Immersive Technology Uses in Interactive Media: A Collection of Case Studies

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Abstract

A collection of case studies that combine immersive technologies such as augmented and virtual reality in various contexts are introduced to outline some of the signals and trends in emerging interactive media. A series of authors share uses of AR/VR/MR in a wide range of fields including tourism, education, archeology, communication, and more. Common themes, affordance, and challenges are pulled out and used to extrapolate likely trends moving to the future. This work also starts to build an overall framework to evaluate immersive media implementation strategies and research methodologies.

Keywords: Immersive Media, Augmented Reality, Virtual Reality, Extended Reality, Immersive Media Design, Virtual Environments, Augmented Learning

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Introduction

As the technologies that power immersive media become more ubiquitous, affordable, and easier to use, we are seeing a wider breadth of uses in an increasingly broadening scope of disciplines. Likewise, as researchers and educators, we are finding and experimenting with new approaches, affordances, and best practices of using technologies like augmented and virtual realities in classrooms and other educational settings. In an attempt to gain a more multidisciplinary view of these signals we have collected a range of case studies that implement these technologies in diverse fields of study. Some of the emerging findings suggest that motivation and approach are connected to the goals of the technology use. So it seems prudent to try and understand at least in part what using immersive technology can bring to the message or essence of a media project in order to determine if it adds value and if so, how to best leverage the technologies. Moreover, some of our case study researchers are growing increasingly concerned about the privacy and data collection implications, particularly in classrooms, of these technologies (Hawkinson & Klaphake, 2020) and of the business practices of the companies that manufacture and control these devices. While some authors are wary of the remaining limitations and drawbacks in need of perhaps some enhancements to bring virtual experiences closer to the realities they seek to emulate, overall, the authors are encouraged with the growing potential of the technology to expand access to places and experiences in different contexts, especially during a pandemic.

Case Study 1: Implementing Web VR for Facilitating English Language Acquisition

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This is a use case of the implementation of a My Hometown VR project in a 15-week course called Digital Media Projects using English. The course was taught during the COVID-19 pandemic, which caused uncertainty about whether the class would be conducted face-to-face or online. Since My Hometown is a fully online resource with all materials available through its portal, this was seen as an advantage. An online pivot occurred about 5 weeks into the semester, and this class began meeting online for discussions. The My Hometown platform has a message board for communicating with the teacher, and a Discord server was set up for questions. The course could have been conducted entirely online asynchronously.

Background

My Hometown Project was kicked off in April 2019 as a face-to-face class project, and in the beginning Google VR apps, Expeditions and Tour creator, were used to get students to create virtual tours of their hometowns. Tour guiding was conducted in class with students taking their classmates on virtual tours of their hometowns viewed on mini VR goggles that were attached to smartphones. A BYOD approach was adopted in relation to the use of smartphones; however, the mini VR goggles were provided by the instructor. This setup worked well before the COVID-19 pandemic when all classes were face-to-face. For more details on this first iteration, readers are recommended to refer to Alizadeh and Hawkinson (2021). Nevertheless, in 2020 after the emergency shift to remote teaching and learning, it was impossible to continue with smartphone VR, given that the Expeditions platform mandated the connection of the tour guide and tour participants to the same local network. Soon after, Google decided to shut down its VR applications. All these triggered the shift to WebVR, which turned out to be more accessible causing minimal levels of physical discomfort such as sickness or fatigue and which helped expand the scale of the project

beyond borders. Since then, My Hometown Project has witnessed international growth with collaborators from Indonesia, Malaysia, China, and Vietnam and now has its own independent platform.

Participants

A remarkable percentage of students conduct graduate work in the fields of architecture, design, informational technology, chemical engineering, and biology at this university. Four undergraduate students enrolled in this elective course: two chemistry majors, a biology major, and a design major.

Project Description

Alizadeh and Hawkinson's book chapter, "Smartphone Virtual Reality for Tourism Education: A Case Study" was analyzed before implementation in order to glean insights into the feasibility of offering a virtual reality class with the current technological affordances available at the university.

Immersive Design

According to the research of Alizadeh and Hawkinson (2021), VR-enabled learning on lowcost VR viewers, such as Google Cardboard, are prone to self-reported shortcomings, including eye strain, dizziness, nausea, and neck/back strain. Therefore, a decision was made not to introduce headsets but, instead, to require only a computer-based browser for the project. In addition, the network bandwidth required for this project could be problematic in the classroom, so the class relied on conservative technology: only requiring students' Gmail (for an e-portfolio as required for university assessment and browser-based Thinglink and My Hometown). These simple browser-based tools worked with the available broadband, and students did not report any issues with using them on their laptops.

Course Content

The course was divided into ten stages. The first five stages focused on setup and theory. Topics covered included the experience economy, the reality-virtuality continuum, and the art of storytelling. The last five stages focused on creating a multimedia tour of each student's hometown, including artifact curation, narration, and navigation.

Student feedback

Each student produced an individualized VR tour of their hometown. One of the major affordances of the course is the fact that students create their tours through the lived experiences of a resident of that location. Oral feedback was collected during the weekly Zoom chats, and students reported that this aspect was a high point of the course. It was particularly meaningful for students who already enjoyed writing blogs or producing digital content, such as the case of one student who was an avid blogger and another student who maintained an active Instagram account. One example of how the students creatively produced original media was the soundtracks to their tours. One student played her guitar-like instrument, a shamisen, which is native to her region, to create an original soundtrack for her tour, while another student used additional applications, such as Audacity, to layer sound

effects for their tour. In these cases, their level of involvement in the creation progressed beyond what was required in the course, which was to select a royalty-free MP3 file.

Conclusions

As the field of digital humanities continues to grow, we are likely to see a rise in collaborative web-based projects across institutions. My Hometown is an internet-based course at the intersection of storytelling and VR that allows students to personalize their digital presence by showcasing a location important to them. When students create and curate their content through this process of participating in a course that highlights the study of current theories, such as the experience economy, and easy-to-use online tools, such as Thinglink, they connect their learning beyond the classroom and beyond the university to the larger global digital landscape.

Case Study 2: Developing immersive learning experiences for "Emaki-mono", Japanese historical narrative picture scrolls.

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Introduction

According to The Courses of Study for Middle Schools by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), students should learn traditional linguistic culture in the subject of Japanese language. More specifically, students are expected to have opportunities "to be exposed to the world of classic literature," and "enjoy the world", as well as "to be exposed to the viewpoints and ways of thinking expressed in classic literature and imagine the characters and author's thoughts.". On the other hand, according to a MEXT's nationwide survey of students, Japanese literature is one of the lowest favored subjects in schools. One of the possibilities to address this problem is to use information and communication technologies (ICT).

VR Ban Dainagon Emaki

We developed *VR Ban Dainagon Emaki*, a virtual reality experience for learning a Japanese traditional picture scroll. In the Heian period, illustrated scrolls, called Emaki or Emakimono, were highly popular. The earliest extant examples date from the 12th century. They include fictional tales such as the famous Genji Monogatari Emaki (Picture Scroll of the Tale of Genji). Here excerpts from the text are alternated to paintings of representative scenes. This format quickly gained favor, and was used continuously throughout the medieval period and into the Edo period.

Bandainagon Emaki is said to have been made in the late Heian period, at around the 12th century. It is a narrative picture scroll depicting the Otenmon Incident in 866. As a typical example of the feature of emaki, the first roll of Bandainagon Emaki has a scenery of fire at Otenmon (the red-painted front gate) which depicts flaring Otenmon, crowds of viewers, government's officers trotting down on to the site upon receiving information, and so on, in a few meters long series of pictures.

Learning classic literature is not easy for students, but learning Emaki involves further challenges, such as missing text, varied interpretations, and media/art literacy deficiencies

that might be less pronounced with text literature. However, VR Bandainagon Emaki can help resolve these issues by following ways. First of all, students can easily view the whole scroll of an Emaki in a virtual space since there's no limit for the display size. If you surround them by the scroll, they only have to rotate their head to skim through it. This would help students to understand how the story of an emaki is organized. For our VR app, we obtained the photos of the Emaki from National Diet Library Digital Collections and stitched them together into three images, and arranged them in a C shape. In this way, students can easily grasp, literally, the big picture of the story, in which the first part describes people rushing to the gate where the fire accident is happening, the second part shows the burning gate and the third part hints who plotted the arson. The VR app, developed on Unity game engine, was made available first for Oculus Go and later for VIVE Focus Plus. On both devices, users can walk in the virtual room, take a closer look at the Emaki or just look around to experience the world of the Emaki in an immersive fashion.

Overview of the virtual room





Figure 1. A view of VR Bandainagon Emaki virtual environment

The second benefit of using VR is to make students more interested in the characters on an Emaki. It is well known that seeing people in an immersive environment makes the users feel empathetic toward them (Schutte & Stilinović, 2017). Moreover, embodiment, namely being able to influence virtual space by the user's own body, is also known to enhance learning (Johnson-Glenberg et al., 2020). In VR Bandainagon Emaki, we animated the characters using Live2D, a 2D animation authoring tool widely used for games and anime. Live2D allows animated 2D characters directly from source images. We extracted characters from Emaki images on Adobe Photoshop and applied "art meshes" (polygons), which can be deformed by parameters. The meshes can be applied to different parts of the character's body, such as eyes, mouth, head, and limbs, and changing their shapes by adjusting the parameters allows expressions like blinking, talking, nodding or running. These expressions greatly expand the expressiveness of characters and enable the characters to play out the stories more effectively.

Finally, VR allows multiple users to view an Emaki together. Organizing students into groups and letting them work as a team to discuss the interpretation of an Emaki can improve the motivation of students and the understanding of source materials. One of the authors has practiced an active learning approach of Emaki teaching, by printing out the whole Emaki and letting the students annotate it together by placing Post It Notes on the surface of the printout. This practice was possible because wide blank walls were available at the college, but for those who do not have access to such space, VR can be used instead. We took the images from the original VR Bandainagon Emaki and installed them into a scene of Mozilla Hubs, a social VR platform, for multiplayer experiences. Unlike the original VR Bandainagon Emaki which was developed as a single user standalone software for VR HMDs, this Mozilla Hubs version is built as a WebXR app and viewable on both PC browsers and VRHMDs. A Mozilla Hubs room can be shared with other users by a URL and have conversations and add objects (e.g. images, marker lines) together. This would allow students to have discussions and annotate the emaki in a virtual space. Currently, only text and audio annotations are used for learning aids, but we plan to add character animations, as in the original VR Bandainagon Emaki, to this experience.

Case Study 3: Simulating international diplomacy using VR technology at Model United Nations

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Introduction

Model United Nations (MUN), with a history of over 70 years, is an established learning activity conducted around the world as a means of simulating international diplomacy, deepening students' understanding of the role of the United Nations, and increasing awareness of global issues. MUN requires students to role-play, research and establish positions that may be very different from their own personally. In 2020 and 2021 the Japan University English Model United Nations (JUEMUN) was conducted solely online due to the ongoing COVID-19 pandemic. After the JUEMUN online conference was successfully concluded in summer of 2021, the idea of combining VR and MUN simulations was considered in order to allow student delegates the chance to participate with avatars in a VR environment while conducting an MUN meeting. Faculty were interested in observing the effects of how simulations in this virtual environment could be utilized to further develop students' negotiation strategies for use in face-to-face MUN events.

Organization and Planning

Seven students from Kyoto University of Foreign Studies' Global Studies department were chosen based on their prior MUN experience and their expressed interest in exploring English negotiation strategies for use in future MUN conferences. These students included both Japanese and international students and for all participating students English was considered to be their foreign language. Sessions were organized around simulating the United Nations Security Council (UNSC) with three 90-minute sessions being conducted over 3 weeks. During the simulation student delegates convened to discuss and create a UNSC presidential statement on behalf of the international community regarding the recent withdrawal of the United States from Afghanistan, which concluded on August 30th, 2021.

Virtual Learning Environment Design

WebVR was chosen to be the platform from which to create a virtual replica of the United Nations Security Council Chamber. WebVR uses open standards like Open WebXR and A-Frame programming to make the content as accessible as possible to as many devices, operating systems, and Internet browsers (Neelakantam & Pant, 2017). The virtual learning environment was created to be a digital twin of the actual environment in New York but with

added features and items that might assist in the simulations, such as private meeting rooms and document viewing screens (Stiles, 2000).

Orientation Session

All participants joined a 60-minute orientation session conducted online in the UNSC VR environment. Faculty explained the schedule, objectives, and introduced the VR replica of the UNSC chambers. From early on in the session the 7 student delegates quickly became comfortable accessing the VR environment, controlling their self-designed avatars, and maneuvering around the VR UNSC chambers to explore the main meeting room and 4 adjacent meeting rooms which could be used for private consultations.

Session 1

All participants joined a 90-minute session that began with Formal Consultations, with each of the 7 student delegates delivering their 90-second opening remarks from their assigned seats at the large round table, similar to the actual UNSC table in the main UNSC meeting chamber. Speeches included their country's or organization's understanding of the situation and their objectives for drafting the official presidential statement on the issue of the chaos that was being created during and after the United States recent withdrawal from Afghanistan in the summer of 2021. Upon the conclusion of the 7 speeches, the floor was opened for questions regarding the content of the speeches. As this is similar to an actual face-to-face MUN meeting, the delegates were very adept and efficient at moving through this part of the simulation.

After Formal Consultations, the president moved the meeting into Informal Consultations in which delegates were able to move around the chambers to have either public or private negotiations with each other regarding draft clauses they wished to see added to the draft statement, which was due at the end of session 1. Faculty moved their own avatars around the environment observing several private discussions and noticed that delegates were: 1. staying in their assigned character roles; 2. using diplomatic language that they had been taught; and 3. working diligently on trying to negotiate the presidential statement clauses, while protecting their own national interests. By the end of the UNSC Session 1 the student delegates had submitted over 20 draft clauses to a Google document, which would be considered for the presidential statement. Clauses were concerned with the following topics: 1) Care for refugees; 2) Establishing a safe zone in Kabul for UN aid organizations; 3) UN support for bilateral or multilateral negotiations with the current Taliban government of Afghanistan; 4) The freezing of international assets of the Afghanistan government; and 5) The condemnation of superpowers hastily abandoning their regional responsibilities.

Session 2

Session 2 opened again with Formal Consultations for opening remarks, and then the president quickly moved the session into Informal Consultations for students to continue negotiating and amending the draft clauses for the presidential statement. Negotiations mainly centered on whether or not the UNSC could agree to support bilateral negotiations over multilateral negotiations, the establishment of a safe zone in Kabul, and whether or not the UNSC could support the freezing of Afghanistan's international assets. Faculty observed that delegates stayed in character, following their objectives, as they negotiated the contents of draft clauses, writing amendments that would move the members closer towards

consensus. Student delegates utilized the 4 meeting rooms in the VR environment, often moving from room to room to discuss with fellow delegates. By the end of the simulation, student delegates had submitted and amended 20 clauses to be included in the UNSC presidential statement and reached consensus on the document.

Conclusions

Student delegates seemed to show more willingness to stay in character in the VR game-like environment than what has been observed of these same students participating in face-to-face and online MUN simulations. Furthermore, the online gaming environment provided a fun activity for students to engage in, while also learning about international diplomacy. Further research is needed to develop the use of VR environments in MUN simulations as a way to: 1) practice and prepare negotiation skills and techniques for use in face-to-face MUN conferences; and 2) develop an alternative platform for new Model United Nations activities to develop.

Discussion and Conclusion

These case studies have revealed some common threads and signals toward best practices for designing learning experiences with immersive media. One of the main considerations from all of the studies was that the use of immersive technology adds value to the learning. Whether the learning goals of these studies could objectively be better met with different tools and approaches is open to debate, but each of these studies was carried out, at least in part, in order to explore new ways in which immersive media might enhance the learning experience, and possibly improve learning outcomes. Such improvements are made possible through an examination and deeper understanding of how augmented and virtual realities are designed and used. It is our hope that these case studies illuminate how immersive technologies can have a high potential for impact, especially in making experiences and materials more widely accessible, while being highly dependent on the design, limitations and implementation of the tools (Hawkinson et al., 2015).

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