



# A REVIEW OF RESEARCH ON AUGMENTED REALITY IN EDUCATION

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## Synopsis:

A more effective learning process can be achieved by encouraging students to actively participate in their education through the use of technology in the classroom. According to a prior study, learning will become passive in the absence of technology that encourages critical thinking, meaning-making, or meta cognition. Augmented reality (AR) has proven since its debut that it can dramatically enhance learning by making it more interesting, effective, and relevant. Because of its cutting-edge technology, users will be able to interact with virtual and real-time applications and have authentic experiences. Additionally, the incorporation of AR with education has lately drawn research attention since it allows students to immerse themselves in real-world events. As a result, this study reviews the research that has been done on AR. The usage of augmented reality in several academic fields is discussed in the study, including history, geography, biology, chemistry, arithmetic, and physics. The advantages of augmented reality (AR) in comparison to traditional technologies (such as e-learning and courseware) and traditional teaching methods are also explored in this essay (chalk and talk and traditional books). Reviewing the research's conclusions demonstrates that augmented reality (AR) technologies have potential and advantages that can be used in education. The report also identifies the drawbacks of AR, which can be explored in further research.

**Keywords:** Augmented reality, Technologies, Applications

## 1. Introduction:

Traditional teaching methods, in which the teacher controls the classroom and is solely responsible for the learning environment, are no longer used. All of the responsibilities and authority fall under the purview of the teacher, who also serves as the class speaker and makes all decisions regarding what and how to teach the pupils. In this study, this word will be used to describe instruction that involves teachers using chalk and a chalkboard and students utilizing pens and paper. Instead, the instructor uses other techniques including lecturing, question-and-answer sessions, and demonstrations using examples.

In particular, teacher-centered instruction can be especially effective for:

- Sharing information that is difficult to find elsewhere
- Quickly presenting knowledge;
- Creating interest in it;
- Instructing listeners who choose to learn. However, there are various obstacles, such as:
- Not all students learn best by listening;
- Maintaining students' interest is frequently challenging;
- The strategy typically calls for little to no critical thinking;
- It makes the assumption that all students learn in the same impersonal manner.

Traditional educational approaches as we once knew them are fading into history. They are being influenced by technological advancements and are becoming more and more digital. In reality, the education technology industry so-called EdTech business is projected to increase at a 17% annual rate to \$252 billion by 2020.

A leader among the most important EdTech trends, augmented reality is deserving of this distinction. By 2020, more than one billion users are anticipated to adopt the trend, creating a wealth of potential for businesses and educational institutions.

## 2. Augmented Reality:

In schools all across the world, augmented reality in education is rapidly gaining popularity. Through enhanced engagement and interactivity, augmented reality (AR) enables educators to enhance learning outcomes. It improves kids' development of skills like teamwork, problem-solving, and creativity to better prepare them for the future. It is also beneficial for conventional schooling that emphasises technical expertise and knowledge.

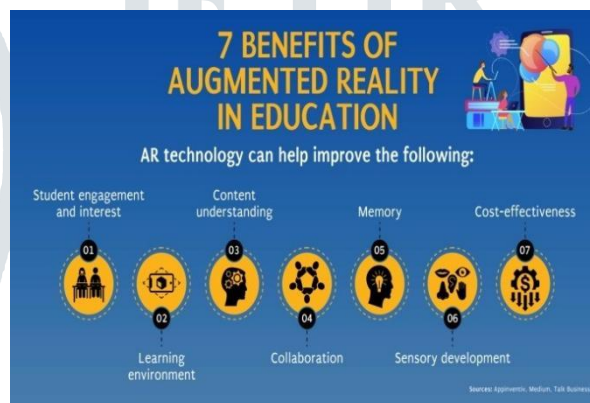
With the help of augmented reality technology, one can improve reality by overlaying a layer of information over the original sights. When one points the camera of their gadget at specified locations, this layer of computer-generated visuals becomes apparent. With a superior visual and sensory experience, this activity presents a visual that improves learning. Simply put, users perceive digital information layered over real-world visuals, which can enhance their perception of and comprehension of reality.

A pre-existing environment is enhanced with noises, films, and visuals. Images are superimposed on the surrounding environment using four key components: cameras and sensors, processing, projection, and reflection. These elements each perform a distinct role. For instance, before overlaying digital content on the user's vision, cameras and sensors can determine the depth of a picture or the distance between two objects. Reflection and projection enhance what a user sees with virtual information; projection mapping, for instance, allows AR apps to digitally overlay video onto any real-world surface.

Widespread adoption of AR has generally been hampered by wireless networks' constrained bandwidth and high latency when it comes to processing and delivering data. However, opportunities to fully explore AR's potential are growing as a result of quicker wireless connectivity provided by 5G cellular networks and the greater processing capacity of next-generation devices.

### Benefits of AR Technology In Education

In the field of education, augmented reality offers a number of desirable benefits, such as:



- **A Swift and Effective Learning System**

Students may learn through engaging visuals and total immersion with augmented reality in the classroom. Additionally, speech technology engages students by delivering in-depth information about the subject in a voice format. In essence, the idea of eLearning with AR focuses on a key sense that humans use to collect information.

- **Easy Access to Learning Materials Anytime, Anywhere**

Textbooks, tangible forms, posters, and printed brochures can all be replaced with augmented reality. Additionally, this kind of mobile learning lowers the cost of educational resources and makes them accessible to everyone.

- **Immersive Practical Learning**

Additionally, it can support professional training. Imagine being able to cook meals or pilot a spacecraft without endangering other people or costing a fortune.

- **Engage Students and Spruce Up Their Interest**

The education system and gamification of AR can improve student attitudes. It enhances teamwork and capacities while making learning engaging, enjoyable, and effortless. Additionally, it offers several options to inject unparalleled involvement through a computer-generated environment, thereby lessening the strain of classes. Students that participate in online learning get an improved setting where they may observe concepts in action. Companies employ skilled AR developers to create these applications.

- **Wrapping Up**

By completely changing the learning process, augmented reality can revolutionise the current educational system. Overall, it will influence students' interest and increase their productivity. Additionally, by providing an immersive learning environment, this will aid students in understanding ideas and make learning simple. Additionally, by providing a superior learning experience through technology, educational institutions will attract enormous attention.

### Technologies that power augmented reality

The three main technologies that enable augmented reality are as follows. In fact, these are the technologies that make it possible to superimpose digital media on physical spaces in the right dimensions and at the right locations. They communicate with one another by providing data to one another in order to make augmented reality (AR) operate, rather of functioning as standalone technology.

- **SLAM:**

Virtual images are rendered using SLAM over actual locations and objects. It functions with the aid of localising sensors that map the complete physical space or item, such as gyroscopes and accelerometers. Its algorithm renders the virtual image in the proper dimensions on the space or object, conducting a complicated simulation of augmented reality. Nowadays, the majority of augmented reality APIs and SDKs provide built-in SLAM functionality.

- **Depthtracking:**

To determine how far an object or surface is from the camera sensor of the AR device, depth tracking is used. The process is analogous to how a camera would focus on the intended object while omitting the background.

- **Image Processing and Projection:**

Following the completion of SLAM and depth tracking, the AR programme processes the image in accordance with the specifications and projects it on the user's screen. A specialised device (like the Microsoft HoloLens) or any other device running the AR application could serve as the user screen. The AR application processes the image in the backend using data obtained from the user's device lens. The image may be rendered in the appropriate size and location thanks to SLAM and depth tracking.

#### How AR applications detect objects

Primary among them are two types of technologies that detect objects: trigger-based and view-based. Both trigger-based and view-based augmentations have several subsets.

#### Trigger-based augmentation:

Augmentation that is activated by triggers that detect AR markers, symbols, icons, GPS locations, and other elements. The AR app analyses the 3D image and projects it on the user device when the AR device is pointed at the AR marker.

#### Marker-based augmentation:

This type of augmentation relies on scanning and identifying AR markers to function. Paper printer markers in the shape of distinct patterns are known as AR markers. They resemble bar codes in appearance and allow the AR app to produce 360-degree photos that have been digitally improved on the AR device.

#### Location-based augmentation:

The real-time position of the device is picked up by the AR app in this way of augmentation, and it is combined with dynamic data obtained from cloud servers or the app's backend. The majority of location-based augmentation is used by vehicle parking helpers and AR-enabled maps and navigation systems.

#### Dynamic augmentation:

The most responsive type of augmented reality is dynamic augmentation. It makes use of the motion tracking sensors in the AR gadget to identify real-world images and superimpose digital images over them.

#### Augmentation:

The AR programme detects these surfaces because they are dynamic (such as buildings, desktop surfaces, the outdoors, etc.). For the purpose of aligning reference points and displaying pertinent information on the screen, the app connects the dynamic view to its backend.

### 3. AR Applications:

- **Engineering:** Production, training, and support are all typical engineering applications for augmented reality. Instead of relying on a repair manual, AR helps technicians in the pump industry simulate complex pump installations in water and wastewater operations.
- **Medicine and healthcare:** The advantages of augmented reality (AR) for healthcare are abundant, ranging from physician education and training to surgical visualization and disease prevention simulations. One healthcare augmented reality application, for instance, shows a patient's body, including the precise locations of veins. This makes it easier for doctors and nurses to start an IV or draw blood more precisely before a surgery or during a medical exam.
- **Retail:** AR has the potential to improve customer-product interactions. A smart phone can be pointed at a product by a customer browsing the aisles of a store, prompting an augmented reality app to provide relevant information. Apps powered by augmented reality are available from retailers like Ikea, allowing customers to envision furniture in their own homes before making a purchase.
- **Manufacturing:** According to Deloitte, a growing shortage of manufacturing skills could result in the unfilled of approximately 2.4 million positions between 2018 and 2028. In bridging that gap and addressing manufacturing's complex processes, augmented reality (AR) may be crucial. Manufacturing equipment, for instance, requires routine maintenance because it frequently involves dozens of processes for hundreds of individual components. AR has the potential to increase manufacturing workforce productivity by teaching employees how to maintain equipment and conduct remote diagnostics of it.

- **Entertainment:** Despite not being the first augmented reality (AR) video game, Pokemon Go has become one of the most popular since its 2016 release and has received over 1 billion downloads as of February 2019. The adoption of 5G technology will expand, and improvements in augmented reality will revolutionise how people pass their leisure time. A Deloitte survey found that millennials and Generation Z (those between the ages of 14 and 36) intend to utilise 5G to stream more video, play more social online games, and immerse themselves in more augmented reality (AR) digital environments.

- **Space exploration:** Humans may soon travel to Mars thanks to a technology developed by Lockheed Martin that blends machine intelligence and augmented reality. On-site astronauts might wait more than 40 minutes for repair instructions from Mission Control on Earth if a mechanical issue occurs on Mars. This technology incorporates an augmented reality (AR) visor that projects an overlay of data—such as heat, gas mixes, and other crucial information—over a physical location, enabling astronauts to quickly identify problems on their own.

- **Military and defence:** Nothing can replace the demanding and physically taxing components of preparing soldiers for battle. However, the military is able to add a layer of training with augmented reality that could help create better troops. These applications enhance situational awareness and teach users how to safely and swiftly interpret information. During a military operation, tactical augmented reality (TAR) can, for instance, provide tactical mapping to aid soldiers in locating allies and spotting enemies.

**Challenges in AR:** Despite the listed benefits, there are certain pitfalls you should take into account when building EdTech solutions with augmented reality:

- **A lack of necessary training:** Some teachers might have trouble putting these new technologies into practice, because their prior training does not provide them with the necessary skills. To use augmented reality apps in education, only the most innovative educators and educational establishments are prepared.

- **Dependence on hardware:** In order to use augmented reality in the classroom, you need a certain set of resources. For instance, not all students have smart phones that are equipped to run augmented reality software.

- **Content portability issues:** The augmented reality app you create must function equally well on all platforms and devices. However, it is virtually impossible to offer AR content of the same quality on any device.

**Conclusion:** Augmented Reality is the best way to engage the students. Technology is the most attractive concept for kids. There is still much that can be learned about the great potential of augmented reality in education. AR is becoming more widely available and used thanks to the current acceptance of mobile technology and the most recent hardware advancements. Therefore, it could be wise to start moving in this direction right away.

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