Virtual Simulation Based Intercultural Learning

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Abstract. The communication across cultures is challenging, but it is more and more important with the development of economic globalization. Virtual simulation technologies could help create an immersive situated learning environment for improving the intercultural learning experience. Global Understanding (GU) is an international collaborative education community for improving the intercultural competence of the students. We study the approaches that virtual simulation technologies introduced into GU based on the analysis of virtual simulation in intercultural learning as well as the case of Shaanxi Normal University (SNNU) incorporating virtual simulation in teaching history and culture. The knowledge and communicating skills of different cultures are the two important factors in intercultural learning, and we believe they could be improved by virtual simulation based immersive experiencing and interactive virtual simulation respectively. The already-made virtual resources and the ones made collaboratively by the students, including 3D models, panoramic videos/images, and video games, together with the virtual reality content distribution methods could form an ecosystem for the virtual simulation based intercultural learning.

Keywords: Cultural learning · Global understanding · Virtual simulation · Situated learning

1 Introduction

People around the world have been pursuing better understanding of each other for hundreds of years. With the development of information communication technology (ICT), it is much easier than ever before for people from different countries getting connected with each other, with which people could work together, study together and even live together. Distance learning provides an important opportunity for the students learning many courses with students of different countries under the direction of a professor, which make the online education cross the boundary of countries. MOOCs have been the most successful distance learning pattern in recent years, which help students improve

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their learning mainly in their specialties. There exists another type of global collaborative learning projects, the main aim of which is to help the students understand different cultures to improve their intercultural competence, which is even more important than the professional knowledge in the globalization era. Global Understanding (GU) project[1], initialized by East Carolina University (ECU), involving more than 40 universities/colleges from more than 30 countries, is an international collaborative education community for the students studying different cultures. In every GU session, the students from a pair of partner universities discuss a certain culture topic together under the direction of the teachers from both sides, mainly through the video conferencing system. The intercultural learning in GU helps the students enhance a greater understanding of people from other cultures and form more positive attitudes according to the feedbacks of the GU students [7].

Learning different cultures is the essential goal of GU, and the virtual collaborative classroom of GU helps improve the cultural competence of the students. However, the traditional communication approaches in GU such as the video conferencing and text chatting limit the students' learning experience. Because the first-hand experience is very important to understand a foreign culture [8], and the learning happens in the context where the knowledge belongs to according to the theory of situated learning. As we know, it is the best to learn a culture by living in the environment for some time, however, it is not easy for most of the students studying abroad, and that is one of the reasons of establishing GU 15 years ago. Though GU provides a virtual classroom for students from different countries, where they can have the same class together at the same time, it is clear that the intercultural communication between two sides is not as good as studying abroad for the students. Virtual simulation can help create a virtual environment which could be used to show cultural objects and activities for foreign partners, in which the students can learn the culture immersively. Virtual simulation based cultural learning is more interesting and the students can get more knowledge while they experience in the virtual environment by themselves, and the guidance from their partners can help them understand the culture directly as they are really present in the environment. It would outperform the traditional communication methods which involve oral, video and image demonstrations because the knowledge they get is directly from what they experience. According to our practice in teaching history and culture in SNNU, the virtual simulation based teaching methods would promote the intercultural learning with the capability of generating situated learning environments and make the students understand foreign cultures better.

Culture usually has a close relationship with history as Nunn states: "historical events can have long-term impacts that continue to be felt today" [18], thus the virtual heritage resources (including sites, figures, and events) help the students understand past culture [13]. Most of the students of SNNU attending the GU course major in history, therefore we mainly discuss the virtual simulation based intercultural learning in the context of history and take the historical

[1] http://www.ecu.edu/cs-acad/intlaffairs/Global-Understanding.cfm.

resources as the main simulation target. The rest of the paper is organized as follows: Sect. 2 discusses the virtual simulation technology for improving intercultural learning and related work. The method we apply virtual simulation technologies in intercultural learning with GU as an example is discussed in Sect. 3.

2 Intercultural Learning and Virtual Simulation

The goal of intercultural learning is to improve the knowledge, skills of the students on the cultures different from their own [12]. In this section, we discuss the virtual simulation methods that improve the students' cultural knowledge and cultural communication skills with immersive experiencing and interactive simulation respectively.

2.1 Virtual Simulation for Intercultural Learning

Virtual simulation technologies such as virtual reality (VR), augmented reality (AR), mixed reality (MR), and video games provide new opportunities for learning different cultures in an experimental way. The XR (VR, AR, MR) devices, as well as portable devices such as smartphones and iPads are available in the classroom and home for many students. There are more and more virtual resources and the creation of them is getting easier. In a consequence, it is practical to introduce virtual simulation resources into the intercultural learning.

A virtual environment is created in computers that simulates the real world. It could be a social space, where educational interaction occurs and "the students are not only active, but also actors" [9]. They are widely used for the education in science, technology, and engineering [20], while they are less used and studied in cultural learning. The virtual simulation technologies could provide an immersive situated learning environment for better understanding cultures, which makes the virtual simulation more important for arts and humanities than natural sciences. Virtual reality (VR) is considered as a learning tool that helps increase meaningful social interactions and reduced social anxiety especially for the online courses [10]:

> "That makes it possible for students who live hundreds of miles apart to come together and share the same experience online. This is different from a discussion board or video chat in that students are actually seeing and hearing in a shared environment, erasing distance in the virtual space, rather than each being solely exposed to their own immediate surroundings as they sit at their computers. This simulated environment...contributes to a sense of presence."

VR makes it possible that the learning can happen "then" and "there" [4] as a result it increases the interest of the students and improves the performance at the same time. Cultural knowledge could be learned in an experiential learning

pattern in an immersive virtual learning environment [19], and the learnability in a 3D virtual heritage is analyzed and proved in [25]. Virtual learning environments with virtual characters from other cultures, combined with authentic intercultural situations, hold potential for intercultural training [15], e.g. a situated cultural festival learning system is developed and used in teaching Chinese cultural festivals [5], and improving the learning motivations and outcomes compared with those of students who were taught using traditional methods. Virtual environments are even considered better than books and videos in history education in [14], where an ancient city Uruk around 3000 B.C. was reconstructed and populated with AI-controlled 3D avatars. The students could not only observe historical buildings, events, they could also interact with the simulated objects and persons. Besides immersive and interactive experiencing, a properly designed virtual world could "facilitate intercultural collaborative learning" [12]. VR games can help teach languages and culture as stated in [6], and VR could enhance remote collaboration [2,3].

Virtually reconstructed places provide opportunities for "authentic experiential learning activities that have the potential to re-mediate students' understanding of space and place through enacted interaction, and to make the learning more memorable" because of embodied experiences [21]. Immersive virtual reality could help enhance the spatial awareness and interest of students in the subject of history [22]. History could be simulated in historical virtual worlds (HVWs), and the historical re-enactment in the HVWs allows historians to criticize different interpretations of history and produce new knowledge on the past [16]. Historical events could be simulated in virtual environments, for example, the user could enact as different roles in a historical event as stated in [24], which give the students an overall experience of a historic event.

Virtual recreated materials are important sources for learning culture but they are new to most teachers and students, therefore they should do additional preparations, e.g. the user requirements for architectural heritage learning through virtual reality as stated in [1]. SNNU has set up a virtual simulation based teaching center for history and culture along the Silk Road for studying the virtual simulation technologies for teaching history and culture as well as training the students with the required skills for their further study and work. They provide the theoretical and practical basis for incorporating virtual simulation technologies in intercultural learning with GU as the testbed. According to the related research and our practices, the functions of the virtual simulation methods for intercultural learning could be classified into two categories: demonstration and interactive simulation.

2.2 Virtual Demonstration

There are various VR techniques as well as devices, but most of them are for personal experiencing. For culture communication, VR can be used to create a virtual object or environment, in which foreign students could explore and experience by themselves. There are lots of already-made VR materials, e.g. 3D recreated historical sites, 360-degree videos and images (e.g. YouTube virtual

reality channel[2]), etc. We can use the virtual resources provided by museums, historical heritages such as digital Dunhuang Magao Grottoes[3], where virtual simulation technologies have been widely used. Some universities construct their own VR materials by their own faculties or together with some companies. Most of these already-made VR materials could be used freely, therefore, the teachers need to do good research to introduce suitable related VR materials into their courses based on the VR devices they have.

The students can feel and even touch what is demonstrated by VR, i.e. they are virtually brought into the cultural environment that they are going to learn. Though it is not the same with what they physically visit in the environment, what they can see and feel is even more real compared to the traditional methods, including oral explanations, demonstrations by image, videos, etc. Figure 1 shows a famous Chinese historical site, Dunhuang grottoes. When the students put on the VR headsets, they would feel like they are placed in the Dunhuang caves, where they can watch the murals on the wall and walk around, as shown in Fig. 2.

Fig. 1. Virtually Recreated Dunhuang Caves

2.3 Interactive Virtual Simulation

Interactive VR applications are much better than personal experiencing ones because experiencing a different culture usually needs the guidance from local people, which is similar to that a tour guide is usually needed when we travel to some new place and want to understand the culture better. The foreign students could meet the native students in the virtual simulated environments, for example, if our students want to show an ancient city of China to their partners, they

[2] https://www.youtube.com/channel/UCzuqhhs6NWbgTzMuM09WKDQ/.
[3] https://www.e-dunhuang.com/index.htm.

Fig. 2. Virtual experiencing in the virtually recreated Dunhuang caves

could construct the ancient city virtually and invite their partners to join them in the virtual city. Our students could introduce some famous buildings and historical events to their partners, such as how the Spring Festival is celebrated in China.

Interactive VR environments are mostly related to game platforms, where the interaction between users and the interaction between users and the environment is possible. In SNNU, we use virtual simulation technologies mainly in two parts: (1) immersive demonstration of historical sites (existing or non-existing); (2) game-based interactive virtual environments built by the students.

Minecraft[4] is a popular sandbox game, and it has been widely accepted as an education tool, in the virtual world of which players can build almost anything they want, and they can perform some collaborative activities together. Huge numbers of buildings as well as cities have been created with different kinds of blocks in Minecraft, e.g. the St. Peters Basilica in the Vatican[5] as shown in Fig. 3. Huge scale architectures could be virtually reconstructed in a crowdsourcing pattern [17], though it is an effective method, it is difficult, if not impossible, to reconstruct an ancient city completely with manually placed blocks. Some automatic or semi-automatic methods could be used for building a large city in Minecraft based on the GIS data and digital maps [11].

SNNU is located in Xi'an (called Chang'an in history), an ancient city of China, which 13 dynasties made as their capital city in history. It is difficult for a foreign students who know little about China and Xi'an to have a deep understanding about this city even after the introduction by their partners in Xi'an, according to our experience of GU, because it could only develop "with attention to experience" [8]. In SNNU, we are working on a project to recreate

[4] https://minecraft.net/.

[5] https://www.planetminecraft.com/project/lvl-60-special-beautiful-detailed-st-peters-basilica-world-download/.

Fig. 3. St. Peters Basilica in Minecraft

the Chang'an city in Tang dynasty. All the ancient buildings in the city are being built by our students in Minecraft collaboratively. The virtual Chang'an city would be a good environment for the foreign students to visit. It is historicaly accurate because it is recreated by the students of history major. Some of the buildings, e.g. the Big Goose Pagoda, Mingde Gate, the Temple of Heaven in Tang dynasty, virtually built by the SNNU students are shown in Figs. 4 and 5.

Fig. 4. Big Goose Pagoda in Minecraft (right) according to historical drawings (left)

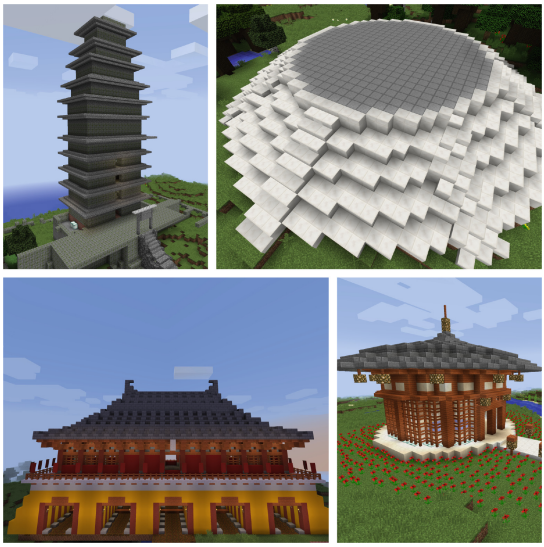

Fig. 5. Ancient buildings in Chang'an city in Minecraft

3 Virtual Simulation in Global Understanding

3.1 Intercultural Learning in GU

GU provides the students around the world a platform for studying different cultures that they know nothing or very little with the native students of that culture face-to-face without going abroad. Existing cultural/traditional ceremonies and historical heritages are two important sources for cultural learning. In GU, cultural information is introduced to the foreign students in the form of words, pictures, audios, and videos. They worked indeed, however, nowadays the students know more about different cultures than ever before, because there are more and more methods for them to get to know the world. The expectation of intercultural learning of the students is getting higher than before. Therefore, GU should provide the students with intercultural learning of a new pattern that could enhance their interests and help them understand different cultures better, including cultural knowledge and communication skills.

Virtual simulation is a method that could potentially promote cultural learning in GU. We need to tailor these technologies to GU according to its topics. There are four main topics in GU: (1) college life, (2) tradition and family, (3) meaning of life, and (4) stereotype and prejudice. The first two topics are much easier to apply virtual simulation, and they are discussed as follows:

"College life" is the first topic for GU students. They would tell their partners some information about their universities, for example, where the university locates, how many hours they spend on learning every day, what they do in their spare time, etc. They would show some pictures or videos to their partners,

most of which are related to their campuses. The students of both the partner universities can build their virtual campuses in Minecraft. When they talk about college life in the GU class, they can invite their partners to come into their virtual campuses and show them interesting things, such as important buildings, work together to do some games to simulate their real college life. They can also work together in Minecraft to build a building of their campuses based on their discussion. After working with several partner universities, they will build a complete campus and find how they could introduce them better to different partners.

The topic "tradition and family" is important for cultural learning in GU. Tradition and culture are closely related to history, and new technologies have been applied in many museums and cultural companies resulting in many virtually recreated historical sites. Most of them are free, and they provide even better experiences than we physically visiting them. In GU classes, the teachers and students collect this kind of resources and share with their partners, and give them some introduction of them as well as some manuals. Though most of them don't support multiple user viewing at the same time, it could be done asynchronously. After their virtual visiting, the students would discuss more deeply, because they have more knowledge about the partner country's culture. The technology is developing very fast, therefore in the near future the teachers and students might have the GU class in a virtual simulated world as the OASIS in the film "Ready Player One".

3.2 VR Materials Collaboratively Created by the Students

Most projects related to VR in education use already-made VR materials, which are built by companies or teachers. They enhance the students' interests, however, if the students can involve in the construction of the VR materials they can benefit more. With the development of IT and education, the students of different major, even the secondary students, are able to develop VR materials on their own. The 3D modeling tools such as Unity, Blender, Sketchup, as well as some game platforms such as Minecraft, SecondLife could be used in cultural learning. Here we classify the related technologies into two classes: VR content creation and distribution, which could make an ecosystem for virtual simulation based intercultural learning.

Creation of VR Materials. As to the creation of VR materials by the students, we are using Minecraft for the disappeared historical resources and 360° cameras for existing ones.

Minecraft is a sandbox game engine, which is widely used in education. Ancient cities or historical sites of large scale are usually needed for simulating history as well as virtual tours. GIS data and digital maps could be imported into Minecraft [11,23], in which the historical buildings could be reconstructed collaboratively by the teachers and students. 3D virtual worlds could be built using Second Life, OpenSim, etc., compared with which Minecraft has better adaptability, because the secondary students and college students could build anything

they want in Minecraft; 360-degree videos and images are the most convenient means for the students recording existing cultural resources, e.g. museums, cultural activities/ceremonies, because the 360-degree cameras are popular and cheap, and they could be viewed from any perspective by the users.

VR Content Distribution. The distribution of VR materials could be through game platforms such as Steam, or VR device platforms such as Oculus store, however, the most popular and effective means is the web. WebVR helps present VR contents on the web, through which the 3D models, as well as the panoramic videos and images, could be immersively viewed with VR headsets on the web. Facebook's 360-React[6] and Mozilla's A-frame[7] are two of the most popular WebVR frameworks, and they are used in our laboratory by the students majoring in history and museology. Besides the recorded panoramic videos and images, some additional interactive information (e.g. background, navigation, history, etc.) could be integrated into the WebVR applications as the cases of Google Arts & Culture[8], which could serve as the tour guide for the users.

3.3 Requirements for Using Virtual Simulation in GU

Because the virtual simulation technologies are new to most teachers and students, the use of them in GU needs extra preparation besides what we do in traditional GU. First of all, we need to study the methods of how we can make effective use of virtual simulation in GU. The second thing is the resources and devices we need to implement the virtual simulation based learning in GU.

Resources and Methods. At first, we just collect some VR resources related to the GU topics and use them as a new kind of media in the class. We can also produce our own VR resources with some devices. For example, the virtual Dunhuang caves we use in teaching history as stated in Sect. 2.2 are produced by a company. For some traditional culture such as ceremonies and activities, we can use 360-degree cameras to record by ourselves.

The panoramic images and videos taken by the students could help to present the cultures, however, they are not good enough, interactive virtual environments could be constructed from the panoramic resources with the WebVR framework.

The SNNU students of history major go to Dunhuang to do academic investigation every year, and they take 360-degree videos and pictures as shown in Fig. 6. They present these cultural resources to their partners as a WebVR application, which could be viewed either with browsers on PC or smartphones or VR headsets.

[6] https://facebook.github.io/react-360/.
[7] https://aframe.io/.
[8] https://artsandculture.google.com/.

Fig. 6. A Dunhuang Mogao Caves in Dunhuang Museum Recorded by the students

Devices. In our practices of virtual simulation based intercultural learning, we use some VR devices such as VR headsets (e.g. Google Cardboard, HTC Vive, Oculus Rift, etc.), 360-degree VR cameras (e.g. Insta360 Pro2).

The VR resources and devices are important for implementing virtual simulation based intercultural learning, however, the virtual simulation based teaching/learning methodology is critical and needs further study.

4 Conclusion

We studied the approaches that virtual simulation technologies introduced into GU based on the analysis of virtual simulation in intercultural learning as well as the case of Shaanxi Normal University (SNNU) incorporating virtual simulation in teaching history and culture. Virtual simulation based immersive experiencing and interactive virtual simulation could improve the students' knowledge and communicating skills of different cultures. Already-made virtual resources and the ones made collaboratively by the students, including 3D models, panoramic videos/images, and video games, and the virtual reality content distribution methods together form an ecosystem for virtual simulation based intercultural learning. In the future, we are going to study the virtual simulation based methodology for intercultural learning, including the course design, learning assessment, etc.

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