Virtual Reality, Mixed Reality, and Augmented Reality
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By Hui-Fen Chang and Hanwen Dong

Overview and Definition
Virtual reality (VR), augmented reality (AR), and mixed reality (MR) are technologies that create immersive experiences. VR is a simulated and digitally-generated 3D environment that users can interact with through the use of a head-mounted display (e.g. Google Cardboard and VIVE) and handheld controllers. Possible interactions include moving and looking around, selecting and assembling objects, and talking with other users via voice chat. Examples of VR applications include Minecraft VR and Google Earth VR. AR overlays digital information onto the real world, allowing users to view real and virtual objects simultaneously through a mobile device or smart glasses. Examples of AR applications include Pokémon Go and Snapchat’s Lens Studio. MR combines VR and AR, allowing users to interact with objects in both realities. Examples of MR applications include Case Western Reserve University’s HoloAnatomy and NASA’s OnSight. The three realities are commonly referred to together as extended reality (XR).

Why Do You Need to Know?
VR and AR technologies are catching the attention of higher education. The technologies were featured in the NMC Horizon Report 2016 Higher Education Edition as one of the most important developments in educational technology for higher education, stating “[t]hese two flexible, immersive technologies spark similar educational outcomes, bringing learners to a deeper level of cognition as they attain new perspectives on underlying data” (Johnson et al. 2016, 40). There is empirical evidence to show that XR technologies are effective for promoting active learning and student engagement with learning materials (Pomerantz and Rode 2020). XR also offers promising technologies for distance education. As higher education institutions are exploring the potential of XR for teaching and learning, some academic libraries are expanding or considering extending services to provide XR spaces and technologies in support of the teaching and learning mission of their institutions.

Current Applications in Libraries and Higher Education
VR and AR have been used in higher education, and there is growing interest in using XR technologies in classrooms (McGrath, Hoffman and Dark 2023). For example, medical educators are exploring cutting-edge technologies of AR and XR to enhance student learning of human anatomy and medical procedures. At UC Berkeley, architecture instructors are developing XR tools to use in the design process. Teams at MIT have developed XR educational resources, including Cellverse to teach molecular biology.

Libraries, including those that are health sciences-focused, provide teaching, learning, research, and experiential opportunities with dedicated spaces such as VR classrooms (e.g. J. Willard Marriott Library at the University of Utah) and immersive VR studio labs (e.g. Virtual Reality & Augmented Reality at North Carolina State University Libraries). These classrooms and lab spaces include software and hardware that enable simulation, experimentation, and tours. According to a recent...
study, among the 123 member libraries of the Association of Research Libraries, 49 libraries had dedicated spaces for patrons to use AR or VR technology (Greene and Groenendyk 2021).

Libraries with XR spaces can offer various types of support to their campuses, such as instructional support through workshop offerings, pedagogical support through curricula integration, and loanable technology support through equipment checkouts. Scholarly support can also be provided through consultations and collaboration with application development using Unreal Engine or Unity. However, the scope and extent of these services depend on libraries’ existing XR infrastructure, including the availability of software and hardware and the expertise of the support staff.

Libraries have been applying XR to established and new services. For instance, the Augmented Archives at Washington College’s Archives & Special Collections allowed users to access and engage with archival materials situated behind display cases using iPads and an AR app. The Augmented Archives laid the groundwork for other XR projects including a Virtual/Augmented Reality Digital Imaging Studio and Digital Scholarship in Museum Partnerships that engage students in real-world learning opportunities.

Other programming examples include 360-degree video virtual library tours (e.g. Widener Library tour at Harvard University), Virtual Information Literacy Live Augmented Game Experience (VILLAGE) at Syracuse University Libraries, VR-based reference support to enhance students’ eBook browsing experiences (Hahn 2018), information literacy instruction using scenarios created in a VR environment (Smith 2019), and integration of 360-degree videos into disciplinary instructions (Moore and McAvoy 2018).

Potential Hurdles

Libraries considering starting XR spaces or services must account for cost, space, and staffing. High-end software and hardware, with specific systems and graphic processing requirements, are more desirable due to their higher performance levels (e.g., high frame rate and low latency). Other costs include initial purchases and ongoing maintenance for repairs, replacements, and upgrades. In regards to space, having a large dedicated permanent area is ideal for in-library use, so it may be necessary to repurpose existing spaces, such as group study rooms; devices that facilitate an immersive experience and incorporate real surroundings also have specific space requirements. Furthermore, knowledgeable staff should be available to provide instruction or support. Reallocation and training existing staff may be necessary for libraries that cannot easily create new positions.

Another consideration is updating library policies, such as establishing time limits for equipment use, implementing a liability waiver release form, and protecting users’ privacy—Meta Quest 2, for instance, allows Meta to utilize users’ personal data according to their terms of service and privacy policy. Moreover, supporting XR technologies can also be challenging due to a lack of standardizations across various platforms; difficulty troubleshooting bugs; and ensuring patrons can use all the tools and applications, some of which lack accessibility and can cause discomfort such as dizziness and motion sickness.

Conclusion

Virtual reality, augmented reality and mixed reality allow educators to create immersive learning experiences for students. These innovative technologies enable active learning and promote student engagement with instructional content in a new way that is beyond the limitations of traditional classrooms. Today, many libraries are using these technologies to create spaces to support teaching and learning on campus. Librarians can also leverage these available technologies and spaces at their libraries to create immersive learning for their own library orientation and instruction. To implement XR for library instruction, we must ensure that we understand the technologies and how they work. It is without question that XR technologies offer exciting new opportunities for teaching and learning.

Tools Discussed

- Apple Vision Pro
- Google Cardboard
- Meta Quest
- Microsoft HoloLens
- Samsung Gear VR
- Unity
- Unreal Engine
References


Further Readings


