Best Practices for Virtual Reality in Higher Education

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Analyst(s): Marty Resnick, Glenda Morgan

CIOs of higher education institutions who wish to gain a competitive advantage by differentiating their learning environments need to facilitate and support the implementation of virtual reality solutions, which will increase student learning and engagement.

Key Challenges

- Universities struggle with creating learning environments in which students can obtain authentic but low-stakes, hands-on experience; for example, working with patients or understanding human anatomy. Virtual reality (VR) increasingly offers solutions to this quandary.
- Higher education is an increasingly competitive environment and universities are looking for ways to differentiate and to create a unique brand.

Recommendations

For CIOs of higher education institutions driving innovating learning environments:

- Implement VR technologies and experiences that appeal to students and that demonstrate new and innovative ways to ensure student satisfaction and success.
- Facilitate the development of immersive VR environments (in disciplines where it makes most sense) to make course work more engaging, compelling and effective for students.
- Begin with a "buy rather than build" VR strategy, where it makes sense, ensuring your applications address real institutional challenges.

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Strategic Planning Assumption

By 2021, 60% of U.S.-based higher education institutions will intentionally use VR to create an enhanced simulation and learning environment.

Introduction

Higher education institutions continue to increase their interest and exploration of immersive technologies; specifically, the computer-generated (digital) environment of virtual reality (VR), which allows students to fully immerse themselves in a virtual world.

From a higher education perspective, the interest in VR stems from the following drivers:

- It enhances the efficacy of learning for students.
- It helps to attract and retain students.
- It prepares the students for their careers.

Although higher education institutions are still testing the efficacy of VR learning, there are an estimated four times as many VR headsets in universities today as compared to just one year ago (5.6 per university in 2017 compared to 1.5 in 2016).[1]

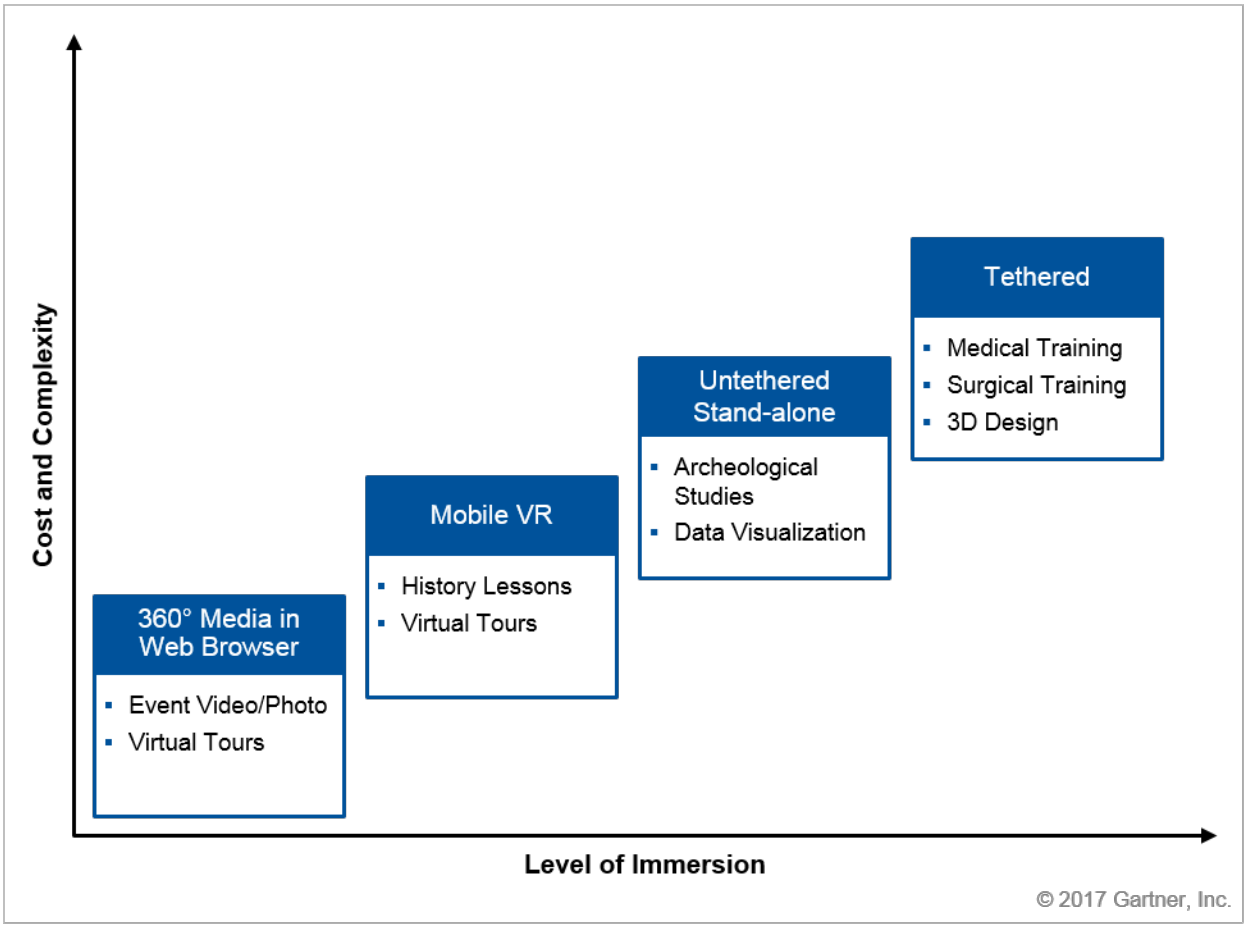
This increase in headsets spans use cases from courses intentionally supplementing curriculum with VR experiences, to utilizing Google Cardboard technology to send out to prospective students for virtual campus tours and information (such as used by Savannah College of Art & Design). Whatever the reason for the increase in VR, it does show that higher education institutions are beginning to see the intrinsic benefits that a VR experience brings to the learning environment.

The ability to immerse students in a virtual world allows instructors to provide an enhanced learning environment. For example, a student could perform a surgery on a 3D patient, visualize a large

building to make design changes, take a deep dive down to the ocean floor to study marine life, or explore an atom from the inside out.

Many believe that the benefits of VR in higher education are centered around the medical sciences, but our research shows that VR is beneficial across multiple disciplines and administrative functions. Figure 1 below highlights several use cases, along with the different types of technologies used for VR environments that leading vendors offer.

Figure 1. Types of VR Experiences Based on Cost, Complexity and Level of Immersion



Source: Gartner (August 2017)

This research note will now explore the best practices and the complexities of utilizing VR in higher education.

Analysis

Implement VR Technologies and Experiences That Appeal to Students

Competition between higher education institutions has always been a factor in the sector, but it is becoming more intense as they fight for ranking positions and a share of declining enrollments. Colleges and universities are constantly looking for ways to differentiate themselves from the competition and attract more and better students. At the same time, students are looking for a place to learn that offers them the greatest chance of success after graduating, while also exposing them to some of the latest and most innovative tools and technologies. Students are also increasingly looking for an on-campus experience that is seamless and reflects the kinds of experiences they get in their off-campus life.

From the beginning of the process of choosing a university, students develop a perception of each possible choice and begin to make their shortlists. Virtual reality (VR) provides universities with the opportunity to help form a positive perception in the minds of potential enrollers from day one. For example, the use of 360-degree video for virtual tours, testimonials from students that have experienced VR technologies at a particular institution, and a campus that provides a wide array of technologies as proof that the university is innovative and committed to student success. Enrolled students benefit from learning experiences enhanced through immersive learning. Although it is still early days, the adoption of VR should manifest itself in improved metrics such as increased retention and better graduate placement.

Strategic investment in and a commitment to VR will increasingly become one of the ways that campuses will differentiate themselves in a competitive environment. Immersive technologies should be on the strategic radar of all CIOs in higher education, regardless of size or type.

To ensure that their respective institutions don't get left behind, CIOs should take the following steps:

- Develop a potential set of use cases for immersive technologies to help you identify applications that will work well for your institution and avoid costly mistakes. To do this, look both to other higher educational institutions and to the market for inspiration, then adapt these examples to build a use case that fits a need on your campus.
- Experiment with small, contained pilots that leverage engaged campus partners to better understand the scope of support and skilled staff time needed to maintain a larger VR presence on campus.
- Experience different types and levels of VR (i.e., Google Cardboard, Oculus Rift, or Samsung Gear VR) to establish what choice of technology (platform and hardware) makes the most sense for specific educational goals (see "Immersive Technologies Offer Infinite Possibilities").
- Share knowledge and collaborate across the institution to establish best practices and lessons learned.

Develop an Immersive VR Environment to Make Course Work More Engaging, Compelling and Effective for Students

Supplementing course work in a traditional classroom with a virtual world facilitates a truly interactive educational experience. However, that experience needs to create a sense of presence or "being there" for the student to experience the full efficacy desired.

According to the International Society of Presence Research (ISPR), "presence" is defined as "*a psychological state or subjective perception in which even though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience.*"

For the classroom, this means that students need to be in such a technologically immersed experience that their perception is they feel they are truly in a real environment. This makes the learning experience much more effective and also confirms to the students that it is a simulation designed to teach, not just a game.

For example, if a student who is training to become a surgeon wants to experience what it is like in an operating room, the virtual operating room must be lifelike. Not just the operating room itself, but the tools, the patient and the procedure. This will create the optimal results in preparing the student for the "real" world.

Conversely, any break in the presence could have a negative impact on the overall success of the simulation. Breaks in presence aren't always caused by technology flaws (i.e., latency, glitches or 3D rendering) but also by a person speaking from the real world and not being represented in the virtual world, or environmental sounds outside of the immersion (i,e, a mobile phone notification).

Presence is enhanced by certain VR technologies and simulations:

- **A stable spatial place —** The student gains a strong sense of being in a physical place with physical objects, despite actually being in a virtual world.
- **Self-embodiment —** The student has a body in the virtual world and is not just watching. The idea of being a first person (with hands) versus a third person.
- **Physical interaction —** Presence is not just perceived from the visual environment; audio and haptics (tactile) feedback can also enhance the experience.
- **Social communication —** Students should not be "alone" in the environment, but able to interact with others even though they may be non-player characters (NPC) that are controlled through an AI interface.

Developing a realistic virtual environment requires work and experience. Oftentimes, higher education institutions do not have the technology subject matter expertise in-house and will need to outsource at least their initial projects. However, over time, institutions may determine that investing in a VR product development team makes more sense and will open opportunities for expanding VR capabilities across multiple disciplines.

Begin With a "Buy Rather Than Build" Strategy

A perennial challenge for higher education institutions is to resist the impulse to build their own applications and technologies, especially when dealing with tools being used in specialized settings and those used for teaching. To begin a VR journey, this temptation should be resisted for a number of reasons.

- Staffing is always an issue in higher education IT and most CIOs have limited ability, both internally and externally, to attract and hire new staff, especially in a competitive environment such as VR.
- The field is changing so rapidly — especially with regard to the kinds of platforms and approaches that will become standard — that staffing decisions made now may prove to be the wrong bet as other standards emerge.
- By buying the VR technologies that your institution needs, you will be able to benefit from the great advances rapidly being made in the developing and highly competitive field of VR. This would be far less likely even if you were able to assemble a development team on your own campus.
- Any in-house development process is likely to be more expensive than purchasing a solution.

Part of the promise of this wave of VR for higher education is the availability of cost-effective and consumer-grade solutions. These are significantly different from the very expensive and highly specialized environments of, for example, cave automatic virtual environments (CAVE) from previous instantiations of VR.

As VR becomes more established in the institution, use cases become more pervasive across multiple disciplines. Thus, the need arises for custom development based on unique needs and user feedback, and CIOs should consider the establishment of a VR product development team. This should be implemented once best practices have been established and lessons learned from successful VR initiatives. It will also require the help of subject matter experts, who will most likely be outsourced. The University of Toledo case study (discussed later in this note) reveals such an institution in which VR has become pervasive and for which a VR product development team was needed to support the program's growth and scalability.

Some larger research institutions — medical schools, allied health institutions and vocational institutions — will likely have the need, resources and budget to build some of their own applications on Day 1. These institutions and schools should be careful to ensure that the desire to build these custom applications is truly warranted before embarking on building a custom development team.

Skill sets that will be required for VR product development teams are different from traditional application development and are more reflective of game development. They include:

- Story design and character development
- Simulation game design and development
- 3D modeling and animation

- Artificial intelligence
- Web development
- Database design and development
- Back-end infrastructure and integration
- Testing (automated and manual)
- Hardware and infrastructure support
- Front-end development (often with a game engine like Unity or Unreal Engine)

CIOs should collaborate with other higher education institutions and industry partners to ensure that knowledge and insights are shared to push the development of VR technologies as far as possible (i.e., don't do it yourself in a dark room).

Case Study

University of Toledo's Interprofessional Immersive Simulation Center has an entire floor devoted to 3D virtual immersive reality (ViR). The floor is composed of a wide array of technologies including: stereoscopic/3D simulations, motion tracking, radiological visualization, and a broad range of illustrations that utilize 3D, augmented reality (AR) and VR technologies. However, the use of VR in the university does not stop there.

University of Toledo Vice President CIO/CTO Bill McCreary runs the simulation center and 3D AR/VR technologies across the university. Mr. McCreary is a firm believer that building a variety of compelling and immersive products creates an active learning environment for students — a learning environment that is attractive and more effective for students enrolled in a wide variety of programs that include medicine, geology, nursing, law, business, engineering and environmental science, to name a few.

According to Mr. McCreary, VR technologies and simulation games enable the university to create a low-risk and low-cost environment, as compared to building physical operations. These technologies also offer asynchronous learning, where students can proceed at their own pace, allowing personalized progression of the content. The belief at the university is that 3D AR/VR simulation gaming technologies offer broad implications across numerous environments that enhance retention through better learning, while giving students a better chance of success in their education and future careers. This technologically-based pedagogy has created a competitive differentiator for the university, not only attracting new students, but also increasing retention of existing students.

Due to the fast pace and change of 3D AR/VR technologies, as well as the large demand for VR simulation games and content across the multiple disciplines at the university, Mr. McCreary has just formed an academic governance group for this specific area. The new governance team will

consist of passionate individuals with subject matter expertise from a variety of fields that find value in these technologies, and help prioritize the content development program for the production team.

The 3D AR/VR production team is a virtual reality center of excellence (VRCoE) that is utilized by virtually every academic department on campus. This product development team builds all the 3D AR/VR and simulation content utilized across the university. The team consists of individuals with many skill sets and responsibilities including simulation game designers, illustrators, animators, software developers, artificial intelligence scientists, infrastructure engineers, and 3D modelers. This team has broad expertise and gives the university the flexibility and availability to offer content for a variety of academic programs. Essentially, the university is running a small simulation game studio for the benefit of the academic programs and student development.

The university's VRCoE is enabled by the combined capability of several key resources. While the Interprofessional Immersive Simulation Center's 3D VR represents a strategic asset, the majority of the technical product development team is located in multiple areas of the campus, including the Simulation Game Studio adjacent to the College of Engineering. This team is developing 3D AR/VR simulation game content to be used in a variety of formats, including large 3D VR specialized rooms, AR/VR head mounted displays and 2.5D web interfaces. The broad organization overseen by Mr. McCreary provides the extensive skill sets required for a strong product development team. Combining all the skills from visual arts through engineering and computer science enables a strong product development team for the entire university enterprise. This type of development is simply not possible for any one academic college or program to do on its own, as it will lack the skills and scale required for this type of program.

Acronym Key and Glossary Terms

Virtual reality (VR)	Computer-generated (digital) environments to fully immerse users in a "virtual world."
Virtual immersive reality (ViR)	A term used to describe environments that are completely immersive by use of virtual reality experiences and technologies. Often used in place of the term VR.
Augmented reality (AR)	Overlaying digital information on the physical world.
Mixed reality (MR)	A blend of the physical and digital worlds in which users may interact with digital and real-world objects while maintaining presence in the physical world.

Gartner Recommended Reading

Some documents may not be available as part of your current Gartner subscription.

"Immersive Technologies Offer Infinite Possibilities"

"Preparing for a World Beyond Apps"

"Top 10 Strategic Technologies Impacting Higher Education in 2017"

"Top 10 Business Trends Impacting Higher Education in 2017"

"The Future of the Student Experience Is Personal"

Evidence

[1] "VR First: Democratizing the Innovation Landscape of Virtual Reality." VR First.

[2] The International Society of Presence Research (ISPR)

[3] J. Jerald. "The VR Book: Human-Centered Design for Reality." ACM Books. 2015.

GARTNER HEADQUARTERS

Corporate Headquarters
56 Top Gallant Road
Stamford, CT 06902-7700
USA
+1 203 964 0096

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BRAZIL
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