Augmented Reality: As an Educational Tool of Teaching

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1. Introduction

The rapid advancement of technology give rise to new improvements in education. The occurrence of improvements raises a question mark whether these technologies may be efficient in education or not. Augmented Reality (AR) is one of the technologies which have become widely used and issue of concern. AR is defined as a technology where real world and virtual images are blended and a real-time interaction is ensured. This technology may be implemented by using various types of technologies such as desktop computers, laptops, portable devices and smart phones. The applications created by using AR allows the usage of 3D objects, 2D images, videos and animations both separately and simultaneously. In this sense, users can interact with incidents, objects and data by the aid of using natural ways.

In educational AR applications, multimedia materials such as images, texts, audios, 3D objects, 2D or 3D animations and videos are used depending on the learning objectives. In this kind of multimedia materials, sensuous, interactive and well-designed multimedia lets the learner to participate in the learning process actively and helps maintaining a permanent learning at the same time. AR applications provide students with multimedia learning environment. AR learning environments that are well designed upon the principles of multimedia learning theory have an important potential for decreasing the cognitive load of individuals and providing an effective learning process. In addition to this, AR learning environments give opportunity to students to see 2D objects as 3D to analyse objects from various perspectives and to learn through experience. In this way, a more permanent and effective learning occurs where the students are more active.

In literature, it is stated that AR applications provide important aids to education process. However, a research in this field is early stage. Implementation examples are needed in order to integrate the AR technology into the areas of education. Accordingly, the AR applications should vary in different fields and levels of education.

2. Definitions of Augmented Reality

According to Vangie Beal (2018),
“Augmented Reality is a type of virtual reality that aims to duplicate the world's environment in a computer.”
According to Tech Terms,
“Augmented Reality is computer-generated content overlaid on a real-world environment.”
According to Merriam-Webster online dictionary,
“Augmented Reality is an enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device.”
According to Tech Target,
“Augmented reality is the integration of digital information with the user's environment in real time.”

3. What is Augmented Reality?

Augmented reality is the technology that expands our physical world, adding layers of digital information onto it. Unlike Virtual Reality (VR), AR does not create the whole artificial environments to replace real with a virtual one. AR appears in direct view of an existing environment and

adds sounds, videos, and graphics to it. A view of the physical real-world environment with superimposed computer-generated images, thus changing the perception of reality, is the AR.

The term 'Augmented Reality' was coined in 1990 by Thomas Caudell, and one of the first commercial uses were in television and military. AR rolled out its second wave and nowadays is mostly related to the interactive concept. 3D models are directly projected onto physical things or fused together in real-time, various augmented reality apps impact our habits, social life, and the entertainment industry.

4. How does Augmented Reality Work

In Augmented Reality, images, animations, video, 3D models may be used in natural and synthetic light. AR can be displayed on various devices like digital screens, 3D glasses, handheld devices, mobile phones, head mounted devices like VR helmets, etc. To produce AR visuals following components are used.

5. Camera and Sensors

Cameras on devices are scanning the surroundings and with this info, a device locates physical objects and generates 3D models. It may be special duty cameras, like in Microsoft Holo lens and Motion Kinect or MOCAP devices, or common smartphone cameras to take pictures/videos.

5.1 Processing

AR devices eventually should act like little computers, something modern smart phones already do. In the same manner, they require a CPU, a GPU, flash memory, RAM, Bluetooth / Wi-Fi, a GPS, etc. to be able to measure speed, angle, direction, orientation in space, and so on.

5.2 Projection

This refers to a miniature projector on AR headsets, which takes data from sensors and projects digital content (result of processing) onto a surface to view. In fact, the use of projections in AR has not been fully invented yet to use it in commercial products or services.

5.3 Reflection

Some AR devices have mirrors to assist human eyes to view virtual images. Some have an "array of small curved mirrors" and some have a double-sided mirror to reflect light to a camera and to a user's eye. The goal of such reflection paths is to perform a proper image alignment.

6. Types of Augmented Reality

There are four types of Augmented Reality:

1.Markerless AR

Some also call it to image recognition, as it requires a special visual object and a camera to scan it. It may be anything, from a printed QR code to special signs. The AR device also calculates the position and orientation of a marker to position the content, in some cases. Thus, a marker initiates digital animations for users to view, and so images in a magazine may turn into 3D models.

Fig.1. Marketless Augmented Reality

2. Marker-based AR

Also known as location-based or position-based augmented reality that utilizes a GPS, a compass, a gyroscope, and an accelerometer to provide data based on user's location. This data then determines what AR content you find or get in a certain area. With the availability of smartphones this type of AR typically produces maps and

Fig. 2. Market-based Augmented Reality

directions, nearby businesses info. Applications include events and information, business ads pop-ups, navigation support.

3. Projection-based AR

Projecting synthetic light to physical surfaces, and in some cases allows to interact with it. These are the holograms we have all seen in sci-fi movies like Star Wars. It detects user interaction with a projection by its alterations.

Fig. 3. Projection-based AR

4. Superimposition-based AR

Replaces the original view with an augmented, fully or partially. Object recognition plays a key role, without it the whole concept is simply impossible. We've all seen the example of superimposed augmented reality in IKEA Catalog app that allows users to place virtual items of their furniture catalog in their rooms.

Fig. 4. Superimposition-based AR

7. Common uses of Augmented Reality

1. Education: Interactive models for learning and training purposes, from mathematics to chemistry.
2. Medicine and Healthcare: To help diagnose, monitor, train, localize, etc.
3. Military: For advanced navigation, marking objects in real time.
4. Tourism: Data on destinations, sightseeing objects, navigation, and directions.
5. Broadcasting+8: Enhancing live events and event streaming by overlaying content.
6. Industrial Design: To visualize, calculate or model.

8. Uses of Augmented Reality in Education

Augmented reality in education can serve a number of purposes. It helps the students easily acquire, process, and remember the information. Additionally, AR makes learning itself more engaging and fun.

1. Accessible Learning Materials – Anytime, Anywhere

Augmented reality has the potential to replace paper textbooks, physical models, posters, printed manuals. It offers portable and less expensive learning materials. As a result, education becomes more accessible and mobile.

2. No Special Equipment is Required

Unlike VR, augmented reality doesn't require any expensive hardware. Because 73% of all teens currently own a smartphone, AR technologies are immediately available for use for the majority of the target audience.

3. Higher Student Engagement and Interest

Interactive, gamified AR learning can have a significant positive impact on students. It keeps them engaged throughout the lesson and makes learning fun and effortless.

4. Improved Collaboration Capabilities

Augmented reality apps offer vast opportunities to diversify and shake up boring classes. Interactive lessons, where all students are involved in the learning process at the same time, help improve teamwork skills.

5. A Faster and More Effective Learning Process

AR in education helps students achieve better results through visualization and full immersion in the subject matter. A picture is worth a thousand words, right? So, instead of reading theory about something, students can see it with their own eyes, in action.

6. Practical Learning

Apart from schooling, professional training can also benefit greatly from the use of AR. For example, accurate reproduction of in-field conditions can help master the practical skills required for a certain job.

7. Safe and Efficient Workplace Training

Imagine being able to practice in heart surgery or operating a space shuttle without putting other people in danger or risking millions of dollars in damage if something goes wrong. It is possible with AR.

8. Universally Applicable to any Level of Education and Training

Be it learning games for kindergarten or on-the-job training, AR isn't limited to only one use case or field of application.

9. Motivation

Augmented reality provides new ways of learning; teachers get to catch the attention of students and motivate them better, while students get new tools to visualize their subjects and complex concepts as well as obtain practical skills. Moreover, even parents can benefit by engaging their children in studying with playful apps.

9. Conclusion

AR technology can transform each class into a surprising and motivating learning environment where students become actively involved in the learning process. As we have seen, content is brought to life and presented in new different ways that wouldn't be possible without this type of technology.

Because AR is delivered through mobile devices, students are not tied to their desks and can access information when and where they need it, and take it with them—so it helps students learn at their own pace by revealing information when they are ready.

AR is about augmenting experiences in real-world environments, that is, the context where the learner happens to be. AR technologies can take any situation, location, environment, or experience to a whole new level of meaning and understanding. Creating an interactive content presentation with context-aware information that students can access on their devices can help them to connect with the lesson on a deeper level.

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