Designing Immersive Learning Experiences

An Introduction to Instructional Design for Virtual Immersive Environments

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Abstract

Over the past decade, VIEs have advanced, offering more impactful learning experiences than traditional methods by integrating innovative technology with sound instructional principles. The book provides a comprehensive guide to best practices and successful applications of VIEs, targeting instructional designers and educators aiming to enhance their design skills and explore VIE technology. It highlights the importance of aligning instructional design with learning objectives to create engaging, effective, and immersive educational experiences. Additionally, the text addresses the need for managing cognitive load, collaboration, and potential risks like addiction and social isolation, setting a foundation for responsible use of VIEs in educational settings.

Introduction

In the last decade, the rapid development of virtual immersive environments (VIEs) has provided myriad opportunities to create effective learning experiences than traditional instructional methods. To fully leverage the potential of VIEs as an educational tool, instructional designers must ground their designs in theory and best practices to ensure that learning outcomes are achieved.

The current book affords a wide-ranging guide to creating best practices of instructional design methods and strategies for VIEs and providing examples of successful VIE applications in educational settings. It is intended for instructional designers and educators who want to explore the potential of VIE technology for learning and to improve their design skills.

Effective VIE design requires learners' attention to interact with the virtual environment, how content is presented, and how instruction can be aligned effectively with the learning objectives. By incorporating sound instructional design principles, VIE designers can create immersive, engaging, and impactful learning experiences that meet the needs of learners in the 21st century.

The potential of VIEs to create meaningful and compelling learning experiences is vast, but it requires a concerted effort to design and develop these experiences. With sound instructional design principles, VIE designers can create immersive learning experiences that are more impactful than traditional instructional methods. This book introduces you to the necessary guidance and tools to design and develop effective VIE learning instruction.

The VIEs technology is rapidly changing, and we look forward to the many exciting developments in this evolving field.

What is VIE?

A Virtual Immersive Environment (VIE) is a simulated digital environment that provides the user a high level of interactivity and immersion. VIEs can be designed to simulate real-world or entirely fictional environments, often allowing users to interact with the environment and other users in real time.

VIEs are a novel form of interactive media that can provide users with an immersive, interactive, and multi-sensory experience. By simulating a virtual environment, VIEs have the potential to transport users to a different reality, allowing them to interact with the simulated world in a more engaging and experiential way. This has the potential to create new opportunities for entertainment, education, and even training purposes. VIEs are an exciting advancement in media technology that has the potential to transform the way we experience and interact with virtual content. As VIEs develop, they may become an increasingly important and influential part of our daily lives.

Some common features that may be included in a VIE are:

- A 3D virtual environment that simulates a real-world space or creates an entirely new world.
- The ability to move around and explore the virtual environment, often using a head-mounted display (HMD) and hand-held controllers or other input devices.
- The user can interact with and manipulate interactive elements such as objects, tools, and characters.
- Feedback, such as sound, haptic feedback, and visual effects, to create a more realistic and engaging experience.
- Real-time rendering and updates allow the user to see changes in the environment or interact with other users in real-time.

One example of a VIE is Metaverse, a virtual world where users can create avatars, interact with other users, and explore a vast and diverse virtual environment. Another example is the virtual training simulations used by the military, where soldiers can train in realistic combat scenarios without the risk of physical harm. Recently Vive Sync has introduced a platform for collaborations where you feel you are meeting face-to-face and can interact with 3D content.

Overall, VIEs have the potential to create powerful and impactful experiences for users. As technology evolves and improves, VIEs are likely to become even more sophisticated and immersive, opening up new possibilities for education, entertainment, and beyond.

Immersion is the sensation of being fully engaged in a real-life experience. We can experience it in various media, including literature, painting, music, architecture, and film. One common example of immersion is when we watch a movie and become so engrossed in the story that we temporarily forget that we are just watching a projection.

In literature, immersion is often used to create a more vivid and engaging reading experience. For example, as Gerrig and Rapp (2004) note, in his book Experiencing Narrative Worlds, the main character in Paul Theroux's novel, My Secret History is transported to another time and place when he reads his travel journal, allowing him to forget his worries and become fully immersed in the story:

"I laughed out loud. Then I stopped, hearing the echo of the strange sound. For a moment in my reading, I had been transported, and I had forgotten everything-all my worry and depression, the crisis in my marriage, my anger, my jealousy" (p. 267).

This example illustrates the powerful impact that immersive storytelling can have on the reader, allowing them to become fully immersed in the story and temporarily escape from the concerns of the real world.

Immersion is a powerful tool for creating engaging and impactful experiences in various contexts, including VIE. By understanding the principles of immersion and its purposes, we can design more effective and meaningful experiences for learners and users.

References

Gerrig, R. J., & Rapp, D. N. (2004). Psychological processes underlying literary impact. *Poetics Today*, *25*(2), 265-281.

Class Activities: Immersive Story Creation

Each group selects a unique theme to craft a story in this activity. The main objective is to develop an engaging narrative, illustrate it through graphics, and supplement it with voice-over narration to bring the story to life.

Initially, each group chooses a setting that corresponds to their theme. This could be anything from a bustling city to a serene village or even a mystical forest. The chosen setting is then represented through graphics created by each group.

Subsequently, each group delves into creating characters that will populate their chosen setting. They ponder the roles these characters will assume and their unique traits. Each group brings these characters to life through their illustrations.

With the setting and characters set, each group embarks on constructing their story. This narrative may encompass thrilling adventures, gripping mysteries, or profound friendships, provided it aligns with the theme. Each group ensures that their narrative has a clear beginning, middle, and end.

Throughout the story creation process, each group is encouraged to enhance their story's engagement by integrating dialogue, dramatic situations, and unexpected twists.

Once the story is complete and the illustrations have been created, each group records a voice-over narration for their story. This narration should encapsulate the story's emotions, tone, and pace, bringing the narrative to life.

After completion, each group presents their illustrated story and voice narrative to the class. The rest of the class immerses themselves in the world created by the presenting group, listening to the voice-over and viewing the illustrations.

After the presentations, a group discussion is held where everyone shares their thoughts on each story. Which parts were most enjoyed? How did each story make them feel? What lessons were learned from the narratives?

Additional Instruction

To create a captivating story, students should develop an engaging plot with conflict, resolution, and a logical sequence of events. Characters should be relatable and well-developed, with actions and motivations aligning with their personalities. Detailed setting descriptions should help readers visualize the story world and enhance immersion. Consistent world-building is essential for coherence, even if the story world is entirely fictional. Narrative pacing is also crucial to sustain reader interest, blending tense, high-action scenes with slower, introspective moments. Students should utilize vivid imagery and sensory language to bring the story to life, describing what characters see and their experiences across the senses. Authentic dialogue reflecting the characters' natural speech patterns contributes to immersion.

The voice narrative should also express the story's emotions, tone, and pace and be well-pronounced for clarity. Integrating detailed illustrations that align with the narrative further enriches the storytelling experience. Finally, students can incorporate plot twists, suspense, humor, emotional moments, or thought-provoking themes to maintain reader engagement.

To create this experience, each group can decide what software to use and how to deliver it.

Real Environment Versus VIE

To argue, the difference between a Real Environment (RE) and a Virtual Environment without entering a philosophical discussion is that a RE is simply a physical, palpable environment that exists in the real world. In contrast, a virtual world is a simulated digital environment that exists in a computer or other electronic media.

In a study published in the Journal of British Surgery (Graafland et al., 2012), the authors indicate that one of the main advantages of VIEs over REs is providing a safe and controlled environment for medical training and practice. Contrary to REs, VIEs can replicate complex and high-risk scenarios in real environments and allow repeated practice without endangering real patients. In addition, VIEs can provide immediate feedback to enhance skill acquisition, which can improve learning outcomes.

Another example of the difference between a RE and a VIE can be seen in architecture and urban planning. According to a study published by (Liu, 2020), VIEs such as virtual reality can provide architects and planners with a powerful tool for simulating and evaluating the impact of design decisions in complex urban environments. VIEs can enable planners to explore different scenarios and test the effects of different design options in a safe and controlled manner.

However, VIEs also have limitations that must be taken into account. One major limitation is that the level of immersion and realism provided by VIEs may need to be increased to capture the complexity and nuances of real-world environments. In addition, VIEs may not accurately reflect the experience of users in the real world, which can limit the ability to draw accurate conclusions and make informed decisions. The lack of fidelity can reduce the user's sense of presence and engagement. Fidelity refers to the degree of similarity between the VIE and the real world, and low fidelity can limit the effectiveness of training and education. In addition, some users may experience discomfort or motion sickness in VIEs, which can further reduce their effectiveness (McMahan et al., 2012).

Another area for improvement of VIEs is the potential for technical challenges that can limit the effectiveness and reliability of the simulation. VIEs are complex digital systems that require specialized software, hardware, and technical expertise to design, build, and operate.

While VIEs offer many advantages over REs in certain contexts, their limitations must also be considered.

References

Graafland, M., Schraagen, J. M., & Schijven, M. P. (2012). Systematic review of serious games for medical education and surgical skills training. *Journal of British Surgery*, *99*(10), 1322-1330.

Liu, X. (2020). Three-dimensional visualized urban landscape planning and design based on virtual reality technology. *IEEE access*, *8*, 149510-149521.

McMahan, R. P., Bowman, D. A., Zielinski, D. J., & Brady, R. B. (2012). Evaluating display fidelity and interaction fidelity in a virtual reality game. *IEEE transactions on visualization and computer graphics*, *18*(4), 626-633.

Class Activities: RE Versus VIE

Each group will embark on a significant exploration of Real Environments (REs) and Virtual Immersive Environments (VIEs). Your first task is to conduct a comprehensive literature review on using REs and VIEs in an assigned field like

remote learning or virtual laboratories. Your focus should be on research studies that provide a comparative view of both environments, considering benefits, limitations, user experiences, and learning outcomes.

Simultaneously, select or construct two case studies from your field, one illustrating using an RE and the other a VIE. Your analysis should cover design, implementation, user engagement, learning outcomes, and challenges encountered. Then, compile your findings from the literature review and case study analysis into a detailed comparative report. Your report should highlight the advantages and drawbacks of using REs and VIEs in your field, suggesting potential solutions or strategies to overcome any limitations identified with VIEs.

Once your report is ready, prepare a presentation for the rest of the class, explaining your findings, comparative analysis, and proposed solutions. Be ready to engage in a Q&A session following your presentation to clarify any queries and to encourage an open exchange of ideas. Finally, after all presentations, each group will provide a peer review of another team's project. Highlight the strengths, suggest areas for improvement, and offer additional insights or perspectives. Remember, this exercise aims to deepen your understanding of REs and VIEs and improve your research, critical thinking, and communication skills.

VIE Development Process

The development of Virtual Immersive Environments (VIEs) began in the mid-20s. One of the earliest examples of this technology was the Sensorama, a mechanical device created by filmmaker Morton Heilig (1962), which was the subsequent creation of VR systems by researchers and commercial companies, including the Virtuality Group and Nintendo.

In 1968, Ivan Sutherland, an American computer scientist considered one of the fathers of computer graphics and virtual reality, created the first head-mounted display (HMD), a critical development in creating immersive virtual environments. However, the high cost of the technology and limited computing power at the time made it challenging to create compelling VR experiences.

In the 1980s, companies such as NASA and the US military began experimenting with VR and VIEs for training. The development of more powerful computer graphics hardware and software in the 1990s led to more sophisticated VIEs, such as the popular game "Myst" and the first-person shooter game "Doom."

The production of the new generation of VIEs started in the mid-2000s, with the release of games such as "Second Life" and "World of Warcraft," which provided players with an immersive and interactive virtual world. More recently, developing new hardware, such as the Oculus Rift, HTC Vive, and Microsoft HoloLens, has made it possible to create even more realistic and compelling VIEs.

Today, VIEs applications are used in gaming, entertainment, education, and training, to name a few. It will likely significantly impact how we experience and interact with virtual content.

References

Heilig, M. L. (1962). Sensorama simulator, us patent no. 3050870. *US Patent and Trademark Office. https://patents. google. com/patent/US3050870A/en*.

Class Activities: VIEs Impact Discussion

Each group will pick an application of VIEs, such as gaming, entertainment, education, or training. They will analyze how VIEs have impacted their chosen field and present their findings to the class. This will include a look at specific examples of VIEs in their field, their benefits, challenges, and the future potential of VIEs in that area.

What Makes VIE unique?

Virtual Immersive Environments (VIEs) have unique features that distinguish them from other media and communication technologies. These features include **interactivity, presence, and immersion**, allowing users to involve with digital content in new and meaningful ways.

Unlike traditional media, which are typically passive and one-way, VIEs enable users to actively engage with instructional materials, manipulate them, and explore environments in a hands-on, interactive way. This interactivity is facilitated by a range of input devices, such as controllers, keyboards, and motion sensors, that enable users to navigate and manipulate the VIE in real-time. This makes VIEs particularly well-suited for training, education, and gaming applications, where users must develop and practice specific skills and behaviors.

Another key feature of VIEs is presence, which refers to the feeling of being in and part of the virtual environment. Presence is achieved through sensory feedback, including visual, auditory, haptic, and olfactory cues, creating realism and coherence in the VIE. This sense of presence can enhance users' engagement and motivation and lead to more effective learning and training outcomes.

One important aspect of presence is the sense of “tunneling” that can occur in VIEs. Cognitive tunneling occurs when users become so focused on a particular aspect of the environment or task at hand that they lose awareness of other aspects of the environment (de Oliveira Faria, 2020). This can be either positive or negative, depending on the situation. For example, in a training simulation for firefighters, tunneling on the location of a fire may be beneficial, but tunneling on the use of a particular tool may be detrimental to the overall effectiveness of the training. Designing VIEs to encourage users to remain engaged with the environment is important. This can be done through various design features, such as dynamic and interactive environments, meaningful choices and consequences, and clear feedback on performance.

The third key feature of VIEs is immersion, which refers to the degree to which users are absorbed and focused on the VIE, to the point of losing track of their physical surroundings. Immersion is facilitated by the interactivity and presence of the VIE, as well as by the ability of VIEs to create complex and dynamic virtual environments that can be tailored to the user's interests and needs. This immersion can enhance users' emotional and cognitive engagement with the VIE and increase learning and training effectiveness (Radianti et al., 2020).

An example of cognitive engagement in VIEs can be seen in a study conducted by Parong and Mayer(2021), which explores the use of Virtual Immersive Environments (VIEs) for teaching history, focusing on whether the immersive nature of VIEs can facilitate learning. The authors conducted a study in which participants learned about historical events using either a VIE or a traditional computer-based learning environment and then completed a test to measure their knowledge retention. The results showed that participants who learned using the VIE had higher knowledge retention scores than those who learned using the traditional environment. The authors conclude that VIEs can potentially enhance learning outcomes by creating a more immersive and engaging learning experience. However, they also note that further research is needed to fully understand the benefits and limitations of this technology for learning.

The unique combination of interactivity, presence, and immersion makes VIEs well-suited for a wide range of applications. In particular, VIEs have shown great promise in medical training, where they can provide a safe and controlled environment for trainees to practice complex and high-risk procedures (Graafland et al., 2012). VIEs have

also been used in fields such as architecture, urban planning, and engineering, where they can enable users to explore and evaluate complex designs and structures (Liu, 2020).

However, there are also challenges associated with using VIEs, including hardware and software glitches and the potential for negative effects such as motion sickness or disorientation. In addition, there are concerns about the potential social and ethical implications of VIEs, such as the potential for addiction or social isolation and the potential for VIEs to be used for deceptive or manipulative purposes. For example, a study by Segovia and Bailenson (2009) found that young elementary children who watched their virtual doppelganger swimming with orcas believed the virtual experience to be real, even a week after the experience. Similarly, in other recent studies, young children would connect with "virtual characters" or avatars, and the VR avatars were seen as more real and influential than those on other mediums, such as television. This made it more difficult for the children to inhibit their actions or not follow the avatar's commands (Kenwright, 2018).

Furthermore, it is not just young children who internalize VR scenarios; these scenarios can also impact young adults. This highlights the need to carefully consider the potential effects of VR experiences, particularly in the context of ethical concerns such as informed consent and participant well-being. It is important for researchers to ensure that appropriate protections are in place to safeguard.

Despite these challenges, the unique combination of interactivity, presence, and immersion offered by VIEs make them an important and growing area of research and development, with potential applications in a wide range of domains.

References

de Oliveira Faria, N. (2020, March). Evaluating automotive augmented reality head-up display effects on driver performance and distraction. In *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)* (pp. 553-554). IEEE.

Graafland, M., Schraagen, J. M., & Schijven, M. P. (2012). Systematic review of serious games for medical education and surgical skills training. *Journal of British Surgery*, *99*(10), 1322-1330.

Kenwright, B. (2018). Virtual reality: ethical challenges and dangers [opinion]. *IEEE Technology and Society Magazine*, *37*(4), 20-25.

Liu, X. (2020). Three-dimensional visualized urban landscape planning and design based on virtual reality technology. *IEEE access*, *8*, 149510-149521.

Parong, J., & Mayer, R. E. (2021). Cognitive and affective processes for learning science in immersive virtual reality. *Journal of Computer Assisted Learning*, *37*(1), 226-241.

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, *147*, 103778.

Segovia, K. Y., & Bailenson, J. N. (2009). Virtually true: Children's acquisition of false memories in virtual reality. *Media Psychology*, *12*(4), 371-393.

Class Activities: Creating a VIE

In this activity, you will work in groups to build and critically analyze a Virtual Immersive Environment (VIE). This activity will require creativity, collaboration, critical thinking, and the application of your understanding of the unique features of VIEs—interactivity, presence, and immersion.

Each group will create a basic design for a VIE intended for a specific application, such as education, training, entertainment, etc. The design does not have to be technically exhaustive, but it should consider the unique features of VIEs.

Interactivity: How will users interact with the environment? What input devices will they use?
The groups would plan out how users can interact with their virtual tour. For instance, users might click on various objects in the environment to learn more about them, such as pyramids, hieroglyphs, or the Nile River. Alternatively, they could engage with virtual characters representing people from that time, like pharaohs or farmers, to get snippets of stories or facts about life in Ancient Egypt.

Presence: How will you make the user feel a part of the environment? What sensory feedback will you provide?
To create a sense of presence, groups will discuss ways to incorporate sensory feedback. They plan to include ambient sounds like bustling marketplaces, the flowing Nile, or ancient music. They also visually represent the change from day to night, capturing the grandeur of the pyramids under the stars.

Immersion: How will you keep the user engaged and focused on the environment?
To enhance immersion, the groups might add tasks or challenges within the environment. For instance, users might have to decode hieroglyphics or plan a harvest using the flooding patterns of the Nile. These tasks could also contribute to a larger narrative or quest in the tour, such as helping to build a pyramid or preparing for an important religious festival.

How do People Learn from VIE?

Learning is a complex process consisting of many factors that involve a wide range of cognitive, social, and emotional factors. At its core, learning involves acquiring and integrating new information and experiences into an individual's existing knowledge and skills, leading to changes in behavior, attitudes, and understanding.

According to De Houwer et al. (2013, p.1), "Learning has been defined functionally as changes in behavior that result from experience or mechanistically as changes in the organism that result from experience.". Or, Learning is a change in what you know caused by experience. Meaningful learning is a generative activity in which the learner actively seeks to make sense of the presented material (Fiorella & Mayer, 2015).

These definitions emphasize that learning is an active process in which individuals acquire new knowledge or skills by engaging with the material or through instruction. The learning process involves acquiring and integrating new information into one's existing knowledge structures, allowing for more complex understandings and abilities.

One important aspect of learning is attention, which involves focusing on and processing relevant information from the environment. Attention is influenced by novelty, relevance, and personal interest and can be enhanced through repetition, chunking, and elaboration (Schunk & Zimmerman, 2012).

Another key aspect of learning is memory, which involves the encoding, storing, and retrieving of information over time. Memory is influenced by attention, relevance, emotional valence, and elaboration and can be enhanced through techniques such as repetition, rehearsal, and organization (Roediger & Butler, 2011).

Social factors also play an important role in learning, particularly in developing skills and behaviors influenced by social norms, expectations, and feedback. Social learning can occur through direct instruction, observation, imitation, or collaborative learning activities and can be facilitated through scaffolding, modeling, and peer feedback (Bandura, 1977).

Emotional factors also play a key role in learning, particularly in developing attitudes, beliefs, and values that influence behavior and motivation. Emotions can enhance or detract from learning (Özhan et al., 2020) depending on their valence, intensity, and relevance to the task or topic, and can be regulated through techniques such as self-talk, mindfulness, and emotion regulation strategies. Effective learning requires attention, memory, social support, emotional regulation, appropriate learning strategies, and metacognitive awareness of one's own learning processes.

Learning in VIEs, such as VR, can be linked to different learning styles, as defined by Kolb's experiential learning theory. This theory categorizes learning into four modes: concrete experience, reflective observation, abstract conceptualization, and active experimentation. VR is highly compatible with experiential learning as it supports active knowledge construction through experimentation, enables learners to experience consequences, and provides immersive environments closely emulating real-world operations. Studies have demonstrated that VR can cater to all four learning styles and effectively support experiential learning by offering concrete experiences, encouraging reflective observation, and promoting abstract conceptualization. As such, VR can be a versatile tool to enhance learning for individuals with different preferences and learning styles (Lee et al., 2010).

The unique affordances of Virtual Immersive Environments (VIEs) offer a rich and engaging learning environment. One important aspect of learning in VIEs is active and hands-on learning strategies, which allow learners to manipulate and

explore digital content in real-time. Various input devices, such as controllers, motion sensors, and haptic feedback systems, facilitate this interactivity, which enables learners to navigate and manipulate the VIE realistically and engagingly (Felnhofer et al., 2015).

Another key aspect of learning in VIEs is creating a sense of presence, or the feeling of being in and part of the virtual environment. Presence is achieved through sensory feedback, including visual, auditory, haptic, and olfactory cues, creating realism and coherence in the VIE. This sense of presence can enhance learners' emotional and cognitive engagement with the VIE and lead to more effective learning and training outcomes (Felnhofer et al., 2015).

Farra et al. (2018) explored the student experience with varying levels of immersion in virtual reality (VR) simulations in nursing education. Initial studies of varying levels of virtual reality simulations (VRS) showed equal or improved learning outcomes with higher levels of immersion. The authors found that both moderate and highly immersive VRS was positively perceived by participants, with a more immersive experience reported when using the Oculus. However, they pointed out that further research is needed to fully understand how students perceive and learn from VRS and identify best practices for developing appropriate skills and knowledge using VRS.

Moreover, using social and collaborative learning strategies is another important key in VIEs, allowing learners to engage with others in the virtual environment. This can be synchronous or asynchronous communication, such as chat, audio or video conferencing, or virtual collaboration tools. Social learning can be facilitated through scaffolding, modeling, and peer feedback, enhancing motivation, engagement, and learning outcomes (Dunleavy et al., 2009). Effective learning in VIEs requires the application of appropriate learning strategies, such as active and hands-on learning, creating a sense of presence, and using social and collaborative learning strategies.

References

Bandura, A. (1977). Social learning theory Prentice Hall. *Englewood Cliffs, NJ*, *247*.

De Houwer, J., Barnes-Holmes, D., & Moors, A. (2013). What is learning? On the nature and merits of a functional definition of learning. *Psychonomic bulletin & review*, *20*, 631-642.

Dunleavy, M., Dede, C., & Mitchell, R. (2009). Affordances and limitations of immersive participatory augmented reality simulations for teaching and learning. *Journal of science Education and Technology*, *18*, 7-22.

Farra, S. L., Smith, S. J., & Ulrich, D. L. (2018). The student experience with varying immersion levels of virtual reality simulation. *Nursing education perspectives*, *39*(2), 99-101.

Felnhofer, A., Kothgassner, O. D., Schmidt, M., Heinzle, A.-K., Beutl, L., Hlavacs, H., & Kryspin-Exner, I. (2015). Is virtual reality emotionally arousing? Investigating five emotion-inducing virtual park scenarios. International Journal of Human-Computer Studies, 82, 48-56.

Fiorella, L., & Mayer, R. E. (2015). *Learning as a generative activity*. Cambridge university press.

Lee, E. A. L., Wong, K. W., & Fung, C. C. (2010). Learning with virtual reality: Its effects on students with different learning styles. *Transactions on edutainment IV*, 79-90.

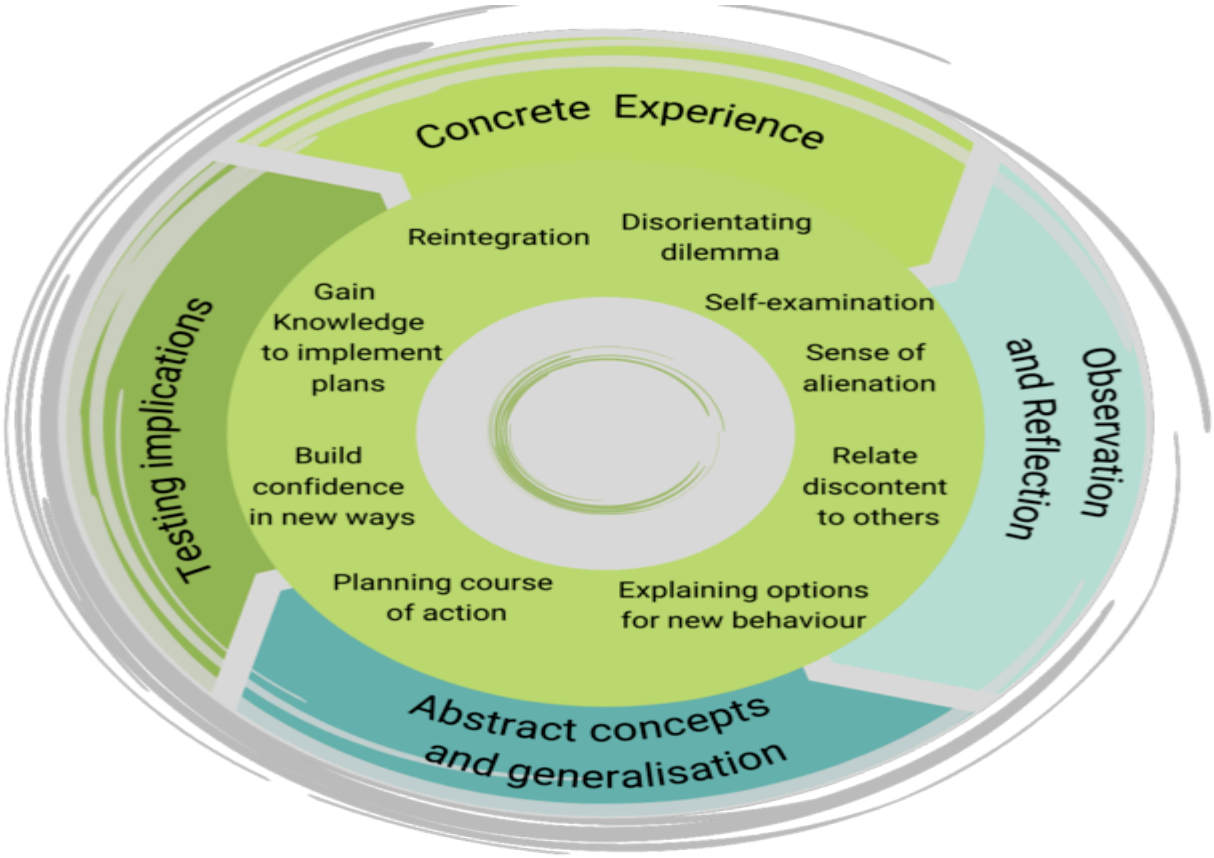
Özhan, Ş. Ç., & Kocadere, S. A. (2020). The effects of flow, emotional engagement, and motivation on success in a gamified online learning environment. *Journal of Educational Computing Research*, *57*(8), 2006-2031.

Roediger, H. L., & Butler, A. C. (2011). The critical role of retrieval practice in long-term retention. Trends in Cognitive Sciences, 15(1), 20-27.

Schunk, D. H., & Zimmerman, B. J. (Eds.). (2012). *Motivation and self-regulated learning: Theory, research, and applications*. Routledge.

Class Activities

In this assignment, students apply Kolb's Experiential Learning Theory to an exciting exploration of a well-known global landmark. The theory suggests that effective learning occurs through four key stages - **concrete experience, reflective observation, abstract conceptualization, and active experimentation.** The following provides an overview of how each stage integrates into the assignment.



"Transformational Experiences (Kolb and Mezirow combined model)" by Ray O'Brien is licensed under CC BY-SA 4.0.

Concrete Experience (CE):

First, students engage in a hands-on experience involving a virtual tour of a global landmark. Students, for example, use Google's 3D function to explore the Eiffel Tower or the Great Wall of China. Navigating the structure, students examine the details, understanding its structure from different perspectives. Take notes on observations and document descriptions of the experience.

Reflective Observation (RO):

Following the virtual exploration, students reflect on the experience. Consider how this exploration differs from simply viewing static images of the structure. Document notable observations and feelings about the experience in a reflective paragraph or share them in a class discussion.

Abstract Conceptualization (AC):

The next stage involves connecting the experiences to broader concepts. Students research the history, architectural style, cultural significance, and other related facts about the landmark they explored. The aim is to draw connections between the observations made during the Google 3D exploration and the information found in the research.

Active Experimentation (AE):

Finally, the students put what they have learned into practice. Design a 3D model of a building inspired by the architectural style of the explored landmark, or write a travel blog post about the landmark and its significance, using the virtual tour as a reference. This stage is an opportunity for creative exploration.

This process, transitioning from concrete experience to reflective observation, abstract conceptualization, and ultimately active experimentation, represents the core of experiential learning. Tools like Google's 3D function allow students to experience this cycle firsthand, even within a virtual learning environment. Students are encouraged to engage deeply in observations, research findings, and creative projects.

Where is the Pedagogy?

Pedagogy is the study of how teaching and learning occur and the practice of teaching in formal education. It involves the theories, methods, and practices that support effective learning and teaching. The application of pedagogical principles is particularly relevant in virtual immersive environments (VIEs), where the design of educational experiences requires a deep understanding of how people learn and how to support their learning effectively.

Pedagogy is “the art and science of teaching," encompassing theoretical and practical aspects of educational instruction. It includes the selection of appropriate instructional strategies, the organization and sequencing of content, and the assessment of student learning. It is concerned with what and how it is taught, considering learners' developmental needs, prior knowledge and experiences, and the social and cultural contexts in which learning occurs. It is a dynamic and constantly evolving field, shaped by ongoing research and the changing needs of learners and society (Haihuie, 2006).

VIEs are ideal for active learning because they allow learners to explore and interact with digital content in real-time, an essential pedagogy principle. This is achieved through various interactive features, such as simulation environments, virtual laboratories, and gamification elements, which can support problem-solving, experimentation, and exploration (Gee, 2003). Active learning in VIEs can also be enhanced using social and collaborative learning strategies like group work, peer feedback, and discussion forums.

Another critical principle of pedagogy in VIEs is the use of personalized and adaptive learning approaches. VIEs allow personalized learning environments tailored to individual learners' needs, interests, and abilities. This is achieved through analytics and tracking tools, which can monitor and analyze learners' progress, behavior, and preferences in real-time. Personalized learning in VIEs can also be enhanced through adaptive learning technologies, which can adjust the difficulty and pacing of learning activities to match the learners' abilities and preferences (Frasson, 2021).

Moreover, VIEs can create a powerful sense of presence and immersion, enhancing learners' engagement, motivation, and learning outcomes. This is achieved through realistic and immersive simulations, virtual reality, and other immersive technologies, which can create a sense of "being there" and enhance learners' emotional and cognitive engagement with the learning experience (Vesisenaho et al., 2019).

Taçgin et al. (2016) developed a pedagogical model for VIEs using augmented reality (AR) to teach chemistry. The model was based on the constructivist approach to learning, emphasizing the importance of active, experiential learning and scaffolding the development of students' knowledge and skills. The researchers designed a series of AR experiences, including simulations and interactive games that allowed students to explore the concepts and principles of chemistry in a hands-on, immersive environment. The experiences were scaffolded to build on students' prior knowledge and gradually increase complexity, supporting the development of more advanced understandings of the subject matter. In addition to providing engaging and interactive learning experiences, the AR platform allowed for real-time feedback and assessment of student learning. The researchers were able to track students' interactions with the virtual environment and use this data to assess their understanding of the subject matter and provide targeted feedback and support. AR, in this context, allows for a more personalized and flexible approach to instruction, catering to individual students' diverse needs and learning styles.

References

Frasson, C. (2021, October). A framework for personalized fully immersive virtual reality learning environments with gamified design in education. In *Novelties in Intelligent Digital Systems: Proceedings of the 1st International Conference (NIDS 2021), Athens, Greece* (Vol. 338, p. 95).

Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in entertainment (CIE)*, *1*(1), 20-20.

Haihuie, S. (2006). Pedagogy and Technology: Is it the art and science of teaching or is it the media of transmission that enhances distance learning?.

Taçgin, Z., Uluçay, N., & Özüağ, E. (2016). Designing and developing an augmented reality application: a sample of chemistry education. *Turkiye Kimya Dernegi Dergisi Kısım C: Kimya Egitimi*, *1*(1), 147-164.

Vesisenaho, M., Juntunen, M., Häkkinen, P., Pöysä-Tarhonen, J., Fagerlund, J., Miakush, I., & Parviainen, T. (2019). Virtual reality in education: Focus on the role of emotions and physiological reactivity. *Journal of Virtual Worlds Research*, *12*(1).

Activity: Personalized Augmented Reality Exploration using Augment Software

Objective: This activity aims for students to use Augment, an Augmented Reality (AR) tool, to select and place 3D virtual objects in their immediate environment and reflect on their observations.

Materials Needed: Augment AR software: https://www.augment.com/. Students are instructed to use the trial version. The 3D objects selected should be relevant to the subject being studied in class.

Procedure:

1. Object Selection Phase: Students must familiarize themselves with the Augment software. They should follow this link to learn how to use this software: https://help.augment.com/en/.

After familiarizing themselves with the Augment software, students must select and place a 3D virtual object in their real-world environment. The selection of the 3D object should be directly related to their current course of study. For example, a science student might choose a 3D molecule model, whereas a history student might choose a historical character.

2. Exploration Phase: Once the objects are placed, students are to explore and interact with the 3D models in detail, noting their observations and thinking about how these objects relate to their environment and the subject of study.

3. Presentation Phase: Students are to prepare a brief presentation or report based on their AR exploration. This presentation should include their observations from the AR exploration and how these observations connect with their current lessons.

4. Reflection Phase: Finally, students are to reflect on their AR experience, discussing what they learned, what they found challenging, and how they think they can apply their new knowledge in the future.

This activity integrates the pedagogical principles of active learning, personalized learning, and immersion. It allows students to actively engage with their learning material, personalize their learning journey according to their interests, and experience a sense of presence and immersion in the learning process.

How Does VIE Affect Human Learning?

Virtual Immersive Environments (VIEs) have the potential to greatly impact human learning by providing a rich and engaging learning experience that is interactive, immersive, and customizable. VIEs offer a unique opportunity to enhance learners' cognitive, social, and emotional engagement with the learning experience, leading to more effective and lasting learning outcomes. This section will explore how VIEs affect human learning and some key factors contributing to their impact.

The ability of VIEs to enhance learners' engagement and motivation is designed to be immersive and engaging, offering learners a sense of presence in the digital environment. This can be achieved through the use of realistic and interactive simulations, as well as the ability to customize the learning experience to the individual's interests and preferences. This sense of engagement can lead to increased motivation, leading to greater attention, effort, and persistence in learning (Carbonell-Carrera et al., 2021).

Another aspect of VIEs is their ability to provide a highly realistic and interactive learning experience. VIEs allow learners to interact with digital content in a way that closely mimics real-world scenarios, allowing for experiential and hands-on learning. This can be achieved through the use of simulation environments, virtual laboratories, and gamification elements, which can support problem-solving, experimentation, and exploration. The highly realistic and immersive nature of VIEs can also enhance learners' memory of the learning experience and promote the transfer of learning to real-world settings (Mütterlein & Hess, 2017)

An additional key factor in the effectiveness of VIEs is their ability to provide personalized and adaptive learning experiences. VIEs can be tailored to individual learners' specific needs, interests, and abilities, allowing for a highly customized and relevant learning experience. This is achieved through the use of analytics and tracking tools, which can monitor and analyze learners' progress, behavior, and preferences in real-time (Osadchyi, 2020).

Analytics and tracking tools are becoming increasingly important in VIEs to measure and analyze student performance, engagement, and learning outcomes. These tools enable instructors to monitor students' progress in real-time, identify areas where students struggle, and adjust their teaching strategies accordingly.

For example, eye-tracking devices can be used to identify optimal gaming environments that support cognitive development in two ways. First, eye tracking can be used to monitor participants' attention to channels through which cognitive feedback is conveyed. Cognitive feedback informs players about the consequences of their actions during gameplay and can influence learning outcomes. Second, eye movements provide evidence of engagement in cognitive processes. Longer fixation durations could indicate that participants are engaging in analysis and problem-solving, whereas shorter fixation durations suggest that participants might be glossing over the content. However, it remains impossible to determine comprehension based on eye-tracking data alone. To effectively deploy eye-tracking measures in VIEs, a list of generic behaviors that users/players engage in, such as navigation, needs to be delineated, and the associated cognitive processes must be identified and investigated further (Rappa et al., 2022).

Personalized learning in VIEs can also be enhanced through adaptive learning technologies, which can adjust the difficulty and pacing of learning activities to match the learners' abilities and preferences.

VIEs have the potential to greatly impact human learning by providing a highly engaging, realistic, and personalized learning experience. By enhancing learners' engagement and motivation, providing a realistic and interactive learning

experience, and offering personalized and adaptive learning, VIEs can support more effective and lasting learning outcomes in various educational and training contexts.

References

Carbonell-Carrera, C., Saorin, J. L., & Melián Díaz, D. (2021). User VR experience and motivation study in an immersive 3D geovisualization environment using a game engine for landscape design teaching. *Land*, *10*(5), 492.

Mütterlein, J., & Hess, T. (2017). Immersion, presence, interactivity: Towards a joint understanding of factors influencing virtual reality acceptance and use.

Osadchyi, V., Chemerys, H., Osadcha, K., Kruhlyk, V. S., Koniukhov, S., & Kiv, A. (2020). Conceptual model of learning based on the combined capabilities of augmented and virtual reality technologies with adaptive learning systems. In *Ceur workshop proceedings* (Vol. 2731, pp. 328-340).

Rappa, N. A., Ledger, S., Teo, T., Wai Wong, K., Power, B., & Hilliard, B. (2022). The use of eye tracking technology to explore learning and performance within virtual reality and mixed reality settings: a scoping review. *Interactive Learning Environments*, *30*(7), 1338-1350.

What Don’t We Know About Learning in VIE?

Virtual Immersive Environments (VIEs) have been recognized as practical tools for enhancing learning in various domains. Although research in this area has grown noticeably over the past decade, we still need to learn more about learning in VIEs.

One crucial issue is the need to analyze the long-term effects of VIEs on learning outcomes. Most studies in this area have examined short-term data and focused on immediate gains in knowledge or skills. More research is needed to determine if these gains are sustained over time and transferable to real-world settings.

Another important consideration is the impact of individual differences on learning in VIEs Factors such as age, gender, and cultural background may affect individuals’ experience.

There is also a need for more research on the optimal design of VIEs for different learning outcomes. While many studies have examined the impact of various design elements, such as level of immersion or interactivity, there is still much to be learned about designing VIEs to support specific learning goals effectively.

One of the biggest challenges is improving the fidelity of the virtual environment, which depends on the computing power available to replicate reality accurately. There are also issues regarding navigation and control, making them hard to use for long periods. On top of that, the motion sickness and other adverse effects from playing or using VIEs for extended periods need to be addressed.

Accessibility and equity regarding the digital divide are alarming issues. The hardware and software for VIEs can be expensive for most people. It requires a certain amount of physical and mental agility to operate in VIEs. People with disabilities may be unable to use them. There is also the ethical use that needs attention.

Lastly, we must know how to design social interactions to promote learning effectively. This includes considerations such as group size, the role of different types of feedback, and how to balance social interaction with personal knowledge.

While there is much we still need to learn about learning in VIEs, continued research in this area is essential for maximizing the potential of this technology to enhance learning outcomes.

Do Visuals Make a Difference in Learning?

Visuals in virtual immersive environments (VIEs) can significantly impact learning. VIEs are digital environments that allow learners to experience realistic simulations of real-world situations, and visuals can be an important component of these simulations.

Visuals in VIEs can help learners to better understand complex concepts by providing a more vivid and realistic representation of the information being presented. For example, in a medical VIE, visuals can show the internal structure of the human body, providing learners with a better understanding of anatomy and physiology.

In addition, visuals in VIEs can make the learning experience more engaging and interactive, which can improve student motivation and enthusiasm for the subject matter. By incorporating visuals into the VIEs, learners can better connect with the content and feel more immersed in the learning experience.

However, it's important to note that the effectiveness of visuals in VIEs depends on how they are designed and implemented. Poorly designed visuals may not provide the desired learning outcomes, and may even distract or confuse learners. Therefore, it's important to carefully consider the learning objectives, target audience, and instructional design when using visuals in VIEs for education.

Visual aids are effective in enhancing learning outcomes because they can help to reduce cognitive load. When information is presented in a visual format, learners can process it more quickly and efficiently than when presented in a text-only format. This can free up cognitive resources that can be used to more effectively engage with the material and apply it to new situations (Sweller, 2010).

According to Moreno and Mayer (2007), some strategies to reduce cognitive load include:

Split attention effect: Avoid presenting information in multiple formats that require learners to split their attention.

Redundancy effect: Avoid presenting the same information in multiple formats, as this can cause cognitive overload.

Worked example effect: Providing worked examples can help reduce cognitive load by illustrating problem-solving strategies.

Modality effect: Presenting information using multiple modalities (e.g., visual and auditory) can help reduce cognitive load.

Expertise reversal effect: The level of instructional guidance provided should be adjusted based on the learner's level of expertise.

Scaffolding: Providing support and guidance to learners can help reduce cognitive load and improve learning outcomes.

Progressive disclosure: Gradually revealing information to learners can help reduce cognitive load by allowing them to focus on one aspect of the task at a time.

Use of animations: Animations can be used to demonstrate complex concepts or processes, reducing cognitive load by making the information more accessible.

Feedback: Providing timely and constructive feedback to learners can help reduce cognitive load by correcting misunderstandings and reinforcing learning.

Use of analogies: Analogies can be used to explain complex concepts in a way that is easier to understand, reducing cognitive load.

However, the effectiveness of visual aids depends on a variety of factors, including the type of visual aid, the complexity of the material, and the prior knowledge of the learner. For example, research has shown that visual aids that are closely aligned with the learning objectives are more effective than those that are more tangential (Chandler & Sweller, 1991). Similarly, visual aids that are too complex or detailed can be counterproductive, as they can overload working memory and reduce the effectiveness of learning (Mayer, 2014).

In conclusion, the research suggests that visual aids can have a significant positive impact on learning outcomes, particularly in enhancing memory retention and reducing cognitive load. However, the effectiveness of visual aids depends on a variety of factors, and it is important to carefully consider the design and use of visual aids to maximize their impact on learning.

References

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and instruction*, *8*(4), 293-332.
Mayer, R. E. (2014). Cognitive theory of multimedia learning. In The Cambridge handbook of multimedia learning (2nd ed., pp. 43-71). Cambridge University Press.

Moreno, R., & Mayer, R. (2007). Interactive multimodal learning environments: Special issue on interactive learning environments: Contemporary issues and trends. *Educational psychology review*, *19*, 309-326.

Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. *Educational psychology review*, *22*, 123-138.

Does the Multimedia Principle Affect Learning in VIE?

The multimedia principle is a widely studied and supported theory that suggests that learners can benefit from the use of multiple modes of representation in learning materials, such as text, images, and audio.

The principles of multimedia learning are applicable to virtual immersive environments (VIEs), as these environments often rely on the use of multimedia elements to provide learners with a rich and dynamic learning experience. In this section, we will explore each of the principles of multimedia learning and how they can be applied in VIEs (Rudolph, 2017):

Multimedia principle: In VIEs, the use of multimedia elements such as videos, images, and animations can help learners better understand complex concepts and processes. For example, a VIE that teaches about the solar system can incorporate images and animations of the planets and their movements to provide a more engaging and memorable learning experience.

Coherence principle: In VIEs, it is important to organize the multimedia elements in a meaningful and logical way to avoid overwhelming learners with too much information. By structuring the learning materials into clear and concise segments, learners can better understand the connections between the various elements and how they relate to the learning objectives.

Contiguity principle: In VIEs, it is important to present corresponding words and images near each other in time and space. For example, in a VIE that teaches about the human body, images of organs and their functions can be presented alongside written descriptions of their roles to enhance understanding and memory retention.

Modality principle: In VIEs, using multiple modes of representation, such as animations and narration, can help learners better understand complex concepts. For example, a VIE that teaches about the structure and function of a cell can incorporate 3D animations and narration to provide learners with a more immersive and engaging learning experience.

Redundancy principle: In VIEs, it is important to avoid including redundant information, such as repeating information already presented in other forms. This can help to reduce cognitive load and avoid overwhelming learners with too much information.

Personalization principle: In VIEs, using a conversational style of language can help learners better engage with the learning materials and feel more connected to the content. For example, a VIE that teaches a language can incorporate conversations and interactive dialogues to help learners develop their speaking and listening skills.

Segmenting principle: In VIEs, breaking up the learning materials into shorter segments can help learners better engage with the content and avoid feeling overwhelmed by the amount of information presented.

Pre-training principle: In VIEs, providing learners with an overview of the key concepts and ideas before diving into the learning materials can help to prepare learners better and increase their engagement with the content.

Guided discovery principle: In VIEs, providing learners with opportunities to explore and discover concepts on their own can help to promote deeper understanding and critical thinking. For example, a VIE that teaches about history can incorporate interactive scenarios that allow learners to explore and understand historical events and their significance.

Practice principle: In VIEs, providing learners with opportunities for practice and feedback can help to reinforce learning and increase the retention of new information. For example, a VIE that teaches math can incorporate interactive exercises that allow learners to practice and receive feedback on their progress.

Numerous studies have shown that using multiple modes of representation in learning materials can enhance learning outcomes, particularly in terms of memory retention and problem-solving abilities. The multimedia principle is particularly relevant in VIEs, which offer a rich and dynamic environment that can include a wide range of sensory stimuli. Studies have demonstrated that using multimedia elements such as graphics, animations, and videos in VIEs can improve learning outcomes, particularly when the multimedia elements are closely aligned with the learning objectives (Wright, 2014).

However, the effectiveness of the multimedia principle in VIEs depends on various factors. One of the most important factors is the level of interactivity in the VIE. Interactive elements, such as simulations and games, can be particularly effective in engaging learners and promoting active learning (Mayer & Moreno, 2003). Studies have also shown that the use of interactive multimedia elements in VIEs can improve learning outcomes, particularly in terms of knowledge retention and transfer (Rieber, 2005).

Another important factor that can influence the effectiveness of the multimedia principle in VIEs is the level of cognitive load. Research has shown that multimedia elements can increase cognitive load, particularly if the elements are irrelevant to the learning objectives or too complex (Sweller et al., 2020).

According to Buchner et al. (2022), VIE designers can reduce cognitive load by using methods such as minimizing extraneous cognitive load, segmenting and organizing information, and emphasizing essential information. For example, reducing the number of distractions in the virtual environment, such as irrelevant visual and auditory stimuli, can help learners focus on essential information. Similarly, segmenting and organizing information can help learners better process and retain the information presented in the VIE. Designers can also emphasize essential information through highlighting, repetition, and summarization, which can help learners recognize important concepts and better integrate them into their existing knowledge structures. These techniques can help learners engage more effectively with the learning content and improve learning outcomes.

Therefore, it is important to consider the design and use of multimedia elements in VIEs to avoid overwhelming learners with too much information.

References

Buchner, J., Buntins, K., & Kerres, M. (2022). The impact of augmented reality on cognitive load and performance: A systematic review. *Journal of Computer Assisted Learning*, *38*(1), 285-303.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational psychologist*, *38*(1), 43-52.

Rieber, L. P. (2005). Multimedia learning in games, simulations, and microworlds. *The Cambridge handbook of multimedia learning*, 549-567.

Rudolph, M. (2017). Cognitive theory of multimedia learning. *Journal of Online Higher Education*, *1*(2), 1-10.

Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development*, *68*(1), 1-16.

Wright, W. G. (2014). Using virtual reality to augment perception, enhance sensorimotor adaptation, and change our minds. *Frontiers in systems neuroscience*, *8*, 56.

Collaborative Learning in VIE

Collaborative learning is an approach to education that emphasizes group work, communication, and cooperation among learners. Collaborative learning in virtual immersive environments (VIEs) can provide unique opportunities for learners to engage with content, work together, and develop communication and problem-solving skills.

One of the primary benefits of collaborative learning in VIEs is the ability to provide learners with immersive and engaging experiences that encourage communication and cooperation. VIEs can provide learners with virtual spaces to explore, interact, and engage with content in ways that are impossible in traditional classrooms or other learning environments (Gresalfi et al., 2009). By working together, learners can share their ideas, perspectives, and knowledge to better understand the content and its applications.

Collaborative learning in VIEs can also help learners develop important communication, problem-solving, and teamwork skills. By working together on tasks and projects, learners can practice and develop these skills in a safe and supportive environment (Bellotti et al., 2013). Collaborative learning in VIEs can also help learners develop a sense of community and social connectedness, which can help to foster a more positive and engaged learning experience (Monahan et al., 2008).

One example of collaborative software for VIEs is the HTC Vive Sync platform (HTC Corporation, 2021). The HTC Vive Sync is a VR collaboration platform that enables teams to work together in virtual environments. It provides features such as voice and text chat, screen sharing, and real-time collaboration tools to enhance teamwork and communication. Users can also import and manipulate 3D models, videos, and other multimedia content, making it a versatile tool for collaborative learning and design. HTC Vive Sync can be used for various purposes, including team meetings, virtual events, and educational and training programs. It is a powerful tool for enhancing collaboration and communication in VIEs.

Another example of collaboration software for VIEs is Unity Collaboration. This software allows multiple users to work on the same project simultaneously and see each other's changes in real-time, facilitating collaboration in developing VIEs (Unity Technologies, 2022). Using Unity Collaboration, teams can work together on different aspects of the VIE, such as programming, graphics, and audio, and see how their work fits together in real-time. This can save time and increase efficiency, as team members can work on their areas of expertise without waiting for others to complete their work.

In addition, Horizon Workrooms is another collaboration software platform that allows users to collaborate and communicate in a virtual environment using VR technology. Users can create a customizable avatar and participate in meetings, discussions, and brainstorming sessions with others in the virtual space. Workrooms also offer tools such as whiteboards and file sharing to support collaboration among team members. (Facebook, 2021).

Recently, the development of artificial intelligence (AI) technology has opened up new possibilities for collaboration in VIEs. For instance, AI-powered chatbots and intelligent tutoring systems can provide learners with personalized and adaptive feedback, allowing them to improve their learning outcomes and make better use of the VIE environment.

Collaboration software and technology for VIEs are constantly evolving, with new tools and platforms being developed to support collaborative learning and knowledge construction. By leveraging these technologies, educators and

instructional designers can create more engaging and effective VIE environments that promote active learning and knowledge construction.

However, there are also challenges associated with collaborative learning in VIEs. One challenge is the potential for technical difficulties, such as poor connectivity or problems with the VIE platform, which can hinder communication and cooperation. Another challenge is the potential for social and cultural barriers hindering communication and collaboration among learners from diverse backgrounds.

Collaborative learning in VIEs has the potential to provide learners with unique and engaging learning experiences that promote communication, cooperation, and the development of important skills. While challenges are associated with collaborative learning in VIEs, carefully considering the design and implementation of collaborative learning activities can help mitigate these challenges and promote successful and engaging collaborative learning experiences.

References

Gresalfi, M., Barab, S., Siyahhan, S., & Christensen, T. (2009). Virtual worlds, conceptual understanding, and me: Designing for consequential engagement. *On the Horizon*.

Ma, L. (2021). An immersive context teaching method for college English based on artificial intelligence and machine learning in virtual reality technology. *Mobile Information Systems*, *2021*, 1-7.

Monahan, T., McArdle, G., & Bertolotto, M. (2008). Virtual reality for collaborative e-learning. *Computers & Education*, *50*(4), 1339-1353.

Factors that Make a Difference

Collaboration in virtual immersive environments (VIEs) offers unique opportunities for learners to work together and share knowledge, but it also has unique challenges that differ from collaboration in other learning environments. In this section, we will explore some of the factors that make collaboration different in VIEs.

One of the most significant factors that make collaboration different in VIEs is the sense of presence and immersion that learners experience. VIEs can provide learners with a sense of "being there" that can enhance engagement, motivation, and communication among learners (Gao et al., 2012). This sense of presence can help learners feel more connected to each other and the learning materials, leading to a more engaging and effective learning experience (Al-Gindy et al., 2020).

Another factor that makes collaboration different in VIEs is the role of technology. Collaborating in VIEs requires the use of technology, which can be both an advantage and a disadvantage. Technology can provide learners with new and innovative ways to communicate and work together. For example, VIEs can provide learners with shared virtual spaces to work on projects, explore concepts, and engage with content (Bellotti et al., 2013). On the contrary, Technology can also be a barrier to effective collaboration, especially if there are technical difficulties or learners lack the necessary technological skills.

Cultural and social differences can also make collaboration different in VIEs. Collaboration in VIEs can involve learners from different parts of the world with different cultural and social backgrounds. These differences can lead to communication difficulties and misunderstandings, hindering effective collaboration (Obaid et al., 2012). VIE designers must carefully consider cultural and social factors when designing collaborative learning activities to ensure that all learners have an equal opportunity to participate and succeed.

Another factor that makes collaboration different in VIEs is the potential for anonymity. In VIEs, learners may remain anonymous or adopt a different persona, which can positively and negatively affect collaboration. Anonymity can give learners a sense of freedom and creativity, allowing them to express themselves in new and different ways. However, anonymity can also lead to a lack of accountability and responsibility, hindering effective collaboration (Gao et al., 2012).

Collaboration in VIEs offers unique opportunities and challenges that differ from collaboration in other learning environments. By carefully considering the factors that make collaboration different in VIEs, designers, and educators can create effective and engaging collaborative learning experiences that promote communication, cooperation, and the development of important skills.

References

Al-Gindy, A., Felix, C., Ahmed, A., Matoug, A., & Alkhidir, M. (2020). Virtual reality: Development of an integrated learning environment for education. *International Journal of Information and Education Technology*, *10*(3), 171-175.

Bellotti, F., Kapralos, B., Lee, K., Moreno-Ger, P., & Berta, R. (2013). Assessment in and of serious games: an overview. Advances in Human-Computer Interaction, 2013, 136864.

Gao, F., Luo, T., & Zhang, K. (2012). Tweeting for learning: A critical analysis of research on microblogging in education published in 2008–2011. *British Journal of Educational Technology*, *43*(5), 783-801.

Obaid, M., Damian, I., Kistler, F., Endrass, B., Wagner, J., & André, E. (2012). Cultural behaviors of virtual agents in an augmented reality environment. In *Intelligent Virtual Agents: 12th International Conference, IVA 2012, Santa Cruz, CA, USA, September, 12-14, 2012. Proceedings 12* (pp. 412-418). Springer Berlin Heidelberg.

Is Problem-solving Learning Better in VIE Collaboratively or Solo?

Problem-solving is a critical skill for learners to develop, and virtual immersive environments (VIEs) can provide unique opportunities for learners to engage in problem-solving activities. However, the question remains whether problem-solving learning is better in VIEs collaboratively or solo.

Collaborative problem-solving learning in VIEs can allow learners to share knowledge, perspectives, and ideas. Through collaboration, learners can learn from each other and develop a deeper understanding of the problem and its solutions (Bellotti et al., 2013). Collaborative problem-solving learning can also provide learners with a sense of community and social connectedness, which can help to foster a more positive and engaged learning experience (Al-Gindy et al., 2020).

However, there are also challenges associated with collaborative problem-solving learning in VIEs. One challenge is the potential for communication difficulties and misunderstandings among learners. In VIEs, learners may come from diverse cultural and social backgrounds, hindering effective communication and collaboration (Bellotti et al., 2013). Another challenge is the potential for group dynamics to hinder effective problem-solving. Groupthink, for example, can lead to a lack of creativity and diversity in problem-solving solutions (Obaid et al., 2017).

Solo problem-solving learning in VIEs can provide learners with the opportunity to work at their own pace and develop independent problem-solving skills. Solo learning can also provide learners with a sense of autonomy and control over their learning experience (Gao et al., 2012).

However, solo problem-solving learning in VIEs may not provide learners with the opportunity to benefit from the perspectives and knowledge of others. Solo problem-solving learning can also be isolating and may not provide learners with the sense of community and social connectedness that collaborative learning can provide.

Whether problem-solving learning is better in VIEs collaboratively or solo depends on the goals and preferences of the learners and the specific problem to be solved. Both approaches have advantages and disadvantages, and VIE designers and educators must carefully consider the learning goals and the needs of the learners when designing and implementing problem-solving learning activities.

References

Al-Gindy, A., Felix, C., Ahmed, A., Matoug, A., & Alkhidir, M. (2020). Virtual reality: Development of an integrated learning environment for education. *International Journal of Information and Education Technology*, *10*(3), 171-175.

Bellotti, F., Kapralos, B., Lee, K., Moreno-Ger, P., & Berta, R. (2013). Assessment in and of serious games: an overview. Advances in Human-Computer Interaction, 2013, 136864.

Gao, F., Luo, T., & Zhang, K. (2012). Tweeting for learning: A critical analysis of research on microblogging in education published in 2008-2011. British Journal of Educational Technology, 48(3), 459-474.

Obaid, M., Damian, I., Kistler, F., Endrass, B., Wagner, J., & André, E. (2012). Cultural behaviors of virtual agents in an augmented reality environment. In *Intelligent Virtual Agents: 12th International Conference, IVA 2012, Santa Cruz, CA, USA, September, 12-14, 2012. Proceedings 12* (pp. 412-418). Springer Berlin Heidelberg.

Simulations and Games in VIE

Simulations and games are two types of virtual immersive environments (VIEs) increasingly used in education. In VIEs, simulations and games can provide learners with a unique opportunity to explore complex and dynamic systems, interact with real-world scenarios, and develop problem-solving and critical thinking skills.

Simulations are computer-generated models that aim to replicate real-world systems and situations. They offer a safe and controlled environment for learners to explore complex scenarios, develop problem-solving skills, and enhance critical thinking abilities. In virtual immersive environments (VIEs), simulations can create lifelike settings that enable learners to interact with real-world situations and systems. Additionally, simulations can serve as virtual laboratories, allowing learners to conduct experiments and analyze data without the risks or limitations of physical experiments (McGaghie et al., 2016).

Games are virtual environments that engage learners in an interactive and immersive experience. In VIEs, games can create engaging and interactive learning experiences that motivate learners to explore and learn. Games can also create virtual scenarios that allow learners to develop problem-solving and critical-thinking skills and explore complex and dynamic systems (de Freitas & Oliver, 2006).

Simulations and games in VIEs can provide learners with several benefits. For example, simulations and games can provide learners with a safe and controlled environment to explore complex systems and scenarios without the risks and costs associated with real-world experimentation. Simulations and games can also provide learners with immediate feedback and support, allowing them to quickly identify areas of strength and weakness and adjust their learning accordingly.

However, challenges are also associated with using simulations and games in VIEs. One challenge is the potential for simulations and games to be too simplistic or not reflective of the real world. In such cases, learners may not develop a deep understanding of the complex systems they are exploring (Kebritchi et al., 2010). Additionally, games may be viewed as too entertaining or not serious enough to be considered a valid form of learning.

To overcome these challenges, VIE designers and educators must carefully design and implement simulations and games. Simulations and games in VIEs must be designed with clear objectives and expectations and provide learners with the necessary support and resources to succeed. Additionally, VIE designers and educators must be aware of the potential challenges associated with using simulations and games in VIEs. They must work to overcome these challenges through effective communication, facilitation, and feedback.

Simulations and games in VIEs can provide learners with a unique opportunity to explore complex and dynamic systems, interact with real-world scenarios, and develop problem-solving and critical thinking skills. However, to maximize the potential of simulations and games in VIEs, designers, and educators must carefully design and implement these activities and be aware of their potential challenges.

References

De Freitas, S., & Oliver, M. (2006). How can exploratory learning with games and simulations within the curriculum be most effectively evaluated?. *Computers & education*, *46*(3), 249-264.

McGaghie, W. C., Issenberg, S. B., Petrusa, E. R., & Scalese, R. J. (2016). Revisiting 'A critical review of simulation-based medical education research: 2003–2009'. *Medical education*, *50*(10), 986-991.

Example of Learning with Games and Simulations in VIE

Liu et al. (2017) provide insights into the principles of game design in their book "Virtual, Augmented, and Mixed Realities in Education." By outlining these principles, the authors aim to offer guidance on designing effective and engaging educational experiences that utilize virtual, augmented, and mixed realities.

To describe the principles of game design outlined in the book, Liu et al. (2017) emphasize the importance of elements such as game mechanics, challenges, rewards, feedback, and narrative. They argue that by integrating these elements into educational experiences, designers can create engaging and effective learning environments that motivate learners and promote learning outcomes. Furthermore, the authors suggest that by leveraging virtual, augmented, and mixed realities, designers can create immersive and interactive experiences that enhance learners' engagement and sense of presence, ultimately leading to more effective learning experiences.

Goal setting and feedback: Clearly define the game's learning goals and provide feedback to the learner throughout the game to track progress towards these goals.

Challenge and difficulty: Design games that are challenging but not so complex that they become frustrating for the learner. Gradually increase the difficulty as the learner progresses.

Rules and structure: Communicate the rules and structure of the game to the learner. Provide guidelines and instructions on how to play.

Interactivity and engagement: Design interactive and engaging games, encouraging the learner to explore and experiment.

Personalization and customization: Allow learners to customize their game experience to suit their needs and preferences better.

Narrative and storytelling: Use narrative and storytelling to create an immersive and engaging game environment.

Immersion and presence: Design immersive games that provide a strong sense of presence, allowing the learner to feel fully engaged and involved in the game world.

Collaboration and competition: Provide opportunities for learners to collaborate and compete against each other in a healthy and productive way.

Aesthetics and design: Pay attention to the aesthetics and design of the game, creating a visually appealing and engaging environment for the learner.

Assessment and evaluation: Use game analytics to assess and evaluate learner progress, providing feedback on areas where improvement is needed.

Kapp(2012) presents one set of principles for serious game design in VIEs. These include:

- Clear learning objectives and outcomes.
- Engaging and authentic game scenarios.
- Use of real-time feedback and assessment.
- Customization and personalization of content and learning experiences.
- Collaboration and social interaction among players.
- Multiple challenges and problem-solving opportunities.
- Use of storytelling and narrative elements to enhance engagement and learning.
- Integration of multimedia and other immersive technologies to enhance the gaming experience.

These principles emphasize the importance of designing serious games in VIEs that are engaging, authentic, and relevant to the learning objectives while providing opportunities for collaboration and problem-solving. By incorporating real-time feedback and assessment, as well as personalization and customization of content, serious games can help learners achieve specific learning outcomes while also enjoying the learning experience. By integrating multimedia and immersive technologies, serious games can provide an engaging and memorable experience that enhances learning.

Examples of Serious game design

Using simulations in virtual immersive environments (VIEs) can create an engaging and interactive learning experience for students.

1. Lesson Plan: Climate Change Simulation in VIE

Grade level: 9-12

Objectives:

- Students will understand the basic science behind climate change and its global impact.
- Students will be able to identify climate change's main causes and effects.
- Students will develop critical thinking and problem-solving skills by exploring different solutions to mitigate climate change.

Materials:

- Virtual immersive environment software (e.g., Second Life, Minecraft).
- Climate change simulation module (e.g., Virtual Earth System Laboratory).
- Head-mounted display (HMD) or computer monitor with 3D graphics.
- Hand-held controllers for navigation and interaction.
- Worksheets for note-taking and reflection.

Procedure:

Introduction: Begin the lesson by introducing the concept of climate change and its global impact. Provide examples of how climate change affects our planet (e.g., sea-level rise, more frequent natural disasters) and how human activities cause it. Discuss with the students the importance of understanding climate change and exploring solutions to mitigate its impact.

Simulation: Have students enter the virtual immersive environment and navigate to the climate change simulation module. Instruct students to explore the module and use the interactive tools to learn about the basic science behind climate change, its causes, and its effects. Students should take notes on their findings and reflect on how they can contribute to mitigating climate change.

Discussion: Bring the students together as a group and facilitate a discussion on their findings. Ask the students to present their understanding of the basic science behind climate change, its causes, and its effects. Lead a discussion

on the different solutions to mitigate climate change and their trade-offs. Have students share their ideas on how they can contribute to mitigating climate change.

Conclusion: Conclude the lesson by summarizing the importance of understanding climate change and the need for solutions to mitigate its impact. Ask the students to reflect on what they learned during the simulation and how they can apply these concepts to their daily lives.

Assessment:

Students will be assessed based on their participation in the simulation, note-taking, and reflection worksheets and their contributions to the class discussion.

Using simulation in virtual immersive environments can create an interactive and engaging learning experience for students. By allowing students to explore different scenarios and interact with virtual objects, simulations in VIEs can help students develop problem-solving and critical thinking skills and apply their knowledge to real-world situations.

Games in virtual immersive environments (VIEs) can offer students a dynamic and engaging learning experience. This section presents an illustrative lesson plan that employs a game in a VIE to teach students about ancient civilizations.

2. Lesson Plan: Ancient Civilization Game in VIE

Grade level: 6-8

Objectives:

- Students will understand the basic concepts of ancient civilizations, including culture, architecture, and society.
- Students will be able to identify ancient civilizations' main characteristics and contributions to modern society.
- Students will develop critical thinking and problem-solving skills by exploring and engaging with an ancient civilization game in a VIE.

Materials:

- Virtual immersive environment software (e.g., Second Life, Minecraft).
- Ancient civilization game module (e.g., Civilization VI, Age of Empires).
- Head-mounted display (HMD) or computer monitor with 3D graphics.
- Hand-held controllers for navigation and interaction.
- Worksheets for note-taking and reflection.

Procedure:

Introduction: Begin the lesson by introducing the concept of ancient civilizations and their importance to modern society. Please provide examples of ancient civilizations (e.g., Egyptian, Greek, Roman) and their unique features. Please discuss with the students the importance of understanding ancient civilizations and their contributions to modern society.

Game Play: Have students enter the virtual immersive environment and navigate to the ancient civilization game module. Instruct students to explore the game and engage with the different features of the civilization, including culture, architecture, society, and trade. Students should take notes on their findings and reflect on how the game relates to real-world ancient civilizations.

Discussion: Bring the students back together as a group and facilitate a discussion on their findings. Ask the students to present their understanding of the ancient civilization they explored in the game and its contributions to modern society. Lead a discussion on the different features of the civilization and their historical context. Have students share their ideas on applying their knowledge of ancient civilizations to modern-day situations.

Conclusion: Conclude the lesson by summarizing the importance of understanding ancient civilizations and their contributions to modern society. Ask the students to reflect on what they learned during the game and how they can apply these concepts to their daily lives.

Assessment:

Students will be assessed based on their participation in the game, note-taking and reflection worksheets, and their contributions to the class discussion.

References

Liu, D., Dede, C., Huang, R., & Richards, J. (Eds.). (2017). *Virtual, augmented, and mixed realities in education* (pp. 105-130). Singapore: Springer.

Kapp, K. M. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education*. John Wiley & Sons.

Prototyping a Game

Prototyping a Game

Instructional Design and Gaming

The fusion of instructional design with interactive platforms like **Unity** offers a transformative approach to learning. Instructional design, at its core, is about crafting educational experiences that are both effective and engaging. By utilizing models such as the ASSURE framework, educators can systematically design, develop, and evaluate interactive lessons tailored to their audience. Unity, a leading game engine, becomes an instrumental tool in this endeavor, allowing the creation of these lessons in a dynamic and immersive environment. This section aims to bridge the gap between instructional design principles and the practical application of Unity for educators. With a focus on the ASSURE model, educators will be guided on how to seamlessly integrate their instructional design knowledge into the Unity platform, even without a background in computer science or programming. The end goal is to empower educators to create interactive and impactful learning experiences that resonate with today's digital-native learners.

Before diving into Unity, it's essential to grasp the foundational principles of instructional design. The **ASSURE** model, commonly used for lesson planning, will serve as our guiding framework for creating interactive lessons in Unity. This model will help you align your game design objectives, media selections, and assessments, ensuring that each game component fulfills a specific educational purpose.

A: Analyze Learners

- **Audience Analysis:** Understand the target learners for your Unity project. What are their interests, prior gaming experiences, and learning preferences?
  - **Further Exploration:** Read Chapter 3 of "Conducting a Learner Analysis." This section provides insights into learner analysis and its importance in instructional design.

S: State Objectives

- **Game Objectives:** Clearly define what the Unity game aims to teach or convey.
  - **Further Exploration:** Explore the SMART criteria for objective setting. Websites like UCOP can help you craft clear and measurable objectives.

S: Select Methods, Media, and Materials

- **Game Mechanics Selection:** Decide on the game mechanics that will best convey the subject matter.
  - **Further Exploration:** "Play to Learn" by Karl M. Kapp offers insights into various game mechanics and their educational implications.
- **Asset Gathering:** Collect or design the assets needed for the game.
  - **Further Exploration:** Websites like Unity Asset Store provide a plethora of resources. For design principles, "The Non-Designer's Design Book" by Robin Williams is a great start.

U: Utilize Media and Materials

- **Scene Organization:** Organize the game scenes in Unity in a logical sequence.
  - **Further Exploration:** Unity's official Learning Platform offers tutorials on scene organization and management.
- **Playtesting:** Test the game to ensure it is functional and engaging.
  - **Further Exploration:** Read "Games in Everyday Life: For Play" by Nathan Hulsey for a comprehensive guide.

R: Require Learner Participation

- **Interactivity:** Design game elements that require player interaction.
  - **Further Exploration:** "Interactive Design: An Introduction to the Theory & Application of User-centered Design" by Andy Pratt & Jason Nunes provides insights into crafting interactive experiences.

E: Evaluate and Revise

- **Peer Playtesting:** Have peers play the game and provide feedback.
  - **Further Exploration:** "Understanding feedback" by Elbra-Ramsay and others offers strategies for effective feedback in educational settings.
- **Revision:** Refine the game based on feedback.
  - **Further Exploration:** The iterative design process is key. "What is iterative design" website delves into the importance of revision in design.

Assessment:

- Explore how the selected instructional design models can be adapted or incorporated into the game design process.
- Discuss the unique challenges and advantages of using instructional design methodologies in game development, especially for educational games.
- Elaborate on how these models can ensure effective learning outcomes while maintaining player engagement and interest.
- Discuss the interplay between instructional design and game design.

earning Modalities and Game Design

earning modalities, a concept rooted in the theory that individuals have preferred ways of receiving and processing information, often categorized into visual, auditory, reading/writing, and kinesthetic, play a significant role in the field of game design for learning. This approach suggests that educational games should cater to these diverse modalities to enhance learning outcomes. However, the application of learning modalities in game design is not without controversy. Critics argue that the evidence supporting learning styles is weak and that designing games based on these styles may oversimplify complex learning processes. They contend that effective learning is more dynamic and less dependent on fixed modalities. Despite this, the integration of multimodal experiences in educational games—combining visual, auditory, and interactive elements—remains a popular approach. This strategy aims to engage a broader audience and acknowledges the multifaceted nature of learning, even as the debate over the validity and impact of learning modalities continues.

Watch the video tutorial on installing Unity to prepare for your upcoming activities. Please complete this task promptly to engage fully with the materials and activities."

ssessment:

- Do you think catering to different learning styles is beneficial in educational games, or do you agree with the critics who argue for a more dynamic approach to learning?
- How do you perceive the role of multimodal experiences in educational games, which combine visual, auditory, and interactive elements?

3D Design

This section is designed to guide you through creating your first level prototype in Unity using ProBuilder. After a brief introduction and learning phase, you will spend most of the week building a basic level, which will serve as a foundation for scripting and interactivity in a subsequent module.

ProBuilder is an innovative tool integrated within the Unity engine, designed to enhance and streamline the process of 3D modeling and level design directly in the Unity Editor. It stands out as a versatile tool for both beginners and seasoned developers, offering an intuitive interface that allows you to create, edit, and manipulate 3D objects without the need for external 3D modeling software. With ProBuilder, you can easily construct complex geometries, engage in rapid prototyping of game levels, and experiment with architectural designs. Its features include advanced modeling capabilities such as vertex, edge, and face manipulation, alongside UV mapping for detailed texturing. ProBuilder's seamless integration with Unity makes it particularly valuable for game developers, as it enables the immediate testing of 3D models within the game environment. This tool not only accelerates the workflow of game development but also opens up creative possibilities, making it an essential asset for anyone looking to harness the full potential of Unity in creating immersive 3D worlds and interactive experiences.

Expected Outcomes:

- Explore and familiarize yourself with the Unity ProBuilder interface to craft prototypes for educational games.

Pre-Work Activity: Unity Interface Familiarization

The purpose of this activity is to help you get acquainted with the Unity Editor's interface, ensuring you can navigate and utilize its various components efficiently when starting game prototyping with ProBuilder.

Task:

Unity Interface Overview:

- Open the Unity Editor.
- Allocate at least 30 minutes to explore the Unity interface on your own.
- Use Unity's Interactive Tutorials if available, which can be accessed via the Unity Hub or within the Unity Editor under the Window > Learn tab.

Key Area Identification:

Identify and explore the following critical areas within the Unity interface:

- Scene View: Understand how to navigate the 3D space, select, and manipulate objects.
- Game View: Learn how to preview your game as it would appear during play.
- Hierarchy Panel: Get to know how objects are organized and how to manage scene elements.
- Project Panel: Look at how assets are stored and how to import new assets.
- Inspector Panel: Familiarize yourself with object properties and how to change them.

Hands-On Task:

- Create an empty GameObject in the Hierarchy.
- In the Scene View, practice moving the GameObject around using the move tool.
- Rotate and scale the GameObject, observing the changes in both the Scene and Inspector panels.

Documentation Reading:

- Read the 'Unity Interface' section of the Unity Manual available on the Unity Documentation to reinforce your understanding.

Modeling and Animation with ProBuilder:

Please watch the following videos:

Intro to Unity Editor

ProBuilder Part 1

ProBuilder Part 2

ProBuilder Part 3

Scripting in Unity Using C-Sharp

This section is designed to introduce you to the essentials of scripting, which is the backbone of game development in Unity. We'll be using Visual Studio, a powerful and user-friendly code editor, to write and manage our scripts. Starting with the basics, we'll explore variables – the fundamental units of data storage. You'll learn how to use various data types and how variables interact within your game.

Next, we dive into the world of logic with 'if' statements, understanding how to make decisions in your code. This will lead us to loops – both 'for' and 'foreach' – which are critical for performing repetitive tasks efficiently. We'll see how these loops can work hand-in-hand with arrays, a key concept for managing multiple elements in an organized way. Lastly, we'll cover methods, the building blocks of organized and reusable code, which allow us to perform specific tasks.

To learn C# specifically for Unity, it's important to choose resources that balance general C# concepts with their application in game development. Here are some recommended documents and websites for prework before diving into this module:

Websites:

1. **Unity Learn:**
   - Unity Learn - Scripting
   - Unity's official learning platform.
   - Provides courses specifically tailored to using C# in Unity.

Video Tutorials:

1. **Unity's Official YouTube Channel:**
   - Unity YouTube
   - Features tutorials and best practices.
   - Covers both beginner and advanced topics.

Online Forums and Communities:

1. **Unity Forums - Scripting Section:**
   - Unity Scripting Forum
   - A great place to ask questions and learn from Unity developers worldwide.
2. **Reddit's r/Unity3D:**
   - Reddit Unity3D
   - A community for Unity enthusiasts where you can discuss ideas and challenges.

Please Watch the Following Videos:

Scripting in Unity Part 1

Scripting in Unity Part 2

Scripting in Unity Part 3

Scripting in Unity Part 4

Scripting in Unity Part 5

Scripting in Unity Part 6

Scripting in Unity Part 7

Assessment. Unity Scripting Assignment: Grade Analyzer

Objective: Create a Unity script that analyzes an array of grades and provides feedback about the class performance. You will define a set of grades, calculate the average grade, and use control structures to categorize the overall

performance.

Assignment Details: In Unity, create a new scene and save it as "yourlastnameScene4", then create a new c# script in your script folder and name it " **QuizCalculator** " (Please use the camelcase style naming. Capitalize each word without spacing for writing the name of your script. However, when writing your variables, start with lowercase.; **for instance, gradeAverage.**

Here is the code that you need to complete. Remember, there are multiple ways to solve this problem. Aim to create the most efficient script possible!

```
using System.Collections;

using System.Collections.Generic;

using UnityEngine;

public class QuizCalculator : MonoBehaviour

{

   // Declare an array to hold the quiz grades and a variable to hold the average grade

(Please write the code here)

   void Start()

   {

      // Initialize quiz grades with random values between 0 and 100 use for loop

(Please write the code here)

      // Calculate the sum of all grades using foreach loop

(Please write the code here)

      // Calculate the average grade

(Please write the code here)

      // Log the average grade to the console

  (Please write the code here)

      // Classify performance and log the letter grade to the console if and else if

(Please write the code here)



   }

}
```

Scripting in Unity Using C-Sharp Part2

In this section, we will delve into user input, player movement, and collision handling in Unity, laying the foundation for creating dynamic and interactive games. You'll learn how to harness Unity's input system to translate players' actions—like keyboard presses and mouse clicks—into responsive on-screen movement. We'll explore how to use scripts to control characters or objects, adjusting their position, rotation, and scale based on user input, and implementing collision detection to create realistic interactions between game objects. Whether it's moving a character across a platform, steering a vehicle, navigating through obstacles, or interacting with the game environment, mastering player movement, input, and collision detection is a crucial step towards building engaging and immersive gameplay experiences. Additionally, we'll touch on Unity's UI system, understanding how to create and manage user interfaces that are both functional and aesthetically pleasing.

Please Watch the Following Videos:

User Input

Player Movement

Physic Part 1

Physic Part 2

Assessment 1: Player Health Reduction on Collision with Enemy

Objective:
Add a script to the player character in Unity so that when they collide with an enemy, they lose health. The player starts with 100 health points, losing 20 points with each collision. If the health points reach zero, the player is destroyed.

Step-by-Step Pseudocode:

1. Start with Player Health:
    - Define a health variable for the player and set it to 100.
2. Detect Collision:
    - Implement collision detection with an enemy object.
    - Use Unity's OnCollisionEnter or OnTriggerEnter methods.
3. Reduce Health on Collision:
    - When a collision with an enemy is detected, reduce the player's health by 20 points.
4. Check Health Status:
    - After reducing health, check if the player's health is less than or equal to zero.
5. Destroy Player if No Health:
    - If the player's health is zero or less, destroy the player object.
6. Optional - Display Health:
    - Optionally, include a way to visually display the player's current health (UI element, etc.).

Here's a version of the Unity C# script for the player health system with key sections left blank for you to complete as an exercise: fill the blanks and create a script in unity and add it to your player. Test your game to see if it's working correctly.

```
public class YourLastNamePlayerHealth : MonoBehaviour

{

private int health = ___; // Students should fill in the initial health value

void OnCollisionEnter(Collision collision)

{

// Check if the collision object is an enemy

if (collision.gameObject.CompareTag("___")) // Students should fill in the correct tag

{

// Reduce health

health -= ___; // Students should fill in the correct amount of health to deduct

// Check if health is zero or below

if (health <= ___) // Students should complete the condition

{

// Destroy the player object

Destroy(___); // Students should fill in what needs to be destroyed

}

}

}

}
```

Assessment 2: Play a Specific Sound on Collision

```
public class YourLastNameEnemySoundEffect : MonoBehaviour
{
public AudioClip funnySound; // Assign the specific funny sound clip
private AudioSource audioSource;
void Start()
{
// Get the AudioSource component attached to the enemy
audioSource = GetComponent<AudioSource>();
}
void OnCollisionEnter(Collision collision)
{
// Check if the collision object is the player
if (collision.gameObject.CompareTag("Player"))
{
// Play the funny sound clip
audioSource.PlayOneShot(funnySound);
}
}
}
```

Instruction:

1. **Attach the Script to Your Enemy GameObject:**
    - In Unity, select the enemy GameObject in your scene.
    - Drag and drop the **EnemySoundEffect** script onto the enemy GameObject in the Inspector to attach it.
2. **Add an AudioSource Component:**
    - With the enemy GameObject still selected, click on **Add Component** in the Inspector.
    - Search for **AudioSource** and add it to your enemy GameObject.
    - Uncheck the **Play On Awake** property of the AudioSource component if it is checked. This ensures the sound only plays upon collision, not when the game starts.
3. **Assign the Sound Clip:**
    - In the **EnemySoundEffect** script component, you'll see a field for the **funnySound** AudioClip.
    - Drag and drop your chosen sound clip from your project files into this field.
4. **Ensure Correct Tagging for Collision Detection:**
    - Verify that your player GameObject has the appropriate tag (e.g., "Player").
    - The script uses this tag to identify collisions specifically with the player.
5. **Testing the Scene:**
    - Run your scene and move the player to collide with the enemy.
    - Upon collision, the sound clip should play, indicating that the setup is working correctly.

Publishing Your Game

In this crucial phase of your game development journey, we're going to walk through the process of publishing your Unity game using WebGL. This powerful tool allows you to deploy and run your games on web browsers, making your creations easily accessible to a wide audience.

Here's what you need to know to get started:

1. **Optimize Your Game for WebGL:** Before publishing, ensure your game is optimized for WebGL. This includes minimizing the use of resources, checking compatibility, and ensuring performance is up to par for a web environment.
2. **Build Settings Configuration:** Access the Build Settings in Unity and switch the platform to WebGL. This will enable you to configure various settings specific to the web platform.
3. **Building the Game:** With everything set up, build your game. Unity will compile all the necessary files and assets into a format that can be run in web browsers.
4. **Testing the Build:** It's essential to test your WebGL build locally to ensure that everything works as expected. This can help you catch and rectify issues before going public.
5. **Choosing a Hosting Platform:** To share your game, you'll need to host it online. Platforms like **Unity** offer great ways to publish and share your WebGL games.
6. **Uploading Your Game:** Watch the video Tutorial to upload the build files following the platform's guidelines.
7. **Sharing Your Game:** After your game is uploaded and published, you'll receive a link that you can use to share your game with the world. You can embed this link into your Final website or share it on social media and forums.

Call to Action:

Watch the accompanying video tutorial that covers each step-in detail. After watching, your task is to publish your own game using WebGL. Once it's live, take the sharing link provided by the hosting platform and integrate it into your website. This is a significant milestone, as it transitions your game from development to the hands of players. So, get your game ready, watch the video, and take that exciting step of publishing your creation for everyone to enjoy!

Affordances that Lead to learning

Virtual Immersive Environments (VIEs) offer unique affordances that can promote learning in various contexts.

Immersion and Presence: VIEs provide a high level of immersion and presence, allowing learners to feel as if they are physically present in the environment. This sense of presence can enhance learning by promoting engagement and interest in the content. For example, Liou et al. (2017) found that students who participated in a VIE-based physics lesson reported higher engagement and interest in the topic than those who participated in a traditional classroom setting.

I**nteractivity and Feedback:** VIEs allow for a high level of interactivity and feedback, which can enhance learning by providing opportunities for exploration and experimentation. For example, in a study by Cho and Park (2023), students who participated in a VIE-based simulation of a water pollution scenario could experiment with different scenarios and receive immediate feedback on the outcomes of their choices.

Collaboration and Communication: VIEs provide opportunities for collaboration and communication among learners, which can enhance learning by promoting the exchange of ideas and perspectives. For example, D'Errico (2021) found that VIEs can support collaborative learning by providing a shared virtual space where learners can work together to solve problems.

Personalization and Adaptation: VIEs can be customized to meet learners' individual needs and preferences, which can enhance learning by providing a personalized learning experience. For example, Osadchyi et al. (2018) found that a personalized VIE-based learning environment can enhance learners' engagement and motivation, leading to better learning outcomes.

Realism and Authenticity: VIEs can provide a high degree of realism and authenticity, allowing learners to explore real-world scenarios and situations in a safe and controlled environment. For example, Akhtar et al.(2014) found that VIEs can teach medical students about surgical procedures, providing a realistic and immersive learning experience that is difficult to replicate in a traditional classroom setting.

VIEs offer a range of affordances that can promote learning in various contexts. By leveraging these affordances, educators can create engaging and immersive learning experiences that promote exploration, experimentation, collaboration, and personalization. While there are still limitations and challenges to using VIEs in education, the potential benefits are significant, and further research is needed to understand how to optimize learning in VIEs fully.

References

Akhtar, K. S. N., Chen, A., Standfield, N. J., & Gupte, C. M. (2014). The role of simulation in developing surgical skills. *Current reviews in musculoskeletal medicine*, *7*, 155-160.

Cho, Y., & Park, K. S. (2023). Designing Immersive Virtual Reality Simulation for Environmental Science Education. *Electronics*, *12*(2), 315.

Dalgarno, B., & Lee, M. J. (2010). What are the learning affordances of 3-D virtual environments?. *British journal of educational technology*, *41*(1), 10-32.

D'Errico, M. (2021). Immersive virtual reality as an international collaborative space for innovative simulation design. *Clinical Simulation in Nursing*, *54*, 30-34.

Liou, H. H., Yang, S. J., Chen, S. Y., & Tarng, W. (2017). The influences of the 2D image-based augmented reality and virtual reality on student learning. *Journal of Educational Technology & Society*, *20*(3), 110-121.

Osadchyi, V., Chemerys, H., Osadcha, K., Kruhlyk, V. S., Koniukhov, S., & Kiv, A. (2020). Conceptual model of learning based on the combined capabilities of augmented and virtual reality technologies with adaptive learning systems. In *Ceur workshop proceedings* (Vol. 2731, pp. 328-340).

Do Games and Simulations Teach?

Games and simulations have become increasingly popular in educational contexts due to their potential to engage and motivate learners. However, the question remains: do they effectively promote learning? Recent research provides insight into the effectiveness of games and simulations as educational tools.

A meta-analysis by Girard et al. (2013) investigated the effectiveness of serious games for learning in higher education. The results indicated that serious games moderately affected learning outcomes, suggesting they can be effective tools for promoting learning in higher education.

Another study by Zhonggen(2019) explored the effectiveness of gamification as an approach to promote learning and engagement in various domains. The study found that gamification can be an effective tool for promoting engagement and motivation.

In addition to promoting engagement and motivation, games and simulations can provide learners with opportunities to apply knowledge and skills in realistic scenarios. This is based on the idea that authentic tasks and problems are more engaging and effective in promoting learning than artificial or contrived ones. Furthermore, games and simulations can provide learners with immediate feedback on their performance, which can help them to understand and correct their mistakes.

However, the effectiveness of games and simulations depends on the quality of the design and the alignment with learning objectives.

References

Girard, C., Ecalle, J., & Magnan, A. (2013). Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. *Journal of computer assisted learning*, *29*(3), 207-219.

Zhonggen, Y. (2019). A meta-analysis of use of serious games in education over a decade. *International Journal of Computer Games Technology*, *2019*.

What Don’t We Know About Simulations and Games?

Despite the growing interest in games and simulations for educational purposes, many questions and research areas still need to be answered.
One area of uncertainty is how to design games and simulations that effectively promote the transfer of learning. Transfer of learning is crucial in education, impacting performance in different contexts. It ranges from near to far transfer, with the latter often needs to be achieved. Two mechanisms, reflexive and mindful transfer, drive this process. Education can be designed to enhance both types for improved learning outcomes (Perkins, 1992).

Well-designed games and simulations can promote the transfer of learning. However, the conditions and mechanism under which this occurs need to be better understood (Lieberman et al., 2014).

Another uncertainty area is effectively assessing learning outcomes in games and simulations. Traditional assessment methods, such as multiple-choice tests or written assignments, may not be appropriate for assessing the complex knowledge and skills developed through games and simulations. Alternative assessment methods, such as performance or portfolio-based assessments, may be more appropriate. However, their validity and reliability in games and simulations are not well established.

There is also a need to understand better how games and simulations can promote social and emotional learning. Games and simulations have the potential to provide learners with opportunities to practice and develop social and emotional skills, such as communication, collaboration, and empathy(Lieberman et al., 2014). However, the most effective ways to design games and simulations for these purposes still need to be determined.

Additionally, it is crucial to consider the ethical and social implications of using games in education. For instance, concerns exist that games and simulations might reinforce stereotypes or biases and may not be accessible to all learners. Evaluating the potential influence of games and simulations on learners' attitudes and behaviors is crucial, as is ensuring they encourage positive values and perspectives.

While games and simulations hold great promise as educational tools, we still need to learn more about their effectiveness, design, and impact on learners. Addressing these uncertainties will require further research and collaboration among educators, instructional designers, and researchers.

References

Lieberman, D. A., Biely, E., Thai, C. L., & Peinado, S. (2014). Transfer of learning from video game play to the classroom. Learning by playing: Video gaming in education, 189-203.

Perkins, D. N., & Salomon, G. (1992). Transfer of learning. International encyclopedia of education, 2, 6452-6457.

Aligning Instructional Design Strategies with Affordances of VIE

As the use of Virtual Immersive Environments (VIE) becomes more prevalent in education and training, it is essential to consider how to design instructional strategies that take full advantage of the affordances of these environments. Affordances refer to the potential actions that can be taken in a particular domain, and they are shaped by the environment's properties and the user's characteristics.

As mentioned earlier in this book, one important affordance of VIE is the ability to provide learners with highly interactive and engaging experiences. This can be achieved through the use of virtual reality (VR), augmented reality (AR), or mixed reality (MR), which allow learners to experience and interact with digital content in a more immersive and realistic way than traditional media. This affordance can be leveraged to create more authentic and meaningful learning experiences that help learners develop complex knowledge and skills.

Another important affordance of VIE is the ability to support collaborative learning. VIE can be designed to allow learners to work together in a shared virtual space, regardless of their physical location. This can be particularly beneficial for geographically dispersed learners needing access to traditional learning environments. Using collaborative learning strategies in VIE can help promote social learning, knowledge sharing, and collective problem-solving.

In addition to these affordances, VIE offers personalized and adaptive learning opportunities. VIE can be designed to collect and analyze data on learners' behavior and performance and use this information to adapt the learning experience to their individual needs and preferences. This can help ensure that each learner is challenged appropriately and has the opportunity to achieve their full potential.

To take advantage of these affordances, it is important to align instructional design strategies with the unique characteristics of VIE. This requires a deep understanding of how VIE works and how learners interact with them. Instructional designers need to consider factors such as learners' sensory and perceptual experiences, the types of interactions that are possible in the environment, and the opportunities for collaboration and personalization.

Designing effective instructional strategies for VIE requires a multidisciplinary approach combining expertise in instructional design, educational psychology, computer science, and other fields. This collaborative approach ensures that the design of VIE is grounded in sound pedagogical principles and takes full advantage of the affordances of these environments.

Various instructional design models can be used in VIEs. One example is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), which involves a systematic and iterative approach to designing and developing instructional materials. Another model is the ARCS model (Attention, Relevance, Confidence, Satisfaction), which emphasizes motivating learners and enhancing their engagement with the learning content. A third model is the SAM (Successive Approximation Model), which emphasizes a collaborative and agile approach to design and development, focusing on rapid prototyping and testing.

Other instructional design models used in VIEs include the ASSURE model (Analyzing learners, State objectives, Selecting instructional strategies, Utilizing media and materials, Requiring learner participation, Evaluating and revising), Merrill's First Principles of Instruction model (problem-centered, activation of prior experience, demonstration, application, integration), and the Constructivist Learning Environment (CLE) model, which emphasizes the importance of creating an authentic and interactive learning environment that allows learners to construct their understanding of the material.

Here's an example of a lesson plan using the ASSURE model (Smaldinoet al., 2008) for a VIE.

Subject: Biology
Grade Level: 10th grade
Topic: Cellular Respiration
Duration: 50 minutes

Instructional Objectives:

- By the end of the lesson, students will be able to:
- Identify the key steps in cellular respiration.
- Explain how the process of cellular respiration produces ATP.
- Demonstrate their understanding of cellular respiration through a virtual lab activity.

Materials:

- Computer with Internet access
- Head-mounted display (HMD) and controller
- Virtual immersive environment software
- Virtual lab simulation
- Worksheets

Procedure:

Analyze learners:
Determine the students' prior knowledge and experience with the topic of cellular respiration. Assess their technology skills, and identify any learning or accessibility needs.

State objectives:
Present the lesson's objectives to the students, focusing on what they will learn and how it relates to real-world scenarios.

Select instructional strategies:
Demonstrate the steps of cellular respiration using animations, videos, and infographics. Facilitate a virtual lab simulation to allow students to apply their knowledge and build conceptual understanding.

Utilize media and materials:
Use virtual immersive environment software to provide a 3D visualization of cellular respiration. Use a virtual lab simulation to demonstrate the process of cellular respiration.

Require learner participation:
Provide interactive elements, such as quizzes, polls, and discussions, to encourage active participation and student feedback.

Evaluate and revise:

Collect feedback and assess student performance using a virtual lab report. Revise the lesson plan and instructional strategies based on student performance and feedback.

Assessment:
Pre-assessment quiz: Students will take a short quiz to assess their prior knowledge and understanding of cellular respiration.
Virtual lab report: Students will complete a virtual lab report that includes data analysis and conclusions based on their results.
Post-assessment quiz: Students will take a quiz to assess their understanding of the key concepts of cellular respiration.
This lesson plan using the ASSURE model for VIEs provides an engaging and interactive learning experience that allows students to develop their understanding of cellular respiration through various multimedia resources and virtual lab simulations.

However, there is no one-size-fits-all approach to instructional design in VIEs. Designers may use a combination of models and techniques to create effective and engaging learning experiences.

References
Smaldino, S. E., Lowther, D. L., Russell, J. D., & Mims, C. (2008). Instructional technology and media for learning.

Creating Content for VIE

With the growing adoption of Virtual Immersive Environments (VIEs), the demand for tools and resources to generate content has also surged. Thankfully, numerous options are available for developers and designers to leverage when developing content for IVE.

Game engines, like Unity and Unreal Engine, are prevalent resources for generating VIE content. They offer comprehensive tools and resources that enable diverse content creation, from straightforward games to intricate simulations. These engines facilitate support for numerous platforms, such as virtual reality (VR) and augmented reality (AR) devices, making creating content that can be experienced across multiple devices seamless.

3D modeling and animation software, like Blender and Maya, also serve as valuable resources for creating IVE content. With these tools, developers and designers can generate and animate 3D objects and environments suitable for VIE. They provide many tools that facilitate the creation of lifelike environments, characters, and objects, which can be effortlessly exported to game engines for VIE applications.

Aside from game engines and 3D modeling software, various specialized tools and frameworks are accessible for generating IVE content. One such example is A-Frame, a web framework that enables the development of VR experiences with HTML and JavaScript content. OpenVR offers tools and libraries for constructing VR applications, while ARKit and ARCore are frameworks dedicated to developing AR experiences for mobile devices.

Numerous online resources are also accessible to support the development of VIE content. One example is the Unity Asset Store, which offers an extensive collection of assets that can be used in Unity projects, ranging from 3D models to animations and scripts. Sketchfab is a platform that facilitates the sharing and exploration of 3D models, while TurboSquid provides a vast library of purchasable 3D models.

Besides these resources, online communities and forums can also assist developers and designers involved in VIE projects. The Unity community forum is a significant and vibrant community where developers can seek advice and receive support from other developers. By leveraging these resources and working with online communities, developers and designers can generate innovative and impactful VIE content that can serve diverse educational and training purposes.

Engaging and Interaction inVIE

Engagement and interaction are critical for effective learning in Virtual Immersive Environments (VIEs). By immersing learners in a virtual environment, VIEs can offer engaging and interactive learning experiences to improve learning outcomes. Here are some examples of engaging and interactive experiences in VIE:

Interactive simulations are among the most effective ways to engage learners in VIE. For example, a physics simulation in which learners can interact with virtual objects and experiment with different variables can help them better understand the underlying concepts. One example of such an application is PhET, a collection of physics simulations developed by the University of Colorado Boulder.

Multiplayer games: Multiplayer games can provide engaging and interactive experiences that encourage collaboration and competition. For example, Minecraft Education Edition is a popular game that allows students to collaborate on building projects and explore various subjects like history, geography, and physics.

Virtual laboratories: Virtual laboratories offer a safe and controlled environment for learners to experiment with different variables and perform scientific experiments. For example, Labster is an online virtual laboratory platform that provides learners access to virtual lab equipment and experiments in various subjects, including biology, chemistry, and physics.

Role-playing simulations: Role-playing simulations are another effective way to engage learners in VIE. For example, a history simulation in which learners take on the role of historical figures and make decisions based on historical events can help them develop a deeper understanding of the subject. One example of such an application is Mission US, a series of history-based role-playing games developed by WNET.

Gamified learning experiences: Gamified learning experiences use game elements such as badges, rewards, and leaderboards to motivate learners and provide a sense of progress and achievement. For example, Duolingo is a language learning platform that uses gamification to encourage learners to complete lessons and progress through the levels.

Interactive storytelling: Interactive storytelling allows learners to explore different paths and outcomes based on their decisions, which can create a highly engaging and interactive experience. For example, The Body VR is a virtual reality experience that takes learners through the human body, allowing them to explore different systems and learn how they function.

Engaging and interactive experiences are critical for effective learning in VIE. By providing learners with interactive simulations, multiplayer games, virtual laboratories, role-playing simulations, gamified learning experiences, and interactive storytelling, developers, and designers can create engaging and compelling VIE experiences that can improve learning outcomes. With the growing availability of tools and resources for creating VIE content, the possibilities for engaging and interactive learning experiences in IVE are endless.

Learning Environment

Virtual immersive environments (VIEs) offer unique opportunities to engage and motivate learners. Here are some examples that may invigorate the learners and educators to use these environments:

Collaborative problem-solving environments: VIEs can be used to create interactive problem-solving environments that encourage collaboration and teamwork. For instance, a virtual escape room could be created where students work together to solve a series of puzzles to escape the room. This type of environment promotes collaboration, critical thinking, and problem-solving skills.

Virtual laboratories: Virtual laboratories can be created using VIEs, allowing students to conduct experiments and simulations in a safe and controlled environment. This enables students to learn about chemical reactions without the potential risks of working in a physical lab.

Historical reenactments: VIEs can create reenactments that transport students to different times and places, such as a virtual colonial town where students can learn about life in colonial America and interact with historical figures.

Simulations: Another example of VIEs' uses is to create simulations that allow students to practice and apply their skills in a safe and controlled environment—for example, a virtual flight simulator for practicing flying and learning about aerodynamics and navigation.

Virtual field trips: VIEs can take students on virtual field trips to locations that are difficult or impossible to visit in person. For example, a virtual trip to a remote rainforest can help students learn about the ecosystem and interact with wildlife.

Virtual classrooms: VIEs can facilitate the creation of virtual classrooms where students and instructors can collaborate in a 3D environment. This enables students to attend lectures, participate in discussions, and work on group projects in a virtual classroom setting.

Gaming environments: VIEs are well-suited for creating gaming environments that teach specific skills or concepts. For instance, a virtual game could be developed to impart coding skills or financial literacy.

Technical Knowledge

The popularity of Virtual immersive environments (VIEs) in recent years has given these emerging tools the potential to transform how people learn. However, creating these environments requires unique technical knowledge and skills. This section will explore some of the technical knowledge required for VIE.

One critical technical knowledge required for creating a VIE is knowledge of computer graphics. Knowledge of computer graphics software like Unity, Unreal Engine, or Blender can assist designers in creating engaging and realistic VIEs. The software knowledge includes modeling, animating, and applying textures to 3D objects.
Most of these skills are crucial for designing an enhanced environment that feels natural to users and gives them an immersive experience.

In addition to other technical knowledge, programming skills are essential for creating VIEs, enabling designers to develop interactive content within the virtual environment. Software tools like Unity and Unreal Engine utilize scripting languages like C-sharp and Java suitable for object-orientated programming. Therefore, a deep understanding of these programming languages is crucial for crafting effective scripts that define the behavior of objects in the environment.

Another critical technical knowledge required for VIE is knowledge of 3D sound. Sound is an essential element in creating an immersive environment. The sound must be spatially accurate to match the user's visual experience.

Knowledge of virtual and augmented reality hardware is essential in creating a VIE. This includes knowledge of head-mounted displays, handheld controllers, and motion capture devices. These devices are integral to VIE systems, allowing users to interact with the environment seamlessly.

Lastly, designers must know about user experience (UX) design. UX design is a critical aspect of creating a VIE. Knowledge about UX allows designers to create environments that are easy to use and ables users to interact with the environment meaningfully. The design must be intuitive and lead to a positive user experience.

Creating a VIE requires a unique set of technical knowledge and skills. Computer graphics, programming, 3D sound, virtual and augmented reality hardware, and UX design are all essential skills for creating an immersive and engaging learning environment. As technology evolves, designers must continue to learn and adapt to remain relevant in VIE design.

Development of Effective IVE Experience

The development of effective VIE experiences is a critical aspect of modern learning. To create a successful VIE experience, instructional designers and developers must consider various factors contributing to meaningful and effective learning.

One crucial factor is alignment with learning objectives and desired outcomes. VIE experiences aligned with learning objectives can lead to higher learning and retention levels. It is important to design VIE experiences with specific learning goals and ensure that learning activities and experiences within the VIE are targeted toward these goals.

Another essential factor is engagement. Interactive elements, such as gamification, simulations, and other immersive learning experiences, can help increase engagement and promote active learning. Feedback mechanisms, such as progress bars or immediate feedback, can also improve engagement and guide learners toward achieving their learning goals.

The accessibility and user-friendliness of the VIE is also critical. The technology used within the VIE must be reliable and efficient to ensure that technical issues or difficulties do not hinder the learning experience. Additionally, VIEs should be easy to navigate and use to avoid confusion that can disrupt the learning process.

Lastly, it is important to evaluate the effectiveness of the VIE experience to ensure that the learning goals are met. Assessments and evaluations provide insights into the effectiveness of the VIE in achieving the desired learning outcomes. Continuous evaluation and improvement of the VIE experience can ensure learners have the most effective and meaningful learning experiences possible. Developing effective VIE experiences requires careful planning, design, and evaluation. By leveraging the latest technologies and best practices in instructional design, developers can create engaging and effective VIE experiences that drive meaningful learning outcomes.

Needs Assessment

Virtual Immersive Environments (VIEs) have a unique potential to engage learners and provide interactive and immersive experiences that can improve learning outcomes. However, creating effective lesson plans in VIE requires careful planning and a deep understanding of the learners' needs. Careful planning begins with a Needs assessment as it helps to identify the gaps in learners' knowledge and skills and to design instructional interventions that address those gaps.

Different methods for conducting needs assessments in VIE include surveys, interviews, focus groups, and observation, depending on the context, the target audience, and the instructional content. For example, a survey might be appropriate for a large group of learners, while a focus group might be more suitable for a smaller and more diverse group.

Observation might be used to identify the learners' behavior in the VIE and their interactions with the environment and other learners. Interviews can provide more detailed information about learners' preferences and motivations. When conducting a needs assessment in VIE, we need to ensure that the assessment is aligned with the instructional design goals. For instance, if the goal is to create a VIE to teach a particular skill, the needs assessment should identify the learners' existing knowledge and skills related to that skill and any misconceptions or gaps in their understanding. The needs assessment should also explore the learners' preferences and interests in the VIE context, as these can impact engagement and motivation.

Another important consideration when conducting a needs assessment in VIE is to involve stakeholders in the process. This can include learners, subject matter experts, instructional designers, and VIE developers. Stakeholder involvement can help to ensure that the needs assessment is comprehensive and reflects the needs and interests of all parties involved. It can also help identify potential obstacles to successful implementation and develop strategies to address them.

Once the needs assessment is completed, the results should be analyzed to identify the gaps and needs of the learners. This information can then be used to develop learning objectives, which provide a clear understanding of what learners are expected to know or be able to do at the end of the instruction. The learning objectives should be specific, measurable, achievable, relevant, and time-bound (SMART).

In summary, conducting a needs assessment in VIE is important in developing effective instructional interventions. The assessment should be aligned with the instructional design goals, involve stakeholders, and provide specific and measurable learning objectives. By following these principles, instructional designers can create engaging and effective VIE experiences that address the learners' needs and improve learning outcomes.

Some recent studies have explored the effectiveness of needs assessment in the context of VIE. For instance, a study investigated the use of needs assessment in developing a VIE for a nursing program. The study found that needs assessment effectively identified the learners' needs and preferences, which led to developing a VIE that was engaging and effective in promoting learning (Jeong & Lim, 2022). Another study explored needs assessment in developing a VIE for teaching nursing students. The study found that needs assessment helped identify the learners' existing knowledge and skills and develop learning objectives relevant to their needs. The VIE developed based on these findings effectively improved the learners' knowledge and skills (Gupta et al., 2023).

Overall, these studies suggest that needs assessment is an effective approach for developing VIEs that are engaging and effective in promoting learning outcomes. By carefully analyzing the learners' needs and preferences, instructional designers can develop VIEs that provide immersive and interactive learning experiences that improve learning outcomes.

References

Gupta, S., Wilcocks, K., Matava, C., Wiegelmann, J., Kaustov, L., & Alam, F. (2023). Creating a Successful Virtual Reality–Based Medical Simulation Environment: Tutorial. *JMIR Medical Education*, *9*, e41090.

Jeong, E., & Lim, J. (2022). An Analysis of Priorities in Developing Virtual Reality Programs for Core Nursing Skills: Cross-sectional Descriptive Study Using the Borich Needs Assessment Model and Locus for Focus Model. *JMIR Serious Games*, *10*(4), e38988.

Measurable objectives

In virtual immersive environments (VIE), setting measurable objectives is essential for effective learning. Learning objectives should be designed to address specific knowledge, skills, or behaviors that students should acquire after completing the learning experience.

The measurable objectives in VIE should follow the SMART criteria, meaning they should be Specific, Measurable, Achievable, Relevant, and Time-bound. Specific learning objectives outline exactly what students should be able to do, whereas measurable objectives help assess whether the objectives have been achieved. In VIE, measurable objectives can be assessed through various means, such as quizzes, assignments, and simulations.

In addition, the measurable objectives in VIE should also consider the affordances of the technology. For instance, if the learning experience is a simulation, the measurable objectives should align with the affordances of the simulation, such as specific skills or knowledge that can be acquired through the simulation. Furthermore, the objectives should be designed to enhance the user's engagement and interaction with the VIE.

To ensure that measurable objectives in VIE are effectively designed, instructional designers should conduct a needs assessment to identify the learning goals, the audience, and the environment in which the learning experience will be delivered. This information will help in determining the most appropriate measurable objectives for the VIE.

ABCD model (Smaldino et al., 2008) is a commonly used framework for writing learning objectives. Here's an example of how the model can be applied to write an objective for a VIE:

A: Audience: The audience for this objective is a group of high school students.

B: Behavior: By the end of the VIE experience, the learners will be able to demonstrate their understanding of the physics concepts related to motion.

C: Condition: The learners will use physics simulation software to investigate the relationships between speed, velocity, and acceleration.

D: Degree: The learners will be able to explain the key concepts of motion and calculate the speed, velocity, and acceleration of an object with 90% accuracy.

Overall Objective: By the end of the VIE experience, high school students will be able to demonstrate their understanding of the physics concepts related to motion, using physics simulation software to investigate the relationships between speed, velocity, and acceleration. Specifically, they will be able to explain the key concepts of motion and calculate the speed, velocity, and acceleration of an object with 90% accuracy.

In conclusion, setting measurable objectives in VIE is crucial for effective learning. Instructional designers should ensure that measurable objectives follow the SMART criteria, align with the affordances of the technology, and are designed to enhance the user's engagement and interaction with the VIE.

References

Smaldino, S. E., Lowther, D. L., Russell, J. D., & Mims, C. (2008). Instructional technology and media for learning.

Evaluation

Evaluation of instructional lesson plans in VIEs is a crucial aspect of ensuring that learning objectives are achieved. It involves a systematic process of assessing the effectiveness of the lesson plan, identifying areas that need improvement, and making necessary adjustments to enhance learning outcomes. In this section, we will discuss the importance of evaluating VIE instructional lesson plans and the various methods used to achieve this goal.

Why Evaluate VIE Instructional Lesson Plans?

Evaluation is an essential step in the instructional design process, as it provides valuable feedback on the effectiveness of the lesson plan. The feedback obtained from the evaluation process can be used to improve the design of future lessons and ensure that the learning objectives are met. Evaluation can help to identify any gaps in knowledge and skills, as well as highlight areas where learners require additional support.

Evaluation can also help to identify any technical issues with the VIE, such as slow loading times, poor graphics quality, or other problems that could impact the learning experience. Identifying these issues early can help to ensure that learners have a positive experience in the VIE and that learning outcomes are not negatively affected.

Methods for Evaluating VIE Instructional Lesson Plans

There are several methods for evaluating VIE instructional lesson plans, including formative evaluation, summative evaluation, and user feedback.

Formative evaluation is an ongoing process that involves reviewing the instructional lesson plan during its development and implementation. This method allows for early identification of any issues and provides an opportunity to make necessary adjustments to enhance learning outcomes. Formative evaluation can also help to identify any technical issues with the VIE.

Summative evaluation is a method used to assess the overall effectiveness of the instructional lesson plan once it has been completed. This method involves assessing the learning outcomes and comparing them to the instructional objectives. The goal of summative evaluation is to determine if the learning objectives were met and if the instructional lesson plan was effective in achieving these objectives.

User feedback is another method for evaluating VIE instructional lesson plans. This method involves gathering feedback from learners about their experience in the VIE. This feedback can be obtained through surveys, interviews, or other methods. User feedback can provide valuable insights into the effectiveness of the instructional lesson plan and can help to identify areas for improvement.

Evaluating VIE instructional lesson plans is an essential step in the instructional design process. It provides valuable feedback on the effectiveness of the lesson plan and can help to identify areas for improvement. The various methods for evaluation, including formative evaluation, summative evaluation, and user feedback, provide a comprehensive approach to evaluating instructional lesson plans in VIEs. By incorporating evaluation into the instructional design process, educators can ensure that their VIE instructional lesson plans are effective in achieving learning objectives and providing an engaging and interactive learning experience.

There are a variety of methods and tools that can be used to evaluate the effectiveness of VIE lesson plans. Some common approaches include:

Pre- and post-test assessments of learning outcomes: Comparing student performance on a knowledge or skills assessment before and after participating in a VIE lesson plan can provide insight into the effectiveness of the instructional approach.

Observations of student behavior: Observing how students interact with a VIE lesson plan and identifying areas where they struggle or excel can provide valuable information for improving the lesson plan.

Surveys and questionnaires: Collecting feedback from students about their experience with a VIE lesson plan can provide insight into their engagement, motivation, and overall satisfaction with the instructional approach.

Expert review: Having subject matter experts review the VIE lesson plan and provide feedback on its effectiveness and alignment with learning objectives can be a useful evaluation tool.

Analytics and data tracking: Collecting data on how students engage with a VIE lesson plan, such as how much time they spend in the simulation or how many times they attempt a task, can provide insights into the effectiveness of the instructional approach.

Overall, a combination of these evaluation methods can be used to gather comprehensive data on the effectiveness of a VIE lesson plan.

1. Examples of the lesson plans in VIE

Exploring the Human Body: Grade Level: 9-12

Overview: This lesson aims to provide an immersive learning experience to students by exploring the human body in a VIE. Students will learn about the anatomy and physiology of the human body by using various VIE tools and interacting with 3D models.

Learning Objectives:

- Students will be able to identify and label the major organs and systems of the human body.
- Students will be able to explain the functions of the major organs and systems of the human body.
- Students will be able to analyze the interdependence of different organs and systems of the human body.

Hardware and Software

- Computer with internet access
- Virtual reality headset
- VIE software
    - Human anatomy models

Learning Activities:

Introduction

The teacher will introduce the lesson topic and objectives.

Students will be asked to brainstorm what they already know about the human body.

Virtual Reality Exploration.

Students will put on the VR headset and use the VIE software to explore the human body.

They will interact with 3D models and examine different organs and systems.

The teacher will guide the students and provide explanations and examples.

Analysis and Discussion.

Students will reflect on what they learned during the virtual reality exploration.

They will discuss and compare different organs and systems, their functions, and their interdependence.

The teacher will facilitate the discussion and provide feedback.

Group Project

Students will be divided into groups and given a specific organ or system to study in detail.

They will research and gather information about the organ or system using various sources, including the VIE software.

They will create a multimedia presentation to share their findings with the class.

Assessment

During the virtual reality exploration, the teacher will observe the students and assess their engagement and participation.

At the end of the lesson, students will take a short quiz to test their knowledge of the major organs and systems of the human body.

The group project will be assessed based on the quality of the multimedia presentation and the accuracy and depth of the research.

2. Lesson Plan: Exploring Ancient Egypt in Virtual Reality: Grade Level: 6th-8th grade

Learning Objectives:

Students will be able to identify and describe the key characteristics of ancient Egyptian civilization.

Students will be able to analyze the role of the Nile River in ancient Egyptian society.

Students will be able to compare and contrast the different types of ancient Egyptian architecture.

Hardware and Softwae

Virtual reality headsets

Smartphones or tablets

“Exploring Ancient Egypt” virtual reality app

Paper and pencils

Procedure:

Introduction

Begin the lesson by asking the students what they already know about ancient Egypt. Create a list on the board of their responses. Then, introduce the learning objectives for the lesson.

Virtual Reality Exploration

Divide the class into small groups of 3-4 students. Give each group a virtual reality headset and a smartphone or tablet. Instruct the students to download and open the “Exploring Ancient Egypt” app.

As the students explore the virtual reality environment, they should take notes on the key characteristics of ancient Egyptian civilization, the role of the Nile River, and the different types of ancient Egyptian architecture. They should also discuss their observations with their group members.

Group Discussion

Bring the class back together and facilitate a group discussion on the students' observations. Ask each group to share their notes and observations with the class. Encourage the students to ask questions and make connections between the different aspects of ancient Egyptian society.

Assessment

Instruct the students to use their notes to write a short essay on one of the following topics:

The importance of the Nile River in ancient Egyptian society

The role of architecture in ancient Egyptian society

The daily life of ancient Egyptians

The essay should be a minimum of 500 words and should demonstrate an understanding of the key characteristics of ancient Egyptian civilization.

Conclusion

Wrap up the lesson by having each student share one thing they learned about ancient Egypt. Remind the students of the learning objectives and how they were met during the lesson.

Assessment

The students' essays will be assessed on the following criteria:

Demonstrated understanding of the key characteristics of ancient Egyptian civilization

Use of evidence and examples to support their arguments

Use of proper grammar and spelling

Lesson Plan: Design of VR and 3D Environments for Teaching DNA Structure (You may find more information here)

Objective

Students will understand the structure of DNA and the components of nucleic acids.

Hardware and Software

- Blender 3D modeling software
- Unity game engine
- Protein Data Bank (PDB) files (Safadel & White, 2019)
- ePMV add-ons for Blender
- Adobe Captivate
- Desktop computers
- HTC VIVE headset and controllers
- C# scripts

Lesson Outline:

1. **Introduction**
    - Briefly introduce the concept of DNA and its importance in biology.
    - Explain the use of VR and 3D environments in learning DNA structure.
2. **Creating 3D models of macromolecules**
    - Demonstrate how to import PDB files into Blender.
    - Guide students in creating their own 3D models of DNA using Blender.
3. **Developing a desktop tutorial using Adobe Captivate**
    - Introduce Adobe Captivate and its role in creating interactive lessons.
    - Demonstrate how to import 3D models into Adobe Captivate.
    - Guide students in creating an interactive tutorial about DNA structure using Alessi and Trollip's instructional guidelines (Alessi & Trollip, 1984).
    - Have students practice navigating their tutorial and answering questions to proceed to the next level.
4. **Creating a VR environment using Unity**
    - Introduce the Unity game engine and its role in creating VR environments.
    - Demonstrate how to import the desktop tutorial into Unity.
    - Guide students in programming their 3D objects and environment using C# scripts.
    - Have students practice interacting with the VR environment using HTC VIVE headset and controllers.
5. **Assessing student learning**
    - Provide a final quiz consisting of 15 questions that challenge students' spatial recognition of DNA molecules.
    - Allow students to use either the desktop or VR environment to complete the quiz.
    - Review and discuss the answers to the quiz as a class.
6. **Conclusion**
    - Discuss the advantages and disadvantages of using VR and 3D environments in learning DNA structure.
    - Encourage students to explore other applications of VR and 3D modeling in science education (Safadel, White, 2020).

References

Alessi, S. M., & Trollip, S. R. (1984). *Computer-based instruction: Methods and development*. Prentice-Hall, Inc..

Safadel, P., & White, D. (2020). Effectiveness of computer-generated virtual reality (VR) in learning and teaching environments with spatial frameworks. *Applied Sciences*, *10*(16), 5438.

Safadel, P., & White, D. (2019). Facilitating molecular biology teaching by using Augmented Reality (AR) and Protein Data Bank (PDB). *TechTrends*, *63*(2), 188-193.

Conclusion

Including new technologies such as virtual immersive environments (VIEs) in education can significantly enhance students' learning experiences and outcomes. By integrating instructional methods with innovative technology, educators can create more engaging, interactive, and satisfying learning environments catering to diverse cognitive styles. The potential applications of spatial modeling and three-dimensional objects will continue to expand as technology opens up more significant learning and work opportunities for the future.

To maximize the benefits of VIEs, it is essential to carefully consider instructional design principles, cognitive load management, collaboration, communication, and serious game design elements. Attention must also be given to potential drawbacks such as addiction and social isolation, ensuring these immersive technologies' responsible and healthy use.

Ultimately, VIEs have the potential to revolutionize education and training, offering a dynamic, engaging, and practical approach to learning. As research and innovation continue, VIEs will evolve and improve, providing even more excellent opportunities for teaching and learning in the future.