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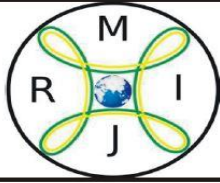
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Future trends in Education - Educational implication of Immersive technologies

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Abstract

ICT changing society dynamically. ICT tools influencing lives. Its influence also felt more and more at educational institutions. Because ICT provides both students and teachers with more opportunities in adapting learning, teaching, and managing the individual needs, society is forcing schools to respond to this innovation aptly. Using ICT in education has become one of the most effective factors in school improvement. In today's scenario, the ability to connect reality and digital content has been steadily improving, opening more options for teachers and students and we may find some excellent examples of augmented reality (AR), virtual reality (VR) and Mixed reality (MR/XR) in education also.

Introduction

Immersive technology (Augmented Reality, Virtual Reality and Mixed reality) which merge the physical and digital worlds to create immersive experience for users. There are enormous possibilities of using immersive technologies in education. In previous module, we discussed in detail about Augment reality and Virtual reality. In this module, we will discuss the Mixed reality, it's applications and educational implication of Augmented, Virtual and Mixed reality. Apart from this, we will also discuss how these technologies can help the persons with special needs.

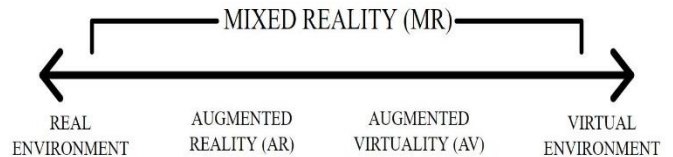
- 1. Mixed Reality (MR):** It combines the features of Virtual Reality (VR) and Augmented Reality (AR) and also called Augmento-virtual reality. Mixed Reality merges the physical and virtual worlds, including real and computer-generated objects. A user can navigate within the environment and interact with both real and virtual objects.

In mixed reality, virtual objects are not just overlaid on the real world but the user can interact with them.

Mixed reality is a step beyond the Augmented reality. MR combines the physical and virtual world; user can also interact with them as well and blur the perception of what is real and what is not.

2.1. Technology to deploy:

- a. Head Mounted Device (HMD) or VR headsets:** The foremost necessity for fully immersive experience



till now is Head Mounted Device (HMD) or VR headsets. There are numbers of HMD/VR headset available currently with specialized configuration and performances. Simplest and cheapest or entry level is Google Cardboard which requires mobile phone as screen. Advance HMD are stand alone, didn't require separate mobile phone like HTC Vive, Oculus Rift, Samsung gear and most advanced HoloLens 2 developed by Microsoft Corporation. Some of them requires high end PCs or Laptop to stream high quality content at high frame rate.

HMD equipped with various sensors like GPS, Gyro meter, Accelerometer, Camera, infrared locators, trackers etc.

- b. Computer:** Computer assisted devices requires to process heavy data in high speed which requires high end latest generation processors like Intel Core i7. Separate graphics processing Unit (GPU) is required.

Term	Description	Why It Matters
Frames per second (FPS)	Frequency at which a system can display consecutive images, or frames	Without a high and constant frame rate (greater than 60 FPS), the motion won't look right, and you could even feel sick
Field of view	The angle of the observable world that can be seen	If the window of view is too narrow, you could end up making unnatural head rotations
Degrees of Freedom (DoF)	The number of directions that an object can move or rotate. The six degrees of freedom are pitch, roll, yaw, left and right, forward and backward, up and down	More DoFs allow you to move more naturally in VR
Latency	The amount of time it takes a system to react/respond to movements or commands	Latency is critical when it comes to the presence inside Virtual Reality—if the system doesn't respond instantly, it doesn't feel real.

c. Important key terms, their description and why it matters to know them while deciding a about deploying MR (Courtesy: Intel):

2.2. Applications of Mixed Reality (MR): Mixed reality is also known as Hybrid reality as it combines the features of Augmented and Virtual reality. Due to advanced computer vision, input devices, graphical processing power and display power, it is possible to experience immersive content. Mixed reality has it's wide applications in almost all fields, few of the followings discussed in details:

a. **Industry:** BAE Systems predominantly operates in the defense sector, but it also builds complex batteries that provide power for electric buses. The British company recently began using an MR system to improve training quality and productivity in their primarily manual battery-building process.

With the aid of Microsoft HoloLens self-contained MR glasses, BAE factory workers can project 3D image-based systematic work instructions onto their workspace, and follow the digital guidance to construct power cells from scratch. BAE claims that this MR solution has cut the battery-building time by as much as 40%.

<https://youtu.be/TfgfF9-1xvA>

b. Medical Education

When medical students study anatomy, there is no substitute for the human cadaver. However, as a complement to working on embalmed bodies, there is currently no substitute for MR, as faculty members and students at Case Western Reserve University in Cleveland discovered back in 2015. The University has not looked back since it began collaborating with Microsoft to develop the teaching capabilities of the HoloLens.

Today, students at Case Western are able to study the human anatomy using a life-sized, standing 3D image, which they can walk around and manipulate, dissect with hand gestures, and examine from unobstructed points of view, which is not always possible with cadavers, as sometimes one organ must be removed in order to view another.

c. Automobile Design

Just as the medical field is using technology to complement cadavers, automobile designers are embracing MR to speed up the reimagining of current vehicle models and the development of concepts for new ones.

Ford was one of the first car manufacturers to embrace MR, which its engineers and designers now use in combination with traditional clay prototype designs and existing car models to create new designs more quickly and at a lower cost.

Ford uses Microsoft HoloLens MR headsets and custom software to superimpose new design features onto their clay models and existing cars, enabling them to visualize how each change will look.

The beauty of this approach is that while physical modeling is still necessary, MR eliminates the need for new clay prototypes every time designers want to explore a change or design feature. Instead, a single clay prototype becomes the base for an infinite number of design ideas. Other car-makers, including Volvo, are also utilizing MR for vehicle design.

d. From Headsets to Hardhats: Mixed Reality in Construction Design

While creating a full-scale clay model of a car is possible, if costly, this kind of prototyping isn't realistic for

construction architects. Until recently, their standard technique has been to create scaled-down 3D building information models (BIMs).

Now MR systems allow architects, building inspectors, and construction workers to see a virtual version of a structure in its actual location at the 1:1 scale. With HoloLens and BIM MR software, architects can even venture inside their creations to evaluate and assess internal elements, highlight issues, and visualize changes using voice commands or hand gestures.

Once a construction project moves into the building phase, MR superimposes BIMs onto the actual, physical structure, enabling identification of any discrepancies between the design and the building, and precise placement of specialized equipment when required.

Safety is paramount on construction sites, so MR hardware is incorporated into hardhats, protecting architects from injury while they use blended reality to check the construction quality and planning schedule in real time.

e. Real Estate

Photos have been used by real estate agents to showcase properties for decades. But now, agents can use virtual reality for this purpose. Unlike photos, VR is immersive, so potential buyers can take three-dimensional walkthroughs and better understand what each property has to offer before visiting in person.

f. Marketing

Thanks to virtual reality, businesses can reach out to their audiences by launching immersive and engaging marketing campaigns. This is particularly important in the age of online shopping, as VR experiences help people get a feel for products without leaving their homes.

For example, IKEA created a VR application featuring a kitchen. Wearing a VR headset and using a controller, people can explore this virtual kitchen and even interact with it.

Mixed Reality May Soon Be Everywhere

Aside from the mixed reality examples above, enhanced, blended and immersive environment apps are undergoing experimentation and testing in many other sectors of industry and commerce. For example, the market for educational MR is already growing steadily, with research company *Technavio* projecting a compound annual growth rate of 59% by 2022.

MR interest is strengthening in many other sectors too. For example, AR company DAQRI found this out when it sought enterprise input and feedback for its MR headset and productivity software in 2017. More than 100 companies from multiple industries jumped at the chance to test the product.

Mobile AR is beginning to look like just a stepping-stone to something much more important. So it might be time

to start thinking about MR’s potential uses for your industry—and even more importantly, how you might benefit from using it within your organization.

2. Difference between Augmented, Virtual and Mixed Reality: Although, we have discussed in detail about Augmented, Virtual and Mixed Reality. Here is the simple difference between them.

Augmented Reality	Virtual Reality	Mixed Reality
Interactive objects are layered on top of the physical environment without the ability to manipulate the augmented objects. AR overlays digital information onto the real world.	The real world is hidden and the user is completely immersed in a digital experience, creating a digital simulation of a real environment.	The capabilities of AR and VR are blended, bringing together the physical and digital world to produce an environment where physical and digital objects coexist and interact in real time.

3. Educational implication of Augmented, Virtual and Mixed Reality:

The immersive technologies (Augmented, Virtual and Mixed realities) are emerging technologies. Although immersive technologies are at the nascent stage and growing exponentially, the way information presented and we experience reality. They will have a dramatic impact on next-generation learners based on data processed. Next-generation of learners will experience rich media embed with cognition effects, and they will be expected to experience immersive technologies as the new norm.

The immersive technologies provide a strong base to advance the educational process. For example, learners can learn about extinct animals like dinosaurs digitally by AR app in a Smartphone. They can also experience the virtual tour of a historical place by using simple cardboard VR glasses and earphones. Simulated experiments in virtual labs can be demonstrated by teachers to engage learners even without visiting the actual lab.

4 (i). Educational implications of Augmented Reality:

The applications of Augmented Reality in education provide an array of ideas in teaching-learning by bridging the gap between the real-world and virtual world.

Following are few of the points that researchers have reported a positive impact of AR in Education:

- Increased content understanding
- Learning spatial structure and function
- Learning language associations
- Long-term memory retention
- Improved physical task performance
- Improved collaboration
- Increased student motivation

As discussed in detail, experiencing AR content mostly requires a smartphone or tablet. Various AR apps are available freely to use for educational purposes. For example, the NCERT's AR app. The 3D content for classes 9th and 10th is currently available. All features of the app are freely explored by the students. Various 3D simulations for activities for Biology, Chemistry and Physics are currently uploaded. The learner can select any activity and use image of particular activity as marker on textbook. The 3D simulation for that image became live and learner can interact with it.

It is very useful for students in today's scenario as all schools are closed due to COVID19 pandemic or where no labs are available in schools to perform practices.

4 (ii). Educational implication of Virtual Reality:

Virtual Reality in education could replace textbooks with interactive educational experiences. For materials such as History, Geography, Social, physical science, this medium could prove to be much more suitable than printed books or even today's audio-video materials.

1. Application in the areas such as Geography, History and Geology. One can explore places all over the world without having to leave the classroom in reality. This could provide opportunity to learn Geography, different languages and develop empathy for various cultural nuances. For history learning, one can go back in time and create tableau of that era and experience life and society as it existed then. Similarly, one can go deep inside the earth and experience the rock formation, origin of volcano, emergence of diamond and other precious metals. This is power of virtual reality.

2. Application in areas of Ocean Sciences, Marine Biology, and Space Sciences: In virtual reality-based classrooms, one can explore the depths of the ocean, experience and observe variety of marine life, and explore the vastness of space. In space, one can even experience future settlements on Mars or Moon and

have a brush with alien stars and asteroids. The learning in these areas can be vastly enhanced through the VR based experience.

3. Application in Biology and Medical field: Using VR one can explore within the human body as well as other living organisms. One can travel within various arteries, visualize pumping of blood by the heart, DNA structure among various other experiences. Medical Students can conduct procedures in VR based operation theatre.

4. Application in area of Health, Safety and Environmental protection: Through VR world, one can step into communities in crisis, in scenarios such as floods, epidemics, earth-quakes, and other human tragedies and experience how aid can be given in such situations. This leads to empathetic action by current students in real world crisis.

5. Creating collaborative learning: VR permits students to share their world with others and thereby co-create better virtual reality content. This would lead to student generated content for future generations of learners.

6. Experience future careers first-hand: VR makes it possible to experience careers such as being a Doctor, an Engineer, a Lawyer, or other such careers by being one and observing life in various industries like medicine, engineering, entertainment and real estate. This enables students to make a well-considered and experienced career choice.

A few roadblocks

The main drawback of VR in educational context is price and accessibility. Most of the Universities and schools might not want to dedicate/or afford a major share of their budget to emerging technologies.

Another disadvantage of VR is content, especially the applications that would run alongside the VR hardware. The freebies available in the public domain platform are not high quality or not made for educational purposes.

To conclude, one of the biggest applications of this technology is to promote curiosity and wonder among learners. Through Virtual Reality, one can transport oneself to another time and place. Though, Virtual Reality may never replace actual travel but it can certainly expose to multiple cultures and places where one may not have time and money to go to. The historical reenactment could be an amazing thing as for now, the time travel is only in the realms of fiction. As time goes by as we lose people with living memory of

events, history becomes more and more abstract. In so far, the field of education is concerned, one of the biggest challenges of adopting VR apart from the current expensive hardware costs is figuring out how VR can be integrated into every subject area and curriculum. This is a challenge for us, the academicians to explore.

4 (iii). Implication of MR in Education:

There are two ways Mixed Reality can be used in the classroom. The first is more traditional, it involves a desktop set up in which students explore a virtual environment using computer, keyboard, mouse, or some other input device, for example a wireless controller: this is properly defined as Virtual Reality.

The second is what today we use to identify as actual MR: it is the fully immersive experience that requires students to wear an HMD (head mounted display) and motion controller, through which they can interact with an environment produced by a mix of real and virtual worlds, where physical and digital objects co-exist.

1. **Virtual trip to Mars:** https://youtu.be/FIS_JkNnCel

The folks at Lockheed Martin have replaced the bus' windows with transparent 4K displays and switchable glass film. This way they eliminated the need for VR glasses, and created a group immersive experience.

The bus is taking round of the city and students inside the bus feeling to be taking round of the Mars.

2. **Case Western Reserve University and Cleveland Clinic Health Education Campus developed a complete anatomical app for Microsoft HoloLens to fully immersed experience of anatomy for medical students.**

<https://youtu.be/SKpKlh1-en0>

Mixed Reality gives professional educators new innovative possibilities to explore with learners thanks to its features:

- Engaging: direct experience generates an effective way to captivate those students who struggle, or it can just provide another opportunity to boost the engagement during lessons at school.
- Universal: regardless of social, economic or geographic disparities, MR at school brings together people and encourages human interaction.
- All-purpose: as said before, Mixed Reality can be used to teach any topic, because it is easier to see and hear something instead of having it explained, above all with abstract concepts.
 - Faraway worlds: using MR devices, students and teachers can go back in time, interacting with objects, animals or human beings that are no longer existing: dinosaurs and primitives get a new, more realistic image in learners' minds.

No geographical limitations: it is not always simple to plan the perfect school trip. Students' safety, as well as school's budget, often affect the range of choices when it is time to decide where to go. Thanks to MR, the class has no more limits. Having a walk on a ziggurat in Chichén Itzá, as well as diving down over the coral reef, is now possible whenever we like.

The applications available for each of these categories are truly stunning, but it is only the tip of the iceberg as the technology that drives them is still young. Only time will tell where these innovations will take us, but for now we can benefit from the experience they are bringing us.

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