

Chapter 7

AR, VR, and AI for Education



7.1 What Is AR and VR?

These days, people spend time in front of devices. We now rely heavily on computers, smartphones, and televisions for our news, social media, entertainment, and other daily needs. As a result of technological advancements in virtual reality (VR) and augmented reality (AR), we can now enjoy a whole new level of interactivity with our devices.

What Is Augmented Reality (AR)? The term “augmented reality” (AR) refers to the process of creating a synthetic environment that combines the digital and physical worlds in an ideal way (Martin 2022). Apps for smartphones and computers that use augmented reality to superimpose computer-generated imagery over a physical setting.

What Is Virtual Reality (VR)? The term “virtual reality” (VR) refers to any technologically created simulation of an external environment (Martin 2022). It is the technology behind those eye-popping 3D movies and games. Combined with computers and sensory gear like headsets and gloves, it allows for creating simulations that are very close to the real world and effectively “immerse” the viewer. Virtual reality is not just for fun and games; it has severe applications in education, science, and training.

How Does AR Work? With the help of computer vision, mapping, and depth monitoring, AR can display relevant content in the right place at the right time (Martin 2022). Due to this feature, cameras may now gather, transmit, and process data to display digital material tailored to the subject being viewed.

By superimposing pertinent digital information over the user’s real-world surroundings in real-time, augmented reality provides a richer, more meaningful experience. You may enjoy augmented reality (AR) with a smartphone or specialized equipment.

How Does VR Work? The primary goal of VR is optical illusion simulation (Martin 2022). The user must position the virtual reality headset's screen in front of his or her eyes. In this way, it becomes impossible to have any contact with the outside world. In virtual reality, the screen is sandwiched between two lenses. The eyes must be adjusted by the user for their eye movement and posture. An HDMI cable linked to a laptop or mobile device can display the images on the screen.

It employs head-mounted displays, audio, and, in some cases, hand-held devices to create an artificial environment. Virtual reality creates a natural environment using visual, aural, and haptic (touch) input.

7.2 How Does VR/AR Fit into the Education System?

The potential influence of VR/AR deployment in the educational system may be summed up in four words: harder, better, faster, and stronger (Tkachenko 2022). The educational system requires cutting-edge technological advancements to adapt to a constantly evolving world. The education system will unavoidably progress toward more cutting-edge technologies like virtual and augmented reality shortly.

Virtual reality (VR) and augmented reality (AR) solutions for education offer readily transferable business models, which are an attractive feature for potential investors (Tkachenko 2022). On the one hand, you will not have to worry about developing a long-term profitable business strategy. There is no way it could ever happen because rules are handled differently in public education.

In augmented and virtual reality (AR/VR) businesses, one of the biggest challenges is developing a sustainable business model; removing this variable frees up significant time for focusing on creating compelling content (Tkachenko 2022). However, that is when things start to get serious. Virtual reality (VR) instruction requires more than just a well-crafted reproduction of a bodily function; teachers must also consider pupils' backgrounds and skill levels.

7.3 Reasons to Use AR and VR in the Classroom

Incorporating cutting-edge technologies like augmented and virtual reality (AR and VR) into the classroom has increased student participation and retention.

Recent years have seen a rise in the use of augmented and virtual reality (AR/VR) technology in STEM education. Teachers use exciting new technologies to introduce their students to new worlds and prospects in their studies and careers.

There are several reasons (Wilson 2019) why these immersive technologies will affect students, and they are becoming increasingly apparent (see Fig. 7.1).

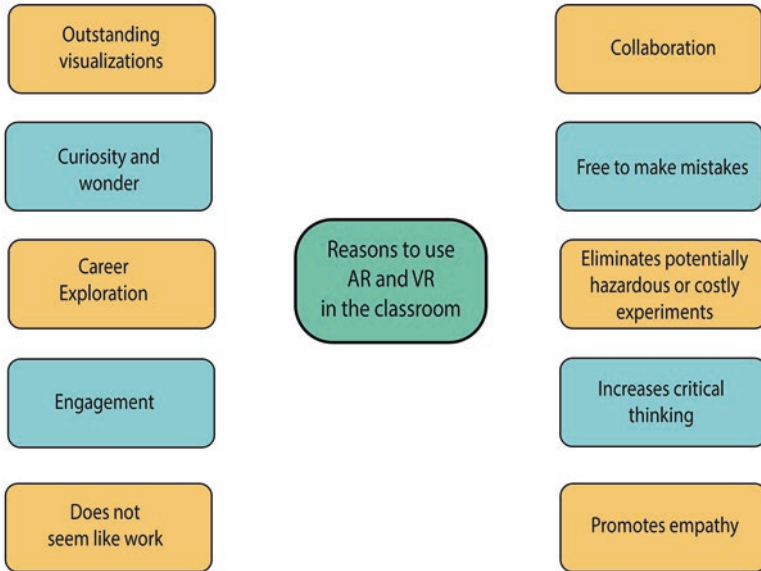


Fig. 7.1 Reasons to use AR and VR in the classroom

1. *Great visualizations:* Most children may encounter limited prospects because of their location, especially in rural areas with poverty rates above the national average. However, by adopting the vision of offering the finest possible experiences through superior instructional technology, students can access thousands of models they may interact with, virtual field trips to exotic locations, and potentially transformative simulations. It gives the students what they can accomplish, motivating them to work more.
2. *Curiosity and wonder:* In the classroom, students using augmented and virtual reality (AR/VR) technology is a beginning, not a conclusion. Unlike what may be found in a lecture or textbook, these interactive activities pique students' enthusiasm for learning. Many students indicate that their interest in a topic was aroused during classes in a virtual environment, leading them to do more research outside of class.
3. *Career exploration:* Experiences in augmented reality (AR) and virtual reality (VR) can show students many career options and assist them in finding their passions, giving them a head start in deciding which course of study or profession to pursue. CTE programs provide students with hands-on training in their chosen field even before they graduate high school by using AR and VR in the classroom, expanding students' access to academic pursuits and opportunities.
4. *Engagement:* Virtual reality models can pique their curiosity and facilitate their conceptualization of complex ideas by putting students in charge of their learning. Because AR and VR allow students to go deeper into topics, alter virtual models in novel ways, and even build their designs and experiments, they can maintain interest and concentration throughout the class.

5. *It does not seem like work:* Students have a great time using AR and VR for study and exploration. These interactive activities make students feel like they are playing, but they are learning through discovery and exploration in ways impossible in a traditional classroom setting.
6. *Collaboration:* Students are likelier to initiate and contribute to teacher and peer-to-peer communication when engaged, interested, and driven. Pair work is typical in the classroom; students work with the instructor to discover new content while exchanging information and perspectives.
7. *Free to make mistakes:* Students can be more safely encouraged to make mistakes and learn from them in virtual science labs than in the actual world. Students can make mistakes, gain valuable insights, and swiftly recover when using virtual models, all without incurring the cost or stress of having to perform an actual experiment. With this paradigm shifted, students are given more freedom to experiment and grow from their experiences, whether those experiences are successful or not.
8. *Eliminates potentially hazardous or costly experiments:* Using virtual models, middle and high school students can learn about complex topics that would be out of reach in a traditional classroom setting, such as roller coaster construction and heart dissection. Virtual reality (VR) provides students of all ages with high-tech, risk-free, and cost-effective educational experiences, from introducing them to the inner workings of the human and animal bodies to letting them experiment with mechanics and robotics.
9. *Increases critical thinking:* Students can ask “what if?” questions and generate constructive hypotheses in a virtual context, leading them to more credible conclusions. Students are encouraged to use their imaginations to investigate and address issues by manipulating models to observe how different outcomes result from human or environmental actions.
10. *Promotes empathy:* Using virtual reality in the classroom can increase students’ capacity for empathy and positive outlooks on various social groupings and real-world circumstances. Students gain a more nuanced and empathetic understanding of diverse cultures and lifestyles by putting themselves in another person’s virtual shoes.

7.4 The Present Applications of VR and AR in Education

As state of the art in immersive technologies advance, novel applications in the classroom are constantly being developed, and learning at all levels and fields benefits significantly from AR/VR technologies. To help pave the way for the next generation of immersive educational technology, this section highlights recent breakthroughs laying the groundwork for that future.

7.4.1 *K-12 Education: Enriching Classroom Experiences and Expanding Opportunities*

Immersive Learning Curricula and Resource Collections Many augmented and virtual reality (AR/VR) solutions for K-12 education come with pre-made lesson plans and libraries of immersive experiences that can be tailored to meet the needs of individual classrooms. Publicly available resources from government organizations, libraries of immersive content with an educational focus, and specialist services from companies specializing in applying AR/VR in immersive experiences (Dick 2021) are just some of the options currently available.

1. ***Public Resources:*** The Smithsonian Institution maintains a database of freely available 3D models that visitors can use to see Smithsonian Museum objects in their natural environments through augmented reality on a mobile device. These models enhance scale and interaction in three-dimensional space, which are superior to print or digital two-dimensional representations. These materials are ideal for teachers supplementing environmental and American history lessons. Any mobile device with a camera can access the collection via the web-based Voyager platform, which features ten artifacts, such as full-size skeletons, cultural relics, and statues. The National Aeronautics and Space Administration (NASA) provides teachers with interactive educational materials that can be incorporated into lessons or expanded upon in a museum or planetarium setting. NASA launched a virtual reality (VR) experience in 2018 that puts users in the center of a rocket blast-off. The agency also provides 360-degree videos that can be seen online via a VR headset, desktop computer, or mobile device. This virtual reality (VR) experiences can transport students to far-flung locations and give them a taste of what it would be like to live on the International Space Station or explore distant planets.
2. ***Content Collections:*** *The New York Times* has published a guide titled “VR in the Classroom,” which features lesson plans that use the publication’s collection of 360° videos. Teachers with little experience incorporating immersive content into their courses will benefit from the guide’s detailed lesson plans and step-by-step directions covering STEM and humanities topics. In addition to the lesson plans, 360° videos can be used independently in the classroom. You only need a computer, smartphone, or VR headset to see the videos. Many features once available in the Expeditions app—which lets educators create and conduct virtual field trips—are now available on the Google Arts and Culture platform. Artwork, space travel, natural history, musical events, and cultural and historical landmarks worldwide are just some of the 360-degree experiences available on the platform. Teachers can use these activities as building blocks for larger virtual field trips or supplementary materials for existing sessions.
3. ***Edtech Services:*** Avantis, a provider of educational technology, has released a virtual reality (VR) platform for schools called ClassVR. The service includes the necessary gear (plastic VR headsets) and a library of immersive instructional

content that teachers can manage from a centralized administration system on a single computer. This approach allows teachers to integrate virtual reality into guided classes, which is impossible with decentralized libraries because teachers have no control once students put on the headsets. Access to field excursions and other extracurricular activities outside the classroom is only one of the many educational inequalities that inspired the creation of Kai XR, a subscription-based virtual reality (VR) learning platform. The service provides multilingual, instructor-led virtual tours of real-world attractions like museums, landmarks, and outer space. The platform not only provides students with access to immersive locations and virtual experiences but also provides students with the means to create their own.

Subject Specialization Some K-12 products provide experiences for various courses and learning goals, while others focus on a narrower set of topics.

Designed to educate middle school students about marine biodiversity, BioDive by Killer Snails is a virtual reality (VR) experience accessible over the web. Students take on the role of marine scientists as they use the app to investigate a marine ecosystem and are then asked to record their findings and hypotheses in an electronic notebook. A student needs a web browser and Internet connection to participate in the interactive experience and keep a digital journal. In this way, educators can better monitor and direct their students' academic development.

In order to include Black experiences in middle school textbooks, Movers and Shakers have created an augmented reality tool. Recently, the group released an app called Kinfolk, which has augmented reality (AR) replicas of prominent Black leaders, including Frederick Douglass, Harry Belafonte, and Shirley Chisholm, and allows children to learn about and connect with these figures. Users can check out the digital "monument" for each person of note and view further information about them, like their biography, items from that time period, and even related music.

Special Education Students of all abilities, including those with cognitive and learning challenges, can benefit from the tailored learning solutions made possible by AR/VR. Furthermore, special education children with autism spectrum disorder (ASD) can access intensive programs designed for their unique needs.

The University of Kansas's Center for Research on Learning and Department of Special Education runs the Virtual Reality Opportunities to Implement Social Skills project, abbreviated as VOISS. Students in middle school with learning difficulties are targeted for this initiative, which employs virtual reality experiences to teach and practice social skills. The program gives kids and educators a safe space to experiment with various uses of a headset or Internet-connected gadget.

Young people on the autism spectrum can benefit from Floreo's virtual reality (VR)-based social and life skills instruction. The activities are designed to help participants develop their social skills, prepare them for real-world encounters, and give them opportunities to exercise control over their emotions. The user can practice communication and social cues through story-based interactive scenarios in a gamified setting. Teachers and other adults in authority can monitor students' development and shape their learning with the help of an app on a mobile device.

Higher Education: Putting Theories into Practice and Preparing Students for Their Futures Immersive learning has traditionally been at the forefront of STEM and healthcare. However, higher education institutions are increasingly looking to AR/VR solutions to improve instruction in traditionally “soft” subjects like the humanities, the arts, and even hard sciences like law and business. The benefits of AR/VR for learning are combined with their use in higher education to break through geographical obstacles. Many colleges and universities are less hierarchical than K-12 schools, allowing students more freedom to learn and explore independently under the guidance of faculty (Dick 2021).

STEM Education More and more professors in the STEM fields and educational technology professionals are developing innovative ways to convey the field’s notoriously difficult-to-explain topics through AR and VR. In STEM education, immersive experiences can be beneficial since they provide students with hands-on opportunities that would otherwise be impractical or unattainable.

Researchers from Arizona State University, Northern Arizona University, the University of Arizona, and the University of Colorado Boulder collaborated to create Polar Explorer, a virtual reality (VR) teaching tool for teaching undergraduate students about the effects of climate change on polar environments. This initiative allows students to go on virtual field trips to the Arctic, something few people would ever be able to do due to a lack of funds or physical ability.

Teachers at Spain’s Universidad Católica San Antonio de Murcia created a virtual reality (VR) environment using the web-based Mozilla Hubs to provide students with experience with the coronavirus. When in-person collaboration was impossible owing to COVID-19 safety requirements, students could still work with their professors and peers in real time using virtual environments to explore learning materials like a larger-than-life virus model.

Purdue University’s astronomy students have access to a virtual, collaborative space where they can interact with 3D models of *astronomical* objects. Via a computer and a headset, students and the professor can enter the virtual space and learn about faraway, complicated phenomena that would otherwise have to be explained using two-dimensional images.

Through a new platform called HoloChem, the Air Force Academy is incorporating MR solutions into chemistry classes. The platform, built by GIGXR (a manufacturer of augmented reality, virtual reality, and mixed reality learning systems for STEM and medical education), enables cadets to perform complex chemistry experiments that would be too risky for less experienced learners to perform in real labs.

Medical Training Hands-on, in-person training is essential in the medical field, from learning how to communicate with patients to performing intricate procedures. AR/VR solutions are becoming increasingly popular among medical and healthcare instructors because they offer low-cost, low-risk, and frequently more participatory alternatives to conventional methods of instruction.

The COVID-19 epidemic severely hampered medical education, but the collaborative, MR-based approach proved invaluable for distant learning. Case Western Reserve University has created a medical education program, HoloAnatomy, which uses Microsoft HoloLens MR equipment to improve traditional anatomy teaching methods. HoloAnatomy replaces cadavers with 3D anatomical models that can be interacted with and evaluated in real-time.

Oxford Medical Simulation is a virtual reality (VR)-based medical simulation platform that allows students to practice patient care situations such as taking a medical history and giving treatments. If a class cannot access headsets, the software can be used remotely on a computer. Students can re-experience a simulation as often as they like to learn from their mistakes and improve each time.

The School of Medicine at Imperial College London has begun using Microsoft HoloLens for remote clinical instruction in preparation for the 2020 COVID-19 pandemic. Clinicians wear HoloLens devices to record a live stream of patient interactions during rounds, representing the hands-on clinical experience necessary for medical education. In the same way, students can ask questions in person during rounds; they can do so virtually during virtual rounds. Because of the prevalence of virtual learning environments, opportunities previously limited to a small group of students are now available to a much larger audience.

Arts, Humanities, and Other Disciplines AR/VR in higher education goes beyond the hard sciences to improve instruction in all fields. Academics and experts in all fields increasingly utilize these tools to create more interactive and informative learning environments for students.

In 2018, a visiting professor at Hamilton College taught a class titled “Dream a Little Dream: Virtual Realities and Literature,” which required students to create their own VR worlds based on literary books. Students learned the principles of virtual reality production while also gaining valuable humanities skills like critical thinking and literary analysis.

The Center for Immersive Media at the University of the Arts was established in 2019 to integrate virtual reality (VR), motion capture, and spatial audio into the institution’s stellar performing arts curriculum. Teachers and students can use the space to experiment with virtual and augmented reality for performing arts education.

The Virtual and Augmented Reality Language Training (VAuLT) initiative was established in 2018 at the University of Oregon’s Center for Applied Second Language Studies. VAuLT is an alternative to more conventional methods of teaching a new language that gives students real-world experience in a safe environment. Foreign language learners can use the app to practice more natural conversations and put classroom concepts into context while abroad.

Soft Skills and Career Development In addition to their utility in specialized courses, AR/VR tools can teach students the “soft critical skills” they will need to succeed in the real world. This is especially helpful for future law, business, and healthcare professionals, where soft skills like communication, negotiation, and critical thinking are as crucial as technical know-how.

Bodyswaps, a platform for digitally delivering training in “soft skills,” has created a virtual reality (VR) simulation called Career Mindset Development in collaboration with UK’s *further education colleges*. New employees can use the 15-minute session to hone their verbal and nonverbal communication skills and receive constructive feedback.

Faculty at the University of Michigan has received funding from the university’s Innovation Fund for many immersive technology-based soft skills and leadership development initiatives. Some projects span academic disciplines and learning goals, such as those that teach future lawyers how to provide constructive feedback in the courtroom, those that help nursing students become more effective leaders, and those that train the next generation of social workers.

Technical Education and Specialized Training In order to better prepare students for real-world fieldwork, immersive experiences might expose them to highly specialized and possibly *hazardous* activities. Technical education and specialized training can benefit from AR/VR since it provides a low-risk, low-cost learning environment, much like soft skills training. To further broaden participation in technical education, augmented and virtual reality technology might lessen the burden of acquiring or traveling to training facilities.

Health sciences, advanced manufacturing, agriscience, and transportation are just a few industries that might benefit from the immersive learning tools provided by zSpace, an ed-tech provider that creates interactive AR experiences for specialized hardware. In 2019, zSpace teamed with NOCTI, a provider of resources and credentials for technical and vocational education, to allow students to use the platform to acquire up to thirty-three certifications in various fields. Over fifty US technological universities have adopted zSpace software, the company claims on its website.

The Synthetic Training Environment (STE) is used by the United States Army to give its leaders the tools they need to train and simulate in artificial environments employing augmented reality (AR), virtual reality (VR), and mixed reality (MR). This feature liberates training from being restricted to a particular physical place or terrain, paves the way for more iterative and information-rich training simulations, and equips leaders with the analytical tools they need to tailor training to meet their unique goals.

The FerrisNowVR Initiative at Michigan’s Ferris State University is a virtual reality (VR) program that provides innovative STEM instruction to high school students in underserved areas of the state. The program will use funding from the US Department of Agriculture’s Distance Learning and Telemedicine program to equip twenty high schools and career and technical education centers across 11 counties with the necessary equipment. Students can get college credit for IT or other technical credentials through dual enrollment in university-level synchronous courses without leaving their home district.

Teacher Training: Preparing Educators for Success There are many potential users for educational virtual reality experiences besides schoolchildren and college

students (Dick 2021). The same features that make these technologies useful in primary, secondary, and tertiary settings also put them in a prime position to aid in the professional development of teachers.

The University of Central Florida’s Center for Research in Education Simulation Technology created TeachLivE, an interactive classroom simulation. The program offers a safe space for new and aspiring educators to practice high-pressure handling situations to prepare them for classroom challenges. Teachers can learn about their actions and reactions in a safe, no-risk environment by playing out scenarios in a simulation.

The gender and racial prejudices that may affect instructors’ interactions with their female and minority students are discussed in Teacher’s Lens. Participants use virtual reality headsets to experience a simulated classroom interaction in which they are asked to raise their hands and call on students of varying racial and gender identities. Using the Harvard Implicit Association Test results as a starting point; the program analyzes the participant’s responses to determine whether or not they exhibit unconscious preference. It then provides constructive feedback to help them recognize and overcome any biases.

7.5 Examples of VR and AR in Education

This section will look at ten favorite ways AR/VR is used in the classroom (Marr 2021) to help students learn and stay engaged:

1. Using augmented reality to visualize scientific concepts. With the help of augmented reality, we can now generate a funnel cloud and transport it into the classroom, where the students may have an up-close look at one of these catastrophic storms. Alternatively, kids can use augmented reality (AR) to tour a beehive and learn more about the bees’ vital role in maintaining a healthy ecosystem.
2. SkyView is an augmented reality app that superimposes night sky images, allowing students to travel across space virtually. Anyone with a mobile device and SkyView may look up and learn about the night sky, from stars and constellations to planets and satellites.
3. Dissecting frogs to learn about their internal anatomy was a repulsive procedure to us, and it was probably even worse for the frogs. Students may examine a frog’s interior anatomy with the augmented reality technology built into the Frogipedia app.
4. Microsoft HoloLens has created a mixed-reality method for medical students and practitioners to study the human body. To better learn anatomy and how to treat various medical disorders, students can now really “flow through the bloodstream,” isolate, magnify, and even walk inside the various parts of the human body.

5. The Berlin Blitz in 360°, created by Immersive VR Education for the BBC, allows viewers to experience what it was like to be a part of a nighttime raid on Nazi Germany in 1943.
6. Even though most educators lack the resources to transport their students to places like Mount Everest's Base Camp or the Louvre, those institutions' collections can be experienced through immersive Google Expeditions virtual field trips.
7. If you have ever wanted to rehearse a speech in front of a fake audience before delivering it to real people, you can now do so by strapping on a pair of VR glasses. With VirtualSpeech, you may train your public speaking abilities using cutting-edge VR simulations.
8. The Mona Lisa and other masterpieces are now accessible without the hassle of crowds or glass barriers at Steam's Virtual Museum of Fine Art.
9. In the business world, extended reality can also be used by training businesses. For the benefit of both the public and police, many police departments are beginning to use virtual reality (VR) to prepare officers for dealing with riots and making arrests under specific circumstances.
10. Reading a book to learn a new language can feel very theoretical, but with the help of virtual reality and educational software like Mondly, you can get a more realistic feel for the language even if you cannot visit the nation itself. Virtual reality (VR) environments like those provided by Mondly allow for natural dialogue with native speakers, making learning a language easier and more enjoyable.

You should be excited about the potential of augmented and virtual reality in education after seeing these beautiful examples.

7.6 Advantages and Challenges of Using AR in Education

Here are the advantages and challenges of augmented reality in education.

Advantages of Augmented Reality in Education Educators that have experimented with augmented reality software have found several benefits. What follows are the most important ones (Program Ace 2021)!

- *Access to learning materials:* Many students are left to rely on out-of-date materials or research at home because of a dearth of teaching resources in educational institutions. The most up-to-date information can be downloaded and presented engagingly via an augmented reality app.
- *Access to virtual equipment:* When you need to get familiar with new machinery or learn how to use it, augmented reality software can show you a 3D model of the device and provide helpful instructions. This is an excellent supplement to more conventional textbooks.

- *Higher student engagement:* Students learn more and better retain information when immersed. Many people will find this to be a refreshing break from the norm.
- *Faster learning:* A novel presentation method can speed learning and reduce preparation time. This allows us more time to focus on mastery and exploration in specialized areas.
- *Safer practice:* Anatomy classes, for example, no longer necessitate the dissection of live animals because the process can be accurately simulated in software. Students can acquire the same amount of practice without using harmful materials or equipment.

Challenges of Augmented Reality in Education Although there are many positive aspects to using online learning resources, there are also some drawbacks (Program Ace 2021):

- *Proper hardware is needed:* Older phone models and those running older versions of operating systems do not support the immersive nature of augmented reality applications; hence they cannot be loaded on such devices. Buying smartphones or smart glasses for students might not be feasible for schools that are not known for having cutting-edge technology.
- *The lack of teachers' experience with tech:* A minority of teachers either do not see the value in or are uncomfortable using digital tools. When the instructor is tasked with demonstrating the tool's use and assisting struggling students, this can become a problem.

The advantages of utilizing augmented reality apps in the classroom outweigh the disadvantages. The difficulties above, moreover, are solvable with little exertion.

7.7 Advantages and Challenges of Using Virtual Reality in Education

Here are virtual reality's advantages (Fig. 7.2) and challenges (Fig. 7.3) (Hicks 2016) in education.

Advantages of Virtual Reality in Education

- *Excellent visuals that would be impossible in a regular classroom are available here.* One of the many benefits of virtual reality is the ability to experience new worlds and scenarios in rapid succession. When you put on a virtual reality headset, you are exposed to realistic images that can leave an impression.
- *Creates interest.* Virtual reality (VR) technology is fascinating because it makes possible experiences that would be impossible to "live" in the actual world. The utilization of this technology will inspire students to learn. No matter how old they are, students prefer to sit back and watch anything rather than read.

Fig. 7.2 Advantages of VR in education

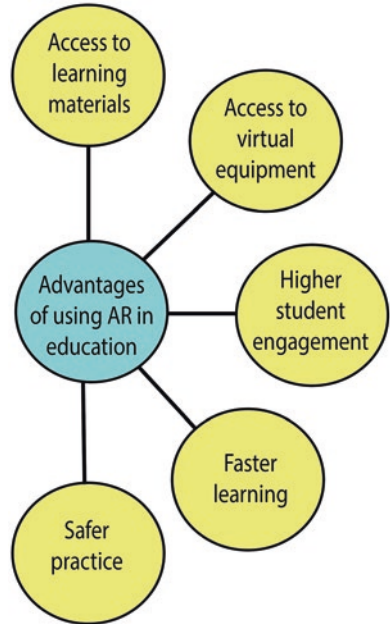
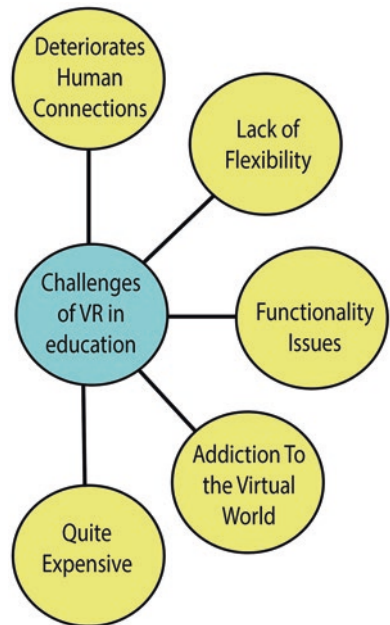


Fig. 7.3 Challenges of VR in education



- *Increases students' engagement.* Engaging students in meaningful ways is a challenge for today's educators. This will no longer be an issue thanks to the widespread use of VR technology in classrooms; students will not be able to resist the temptation to discuss their immersive experiences.
- *It does not feel like work.* Putting on a headset, having information whiz by in front of your eyes as you watch videos and incredible visualizations do not appear like work. Young people will be more motivated to study and learn if they see school as a positive experience. This is a rule of thumb. Generally, while having fun, we pay closer attention, improve our performance, and do not view the activity as a chore.
- *Enhances learning across a variety of disciplines.* Consider the field of medicine. Several forward-thinking medical professionals used virtual reality (VR) equipment in 2016 to expand their horizons and improve their ability to teach others. One more would be the area of writing and editing material. In many cases, VR may aid in correcting content errors and provide fantastic new tools for editing.
- *Eliminates the language barrier.* The inability to communicate effectively is a common impediment to learning. Learning the local tongue is a prerequisite for attending college abroad. Virtual reality allows for incorporating every conceivable language into the system's software. Because of this, students can pursue their educational goals without being limited by language.

Challenges of Virtual Reality in Education

1. *Deteriorates human connections.* Virtual reality has the potential to benefit many current fields of endeavor greatly, yet it also presents severe drawbacks in some situations. Historically, schools have relied on face-to-face interactions between teachers and students. In a virtual reality experience, you are completely isolated from the outside world. This can disrupt students' interpersonal interactions and undermine effective human communication.
2. *Lack of flexibility.* Using a VR headset is a new and exciting experience if you can be adaptable in the classroom, ask questions, and get answers. If you are utilizing a piece of software designed to perform a single task, you cannot do anything besides that. Since learning is not a constant process, pupils may struggle due to a lack of adaptability. That number is continually changing.
3. *Functionality issues.* Errors are to be expected in every computer program. When problems arise, the learning process for your students is halted until the tool is repaired. This is not only uncomfortable but may also be very costly. Therefore, if a student has examinations tomorrow and his VR headset explodes, he cannot study for them. This is merely an illustration; real-world occurrences may vary.
4. *Addiction to the virtual world.* The risk of young people becoming dependent on their online environments is equally substantial. We have observed the effects of extreme events and video games on people. We may even use drugs as an example; if the high is preferable to everyday life, users are more likely to grow dependent on them.

5. *Quite expensive.* The price tag of cutting-edge gadgets might be hefty. There must be a massive investment of billions of dollars in these capabilities if the virtual reality movement is to grow and become mainstream. To add insult to injury, only the wealthy can afford a cutting-edge education that uses the VR platform. Inequality in educational opportunities will result since the poor cannot afford it.

7.8 AI Meets VR and AR

Virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) can collaborate to create content for entire curricula and lesson plans, with AI handling the technical, nuts and bolts details, and VR/AR crafting the immersive, interactive experiences (Liu 2020). Students may find these tools, coupled with AR, exciting.

The realm of virtual reality (VR) and artificial intelligence (AI) simulations provides endless chances for students to escape the conventional classroom setting and enter a realistic, immersive virtual experience (Liu 2020). This helps students become ready for the real world by providing them with experiences as similar as possible, and it also makes learning about the subject fun because they get to live out their studies in a realistic setting.

Create STEM content, build apps, and bring them to life with the help of your students and their teachers. Using the virtual reality (VR) and augmented reality (AR) platform CoSpaces Edu (<https://cospaces.io/edu/>), educators can provide students with real-world coding experience while crafting immersive 3D classroom environments. By using the spatial computing technology of the Merge Cube (<https://mergeedu.com/l/engage>), students can interact with 3D digital content (including virtual reconstructions of ancient artifacts, plant cells, and sculptures) at any time and from any location.

Google Sky Map is another example of a virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) program. This app transforms the user's smartphone into a portable planetarium, allowing them to explore the night sky and keep tabs on stars, planets, nebulae, and more.

As Susan Fourtané writes on the website Interesting Engineering (Fourtané 2022), studies have shown that incorporating technologies like these into the classroom can have a wide variety of positive effects on students.

7.9 How AR, VR, and AI Technology Make Education More Accessible

Due to the COVID-19 epidemic, students of all ages have been forced to seek alternative methods of instruction, and the term “edtech” has entered the general lexicon to describe these new tools for teaching and learning.

One of its primary advantages is reducing geographical constraints on education, which assists students with special needs.

This section will examine three technological developments influencing educational practices (Web Desk 2021).

Augmented and Virtual Reality The primary advantage of augmented and virtual reality (AR and VR) technologies in education is that they make learning more dynamic and exciting, even adding gaming elements to traditional textbooks. Curiscope Virtuali-Tee is a shirt and accompanying app that provides an interactive anatomy lesson. While the other dons the garment, they may use an augmented reality app on their phone to visually peel back the layers and investigate what is happening inside. Some research suggests that this technology could potentially help students with neurological differences. Virtual reality (VR) headsets are used in the Floreo telemedicine platform (<https://www.floreotech.com/>) to provide social and behavioral therapy in institutional settings like schools.

Artificial Intelligence Learning may be made more exciting and personalized with the help of AI technology because it allows students to study on their own time and receive feedback virtually. A rudimentary form of AI called statistics and machine learning is used by Mathematics Sparx (<https://sparxmaths.com/>) to assist educators in assigning student-specific math problems. The UK-based software developer claims that an average of 4 hours of weekly use can improve GCSE maths exam outcomes by one grade. Additionally, Sparx can help youngsters from underprivileged backgrounds catch up to their more privileged peers, thus closing the achievement gap. In the meantime, KidSense.AI (<https://www.diffzy.com/>) has developed a deep learning-based automatic voice recognition system for kids. The Ryobi robot (<https://roybirobot.com/>), an AI-based toy that teaches language and STEM fundamentals, is powered by a system called KidSense, which was trained using samples of children's voices.

7.10 Benefits of Using VR, AR, or AI in a Classroom Setting

The most apparent advantage is higher levels of student involvement. Virtual reality (VR) and augmented reality (AR) make it easy to create engaging educational environments where students may delve deeply into subjects. Moreover, virtual reality and augmented reality have the potential to enhance communication by creating a more engaging setting for education. Lastly, AI can free up teachers' time by automating assessment activities and providing individualized comments to their students (ACTE 2021).

Technology like this is revolutionary because it paves the path for students to engage with concepts in previously impossible ways. With these tools, students can personalize their avatars and explore subjects uniquely (ACTE 2021). Technology's ability to give pupils more control over their learning is one of its most significant

advantages. This greater degree of control inspires students and makes learning enjoyable.

Furthermore, this technology can potentially motivate students by allowing them to play and study—by using a system of incentives. Assessments are taken and graded on the platform(s). In addition, students can advance in levels to access more customization options for their characters (ACTE 2021).

7.11 How VR, AR, and AI Will Transform Universities?

Undoubtedly, the future of education will be altered by the arrival of cutting-edge technologies like virtual reality (VR), augmented reality (AR), and artificial intelligence (AI). The future classroom will be an all-digital, fully immersive experience that caters to experiential learning needs and encourages teaching and learning reminiscent of face-to-face encounters (Shenoy 2021).

Whether it is through the simulation of whole environments in virtual reality, the blending of digital and real-world elements in augmented reality, or the application of machine learning in artificial intelligence, new technologies are set to impact education on all fronts, with a particular emphasis on professional and continuing education, as well as distance and online learning (Shenoy 2021). As a head of a university, are you prepared to make use of these game-changing educational tools?

From Virtual Tours to Medical Marvels Virtual reality (VR) applications within the classroom are anticipated to expand rapidly. That is understandable, after all. Virtual reality (VR) has been around for decades and has enjoyed widespread success in the gaming sector; leading market research firm Grandview Research (Grand View Research 2022) predicts that the VR market size will reach \$48.5 billion by 2025. Thousands of universities now provide virtual reality tours of their campuses, using the technology to replicate an immersive experience. However, the potential influence of virtual reality on online learning programs is enormously significant, especially given the rising cost of graduate school. Virtual reality can help us connect teachers and students. With distance learning tools, instructors and their students can appear together in the same virtual space, allowing them to guide one another through the experience.

The price of virtual reality consumer products has decreased as mobile phone-powered VR headsets and VR-compatible laptops have dropped below \$1000, as reported by eLearning Inside (Kronk 2017). As a result of these innovations, many organizations can afford to adopt virtual reality technology.

The inability to communicate with classmates and professors is a significant drawback of remote education. Understandably, students would grow discouraged and lose interest if they encounter difficulty grasping an idea and receive no assistance. However, virtual reality (VR) has the potential to alter that. Students may feel more engaged in distance learning if they have a greater sense of “presence.” They

could put on a headset and join a virtual classroom with other students and a teacher instead of studying alone at home.

While visiting Averett University in Danville, Virginia, I used their virtual reality equipment to “virtually” investigate human anatomy.

Students at Averett University in Danville, Virginia, may use the virtual reality equipment to “virtually” investigate the human anatomy, make appropriate motions to zoom inside the chest, view the chest muscles, and then click to view the interior cavity. They can then examine the heart on a more microscopic scale, down to the level of individual cells. Along with the virtual reality (VR) investigation, textual information describes the organs and anatomy.

Using this technology, one can practically immediately use anatomical knowledge. Using virtual reality to practice medical procedures allows mistakes to be made without the potentially fatal outcomes of natural treatments. Virtual reality can also help medical students practice for actual procedures. Please think of how this would affect students in continuing education or other professional programs where they are working to develop particular abilities. A professor of physical therapy and anatomy at the University of California, San Francisco (UCSF), recently gave an interview with the UCSF News Center (Baker 2017) about the benefits of virtual reality (VR) for education and training. “Virtual reality can move us to the next level of experience to go from generic anatomy study to a world where anatomy has been disrupted, and the learner has to act on it.”

Virtual reality (VR) technology has the potential to revolutionize several fields by giving students access to extraordinary experiences. Students can practice their language abilities and receive immediate feedback in a setting where they are less likely to feel nervous. It is also possible for students to practice their language abilities with virtual reality scenarios starring animated characters powered by artificial intelligence (AI) rather than by taking a costly trip. Using virtual reality, students in Nicole Mills’ French language and culture lessons in Cambridge, England, can “meet native speakers at parties in their homes and eavesdrop on discussions in Parisian cafés, all without leaving Cambridge,” according to a blog post (Rota 2018) by Educause. This initiative uses virtual reality (VR) film narratives to immerse students in the 11th arrondissement of Paris, a well-established method for teaching foreign languages.

In the future, what is now considered science fiction will be ordinary, such as Tony Stark employing virtual reality to design his Iron Man armor in the Iron Man films. Modern virtual reality allows scientists to explore the inner workings of their creations, such as new medications, robots, or machines. University medical experts are still investigating how virtual reality (VR) can aid in treating a wide range of conditions, from agoraphobia to burn wounds to stroke. Virtual reality can improve and lower research and education costs if embraced correctly and given sufficient network capacity.

Distance Learning, Now Up Close Modern students frequently switch between online and face-to-face learning. Augmented reality (AR) takes this form of immersive learning to the next level by simulating artificial items placed in real-world

settings to enrich students' perceptions of such settings and boost student engagement. Virtual items can be interacted with or explored by students in the same way as real ones. Consider how well-liked this technology has become in games like Pokémon Go and improved retail environments. These insights will inform future teaching practices that increase student interest and achievement.

Any field, from the hard sciences to the arts, can benefit from augmented reality. Imagine a chemistry lesson where students can learn what happens if they mix the wrong organic compounds without being exposed to a dangerous lab setting or a physics class where students can scan their textbook to see the Thrust Equation brought to life with a rocket's takeoff. Students in other classes can experience historical battles as if they were happening right in front of them, travel back in time to hear Franklin D. Roosevelt deliver speeches from his desk in the Oval Office during World War II, witness the Trojan War unfold, or even travel to the moon in the role of astronauts. It is currently possible for students to employ augmented reality (AR) in their study of astronomy by aiming their phones at the night sky and allowing software to see planets and galaxies using location-based technology.

For instance, humanities classes at Duke University (Lester 2018) have used virtual reality to visit historical structures and archaeological sites. At the Western University of Health Sciences in Pomona, California, students can learn about anatomical functions using a virtual dissection table (Brereton 2018). To teach clinical anatomy and physiology and to improve surgical visualization and planning, MEDIVIS (<https://www.medivis.com/>) has created a similar augmented reality (AR) platform for use in medical schools, nursing schools, and hospitals. This tool allows students to explore the three-dimensional tissue structures of the body.

There has been a recent shift toward the "blended" paradigm among traditional and nontraditional students. First-time visitors can benefit significantly from augmented reality applications. Visitors can get directions to their destination, and as they walk, they can use their cameras to gather information on buildings and activities, bringing the campus "to life," much like the future of Google Maps (Nieva 2023). A visitor to the engineering lab might notice a dance class or a debate club convening at the building on their right at 9:00. By being able to approach walls honoring the college's benefactors and reading brief biographies of the contributors, students are provided with an experience that can strengthen their emotional ties to the institution.

These methods can be used in traditional classroom settings and online learning environments, giving students of varying learning styles more opportunities to interact with course materials. Students can see a real classroom and walk freely and interact with their surroundings thanks to the advent of remote-controlled robots. Student-athletes commonly utilize tabletop versions to keep up with their studies when away from campus for sports or matches, but larger robots allow them to participate in a broader range of classroom activities. More students will pay attention in class if AR is used to provide them with interactive experiences. Improved student outcomes are the result.

Leading Higher Education Through Artificial Intelligence All sorts of problems that demand “thinking” from humans or machines may now be tackled with the help of machine learning tools and methodologies, and deep learning is at the forefront of this development. Utilizing machine learning technology, such as AI tools used in self-driving cars or image identification, educational applications range from giving machines “vision” to speech recognition, machine translation, medical diagnosis, etc. Universities would do well to take the lead in adopting and pioneering deep learning as the new scientific infrastructure for research and education. The implications for research in academia and the professional world are immense (Shenoy 2021):

- Not only is melanoma extremely dangerous, but a proper diagnosis is not always easy to make. One institution employs cutting-edge picture recognition technology (sometimes known as “computer vision”) to help diagnose an aggressive but curable form of cancer. The scientists trained a neural network to identify moles and worrisome lesions based on their unique properties (texture and structure).
- The University of California, Irvine, is among the leading medical research institutions in the world, and its researchers are collaborating with gastroenterologists to enhance colonoscopies (UCI Health 2018). Massive volumes of data will be collected in the future to detect polyp growth and make predictions about its development. Depending on whether or not a growth is safe, the scope will display “green, orange, and red” boxes.
- AI aides have been employed in computer classes for Georgia Tech’s undergraduates for several years. There is no need for a human TA to address questions regarding grades or due dates when you have AI, and your students cannot tell the difference. Although artificially intelligent TAs are limited in responding to in-depth topic queries, they can be helpful because many students have the same inquiries.

What Do We Need to Make This Happen? High prices are still a problem, and the day is not far off when AI and VR/AR tools will be as affordable as smartphones and desktop PCs (Shenoy 2021). We need to ensure adequate wireless network capacity to support these incredible applications, powerful enough personal computers, and locations designed for the specific needs of VR and AR. As a society, we overlook the interconnected nature of the sensors, cameras, microphones, cell-phones, glasses, and other gadgets that make immersive technology possible. Not only that, but virtual reality/augmented reality and deep learning are among the most bandwidth-hungry tools employed in universities today. Colleges and universities should begin planning for their potential adoption of virtual reality, augmented reality, and artificial intelligence, including what resources and setup will be needed.

Colleges and universities will be better able to adapt their teaching and learning environments to the demands of today’s students if they can fully take advantage of the technological tools at their disposal. Virtual reality (VR), augmented reality (AR), and deep learning (DL) advances can enhance learning in a variety of contexts, from one-on-one tutoring to improved distance education to enhanced research

capacities and more integrated student life. The value of a college education can only rise if students are given opportunities to engage more deeply with the subject matter they are studying. Universities will be able to meet the needs of their students in today's rapidly developing technology environment if they take advantage of the opportunities presented by the wide range of programs and services available to them. The truth, in whatever form it takes, is a swift ride. In the past 3 to 5 years, the concept of BYOD (Bring Your Device) has exploded in popularity, with many companies allowing employees to use their smartphones to access company data (Shenoy 2021). Teaching and learning are set to be revolutionized by the combination of virtual reality/augmented reality (VR/AR) and artificial intelligence (AI), coupled with students' demands for access to various devices and personalized platforms. In addition, it is not too late to start preparing right away.

7.12 Conclusion

Virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) are more than just buzzwords; they also offer the potential to individualize each student's educational experience and shift away from the cookie-cutter model of schooling to which we have all been accustomed. VR, AR, and AI are technologies that rapidly expand the possibilities for teaching and learning while also providing novel and innovative ways for administrators to monitor student performance, bridge gaps, and collaborate with specialists from around the globe to achieve a centralized way of helping children track and bridge gap areas and accelerate upon areas of excellence. Using virtual and augmented reality, for example, educators can provide students with a more hands-on learning experience with the help of artificial intelligence.

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