# Empowering Students through Library Technology:

## Utilizing 360 Cameras to Create Immersive Educational Content

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## Introduction

Virtual Reality (VR) is becoming ubiquitous in modern corporations, research, entertainment, and education. Companies are using VR for digital showrooms, development, and a myriad of other uses.[1] Universities and schools are using it to teach medical techniques, empathy, and even chemistry concepts.[2] Over the last five to six years, libraries have adopted this technology. Frequently, the amount of technical skill, cost considerations, technophobia, and available applications has limited the adoption of VR technology and curtailed sustained usage.[3] However, despite these barriers, immersive VR still presents a high-impact educational experience for users.[4] VR library initiatives allow individuals to experience technology and build relevant life skills. Additionally, recent advances in 360 capturing technology and software have simplified and reduced the cost of creating immersive VR content. At the same time, the reduction of price in VR headsets makes this content more accessible. This article will discuss the barriers to creating effective VR content for learning and some of the low-cost and low-technical expertise solutions for overcoming said barriers.

## Immersive Virtual Reality and Education

Researchers have found immersive VR content to be an effective learning tool and worth the time of educators and libraries to adopt. VR experiences positively impact student engagement and their sense of self-efficacy.[5] Essentially, the emotional component of learning is met more effectively in VR than in some traditional classroom settings. As many people who speak before audiences know, competing with a cell phone, the conversation of friends, or even the birds outside a window, can be challenging. However, VR headsets block out all other distractions. These experiences occur in the first-person perspective, creating an enhanced emotional connection with the content or a sense of actually being in the virtual world. Additionally, VR content is well suited to specific analytical tasks which require visualizing complex spatial concepts, making it an effective research and teaching tool.[6] Uses of VR in education include mapping world heritage sites, ariel mapping visualizations, data analysis, and even creating/visualizing the docking between ligands and complex proteins in chemistry.[7] In many ways, VR allows users to see information or locations that would be impossible or costly for them to see in person. Other researchers have found VR content particularly helpful in empathy learning.[8] Numerous free applications exist on VR content platforms focused on diversity, critical race theory, and accessibility. Due to the positive aspects of VR, educators have adopted the technology in most subject areas, including the humanities, the social sciences, and STEM fields. However, as the widespread adoption of VR has taken hold, there are considerable barriers to VR as an educational tool.

VR technology is well suited and worthwhile to education, but only under certain circumstances. Ensuring that technology contributes to teaching the desired learning goals is one of the primary considerations for instruction.[9] Regardless of how beautiful or interactive an application may be, it is of little use to students or teachers if it does not cover the desired information. To a certain extent, lesson planning, such as including discussions, worksheets, and reflective techniques, can ensure that students learn the intended information. However, a solid VR application geared towards the specific learning goals of a class makes teaching with VR significantly streamlined. In an ideal VR learning experience, the facilitator or educator utilizes a VR experience focused on the core content for the lesson plan and includes reflective components like discussions or worksheets. Some researchers have found that users learn more about using the headset than the content information.[10] Such instances may result from poor lesson planning and unrelated VR content. Other educational VR technology users have found limited content covering their desired focus.[11] VR technology is recent, and the collection of free applications for education is still growing. Consequently, many educators and researchers have chosen to create their own VR content specifically geared towards their desired learning goals and environments. This option was historically limited to institutions with technological know-how and funding.

In recent years, capturing 3D information has become significantly cheaper and more accessible, allowing k-12 educators,

[1] "IKEA Virtual Reality Showroom." Accessed August 23, 2021. https://demodern.com/projects/ikea-vr-showroom; Bernard Marr, "The Amazing Ways Companies Use Virtual Reality For Business Success." *Forbes*, (2021) https://www.forbes.com/sites/bernardmarr/2017/07/31/the-amazing-ways-companies-use-virtual-reality-for-business-success/; Paul James, "Audi's Next-Gen Showrooms Are Powered by Rift and Vive," *Road to VR* (blog), (2016) https://www.roadtovr.com/audi-virtual-reality-car-showroom-htc-vive-pre-oculus-rift-cv1/.

[2] Feng-Qin Chen et al., "Effectiveness of Virtual Reality in Nursing Education: Meta-Analysis." *Journal of Medical Internet Research* 22, no. 9 (2020), doi: 10.2196/18290; Victoria Gulick et al., "Effect of a Virtual Reality–Enhanced Exercise and Education Intervention on Patient Engagement and Learning in Cardiac Rehabilitation: Randomized Controlled Trial," *Journal of Medical Internet Research* 23, no. 4 (2021), https://doi.org/10.2196/23882; Aleshia Huber et al., "Becoming Immersed: Using Virtual Reality Technologies in Academic Libraries to Expand Outreach and Enhance Course Curricula." *College & Undergraduate Libraries* 27, no. 2–4 (2020), https://doi.org/10.1080/10691316.2021.1902892; Filip Jaskiewicz et al., "Chest Compressions Quality during Sudden Cardiac Arrest Scenario Performed in Virtual Reality: A Crossover Study in a Training Environment," *Medicine* 99, no. 48 (2020), https://doi.org/10.1097/MD.0000000000023374; Donghee Shin, "Empathy and Embodied Experience in Virtual Environment." *Computers in Human Behavior* 78, no. C (2018), https://doi.org/10.1016/j.chb.2017.09.012; Peng Wang et al., "A Critical Review of the Use of Virtual Reality in Construction Engineering Education and Training," *International Journal of Environmental Research and Public Health* 15, no. 6 (2018), https://doi.org/10.3390/ijerph15061204.

[3] Simon Bennie et al., "Teaching Enzyme Catalysis Using Interactive Molecular Dynamics in Virtual Reality," *Journal of Chemical Education* 96, no. 11 (2019): 2490, https://doi.org/10.1021/acs.jchemed.9b00181; Chen, "Effectiveness of Virtual Reality in Nursing Education," 2; Matt Cook et al., "Challenges and Strategies for Educational Virtual Reality: Results of an Expert-Led Forum on 3D/VR Technologies across Academic Institutions,"

[4] Matt Cook el al., "Challenges and Strategies for Educational Virtual Reality: Results of an Expert-Led Forum on 3D/VR Technologies across Academic Institutions." *Information Technology and Libraries* 38, no. 4 (2019): 31-34, https://doi.org/10.6017/ital.v38i4.11075.; Negin Dahya et al., "Perceptions and Experiences of Virtual Reality in Public Libraries." *Journal of Documentation* 77, no. 3 (2021): 627-628, https://doi.org/10.1108/JD-04-2020-0051; Huber, "Becoming Immersed," 257-258; Panagiotis Kourtesis et al., "Validation of the Virtual Reality Neuroscience Questionnaire: Maximum Duration of Immersive Virtual Reality Sessions Without the Presence of Pertinent Adverse Symptomatology." *Frontiers in Human Neuroscience* 13 (2019): 2, https://doi.org/10.3389/fnhum.2019.00417.

[5] Cook, "Challenges and Strategies for Educational Virtual Reality," 26.

[6] Bennie, "Teaching Enzyme Catalysis Using Interactive Molecular Dynamics in Virtual Reality," 2493.

[7] Cook, "Challenges and Strategies for Educational Virtual Reality," 26.

[8] Shin, "Empathy and Embodied Experience in Virtual Environment," 66.

[9] Dahya, "Perceptions and Experiences of Virtual Reality in Public Libraries," 619.

[10] Dahya, "Perceptions and experiences of virtual reality in public libraries," 626.

[11] Cook, "Challenges and Strategies for Educational Virtual Reality," 33.

postsecondary institutes, and libraries to create VR content with specific learning goals. The equipment price for photogrammetry, laser scanning, and 360 video capturing has dropped, along with the software needed to create VR content.[12] In the following section, we will discuss how libraries can create VR content at little cost and with minimal technical expertise.

## 360 Video Content Considerations

Capturing 360 video content is much easier than in the past. A few years ago, individuals who wished to create 360 content had to take multiple photos at different angles from the same location.[13] Another option was to rig multiple cameras together to capture all angles of view from a single point simultaneously.[14] Before purpose-built 360 cameras, creators had to stitch together the files to create 360 videos.[15] Thus, the process consisted of creating a camera configuration, setting up a shot, collecting multiple image files, running the images through software, editing the images, and then repeating the process until the project was complete. Recently, several manufacturers have created consumer-grade cameras that record 360 content that simplifies file and post-production processing.[16] Using a modern 360 video recording camera reduces the number of image files a user needs to capture and eliminates the software stitching process; reducing the learning curve and alleviating some of the time commitment in creating 360 content.

At the University of North Florida, librarians use GoPro Max Cameras to capture 360 videos. The GoPro Max was released in 2019 and costs under $400 depending on current promotions. Its current MSRP is $549 per GoPro's Web site.[17] Before this camera, the GoPro released the Fusion in 2017 at $699.[18] The price difference suggests that the cost of 360 cameras continues to decline. Additionally, using the GoPro phone app simplifies capturing 360 content by streamlining the capture, downloading, and editing process into a single app. There are other 360 cameras on the market, with different positives and negatives; however, the price and simplicity of using the GoPro Max makes it a highly accessible camera. If a library has the funding, significantly more expensive cameras are also on the market. These options offer higher resolutions than the GoPro Max. High end camera arrays may also offer better results but require additional post processing.[19] Despite the variety of options available, the camera's usability was a primary deciding factor.

The Thomas G. Carpenter library also wished to make VR content creation accessible to students and faculty. To facilitate the creation of 360 content, the library systems unit purchased three GoPro Max cameras and made them available for checkout to students and faculty. The GoPro Max is relatively easy to use and durable, making it an excellent choice for technology circulation. The Max circulates as a kit that includes useful items a patron may need to capture content, such as cables, batteries, memory cards, and a mini tripod. Members of the Systems Unit also created laminated instruction cards to provide first-time users with basic information about the cameras. By offering the cameras to faculty and students, the library provided the necessary tools for creating 360 content for use in educational activities. The following section will discuss the workflow UNF librarians developed for capturing and creating VR content.

## Capturing, Editing, and Accessing 360 Content Using the GoPro Max

The GoPro Max functions similar to a standard camera for capturing videos and images. The notable difference is that it has two lenses (see fig. 1). To capture 360 content, users can toggle between standard and 360 videos by using the icon in the lower-left corner of the touchscreen (see fig. 2). Once the setting is selected, video can be captured by using the record button. Despite the simplicity of the process, the camera setup is pivotal. Any camera motion will cause users to become disoriented when capturing 360 videos for VR. It is essential to capture multiple scenes via cuts in the video instead of physically moving through space. Also, the position of the camera relative to the scene is essential. The circulating GoPro kits include small portable tripod approximately two feet high. These are mobile, but it is better to place the camera lens at head level. Doing so ensures any narrators do not tower over the VR viewers and reduces a viewer's sense of displacement due to height change. Finally, trim the video at the start and end of the footage. Trimming footage in the GoPro app is easy and will remove the awkwardness of moving away from the camera or interacting with a phone at the start and end of image capture.



Figure 1: View of GoPro Max front/ https://gopro.com/

Figure 2: Side view of GoPro showing two lenses/https://gopro.com/

Figure 3: View of GoPro Max touchscreen/ https://gopro.com/

[12]Ellyssa Kroski, *32 Virtual, Augmented, & Mixed Reality Programs for Libraries*. Chicago: ALA, (2021).

[13]Kroski, *Virtual, Augmented, & Mixed Reality Programs for Libraries*.

[14]Snežana Stupar-Rutenfrans, Loes E.H. Ketelaars and Marnix S.van Gisbergen, "Beat the Fear of Public Speaking: Mobile 360 Video Virtual Reality Exposure Training," Cyberpsychology, Behavior, and Social Networking 20, No. 10 (2017): 625.

[15]Stupar-Rutenfrans, Ketelaars and Gisbergen, "Beat the Fear," 625.

[16]Han Jin, "Insta360 One X2 Vs GoPro Max 2022: Which is Better for You," *Lucidcam*. accessed March 9, 2022, https://lucidcam.com/insta360-one-x2-vs-gopro-max/.

[17]"MAX," GoPro, accessed 03/09/2022, https://gopro.com/en/us/shop/cameras/max/CHDHZ-202-master.html.

[18]Sean O'Kane, "GoPro's Fusion 360 Camera Costs $699 and Ships in November," *CircuitBreaker*, September 28, 2017, https://www.theverge.com/circuitbreaker/2017/9/28/16374210/gopro-fusion-360-camera-price-release-date.

[19]Vanessa Hand Orellana, "10 Things I Wish I Knew before Shooting 360 Video," *Cnet*, May 31, 2016, https://www.cnet.com/tech/computing/360-cameras-

The easiest way to download a captured video and edit the content is to pair the GoPro Max with a smart phone or other mobile device. Users should install the "GoPro Quick" app on a phone or tablet and add the GoPro max camera to their devices by following the app instructions. After adding the camera, users can view GoPro footage on the app and share it to services such as OneDrive or Google Drive using the share icon. The download process is intuitive; however, the Library Systems Unit also provides a step-by-step process on their resource guide for students and faculty. GoPro also offers a cloud service for a yearly fee, but this is not required to use their device or app. Once a file is shared, the app converts the proprietary 360 files to MP4, making it usable in various editing software and apps.

While the GoPro Quick app will allow for the processing and clipping of VR videos, additional editing contributes to user engagement. UNF licenses Premiere Pro for video editing. Users can combine several VR videos into one and add voice-over or text annotations. Doing so allows for greater educational content sharing and can include reflective prompts. Users can obtain a seven-day free trial of Premiere Pro or purchase an individual license for $20 a month. Due to the complexity of Premier Pro, this article will not address editing in detail. There are many tutorials by both Adobe and creators on YouTube that detail how to edit 360 footage. However, adding voice-overs, music clips, and text annotations allow for a significantly enhanced experience.



Figure 4. An example of the Premiere Pro editing interface.

Once edited and uploaded, YouTube is an excellent option for sharing 360 content. The user interface in YouTube allows phone-based VR viewing, such as Google Cardboard or Oculus devices with the YouTube app. Additionally, hosting on YouTube allows users to view videos on nearly any Internet-capable device outside of a VR headset. If 360 content is viewed in YouTube on a device with a gyro sensor such as an iPad or most smartphones, users can point the device where they want to look while viewing the video. Also, many media players such as VLC Media Player support 360 video playback, and PC users can click and drag to "look around" when viewing 360 content. This allows users who may suffer from motion sickness in VR to still interact with the video. It is worth noting, the GoPro app limits file size sharing to YouTube. However, after saving a video file in the GoPro app to the phone's local storage, larger videos can be loaded directly from the YouTube App up to a size of 256 GB or 12 hours.[12] In addition to allowing simplified access, using YouTube limits the need for hosting servers, making it a low-cost and easily accessible option for sharing content.

## Conclusion

With advancements in technology, 360 content for VR has become accessible to a broader swath of the population. With simplified editing software and reduced costs, users can create VR content that serves specific learning goals and educational contexts. By partnering with other stakeholders, libraries can create educational 360 content and expand the impact of VR implementation beyond commercially available experiences. Doing so allows for the creation of a new medium of Open Educational Resources that can be used by libraries, educators, and community members the world over.

[20]"Upload Videos Longer than 15 Minutes," Google, accessed March 9, 2022, https://support.google.com/youtube/answer/71673?hl=en&co=GENIE.Platform%3DDesktop.

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