# Deploying VR in a Science Museum: Lessons Learned

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## ABSTRACT

The low cost and relative simplicity of consumer VR headsets has made them an attractive choice for education. However, informal education settings, like museums and science centers, face additional challenges not present in the home or classroom. The Fort Worth Museum of Science and History has deployed several kinds of VR activities over the last two years. We report our firsthand observations about the physical and mental assistance and affordances required for successful use of this technology in informal education.

## KEYWORDS

Design, education, interaction, museum, research, themed entertainment, UI/tools, VR/AR/MR

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## 1 INTRODUCTION

Substantial research has investigated the value of virtual reality for classroom [Makransky et al. 2019; Parong and Mayer 2018] and occupational [Bernardo 2017] education. Comparatively little work has evaluated the potential of VR in museums and science centers.

A key role of these institutions is to expose the public to new developments in science and technology. As VR has received substantial public interest, museums have been eager to integrate them into events and exhibits. The devices join existing immersive media used in informal education, such as planetariums and giant-screen theaters.

A framework for evaluating these kinds of digital exhibits in museums has recently been developed [Damala et al. 2019], but many areas of museum-based VR remain firmly in the experimentation phase. Over the last two years, the Fort Worth Museum of Science and History has experimented with a variety of VR experiences for our audience of elementary and middle school field trips, as well as families with young children. With over 300,000 visitors a year, we observed a large variety of responses to various pilot VR experiences

This paper will describe two VR activities deployed at the Museum in 2019: a long-term, unfacilitated exhibit component displaying panoramic imagery and a pop-up facilitated experience in which visitors explored a virtual museum created in Unity. We discuss observations and adjustments made in areas where the needs of VR in a museum environment differ from those in the home or school. In section 2, we discuss the higher physical safety requirements, while in section 3 we look into the benefits of dramatically simplifying control schemes.

## 2 SAFETY, SECURITY, AND COMFORT

A trip to a museum is quite different from a day at home. Throughout the building, visitors are invited to touch, manipulate, and explore objects and ideas in new and surprising ways. As excitement builds, guests—especially younger ones—may interact more forcefully than would otherwise be acceptable. Keeping people and equipment safe in these times of activity is of paramount concern.

Museum visitors often engage with exhibits without supervision. Even when facilitators are present in a space, they may be engaged with other guests or supervising multiple activities. That means any deployed technology must be able to withstand heavy use.

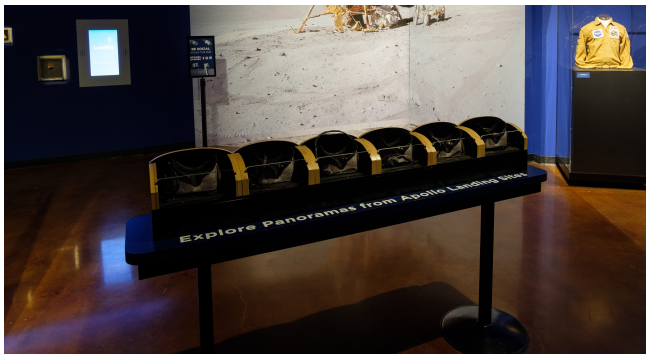


**Figure 1: Our Apollo panoramas exhibit using Oculus Go.**

In the Museum's recent nine-month exhibition on the Apollo Moon landings, we included a set of Oculus Go headsets through which guests could see 360° panoramas taken by the astronauts.

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Each headset was attached to the table by a tether that contained both the charging and security cables. We observed that children would frequently swing the headsets by the tether, over time severing the charging cable and disabling the component. Consumer VR headsets are not typically designed to withstand that level of use.

Common mistakes for first-time VR users can also have bigger impacts in museum settings. Tripping or falling on concrete floors is certainly more dangerous than on carpet. Bumping into a wall at home isn't the same as elbowing a nearby artifact case. Barriers and tethers are critical, especially for 3-degrees-of-freedom content, where walking can be very disorienting. Children will often run right through the virtual walls put up by headset safety systems.

Once guests are safe, there is still the need to persuade them to try the activity. Although VR garners nearly universal interest, we have observed a range of reasons visitors refuse to participate.

For adults in social settings, fear of looking foolish is a common barrier. So is concern about the headset's effect on hair or makeup. We offer disposable masks when a staff member is facilitating an activity; these protect the headset from makeup and can reduce the headset's smudging effect on the face. One persistent problem is the inability of headset straps to accommodate bulky hair styles, such as dreadlocks. For our Apollo panorama exhibit, we removed the straps entirely so that users could just hold the headset up; naturally, this doesn't work if they need their hands free for controllers.

Sanitation is another consideration in a public space. Room-scale VR can be physically challenging and typical headset face plates readily soak up sweat. Replacing these with leather ones greatly reduces absorption and extends their useful life. Staff use disinfecting wipes are regular intervals to ensure the devices remain sanitary.

## 3 COMPLEXITY AND CHOICE

Five years after the commercial launch of the Oculus Rift, nearly all visitors to the Museum have still never experienced VR. Controller-based controls, especially when vision is obscured by a headset, can be difficult to learn. Unlike in home use, museum visitors will spend only a few seconds to a couple of minutes with any given activity. If it isn't immediately clear what to do, they will move on.

**Figure 2: A Museum guest exploring the *Infinity Gallery*.**

Navigation in VR has been a persistent problem and museum-based experiences are no exception [Hayes and Yoo 2018]. A successful strategy to overcome this difficulty has been to reduce choice.

In our Apollo panorama activity, we used 3rd-party kiosk software to lock each of six headsets to a single panorama. To switch panoramas, users would simply put down one headset and pick up another (Figure 1). This interaction mirrors the physical world and presented little difficulty for most guests.

We further explored control schemes in our *Infinity Gallery* experience. This activity consisted of a virtual museum created in Unity and populated the 3D objects from the Museum's collection. Users would move through several rooms containing these objects and simple recreations of hands-on activities. Unlike the panorama exhibit, this room-scale activity was facilitated by a staff member and used only during special events.

Locomotion was initially provided with standard teleport functionality, but tests showed that users frequently became trapped in corners or clipped inside the artifact geometry. In response, we created a mode in which the facilitator could use the keyboard to move the user between fixed points in the gallery. From there, the guest could use room-scale movement (i.e., actual walking) to explore their surroundings. The need to indicate they were ready to move to the next location also helped create conversation between the staff member and the guest.

If users are provided control via controllers, it must be extremely simple. In a second control mode, visitors to the *Infinity Gallery* could cycle themselves between the fixed teleport points. We found that for this to work successfully, every button on the controller had to be mapped to the same function. In our final control scheme, clicking any button on the right controller cycled them one stop forward, while any button on the left took them back. This greatly eased navigation for users unfamiliar with controllers.

Both control schemes reduced choice and freedom compared to traditional joystick or teleport locomotion, however we observed that many users were actually *more* engaged when they didn't have to worry about how they were getting around.

## 4 CONCLUSIONS

Unfacilitated, headset-based immersive experiences remain challenging in museums. However, when they work, visitor response is extremely positive. When designing for this environment, special care must be taken that equipment is extremely robust and the activity is easy to understand and use. Reducing the user's choice is a powerful and, in our experience, successful method of accomplishing the latter task.

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