learning environment. Also, it boosts students' desire to study more, broadens their horizons, and develops their creativity and innovation skills. They will also be forced to control their learning and advance at their own pace and capacity.

The use of augmented reality applications on tablets and smart phones works to increase students' attention and motivation for learning, reduce cases of lethargy, boredom, or reluctance of students to participate and learn, and work to reduce cases of plagiarism. Applications of augmented reality also encourage students to cooperate and share. By using touch and view to interact with the applications' content.

However, augmented reality applications assist in adapting to the various learning styles of students and allowing them to learn at their own pace in a captivating environment. This has led to students' superiority in increasing their motivation for learning abstract concepts and has also allowed students to gain deeper knowledge [29].

The use of augmented reality technology helps learners acquire abstract concepts by enhancing their abilities and knowledge in an engaging and efficient manner. to gain knowledge of subject matter.

Technology that uses augmented reality is also very beneficial for teaching independence. Because it animates the learning environment, permits learning flexibility, and benefits of augmented reality technology, it supports mobile learning, in addition to enabling learners to participate in the teaching and learning processes and helps them improve access actively and effectively to the subject.

The development of abstract concepts, the achievement of tangible results, the motivation of learners, the motivation to infer information, the element of fun and suspense for the learner, the possibility of interaction between the two parties to the educational process, and the provision of powerful information despite its simplicity are all enhanced by augmented reality technology. Use them to make complicated procedures simple and to get precise information [6]; [33].

Through the provision of a variety of educational materials that are tailored to the needs of students and the encouragement of learning through exploration through the three-dimensional scenes that augmented reality technology contains to stimulate motivation, augmented reality technology also works on developing abstract concepts. By providing more enjoyable and appealing e-learning

environments that cross physical and temporal boundaries to provide educational services and support the learner's interaction, control, and discovery, instructors can encourage students' mental abilities and help them develop their abstract concepts [15].

5. Conclusions:

The following inferences can be drawn from the foregoing, which can strengthen the use of augmented reality in addressing issues with teaching abstract concepts:

- Several teaching and learning theories, which adapt the many capacities of this technology, provide the foundation for the application of augmented reality technology in the educational process. The relational theory, behavioral theory, constructivist theory, and other theories are organized around the principles of these theories to acquire or develop concepts generally and abstract concepts. This allowed the various capabilities of augmented reality technology to relate to the methods of these theories in the educational reality.
- The use of augmented reality technology in the instruction of abstract ideas is significant. Through its application in the simulation process of some abstract concepts, theories, or the discovery of some rules, which present an image of falling objects from a certain height and are used to correct some abstract concepts in learners through the training process and contribute to the development of positive attitudes toward solving problems of teaching abstract concepts. Studying concepts in general and abstract concepts is one of the most abstraction-reliant aspects of learning, so using augmented reality technology through its many tools and applications helps it develop because it inspires learners to learn and makes them willing and motivated to do so.
- The use of augmented reality technology may allow users to interact with and immerse themselves in real objects before processing those objects into photos that may then be processed into symbols. Furthermore, given its potential to improve student learning outcomes, augmented reality technology can be utilized in education generally, and specifically in the teaching of abstract concepts. These potential benefits can thus be realized; to increase student participation to address instructional issues involving abstract concepts. The use of digital visual components, audio, or other sensory cues presented through augmented reality technology helps to improve how effectively and actively students participate in learning processes and its many activities.
- The use of augmented reality technology is simple in many fields because it is characterized by the clarity of procedures between the teacher and the learner, which enables the technology of augmented reality to be applied. In addition, it is distinguished by the simplicity of clear information, and it is provided by the teacher, through which it is presented efficiently and effectively. This was supported by the variety of sectors in which augmented reality technology was applied to create and communicate abstract concepts.
- In addition to their immediate interaction between real and virtual things by merging this data, interaction and cooperation and participation between the real and virtual environment to solve the problem, the ability to display content in augmented reality environments in three-dimensional forms, provide information in a simple and clear way, and enter information in a simple and effective way, make all the complex procedures the learner faces easy to use
- With the use of mobile devices and the ability to record and access information, augmented reality technology enables engagement with learners in real time while allowing them to adapt to the features of the virtual world. As these things are constantly accessible, it is simple to use them to offer support and support services wherever you are and whenever you need them at cheap cost.
- Augmented reality technology can improve the efficiency of the educational process, produce observable outcomes, and boost the motivation of the learner to engage in the learning process. It does not require special laboratories and provides the learner with an element of enjoyment and suspense, with the possibility of interaction between the two parties to the educational process. It also provides strong information despite the simplicity of use because of their motivation in deducing information and their compatibility with pleasure and knowledge at the same time.

References

- [1] Al -Ghamdi, Asiri (2018). The effect of the use of augmented reality in the achievement of mathematics among middle school students, the International Journal of Educational and Psychological Sciences: Egypt. (13). 222-289.
- [2] Estapa ,A. & Nadolny ,L. (2015). The Effect of an Augmented Reality Enhanced Mathematics Lesson on Student Achievement and Motivation. Journal of STEM Education ,16(3), 40-48.
- [3] Ferjun (2015). Virtual education embedded across the computer cloud, a working paper for a symposium entitled Computer Cloud and Internet Applications in Education and Training, Horizons in Education Technology, Arab Association for Education Technology 6-7 August 2014.
- [4] Khamis (2015) Virtual reality technology, augmented reality technology and mixed reality technology,

- Egyptian Society for Education Technology, M. 25, p1, p. 1-3
- [5] Al -Dahassi. (2017). Using augmented reality technology in developing sports thinking skills, reading and knowledge magazine. Egypt: Ain Shams University, College of Education, Egyptian Association for Reading and Knowledge. (190). 90-112.
- [6] Abu Khater (2018). The effectiveness of a program that employs the technology of augmented reality in developing some electronic robot installation skills in the technology curriculum for the tenth class students in Gaza, {unpublished Master Thesis}. Department of Curricula and Teaching Methods, College of Education, Islamic University: Palestine.
- [7] Al -Sarhani (2020). The effect of the use of augmented reality technology in developing some concepts of mathematics among sixth -grade primary students in the Kingdom of Saudi Arabia. Research submitted in the "Virtual International Conference for the Future of Digital Education in the Arab World". Taif, (2). 286-307.
- [8] Al -Ghamdi. (2020). The effect of the use of augmented reality in the achievement of mathematics among middle school students in the Al -Baha region in the Kingdom of Saudi Arabia. Journal of the Islamic University for Educational and Psychological Studies, 28 (2), 823-849.
- [9] Ismaeel, D. A., & Al Mulhim, E. N. (2019). Influence of Augmented Reality on the Achievement and Attitudes of Ambiguity Tolerant/Intolerant Students. *International Education Studies*, 12(3), 59–70.
- [10] Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*, 20, 1–11.
- [11] Anderson, E., Liarokapis, F., (2014). Using Augmented Reality as a Medium to Assist Teaching in Higher Education. Coventry University.Uk
- [12] Kojk (2001), modern trends in curricula and teaching methods, Cairo, World of Books, Edition (2).
- [13] Jabour. (2014). The effectiveness of using a teaching strategy based on structural theory to develop scientific concepts and the skills of science operations for the basic stage students in Jordan. Unpublished PhD thesis. Institute of Educational Studies. Cairo University.
- [14] Mohammed. (2022). A proposed functional approach in science is based on learning centered on life and its impact on developing scientific concepts and health awareness and improving the image of the body of mentally handicapped students. *Educational Journal*, c 94, 23-91.
- [15] Redondo, B., Cózar-Gutiérrez, R., González-Calero, J. A., & Ruiz, R. S. (2020). Integration of Augmented Reality in the Teaching of English as a Foreign Language in Early Childhood Education. *Early Childhood Education Journal*, 48, 147-155.
- [16] Yahya (2008), the effectiveness of a program based on therapeutic teaching using animation to develop some scientific concepts among mentally handicapped students who are able to learn in the primary stage, studies in curricula and teaching methods, the Egyptian Association for Curricula and Teaching Methods, No. (139), October, College of Education, University Ain Shams, p. 61.
- [17] Abd Alghafoor. (2012). Educational frameworks for electronic learning design. *Al-Aqsa University Journal (Humanities Series)*, Volume (16), No. (1), pp. 63-86
- [18] Chen, R. W. (2019). Using Augmented Reality Flashcards to Learn Vocabulary in Early Childhood Education. *Journal of Educational Computing Research*, 57(7), 1812-1831.
- [19] Al-Ajmi. (2019). Advances of the students of the Faculty of Basic Education in the State of Kuwait on the use of augmented reality in teaching curricula and computer teaching methods. *College of Education Journal: Tanta University - College of Education*. 74 (2). 206 - 246.
- [20] Wijdenes, P., Borkenhagen, D., Babione, J., Ma, I., Hallihan, G. (2018). Leveraging augmented reality training tool for medical education: A case study in central venous catheterization. In: *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems*, pp. 1–7
- [21] Cheetah. (2018). The effectiveness of the use of Augmented Reality in developing conceptual assimilation among second -grade secondary school students in physics in Riyadh. *Reading and Knowledge Magazine*. Ain Shams University, College of Education: The Egyptian Association for Reading and Knowledge. (205). 39 - 82.
- [22] Daghari. S (2019). The effect of the use of augmented reality technology in developing self -learning skills for primary first grade students. *Scientific Research Magazine in Education: Ain Shams University - Girls College for Arts, Science and Education*. 14 (20). 598 - 615.
- [23] Al -Husayya. (2020). The impact of the technique of augmented reality on academic achievement and visual thinking of the third basic grade students of science in the Qweismeh District, Amman. [A magister message that is not published]. Middle East University: Oman.
- [24] Mansour (2021). The use of augmented reality technology in developing some scientific concepts and skills of searching for information among middle school students in the State of Kuwait. *Scientific Journal: College of Education, Assiut University*. 37 (2). 1-38.
- [25] Al -Otaibi (2022). The impact of the use of the technique of augmented reality in the development of

- mathematical concepts among primary school students in Makkah Al -Mukarramah, Master Thesis, Faculty of Education, Umm Al -Qura University.
- [26] Abdullah (2020). The effectiveness of a program based on augmented reality technology in teaching the Holy Quran reading the deaf students in the primary stage in Jeddah, PhD thesis, Faculty of Education, Umm Al -Qura University.
- [27] Al -Nawiya. (2016). The effect of the use of the techniques of augmented reality in the acquisition of scientific concepts: an applied study on the chemistry curriculum for the tenth grade students, the University of Jordan 2020. *Andalus Magazine: The University of Hassiba Bin Bouali Al -Shlev, the laboratory of functional theory.* 7 (25). 271 - 290.
- [28] Al -Salaqiya, Al -Salmi. (2020). The effect of the use of augmented reality technology in developing imaginary thinking among the tenth grade students in Islamic education in the Sultanate of Oman. *International Journal of Educational and Psychological Studies: Rafad Center for Studies and Research.* 8 (2). 463 - 474.
- [29] Chao ,W. ,& Chang ,R. (2018). Using augmented reality to enhance and engage students in learning mathematics. *Advances in Social Sciences Research Journal* 5 (12) 464-455.
- [30] Al-Zahrani. (2019). The effect of employing augmented reality technology in developing higher thinking skills for middle school students. *Journal of Educational and Psychological Sciences. National Research Center: Gaza.* 2 (26). 70 - 90.
- [31] Abdel-Maksoud. (2017). The effect of the use of augmented reality applications in providing scientific concepts and the effect of their learning among pre - school children. *College of Education Magazine, M.* 17, A 5, 309 - 368.
- [32] Bayoumi. (2019). The impact of the "total and analytical" information method using the augmented reality and the method of learning in an enhanced reality environment based on games to develop social and motivated communication skills among educational technology students. *Education Technology Magazine. The Egyptian Society for Education Technology: Egypt.* 29 (11). 289-427.
- [33] Madanipour, P., & Cohrssen, C. (2020). Augmented reality as a form of digital technology in early childhood education. *Australasian Journal of Early Childhood, 45(1),* 5-13.