Implementing immersive experiences in the classroom

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Students can benefit from well-designed immersive experiences within the flow of their education. Immersive technology provides unique opportunities over digital technology and allows for additional avenues of creativity as the technology becomes more procurable. However, there are limitations to consider when selecting an immersive experience for your class. We examined the latest research to compile the following guidance on best practices.

What is an educational immersive experience?

An educational immersive experience is an engaging, often interactive environment designed to deeply involve learners in a particular subject or skill. These experiences aim to enhance learning by immersing students in scenarios that simulate real-world contexts, often using advanced technologies or creative setups. An immersive experience is enabled by interactive 3D technology, such as a virtual reality (VR) headset (i.e., Meta Quest, HTC Vive), to replicate a real-world activity or experience.

Examples of educational immersive experiences include virtual field trips, historical reenactments using VR, interactive science labs, and language learning through immersive environments. These experiences can be particularly effective in making complex or abstract concepts more tangible and understandable.

Immersive experiences have many applications for learning, including:

- **Practicing:** Simulating real-world scenarios in a safe and affordable environment
- **Applying:** Training skills development through personalized complex experiences
- **Engaging:** Using virtual gaming experiences to learn and measure progress
- **Creating:** Engaging creativity through game building in an immersive world

Considerations for educational immersive experiences

New technology that enables immersive learning is released every day, and selecting the right experience for your learners can be overwhelming. When selecting an immersive learning experience, consider the goals you have for your learners. A good immersive experience should be easy to use, accessible, and support your learning goals to enhance the learning experience. However, other factors, like the complexity of the immersive environment or the amount of data being shared, can influence the success of the experience for your students. Ultimately, the most important thing to consider when choosing an immersive experience is that it's the right fit for your learners and learning outcomes.

Manage the experience

When selecting an immersive experience for your class, prioritize your learning objectives and the desired outcomes you want from your learners after engaging with the technology. Immersive experiences can authentically replicate a real-world experience in a safe environment or present an imaginative, gamified experience that embeds learning throughout. Likewise, immersive environments can range from really simple to highly complex, as well as offer an experience tailored to each student or applicable to everyone. The learning experience can allow your students to sit back and take in

information in a novel way or encourage interaction and collaboration to help learners apply concepts through a hands-on experience. By considering the complexity, relevance, and potential cognitive load, you can select immersive experiences that effectively support your students' learning needs and goals.

Pick an experience that has the right level of authenticity for your class.

Selecting immersive experiences that match the authenticity level required for your class can significantly enhance student engagement and understanding. By aligning the immersive experience with your course objectives, you can create more engaging and effective learning environments.

- **What level of immersion is right for your lesson?** Selecting an immersive experience that aligns with the authenticity required for your class is crucial for maximizing learning outcomes. Authentic learning environments promote deeper engagement and understanding by mirroring real-world contexts and challenges (Herrington & Oliver, 2000). When choosing an experience, consider the complexity and relevance to your course objectives. For instance, a virtual lab simulation might be ideal for a science class to provide hands-on practice without the risk associated with real experiments. Conversely, a historical role-playing scenario might better suit a history class, allowing students to immerse themselves in the sociopolitical dynamics of a particular era. Ensuring the authenticity level matches your students' needs and the curriculum will enhance their engagement and facilitate the application of knowledge to real-world situations.
- **How does authentic replication compare to full gamification?** Integrating immersive experiences into the classroom can take the form of gamified environments or real-life simulations, each offering unique benefits. Gamification leverages game design elements in non-game contexts to motivate and engage students (Deterding et al., 2011). For example, using an immersive game where students must solve environmental problems can foster collaboration and critical thinking in a fun, interactive setting. On the other hand, real-life simulations provide authentic contexts for applying learned skills. For instance, a virtual business simulation can allow students to practice entrepreneurial skills and decision-making in a risk-free environment (Aldrich, 2004). Both approaches can cater to different learning objectives, making them versatile tools for enhancing student engagement and learning outcomes.

Pick an experience that offers an appropriate level of complexity for your students.

Immersive experiences vary in complexity, affecting the learning process. While many games are intuitive, learners still benefit from practice. Advanced games can overwhelm novices, causing confusion, while simplistic games might bore experts, missing key learning opportunities. Thus, it's crucial to choose experiences that offer high-quality learning without being overly difficult or complex.

- **What is the right amount of information?** A trade-off exists between engagement and distraction when using immersive technology. Immersion and interaction increase learner involvement, and thus can improve attention and engagement, but also can distract from the learning outcomes by adding extraneous cognitive load (Han et al., 2021). 'Cognitive load' describes the cognitive resources dedicated towards a task, whereas 'extraneous cognitive load' refers to the resources dedicated toward filtering out unneeded information from the learning experience. Because learners have limited cognitive resources when experiencing something new, an ideal learning environment would have fewer features that distract attention and

require extraneous cognitive load (Sweller, 2020). The amount of extraneous cognitive load depends on the learning task and the types of interactive elements incorporated into the design. For example, visualizations can support text-based information and help learners attend to important ideas, but complex images or graphics can also reduce understanding by confounding the key ideas. Therefore, an immersive experience should communicate the information at the right level for your learners.

- **How can you balance content with interactive tools?** When presenting learners with new immersive technology, it is important to train them how to use interactive features to prevent the need for extraneous cognitive load towards the usability of the immersive features, rather than on the learning task. Likewise, interactive features that are more familiar to the learner should be used when learning highly complex or novel topics. Some studies in which only minor forms of interactivity were used still resulted in high levels of distraction, leading to lowered learning performance (Skulmowski & Rey, 2020; Song et al., 2014). Other studies show there is a compromise between the complexity and/or novelty of the learning content, as well as the familiarity with the type of interactive feature (Kalet et al., 2012). Therefore, the immersive experience should be easy for your learners to use while also engaging.
- **How can movement influence learning?** Immersive technology often involves embodiment - using senses, actions, and bodily experiences to help understand and remember information. Embodied learning involves synchronizing multiple streams of information in working memory, such as tactile information, motor movements, and other sensory information (Skulmowski & Rey, 2017). If these streams of information do not align or if one piece of information is irrelevant (such as sounds or visuals that distract from learning), the learner may become confused and lose sight of the learning objectives (Paas & Sweller, 2012). Learning science suggests that motion should have clear intentions to benefit learning. Therefore, the immersive learning experience that you choose should have purpose in each action your learners make.

Pick an experience that offers the right level of personalization to motivate your students.

New immersive technology promotes a personalized experience for the learner. Personalization in an immersive experience can have a variety of approaches, from ‘choose your own adventure’ scenarios to self-created avatars. When experiences are personalized, learners tend to be more engaged with the content, learn more effectively and efficiently, and experience opportunities to develop self-regulated learning and metacognitive skills.

- **How can immersive experiences promote personalization?** Personalization should be driven by the interests that learners themselves identify (Walkington, 2013). Using these individual interests to personalize the experience cultivates sustained interest in the situation presented. The metaverse is especially useful for fostering situational interest due to the level of presence and agency the user feels. A high level of immersion in a realistic virtual environment may constitute such a novel and intense experience that it helps foster interest in the moment (Buttussi & Chittaro, 2018; Makransky & Lilleholt, 2018; Parong & Mayer, 2018; Makransky & Peterson, 2021). Additionally, immersive experiences can be tailored to adapt to the learner's pace and preferences, providing real-time feedback and adaptive challenges that keep students engaged and motivated. You should be aware of different approaches to personalization when

selecting an immersive experience for your learners, ensuring that the chosen platform or game aligns with the learners' individual goals and interests to maximize educational outcomes.

- **How does personalization influence learning?** Learning environments that adapt to learners' interests can improve learning outcomes by providing concrete grounding for abstract concepts, thus creating more ways of accessing and understanding new content. In education research broadly, studies show that education should focus on helping students develop and maintain situational interest (short-term, situational knowledge-seeking behavior; Knogler et al., 2015), so it can progress into individual interest. This approach is accomplished by using context personalization (including personal details such as the student's name or birth date, or preferences), providing students with learning choices (versions of the same task, allowing for self-paced timing, choices of rewards) and encouraging students to actively generate personalized connections (students are asked to make the connection between the learning materials and their interest by, for example, writing an essay about the potential value of the learning content for their life or future career; Reber, Canning & Harackiewicz, 2018). Immersive experiences can improve motivation through various personalized approaches.

Pick an experience that provides the right level of interactivity.

Choose an immersive experience with the right level of interactivity to engage your learners. Active involvement in virtual environments through critical thinking activities or collaboration with other users can enhance learning outcomes better than traditional methods. Therefore, it is essential to consider how students will interact with the learning content when selecting an immersive experience.

- **What are the benefits of interactive learning in immersive environments?** Research shows that learners who are actively engaged with the learning content, such as generating questions or summarizing in their own words, learn more than learners who passively interact with the learning material, such as reading or watching without any interaction (Szpunar et al., 2013). By involving the learner in the learning process, the learner's attention is engaged during learning rather than passively observing which is more likely to lead to a lack of focus (Pachai et al., 2016). To build upon the learner interaction even further, a learner who draws a concept map of the learned text or creates their own questions is engaging in constructive learning (Chi et al., 1989; Chi & Wylie, 2014). Constructive learning engages attention through active learner participation and promotes new connections in working memory to construct an output. Immersive technology allows the learner to engage with learning content in a variety of ways, including through different settings and platforms. When selecting an immersive learning experience, consider how the learner will interact with the content.
- **How can immersive environments promote interaction and collaboration?** An essential aspect of interactive learning is the exchange of thoughts and ideas among peers through collaboration (Chi & Wylie, 2014). The multi-player nature of metaverse games facilitates real-time collaboration within virtual worlds (O'Conner et al., 2015). Immersive environments enhance collaborative learning by enabling observation of others, fostering cooperative techniques, and transforming individual ideas into collective group efforts (Pinho et al., 2002). Users of VR technology report that the ability to work together and communicate freely in collaborative virtual spaces leads to the development of meaningful connections (Freeman et al., 2020). Additionally, immersive technology offers opportunities to practice social skills in low-risk settings and share goals to complete gamified tasks (Maloney & Freeman, 2020). Consider how your students will communicate when selecting an immersive learning experience.

Consider your learners

Health and wellbeing should be at the forefront when deciding if immersive experiences are right for your learners. When selecting an immersive experience, consider the learners' potential emotional, physical, and behavioral responses to the experience. Pay attention to the duration of exposure to immersive technology and prepare to address any adverse reactions. Additionally, be aware of the types of data collected by immersive technologies and ensure that students and parents understand data privacy and protection measures. While immersive technologies offer significant educational benefits, educators must also be vigilant about potential risks to ensure a positive and safe learning experience for their students.

Plan the length of time that students will be immersed.

While it is important to consider how long learners should use immersive technologies in the classrooms, no evidence-based standards yet exist. Monitoring and setting boundaries on immersive technology usage is crucial, as excessive use can negatively impact mental health and real-world social behaviors, while brief, regulated usage can enhance prosocial behaviors and learning outcomes.

- **How often should learners be immersed?** Recommendations for use of immersive technology vary from as little as 10-15 minutes at a time (NSPCC, 2024) to 2 hours per day (Meta, 2024). However, there are no set evidence-based standards, and research has yet to determine the long-term effects from use of immersive technology in adolescents. When considering time limits for immersive learning, it is important to consider the child's daily screen usage and daily physical activity habits. Parents want screen time recommendations, but simple time advisories cannot be introduced until research has fully evaluated the consequences of screen use on children (Blum-Ross & Livingstone, 2018). Daily screen time in 12–13-year-old children has increased since before the pandemic, from 3.8 hours/day to 7.7 hours/day (Nagata et al., 2022). In a global study surveying guardians of children (ages 0 to 17) who own a VR headset at home, 71.5% of children increased use of their headset since the start of the pandemic (Mado et al., 2022). Before the pandemic, children used their headset around 20 minutes per day, whereas after the start of the pandemic, children used their headset around 30 minutes per day. The World Health Organization recommends less than 1 hour of sedentary screen time for children under 5 years old (WHO, 2019), and both the American Academy of Pediatrics and American Academy of Child & Adolescent Psychiatry recommend limiting *recreational* screen time for children over 5 years old to 2 hours per day. However, no recommendations are written for active or sedentary screen time spent learning, or screen time using immersive technologies.
- **What happens if children spend too much time in immersive environments?** Perception of time differs when immersed in virtual reality – participants report experiencing time as shorter and play for a longer amount without realizing it (Mullen & Davidenko, 2021). Therefore, setting timers and tracking usage can help students regulate their usage. Immersive gaming allows for virtual social interactions, but too much time can also decrease mental health. While brief exposures to gaming can improve prosocial behaviors in children, prolonged use may hinder a child's ability to engage in social behaviors in the real world and could potentially increase risk of psychological issues. Adolescents who played games less than one hour a day presented higher levels of prosocial behavior, as well as greater life satisfaction and fewer symptoms of

hyperactivity and emotional difficulties (Kardefelt-Winther, 2017). Adolescents who played games more than half of their free time showed higher levels of emotional problems and antisocial behavior (Palaus et al., 2017). However, research has yet to determine if video game addiction is a byproduct of psychological disorders, or if video game usage leads to addiction and depression. Monitoring and setting boundaries on students' usage of immersive technology is important to ensure students are safely learning in immersive environments.

Consider how your learners will react to the immersive environment.

Learners may react differently to immersive experiences based on their level cognitive development. While immersive experiences present many opportunities to improve learning outcomes, exposure to unique and unfamiliar environments may also result in negative reactions, especially in young children. Consider the holistic experience and potential cognitive and emotional responses from immersive learning when selecting the right experience for your class.

- **How might learners interpret immersive experiences?** Age is an important factor when considering how to use immersive technology in the classroom. Research shows that immersive experiences presenting realistic scenarios might be perceived and remembered as reality, especially for young children (ages 4-6). Children are more vulnerable to the creation of false memories from realistic, interactive experiences. Preschool-age children who watched an avatar of themselves swimming with orcas and dancing with stuffed mice in VR reported a false memory of the event occurring in their past (Segovia & Bailenson, 2009). If considering immersive learning for young children, consider talking with your learners about how the technology works and what they might expect from the experience.
- **How do learners respond to the experience?** Children are also more susceptible to the visual and auditory spatial stimuli of immersive learning and therefore experience very intense feelings of presence and emotional responses in virtual environments (Baumgartner et al., 2008). Immersive experiences do not necessarily invoke negative emotions; however, immersion has the possibilities to present new, unfamiliar landscapes that might induce phobia or shock in young children. Research in young children shows that children (ages 4-6) showed no emotional distress or differences in enjoyment when learning inhibitory control skills in VR compared to TV (Bailey et al., 2019). Select an experience tailored to age-appropriate content and gauge the response from your learners after participating in immersive learning.

Inform your learners what data is being collected and how it is used.

Immersive experiences have unique ways of capturing data about your learners. Data collected in immersive environments can contain identifiable characteristics that link back to your learners. When introducing immersive technology in the classroom, you and your students should be aware of what data is being collected and how it is used.

- **What types of information could be captured by immersive technology?** Data collected in immersive technology can span from personal data, such as name and location, to biometric data, such as eye gaze and gait analysis. These types of data are all protected by FERPA when collected in educational contexts. Research shows that even non-verbal data, such as movement and eye-tracking data, can be personally identifiable data. A study tracking motion in VR showed that computer-based algorithms could accurately identify participants based on movement

characteristics (Miller et al., 2020). Likewise, students using a VR headset were accurately identified based on biometric movement data, such as pointing, grabbing, walking, typing, and eye gaze, collected over multiple time points (Pfeuffer et al., 2019). When selecting an immersive learning experience, consider what information the company is collecting and how they communicate that information back to the user. Technology companies should always allow participants to opt-out of any data collection and allow individuals to review the types of content accessed by their applications (read more about data protection: XRSI Privacy Framework, 2020).

- **How can you bring awareness to data protection?** When considering introducing immersive technology into your classroom, consider that not all students or parents have digital literacy. Students and parents (as well as educators) should be empowered to understand and manage risks of data sharing and privacy to stay safe online. Digital citizenship programs can be used to educate across development stages, contributing to the long-term goal of making digital worlds safer for this audience. The Children's Online Privacy Protection Act (COPPA29) states specific recommendations for operators of online services directed to children under 13, or those who collect, use, or disclose personal information from children under 13. The Kids Online Safety Act (KOSA) could also impact immersive technology companies through future compliance obligations dictating how adolescents access the metaverse and with what content they could interact. Stay up to date on the regulations of immersive technology and inform your students and parents of data compliance when using immersive technology in the classroom.

Optimize the output

Immersive learning experiences make learning more applicable by simulating real-world tasks in a safe, cost-effective environment, allowing learners to practice without real-world consequences. Research indicates that immersive technology can increase engagement and improve understanding in complex subjects like math and chemistry, as it allows learners to apply concepts in a realistic and controlled setting. Students are also more motivated to learn when immersive experiences are integrated in their class, leading to better overall learning outcomes. Consider the benefits of immersive experiences for your students.

Immersive learning experiences can make learning more applicable.

Immersive experiences make learning more applicable by simulating real-world tasks in a safe, cost-effective environment, allowing learners to practice without real-world consequences. Research indicates that immersive technology can increase engagement and improve understanding, especially in complex subjects like math and chemistry, because immersive learning has tangible applications and deeper encoding of the material.

- **How can immersive experiences make learning more applicable?** Simulating real-world experiences through immersive technology can not only save resources and money, but also present opportunities for the learner to safely trial-and-error without real-world consequences. Simulated environments can be as realistic as needed and allow learners to perform tasks through physical movement, creating the opportunity to learn in a safe space. Research shows that observing or making gestures that are aligned to learning outcomes leads to richer encoding and therefore richer cognitive representations (Paas & Sweller, 2012). Likewise,

authentic application of the learning content can help learners make connections. For example, applying biology concepts in a lab can benefit learning but is also costly and dangerous. Simulated lab experiences can replicate the benefits of practical application while also reducing those logistical barriers.

- **What evidence suggests that immersive experiences make learning more applicable?** Middle school students using immersive technology to learn math showed greater understanding than students using traditional methods (Demitriadou et al., 2020). High school students also reported an increased understanding of complex chemistry concepts while maintaining high levels of engagement when learning about chemical reactions in an immersive environment (Isabwe et al., 2018). Another study with nursing students also found that participants reported the higher immersion environment as more engaging and realistic (Farra, Smith & Ulrich, 2018). It should be noted that in both studies, researchers did not find any difference in learning gains between the two groups. Thus, both findings need to be taken into consideration when using immersive technology for learning—while more immersive elements may be novel and engaging for users, immersive technology alone will not necessarily lead to improved learning outcomes.

Immersive experiences can motivate your learners by teaching real-world skills.

Immersive experiences can personalize content to match students' interests and learning paces, enhancing intrinsic motivation and encouraging active participation. Studies show that high levels of immersion are linked with increased motivation and engagement, with students reporting greater motivation and a strong sense of presence during immersive learning experiences compared to traditional methods.

- **How can immersive experiences promote motivation?** Immersive experiences can promote motivation by creating engaging and interactive learning environments that captivate students' interest. These experiences often incorporate gamified elements, realistic simulations, and immediate feedback, making learning more enjoyable and relevant. By personalizing the content to match students' interests and learning paces, immersive technology fosters a sense of achievement and progress (Walkington, 2013). Additionally, the novelty and realism of immersive environments can enhance students' intrinsic motivation, encouraging them to explore and participate actively in their learning (Makransky & Lilleholt, 2018).
- **What evidence suggests that immersive learning promotes motivation?** Immersive learning shows benefits to student motivation and engagement during the learning experience. Studies show that high levels of immersion are linked with increased motivation and engagement compared to moderate levels of immersion (high immersion condition included external sensors that tracked body position and gestures and had better resolution; Huang, Roscoe & Craig, 2021). After a brief (35-minute) virtual social studies field trip in Google Cardboard, 9–12-year-old students reported greater motivation, demonstrated a strong sense of presence, and asked similar amounts of questions compared to a traditional field trip (Cheng & Tsai, 2019). Children (ages 4-6) were less likely to suppress motor responses and were more likely to participate while learning inhibitory control skills (Simon Says) in XR compared to learning from TV (Bailey et al., 2019). Immersive learning encourages learners to ask questions and engage with the learning content, even after the learning experience.

Immersive experiences can improve engagement in the classroom.

Immersive experiences promote engagement by incorporating interactive features, such as embedded questions and reflection activities, which help learners connect with the content and apply it to real-world situations. Research indicates that greater engagement through immersive learning can lead to better performance, increased test scores, and improved memory retention, though the effectiveness may vary depending on the complexity of the tasks and the learner's familiarity with the material.

- **How can immersive experiences promote engagement?** Because learners have limited attention capacity (Lavie, 2010), engagement is a desirable factor leading to better learning outcomes. Research shows that greater engagement can result in better learning performance, such as increased test scores and better memory retention (Bryson & Hand, 2007). The digital environment has scaled-up interactive features to improve learner engagement or interest in the learning experience and can gamify learning. Not only are learners using additional sensory information (like movement) in a virtual space (Ionescu & Vasc, 2014), but the immersive experience can also embed interactive learning components within the flow of learning. Interactive features within immersive environments, such as embedded questions with immediate feedback while learning or reflection activities that prompt deeper thinking, can improve engagement and help learners make connections between learning content and real-world application.
- **What evidence suggests that immersive learning promotes engagement?** Students learning chemistry showed greater learning benefits when learning from a highly immersive, interactive chemistry lab compared to regular in-person instruction (Johnson-Glenberg et al., 2014). These gains in learning are associated with higher engagement because of the embodied experience and higher collaboration during immersive learning. However, another study showed that learners who engaged in immersive learning reported more extraneous cognitive load when the task was too difficult, despite showing no differences in learning outcomes (Han et al., 2021). Therefore, selecting the right experience at the appropriate level of difficulty is essential to optimize engagement.

Find the right fit for your learners.

New technology is released every day, and selecting the right tools for your learners can be overwhelming. When selecting an immersive learning experience, consider the goals you have for your learners. A good immersive experience should be easy to use, accessible, and support your learning goals to enhance the learning experience. Ultimately, the most important thing to consider when choosing an immersive experience is that it's the right fit for your learners and learning outcomes.

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