DOI: https://dx.doi.org/10.4314/gjedr.v24i1.10

GLOBAL JOURNAL OF EDUCATIONAL RESEARCH VOL 24, 2025: 107-117
COPYRIGHT© BACHUDO SCIENCE CO. LTD PRINTED IN NIGERIA. ISSN 1596-6224 and e-ISSN 2992 - 4480
www.globaljournalseries.com.ng; globaljournalseries@gmail.com

UNDERSTANDING AND DISTINGUISHING IMMERSIVE REALITIES FOR EFFECTIVE INSTRUCTIONAL DELIVERY

(Received 27, February 2025; Revision Accepted 8, March 2025)

IDORENYIN EDET JOHNSON, ETTA IDAKA IDAKA AND AGNES EDET ASUQUO OFFIONG
E-mail: irandyjohnny@gmail.com
ORCID No: https://orcid.org/0000-0001-8787-0014, ORCID No: https://orcid.org/0009-0000-2079-1944, ORCID No: https://orcid.org/0000-0003-4743-6808

ABSTRACT

This paper explores the transformative potential of Immersive Reality (IR) technologies, specifically Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), in education. While IR technologies have demonstrated significant potential to enhance student engagement, learning outcomes, and accessibility, a lack of clarity exists among educators regarding their distinct characteristics, applications, and effective instructional integration. This paper therefore: defines and characterizes VR, AR, and MR; explores the educational applications, advantages, and limitations of each technology; analyzes the similarities and differences between VR, AR, and MR; identifies factors to consider when selecting the most appropriate IR technology for specific set of learning objectives; and, develops a framework for effective instructional utilization of IR technologies in educational settings. Accordingly, this paper seeks to empower educators with the right knowledge and tools necessary to effectively leverage the transformative potential of IR technologies in creating engaging, effective, and inclusive learning experiences for all students.

KEYWORDS: Immersive Reality, Education, Technology Integration, Student Engagement, Learning Outcomes.

INTRODUCTION

The consistency in the revolutionary trends of Information and Communication Technology, especially in education, cannot be overemphasized. Emerging technologies both by design and utilization keep injecting novel dimensions into educational activities (Johnson, et al., 2021), one of which is the Immersive Reality (IR) technologies.

The IR technologies, including the Virtual Reality (VR), Augmented Reality (AR), and Mixed Realities (MR), have significantly revamped the educational ecosystem in the 21st century, while keeping the traditional pedagogical approaches to learning. The IR technologies significantly engage students with interesting and interactive learning experiences, thereby, significantly increasing their involvement and understanding (Park & Kim, 2019).

Idorenyin Edet Johnson, Educational Technology Department, University of Calabar, Calabar, Nigeria
Etta Idaka Idaka, Curriculum and Teaching Department, University of Calabar, Calabar, Nigeria
Agnes Edet Asuquo Offiong, Environmental Education Department, University of Calabar, Calabar, Nigeria

The VR is a technological innovation that immerses people in completely imaginary surroundings. Through VR, students can be taken back to history, sent to far-off planets, or even into microscopic realms. For example, the students can virtually visit the ancient ruins of the Benin Dynasty or perform a dissection on a virtual animal, and have other experiences firsthand that would otherwise be impossible to attain. Research indicates that VR has significantly improved learning outcomes regarding subjects like science, history, and geography (Parsons et al., 2015; Huang & Benbasat, 2019).

On the other hand, AR overlays digital content on the physical world, enriching the tangible setting with interactive components, it can also be used to animate textbooks so that learners see difficult ideas concretely and interactively. For instance, through AR, students can study human anatomy by playfully interacting with 3D models of organs and systems. Studies have also shown that AR enhances students' comprehension of abstract concepts as well as their problem-solving abilities (Kaur et al., 2018; Chen & Chen, 2019; Wang & Tsai, 2021).

The MR, which is a blend of VR and AR, leans more to the integration of the two worlds; physical and digital. In that regard, MR offers immersive experiences where what is real and virtual co-exist. The MR's application in simulating real-world scenarios gives valuable experience-oriented training and practice to learners which could be in medical procedures or engineering exercises. Such activities have been found conducive for students' spatial reasoning, motor skills, and cognitive development (Lee et al., 2020; Wang, et al., 2021).

The use of IR technologies empowers educators to design personalized and adaptive learning experiences that cater specifically to the unique needs of individual students. Moreover, IR technologies engage different multimedia elements to enhance collaboration and teamwork since students can interact in virtual and augmented environments to network, solve challenges and exchange information (Johnson et al., 2024; Johnson et al., 2025). Additionally, for students with disabilities, education is made more accessible through IR technologies which allow them equal opportunities to learn and develop. Presently, there exists a confusion amongst instructors about the three components of IR technologies (Park & Kim, 2019).

Most instructors are not able to clearly place the unique similarities and differences between VR, AR and MR, as well as when to utilize which, and the procedure for effective instructional application of IR technologies. This paper therefore seeks to address VR - the definition, characteristics, educational application, advantages and limitations; AR - definition, characteristics, educational application, advantages and limitations; MR - definition, characteristics, educational application, advantages and limitations; similarities and differences between VR, AR, and MR; factors to consider in choosing between VR, AR and MR, and; procedure for effective instructional utilization of IR technologies.

Virtual Reality (VR)

Definition:

Virtual Reality (VR) is an immersive technology that is in the form of simulated experience and lets users travel to desired digital environments. It combines the virtual reality headsets with other special hardware tools and software applications to enable users interact with and explore the virtual worlds as if you were really there.

Core Characteristics:

Parson et al., (2015) summarized the core characteristics of VR as follows:

i. Virtual Field Trips: The VR is able to take students along to historical sites, far off lands and even microscopic worlds. For example, students can visit the ruins of Rome virtually or the ocean depths. These immersive experiences are able to enrich the comprehension of students on history, geography and science.

ii. Simulations: The VR is capable of simulating real-life situations, and thus helps students hone their skills when there is safe control over the environment. Medical students, for instance, can practice surgical procedures on virtual patients; engineering students are able to design and test virtual prototypes instead of real ones.

iii. Interactive Learning Experiences: VR can provide such interactive learning experiences that attract students toward several modalities. For instance, learners may engage in virtual labs, complete puzzles, and work together with classmates in virtual classrooms.

Advantages of Application in Education:

The VR gives learners immersive experiences in simulated environments for enhance learning outcomes. Basically, Huang and Benbasat (2019)

skilled technician to set up and troubleshoot. Technical problems like motion sickness, and

outlined the basic advantages of VR in education as follows:

i. Enhanced Engagement and Motivation: VR has the potential to capture the attention of learners and generate interest due to its interactive and immersive experiences. While such experiences draw students into virtual realms, learning becomes not only enjoyable but also memorable. Studies have demonstrated that VR enhances student motivation and engagement, which in turn leads to better learning outcomes (Parsons et al, 2015).

ii. Improved Learning Outcomes: VR provides an opportunity to simulate real world scenarios, hence students can be able to apply skills and knowledge which they have gained in their learning and also practice new skills and knowledge in a safe yet controlled environment. For example, medical learners can perform surgical operations on virtual patients, or engineering learners can create and test virtual prototypes. Research findings show that it is possible to improve students' cognitive skills as well as problem solving ability through use of VR technology (Lee, et al., 2020).

iii. Immersion: This is one of the ways that can be used to create personalized learning experiences. This is because VR can be adapted to the specific needs and learning styles of every learner. In many cases, through VR environments, the students learn by themselves and/or collaborate with other students and the teacher over the network. It may also include self-paced instructional modules that vary depending on how well a student understands a concept.

iv. Accessibility and Inclusivity: VR ensures that even students with disabilities get equal access to education. It eliminates the physical barriers and provides an inclusive virtual environment. VR levels the playing field while giving opportunities to all learners.

Limitations in Education

While VR has a number of instructional benefits, the following limitations are also observed to be associated with it:

i. High Cost: The cost of VR hardware and software may be significant for the implementation of such technology in schools and institutions which may face difficulties due to this.

ii. Technical Challenges: VR systems can be complex and pose technical hurdles that require a

iii. hardware failure can interrupt the learning experience.

iv. Limited Social Interaction: VR can provide amazing experiences, but at the same time, it socializes students very little with their teachers. To ensure proper social and emotional development, a balance needs to be found between the use of VR and traditional face-to-face teaching.

v. Potential for Adverse Mental Health Effects: Extended use of VR is associated with adverse mental health effects, including anxiety, depression, and disorientation.17 Usage by students should be monitored so that regular intervals during which the eye and mental overheads are in rest can be provided.

Augmented Reality (AR)

Definition:

Augmented reality (AR) is a new technology that adds digital information on the real world, thereby enriching the user's perception and interaction with his environment. In education, augmented reality provides a very interesting track along the lines of immersive and interactive learning experiences. AR is a form of technology that, in addition to the real world, presents computer-generated texts, images, sounds, or other sensory stimuli to a user (Chen & Chen, 2019). It is a technology that superimposes information on the real world, thus enhancing and making the experience more interactive (Kuar et al., 2018). While combining the physical with the digital, AR makes education more interactive and can be given in a personalized manner, hence, more immersive, informative and effective.

Core Characteristics

Due to its integrated approach to the physical and digital spheres, AR provides an experience that is immersive and unique. Wang and Tsai (2020) outlined the core characteristics of AR as follows:

i. Real-World Overlay: In the real-world, AR superimpose digital content like images, videos or 3D models on objects or environments. This overlay might be invoked by particular markers or GPS coordinates so that users could come across digital information in context.

ii. Interactive AR: By their nature, AR experiences are dynamic and responsive to the user inputs. The users can interact with and manipulate digital objects in the real-time so that the experience is more engaging and intuitive.

iii. Immersive Experience: By combining the real and digital worlds, AR makes an immersive environment much richer. In addition to that, this experience is valuable in learning, training, as well as entertainment as it gives a more engaging and interactive way to receive information.

v. Device Independence: AR makes use of various devices from smartphones, tablets, to specialized AR glasses. This flexibility provides for a wide portfolio of applications and use cases.

Advantages of Application in Education

Based on its potentials, AR could be applied in education in the following ways for enhanced instructional benefits, according to Merghati and Alqahtani (2018):

i. Interactive Textbooks: The AR makes the textbook material interactive instead of just informative. When a student scans a page with his smartphone or tablet, then images in the textbook come alive, and the student sees 3D models and other multimedia content. This makes learning more interesting and helps students understand complicated concepts better by seeing them in action.

ii. Science and Mathematics Education: The AR can enhance learning by making tangible what is often perceived as abstract, like scientific concepts and mathematical equations. Instead of passively learning, students can interact with human anatomy, experiment virtually, and even solve math problems more hands-on. For instance, they can dissect a virtual animal or see the solar system in 3D.

iii. Language Learning: Augmented Reality can enrich language learning through immersive language practice. Students can learn how to speak and listen by interacting with virtual characters in the real world. Furthermore, AR technology can be employed to translate text on the go, so that it is easier for students to learn new languages.

iv. History Education: AR can make history much more interactive by taking students back to historical places and events. Students can go through ancient civilizations, observe the reenactment of historical battles, and even interact with historical personalities. This makes history much more interesting and helps students gain a better realization of former times.

v. Engineering and Design: AR can be used in product design and prototyping within a virtual space. The students are allowed to see their designs in 3D, evaluate how they work, and then make changes before any physical prototypes are made. This may speed up the design phase greatly and also lower costs considerably.

vi.

Educational Limitations

While AR offers great potential for educational enhancement, it certainly comes with drawbacks. According to Wang and Woo (2021), some of the major challenges that currently hinder widespread adoption of AR in education include the following:

1. Technical Limitations:

i. Hardware Constraints: The AR devices, especially smartphones and tablets, often lack the necessary processing power and display capabilities to support effective AR experiences. Consequently, there are performance issues during the execution of heavy AR applications.

ii. Software Compatibility: AR software applications and hardware are often not compatible due to different operating systems and hardware configurations that support varying levels.

2. User Experience Issues:

i. Cybersickness: Extended exposure to AR devices can bring about symptoms associated with cybersickness, including nausea, dizziness, and headaches, which in turn affect the learning experience.

ii. Cognitive Load: Overuse of AR may exhaust cognitive resources, thereby hindering information processing and knowledge retention among learners.

3. Cost and Accessibility:

i. High Cost of Technology: The AR devices and development tools are expensive, so many educational institutions do not invest in this technology.

ii. Digital Divide: There is an unequal access to high-speed internet and sophisticated devices, particularly in developing nations, which subsequently limits the scope that AR can hold in education.

4. Pedagogical Challenges:

i. Teacher Training: Educators are hardly trained adequately on how to incorporate AR in teaching. The lack of adequate training in that regard deprives the educators of the knowledge of the technology itself, creation of engaging AR-based lessons, and assessment of student learning outcomes.

ii. Curriculum Integration: A well-coordinated curriculum with AR experiences is hard to develop.

It requires detailed planning and consideration of the learning objectives and student needs. This is seriously lacking and it poses a serious limitation as well.

Mixed Reality (MR)

Definition:

The MR is a technology that merges the physical and digital realms, enabling users to experience virtual objects within actual surroundings. MR, by integrating digital content into the real world without seams, enhances the immersive experience and human perception while interacting with that content. Significant development in MR technology has been made in recent years, making experiences more immersive and interactive. For instance, Microsoft's HoloLens offers better spatial mapping as well as eye and hand tracking, thus allowing users to interact with virtual objects much more intuitively and naturally than before (Microsoft, 2021). Other significant trends in MR are increased lightweight and cost-effective MR headsets, as well as MR combined with artificial intelligence (AI) and machine learning for smarter and more adaptive experiences (Milgram & Kishino, 2024).

Core Characteristics:

Milgram and Kishino (2024) pointed out the core characteristics of MR to include:

i. Spatial Mapping: The MR systems do not only combine advanced sensors and algorithms but also, they do create a digital representation of the physical environment which makes it possible to accurately place objects and interact with them.

ii. Real-time Rendering: The MR devices use their display capabilities to render virtual objects in real time so that they are synchronized with user's movements and actions.

iii. Hand Tracking and Gesture Recognition: This also is used in mixed-reality systems. In these systems, a user can interact with virtual objects using natural hand movements.

iv. Eye Tracking: The MR systems can make the experience much better by changing the virtual content in real time according to what the user is looking at, if they track the user's gaze.

Advantages of Application in Education:

Mixed Reality (MR) is a developing technology that mixes the real with the digital world, making immersive experiences where virtual objects behave like they are in the actual environment. According to Lee and Chen (2021), Chen and Chang (2021) and Lee and Lee (2021), such a phenomenon has great potential to revolutionize education by offering the following advantages:

i. Interactive Learning Experiences: The MR can make textbooks and lectures much more interactive. For example, students can see 3D models of molecules when learning about complex scientific concepts or instead of reading about them, virtually interact with characters from historical events. Such MR environments enhance student immersion and hence understanding and retention of the learned material.

ii. Hospitality Training and Role Playing: The MR provides a safe and controlled setting where students can apply real-world skills. In fields such as medicine, engineering, and aviation, MR provides an opportunity to simulate complex procedures and scenarios so that students can acquire practical experience without the hazards involved in actual training. For instance, medical students practice surgical techniques on virtual patients while engineering students design and test virtual prototypes.

iii. Collaborative Learning: The MR can be used for the purpose of collaborative learning in that it gives students the opportunity to work together in virtual environments. Students can participate collectively on projects, exchange ideas and perform tasks without regard to their physical positions. This can help cultivate work relationships, communications and creativity.

iv. Personalized Learning: This can be done through MR which is particularly tailored to learning needs and the learning styles of each student. Using all forms of MR, an instructor could take the students on a tour around Mars, while explaining interesting facts about the planet.

v. Accessibility and Inclusion: The MR may be the solution for making education less elusive to students who have disabilities. For instance, learners with visual impairments can get support through the use of MR in explaining graphical concepts and learners with hearing impairments may find visual aids as well as sign language interpreters in virtual environments helpful.

Educational Limitations:

The MR holds great potentials for seeing transformative learning experiences, but it carries some limitations too. If the limitations are not carefully considered, they may impede effective integration MR into education. Such limitations, according to Plass et al., (2019), Muntean (2020) and Huang et al. (2021) includes:

1. Technological Limitations:

i. Hardware Constraints: MR experiences often require specialized hardware, such as high-performance computers and advanced headsets. These devices can be expensive, limiting accessibility, particularly in resource-constrained educational institutions.

ii. Complexity of Software: High-quality MR applications also require sophisticated software development skills and tools. This presents a significant hurdle for most educators and developers not possessing these skills.

iii. Technical Issues: MR systems are susceptible to technical glitches, including delay, tracking mistakes, and projection problems. Such issues interrupt the learning process and cause frustration among users.

2. User Experience Limitations:

i. Cyber Sickness: Long-term exposure to MR experiences may induce symptoms related to cyber sickness, such as nausea, dizziness, and headaches. These effects can greatly reduce the comfort level of users in their interaction with the experience.

ii. Cognitive Load: Experiences in MR can be quite cognitively intense since they often require users to process information about both the real and the virtual environments simultaneously. This is especially the case for younger learners.

iii. Social Isolation: MR experiences can be very isolating because users get immersed in their own virtual worlds. There, is no place for social interaction and cooperation, which are basic components of effective learning.

3. Pedagogical Challenges:

i. Teacher Training: The teachers are not well trained so that they can incorporate MR into their teaching effectively. Therefore, there is a huge need for professional development and training initiatives.

ii. Curriculum Development: High-quality MR-based educational content requires an intense design and planning period. Quite often, this is time-consuming and resource-intensive, and most academic institutions cannot afford such.

iii. Assessment and Evaluation: It can be tough to assess student learning in MR environments due to the ways of learning. Traditional methods may not fit to test the acquired skills and knowledge through such experiences.

Similarities between Virtual, Augmented and Mixed Realities

Immersive realities, namely Virtual Reality, Augmented Reality, and Mixed Reality, have been discovered as instrumental technologies that have changed many sectors of the economy and human lives. Although the three are characterized by specific features, they possess remarkable similarities that establish their potential in changing our readings about and interactions with the world.

Creating Immersive Experiences

The core of VR, AR, and MR is the mission to provide immersive experiences. This relates to the alteration of sensory perceptions aiming for presence or immersion where users feel are really part of another environment or interacting with digital objects in the real world. Park and Kim (2019), Lee and Chen (2021) and Lee and Lee (2021) submitted thus:

i. VR: Fully immerses users into a virtual world. VR disconnects them completely from the real world. In this case, by using headsets specially designed for that purpose, VR can bring people to fantastic worlds, past events in history or distant places and planets.

ii. AR: It superimposes the digital world on the real world by enriching it with additional layers of data. This can be as simple as projecting text messages on a smartphone screen or as complex as creating 3D models of buildings and infrastructures. This can range from the usual signs on the GPS map, to the nearest coffee stop highlighted for the user, to pop up advert at any given time and location in the mall.

iii. MR: This is the stage between virtual and physical worlds where users can interact with digital information as well as the physical environment simultaneously. It makes it possible for a user to digitally manipulate real-world objects, hence creating a completely integrated environment.

Hardware and Software

An immersive experience is facilitated by the advanced hardware and software technologies. Park & Kim (2019) pointed out that they require:

i. Devices that require Specialism: VR, AR, and MR are the devices which require a specialized device e.g. VR headsets, AR glasses, or MR headsets. These devices often are composed of advanced sensors/ displays and processing power to follow user movements,

render realistic graphics, and provide haptic feedback.

ii. Software Sophistication: State-of-the-art software is the key for creation and management of virtual environments, observation over user behaviors, and generating graphic images. It is this software which gives developers possibility to create designs that are truly impressive from the visual as well as functional side.

Enhancing Human Experiences and Interactions

According to Park and Kim (2019) the VR, AR and MR have a common goal enhancing human experiences and interactions:

i. Revolutionizing Industries: There are many industries that may be reimagined by these technologies like gaming, education, healthcare, and entertainment business. Immersive and interactive experiences being the order of the day then it will be possible to say that with the help of such technology learning will become more interesting, healthcare – more available and treatment – more attractive.

ii. Real-World Applications: There are various uses of VR such as simulating real-world scenarios for training purposes, AR provides real-time information and guidance whereas MR enables team work and remote assistance.

Though VR, AR, and MR might be different in the ways they do things, there is an obvious overlap in their principles, requirements and goals (Lee & Chen, 2021). Even if these technologies are not entirely the same, at least they have common principles that makes it possible for users to increase interest towards using them in future as an effective means of interaction with computers and other similar devices and creating the surrounding environment.

Differences between Virtual, Augmented, and Mixed Realities

The most notable examples of these immersive technologies are VR, AR, and MR. While the three share a broad intention to enhance human experiences, their core principles, technological necessities, and user experiences differ vastly from one another. Let's consider some basic grounds on which they differ, Park and Kim (2019), Lee and Chen (2021), Lee and Lee (2021) and Milgram and Kishino (2024):

The Core Concepts

i. VR: In VR, user is completely immersed into a simulated digital environment which detaches him from the real world. With the help of specialized headsets, VR is able to take its users to magic realms, historical events or space journeys.

ii. AR: This technology superimposes digital information on the real world, thus augmenting it with extra layers of data. These can be just simple text displays all the way up to complicated 3D models which enrich the user's perception of reality.

iii. MR: In MR, the physical and digital worlds are merged on a level that an observer can interact with both real and virtual objects at the same time. It is possible through this technology for users to make interactions with virtual objects while in the actual world hence making it a truly mixed reality system.

Immersion Level

i. VR: Provides total immersion, shutting users off from the physical world entirely.

ii. AR: Offers a moderate immersion experience by overlaying digital information on the real world.

iii. MR: Provides an immersion experience quite well, offering the combined presence of the physical and digital realms.

User Experience

i. VR: Delivers an experience that is entirely immersive, sometimes even using motion tracking and haptic feedback.

ii. AR: Adds digital information to the real-world experience, usually accessed through mobile devices or smart glasses.

iii. MR: Aims to provide users with the ability of interacting with objects, whether real or virtual, because this is what makes things more natural and easier to understand.

Technological Requirements

i. VR: Requires high-end hardware, including powerful processors, high-resolution displays, and advanced motion tracking systems.

ii. AR: It can be used with anything from mobile phones to more targeted AR glasses.

iii. MR: Demands specialized hardware which includes MR headsets that should be able to accurately track user's position and orientation.

Applications

i. VR: Ideal for gaming, training simulations, and virtual tourism.

ii. AR: Suitable for gaming, education, retail, and industrial maintenance.

iii. MR: More appropriate for co-designing, remote assistance, and medical training.

With the continuous advancement of technology, the differences among VR, AR, and MR are increasingly becoming less significant. A combination of these technologies will often play a role in creating more complex and occasionally more immersive experiences. Though VR, AR, and MR share a common objective of enhancing human experience, the trio differs considerably on the basis of core principles, technological requirements, and user experience (Park & Kim, 2019).

Acknowledgment of such differences will lead to a better understanding of what each technology is uniquely empowered to do and how it might be employed to transform different instructional exercises.

Factors to Consider in Choosing the Right Immersive Reality for Instructional Exercises

The choice of the most appropriate IR technology to be used in an educational exercise requires accurate consideration of several factors. The following are most relevant factors to be considered in selecting VR, AR, and MR for educational purposes, according to Parsons et al. (2015), Park and Kim (2019), and Plass et al. (2019):

Understanding the Technologies

It's very essential to understand the core concepts of each technology before delving into the usage.

i. VR: By the help of VR, users will be totally immersed in computer generated environment, which gets them disconnected from the real physical world.

ii. AR: AR is classified as a technology that builds an overlay of the computerized information on the live view, enriching it with various layers of information.

iii. MR: By blurring the line between the physical and digital world, MR allows users to interact with both/real/virtual objects simultaneously.

Learning Objectives and Content

i. Complex Concepts and Procedures: VR stands out when it comes to explaining complex concepts and procedures that can't be visualized or simulated in the real world. For example, we don’t have a model to display how to perform surgery but medical students can practice it using VR technology.

ii. Real-World Context: AR has the potential to enrich in-context learning situations via providing information and context. For example, students could use AR for recognizing plants and animals in their natural habitats.

iii. Hands-On Learning: One of the great possibilities that MR offers is hands-on learning, where students can play with virtual objects in the real world. This would be particularly useful for tasks like assembling machinery or conducting scientific experiments.

Learner Characteristics and Preferences:

i. Sensory Preferences: Depending on the preferences of their learners, sensory abilities, and even some of the types of media that have been popular among them, you can persuade. Some learners may prefer the immersive experience of VR, while others may benefit from the visual enhancements of AR or the interactive nature of MR.

ii. Learning Styles: Learning styles are also a consideration when choosing IR technology. For instance, visual learners can benefit from the visual depictions that VR and AR offer while MR provides a hands-on experience for kinesthetic learners.

Technical Requirements and Costs

i. Hardware and Software: The choice of IR technology for example will depend on the availability and cost of necessary hardware and software. VR may demand high-end hardware but AR and MR can be done with more affordable devices.

ii. Technical Expertise: The level of technical expertise required for the development and implementation of an IR experience also influences the decision. VR and MR frequently require more specialized skills, whereas AR is generally easier for educators to access if they have only a basic technical knowledge.

Learning Environment and Constraints

i. Physical Space: The learning environment determines the choice of IR technology. VR requires special rooms to be set up to avoid motion sickness, while AR and MR can just be used in many environments, including classrooms and outdoor settings.

ii. Connectivity: Without reliable internet connectivity, especially cloud-based incident response (IR) applications, are useless. In such cases, standalone VR and AR devices are likely more appropriate.

Accessibility and Inclusivity

i. Physical Disabilities: The discussion above probably hints at the requirements of

learners with physical disabilities. VR and AR often demand fine motor coordination and visual acuity; MR can be much more accessible to those with physical limitations.

ii. Cognitive Disabilities: Different IR technologies should be provided with varying levels of cognitive demands. For some learners, the immersiveness of VR might be overwhelming, while for others, the concentrated attention required by AR and MR might be just what they need.

A careful consideration of all these factors will enable educators to select the most appropriate interactive technology that will enhance the learning experience, engage students and accomplish intended learning outcomes.

A Step-by-Step Guide for Engaging Immersive Reality for Instructional Exercises

Immersive Reality (IR), including VR, AR, and MR, offers a novel perspective on instructional design. While traditional approaches often rely on verbal explanation and static visuals, IR provides the opportunity to create immersive interactive experiences that enhance engagement and knowledge retention among learners. According to Kaur et al. (2018), Huang and Bengbasat (2019), Park and Kim (2019), Lee and Chen (2021), and Lee and Lee (2021), a gradual approach to integrating IR into instructional activities is presented thus:

Step 1: Define Learning Objectives and Target Audience

Clear Objectives: Start with a clearly stated set of specific learning objectives that you hope to achieve as a result of the IR experience. Ensure that the objectives are measurable, attainable, relevant, and time-bound (i.e., SMART).

Identify Target Audience: Think about the age, technical competence, and learning styles of your target audience. This will assist you in adapting the IR experience to meet their requirements and expectations.

Step 2: Select the Appropriate IR Technology

Select the Appropriate Tool: Choose the most suitable information retrieval technology for your learning objective and audience. VR is great for immersive simulations and virtual excursions, AR adds digital content to the real environment, while MR combines physical and digital realms for interactive educational experiences.

Note that Artificial Intelligence systems could be referred to when making a decision on the devices which will allow you to access the virtual reality headsets, augment reality glasses or mixed reality devices, and even the software that will help you develop and deliver an IR content.

Step 3: Design Immersive Learning Experiences

Storyboarding: Develop a storyboard that captures the interplay and experiences in the IR process. This will help you get an overall view of how the flow of the learning process goes and helps achieve a good story.

Interactive Elements: With the help of interactive elements like puzzles, quizzes, and challenges learners are to be given something more than just their lesson.

Real-World Relevance: Provide links connecting the experience of IR with real world scenarios and applications, these will help to make the learning more meaningful and relevant.

Step 4: Develop High-Quality Content

Visual Appeal: Technically this can be achieved by creating eye-catching, high quality 3D models, animations and graphics to increase the immersion and engagement.

Clear Instructions: Provide clear and concise instructions to guide learners through the IR experience.

Accessibility: Your job should involve making sure that learners with disabilities can access the IR content by creating text alternatives, audio descriptions, and other assistive technologies.

Step 5: Pilot Test and Refine

Survey the Learner Community: Administer a pilot study targeting a small number of learners to assess the effectiveness of the IR experience so that you gather data on the learners' technology fluency and their perceptions.

Iterative Design: The content of the IR is refined based on feedback while also enhancing the learning experience as a whole.

Step 6: Implement and Evaluate

Use in Curriculum: Use the experiential learning with Information Resources in your adult education curriculum.

Assess Learner Outcomes: Measure the impact of the IR experience on learner outcomes through assessment of learner performance on relevant assessments and surveys.

Feedback Gathering: Continuous feedback gathering from the students and the teacher regarding what needs improvement.

Conclusively, immersive realities (IR) technologies, which include virtual reality,

augmented reality, and mixed realities, have the potential to transform education by providing engaging and interactive learning experiences. VR can be used for field trips and simulations by transporting students to different virtual locations; AR makes real-world overlaying of digital information possible in interactive textbooks and language acquisition; MR allows collaboration in learning and design with simultaneous access to physical and digital environments. While each technology has its unique advantages and challenges, their thoughtful integration into education can enhance student engagement, comprehension, and skill development.

REFERENCES

Chen, C. H., and Chang, C. C., 2021. Immersive learning with mixed reality: A systematic review. Computers and Education, 161, 104076.

Chen, C. Y., and Chen, S. Y., 2019. The impact of augmented reality on students' learning performance: A meta-analysis. Computers and Education, 132, 103-113.

Huang, H. C., Chen, C. Y., and Chen, S. Y., 2021. A review of mixed reality in education: Current trends, challenges, and future directions. Computers and Education, 165, 104137.

Huang, X., and Benbasat, I., 2019. Virtual reality in education: A systematic review. Computers and Education, 132, 1-14.

Johnson, I. E., Nkanu, C. U., and Udo, A. L., 2021. Checkmating the weaknesses associated with information and communication technologies in education for improved effectiveness and efficiency. Journal of Education and Practice, 12(8), 80-85. http://doi: 10.7176/JEP/12-8-11

Johnson, I. E., Offiong, A. E. A., Edu, G. O., Ekwok, L. N., Sanda, F. A., Tawo, C. N., Imoke, J. E., Umo, U. A., Akpo, A. F., Ekeng, E. B., Ewuru, A. A. Ushie, P. U., Ndome, L. E., Sam, I. E., Oyamo, V. I. and Ushie, C. A., 2025. Effects of doodly-created instructional multimedia environments on academic self-efficacy of undergraduate educational technology students. Ianna Journal of Interdisciplinary studies, 7 (1), 71-83. DOI: https://doi.org/10.5281/zenodo.13895408

Johnson, I. E., Ofoegbu, T., Asogwa, U. D., Offiong, A. E. A., Imoke, J. E., Abanyam, V. A., Ushie, D. E., Addo, D. E., Akanimoh, M. E., Denwigwe, C. P., Ekpoto, D. F. Adams, A. P., Ngwu, M. E. and Iyam, M. A., 2024. Comparing the academic achievement of students taught educational technology with Doodly-created multimedia instructions in classroom and online learning environments. Ianna Journal of Interdisciplinary studies 6 (2), 161-177. DOI: https://doi.org/10.5281/zenodo.12189075

Kaur, M., Singh, R., and Kumar, S., 2018. Augmented reality in education: A systematic review. International Journal of Interactive Mobile Technologies, 12(10), 109-123.

Lee, K. H., Kim, H. J., and Kim, Y. G., 2020. The Effectiveness of Mixed Reality for Language Learning: A Systematic Review. International Journal of Interactive Mobile Technologies, 14(1), 1-17.

Lee, K. M., and Chen, C. H., 2021. Mixed reality in education: A systematic review. Computers and Education, 162, 104137.

Lee, K. M., and Lee, H. J., 2021. A systematic review of mixed reality in education: A focus on learning outcomes and user experience. Computers and Education, 165, 104136.

Lee, K. M., Lai, C. L., and Chen, G. D., 2020. Virtual reality in education: A systematic review. Educational Technology and Society, 23(4), 242-258.

Merghati, S., and Alqahtani, M., 2021. The potential of augmented reality in education: A systematic review. Education Sciences, 11(12), 1072.

Microsoft., 2021. Microsoft HoloLens. https://www.microsoft.com/en-us/hololens

Milgram, P., and Kishino, F., 2024. A taxonomy of mixed reality visual displays. IEICE Transactions on Information and Systems, E77-D (22), 1231-1239.

Muntean, I., 2020. Mixed reality in education: A systematic review. Computers and Education, 147, 103822.

Park, N., and Kim, Y. K., 2019. A systematic review of immersive realities in education: Current status and future directions. Educational Technology Research and Development, 67(4), 949-973.

Parsons, X., Rizzo, A. A., and Bailenson, J. N., 2015. Virtual reality as a tool for experiential learning: A meta-analysis. Frontiers in Psychology, 6, 1157.

Plass, J. L., Moreno, R., and Brünken, R., 2019. The use of Mixed reality in education: A meta-analysis. Educational Psychology Review, 31(2), 315-346.

Wang, S., and Tsai, C. C., 2021. The effectiveness of augmented reality in science education: A meta-analysis. Computers and Education, 162, 104137.

Wang, S., and Woo, H. K., 2021. A review of augmented reality applications in higher education. Computers and Education, 166, 104188.

Wang, X., Wang, Y., and Wang, X., 2021. The Effectiveness of Mixed Reality in Chemistry Education: A Systematic Review. Computers and Education, 162, 104132.