VR Creation Experience in Cultural Heritage Education: A Preliminary Exploration

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ABSTRACT

Despite an increasing adoption of virtual reality (VR) in education, few studies have explored VR creation in cultural heritage education. This study aims to investigate students' experience of creating VR content featuring cultural heritage in an undergraduate general education course repurposed from a digital collection course. A survey was conducted with 87 students, collecting both close-ended and open-ended responses. A coding framework was designed to analyze students' open-ended responses. Preliminary findings show that students were largely satisfied with the experience, which helped learners from diverse academic backgrounds toward acquiring technological skills that are essential for the 21st century workforce. The VR creation experience also motivated the students to learn more about cultural heritage. Technical issues regarding spherical photo-taking and the online VR creation tool were identified, which may call for new alternative tools and devices. Findings offer empirical evidence on the value of integrating VR creation into cultural heritage education, as well as implications for pedagogical design and educational applications of VR creation.

KEYWORDS

Virtual Reality Creation; Cultural Heritage; General Education

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Information Technology; Education Technology; Humanities; Culture; Cultural Heritage

INTRODUCTION

Virtual Reality (VR) is defined as a complex technology which exploits existing technologies (e.g., 3D graphics, robotics, etc.) to create an immersive and interactive digital environment (Carrozzino & Bergamasco, 2010). It has been adopted as one of the various digital technologies (e.g., Augmented Reality) for documenting and preserving cultural heritages. While this technology has been increasingly adopted in education, VR creation in cultural heritage education is relatively new and under-explored. VR creation is usually perceived as an activity requiring professional devices and specialized technological skills (Feurstein, 2018). In this study, undergraduate students from diverse academic backgrounds in a general education course on cultural heritage used their smartphones and a free online VR creation tool to create VR stories of cultural heritage. This study targeted 124 students enrolled in this course in Fall 2018. Valid survey responses were collected from 87 students to understand their experience of VR creation. By analyzing the survey responses, this study aims to answer the following research questions:

RQ1: What are the benefits of creating a VR story of cultural heritage as perceived by students?

RQ2: What are the issues/challenges arising from students' experience of creating a VR story of cultural heritage?

The first research question sets out to understand students' opinions on the benefits of VR creation in the context of cultural heritage education, whereas the second research question aims at identifying possible issues/challenges encountered by students during the process of VR creation. Our findings will provide empirical evidence on the values and challenges of integrating VR creation into cultural heritage education and thereby shed light on pedagogical design and educational applications of VR creation.

RELATED WORK

VR for Cultural Heritage

VR technology has been rapidly adopted for conservation and restoration of cultural heritage. VR helps to reconstruct damaged or destroyed historic objects, buildings, and environments. VR also facilitates the presentation of heritage information via sensational means rather than linguistic codes, allowing apprehension by both expert and nonspecialized users (Carrozzino & Bergamasco, 2010). In recent years, thanks to the availability of advanced software and hardware, museums are able to preserve and display artefacts digitally. Historic artefacts and architecture are made accessible online as interactive 3D models, giving rise to

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Virtual Museum (VM) systems which are an effective solution for communication of cultural contents (Barbieri, Bruno, & Muzzupappa, 2017). Visitors can view digitized cultural objects and explore virtually reconstructed historical places by means of VM-hosted installations. VR technology in such features as mobile guides and interactive exhibits enhances visitors' experience with collections and exhibits, through engaging and educational methods available both inside and outside of the museums. VR is beneficial for both cultural preservation and visitors' experience (Alelis, Bobrowicz, & Ang, 2015).

VR for Education

VR enables students to interact with visualizations of abstract ideas and has been utilized as a medium for concept delivery, training, or skill application (Cheng & Wang, 2011). VR allows the creation of virtual environments and users' intuitive interaction via real-time natural manipulations (Mikropoulos & Natsis, 2011), leading to its pedagogical affordances in the classroom. Using VR not only encourages active participation, but also increases the interactivity and individualization of the learning process, contributing to effective learning (Mikropoulos & Natsis, 2011). The operation of the virtual environment offers a unique sense of engagement to the students as active learners via continuous interactions (Martín-Gutiérrez, Mora, Añorbe-Díaz, & González-Marrero, 2017; Baxter & Hainey, 2019). The immersion, interaction and imagination brought by VR experience are also shown to increase learners' motivation (Curcio, Dipace, & Norlund, 2016). However, most studies on VR for education to date focus on the learning experience where students are *consumers* of VR content. The creation of VR has been mostly discussed from the perspective of instructional designers and technicians (Feurstein, 2018). To the best of authors' knowledge, there is little empirical research that explores students' experience of VR content creation in cultural heritage education. This study aims to bridge the gap.

RESEARCH CONTEXT AND METHOD

Research Context

This on-going study was conducted in a large university in Hong Kong. This study involved an undergraduate general education course on digitizing cultural heritage, as a repurposed Digital Library course aiming to teach information science and technology as well as cultural heritage information to a broad audience (Hu, Yu, Alman, Renear, & Carbo, 2017). Students from any disciplines could enroll in the course. Two important learning outcomes of the course are to "demonstrate a good understanding of cultural heritages, their values and significance" and "apply digital technologies to promoting local cultural heritage to a global audience". The course was delivered through a 2-hour lecture given by an instructor and 1-hour small-class tutorial each week given by a teaching assistant. In alignment with the two course learning outcomes, one of the course assessments was to create an individual VR story to showcase a cultural heritage of the student's own choice. One tutorial was designated for this assignment, with hands-on practices of taking a VR-friendly spherical photo (Figure 1) using a smartphone app *Google Street View* and creating a draft VR story using an online tool *Stories360* [http://stories360.org/].



Figure 1. Sample spherical photo.

VR Story-creating Procedures

These procedures were used to instruct the students how to create a VR story. First, the *Google Street View* smartphone app was used to take at least one spherical photo of the site of cultural heritage. Second, the photo was uploaded to the web interface of *Stories360* for generating a basic VR story. Different objects could then be added to the story, including text, image, interactive video, and background music or narration. The product was then saved online and could be viewed via any mobile devices. Both the regular and duallens views (Figure 2) are available where the latter can be activated when a pair of VR glasses is used.



Figure 2. Dual-lens view for VR glasses.

Data Collection

Adopting the mixed method approach, both quantitative and qualitative data were collected from an end-of-semester survey on students' overall experience of creating a VR story of cultural heritage. Consents were obtained from students prior to data collection. Besides demographic information (e.g., gender, handedness), the questionnaire contained both close-ended and open-ended questions, asking about students' satisfaction with and perceived benefits of the experience of VR story creation, issues arising from the experience, and suggestions for a similar experience in future courses. Their participation was entirely voluntary, and no compensation was provided.

RESULTS

A total of 87 responses were collected (responses rate = 70.2%). Among the survey respondents, 57% were female and 38% were male, leaving 5% not disclosing their gender. Half of the students (52%) were bespectacled, and a minority of them (5%) were left-handed.

The majority of respondents (90%) were satisfied with their VR story-making experience in the course. All of them deemed that they received enough instruction and resources on creating a VR story. A considerable portion of students (76%) were in favour of creating VR stories in their future courses, whereas 6% were not in favour and 18% were neutral.

Responses to the open-ended questions were coded with thematic content analysis. With the grounded theory approach (Strauss & Corbin, 1994), the codebook was developed from the data through an iterative coding process. An excerpt was defined as a unit with an independent meaning and was usually an utterance. The coding was done by two coders to calculate inter-rater reliability. Table 1 displays the coding framework with frequency information for each code. Learning new technology, particularly spherical photo taking was mentioned frequently (37%) as a benefit of the VR creation experience:

"The best part of the experience was seeing how current technology could allow individual pictures to be pieced together in order to create a [spherical] photo" – P57

VR creation was seen as a new and positive experience to many respondents (23%), being described as "fresh" (Participant 27(P27)), "meaningful" (P28), "comprehensive" (P11), and "magical" (P15). It was even more encouraging for students with less technical experience:

"Before making VR, it seemed like a big thing but now we know it's an easy thing and it makes me feel good about myself." – P59

One third of the comments on benefits linked the VR creation to the subject matter, cultural heritage. 19 of them remarked that the respondents did physically visit the site of cultural heritage for collecting materials for the VR story:

"[The VR story-making experience] encouraged me to visit cultural heritages which I would not usually do so." – P84

There were also 14 responses on how the experience enabled the students to learn more about and appreciate cultural heri-

Code	Definition	Count
	Perceived Benefits of VR Story Creation	103
Spherical photos	Participant mentioned viewing, capturing, and/or creating spherical or 360-degree photos.	37
New or positive experience	Participant mentioned VR production as a new and/or positive experience	23
Visiting the heritage	Participant mentioned physically visiting the site of cultural heritage for making the VR story.	19
Appreciating the heritage	Participant mentioned learning something or more about and/or appreciating the cultural heritage via the	14
	VR story-making experience.	
Ease of VR story-making	Participant mentioned the ease of creating VR stories.	10
	Issues / Challenges about VR Story Creation	<u>79</u>
Taking spherical photos	Participant mentioned issues regarding capturing, viewing, or other actions on spherical photos.	23
Operation	Participant mentioned issues arising when viewing, using and/or operating the VR story-making tool.	20
Features and functions	Participant mentioned the issues regarding features/functions of the VR story-making tool.	15
Alternative devices and tools	Participant mentioned and/or suggested alternative devices/tools for VR creation.	8
Need for sample work	Participant mentioned the need of sample VR stories for their reference.	5
Speed and stability	Participant mentioned issues regarding the speed and/or stability of the VR story-making tool.	4
Other issues	Participant mentioned other miscellaneous issues related to the VR story-making experience.	4

Table 1. Coding framework and code counts.

A total of 182 excerpts were extracted from the responses and 28% were double coded, with a Cohen's kappa coefficient of 0.93, implying a substantial to excellent level of agreement (McHugh, 2012). As shown in Table 1, there are 103 excerpts containing respondents' perceived benefits in their VR story creation experience and 79 about the issues arising from the experience.

tage, in terms of their "current situation" (P43), "details" (P74), "importance" (P8), "interesting facts" (P64), and "aesthetic merits" (P21).

As for issues arising from the VR story-making, the most mentioned one was dissatisfaction toward technical issues when taking spherical photos: "I have spent nearly two hours on taking two [spherical] photos as there are too many slits and twists due to technical problems." – P29

Another commonly raised issue was related to the online tool used to create the VR story (i.e., *Stories360*):

"The loading speed of Stories360 [was an issue]." – P86 "Stories360 is in lack of different functions to create the ideal visual effects." – P58

Some students suggested alternative tools and devices such as the "360 Camera" to replace smartphones for taking spherical photos (P55) and a "more advanced platform" (P38) than Stories360 for creating VR story.

DISCUSSION

The results show that students were largely satisfied with their VR creation experience. The idea of VR creation in and of itself was deemed as a benefit, which to most students was a new experience from which they could learn new skills on "current technology" (P57). Given that students of this general education course were from diverse academic backgrounds including fields that are traditionally less technology-oriented, this benefit could be attributed to the ease and "simplicity" (P8) of making a VR story via a smartphone. In fact, some students who were anxious about making "technologically intensive" products became more confident in using digital technology through this VR creation experience. It is noteworthy that the tutorial session that taught and scaffolded the students how to use the tools was also indispensable for gaining this benefit Martín-Gutiérrez et al., 2017. As a good mastery of information technology is necessary for the 21st century workforce, this finding demonstrates the effectiveness of a "low tech-barrier" approach of VR creation in teaching current information technology in general education courses.

Another major benefit was students being more motivated to explore the cultural heritage of their choices. Students found it "enjoyable" (P31) to use their smartphones to take spherical photos of cultural heritage sites, which required students to make visits to the actual sites of cultural heritage, leading to their gains in knowledge regarding the status and significance (e.g., historic) of cultural heritages. Instead of merely capturing a digital representation of the site, students had to think about how to effectively present it as a story in VR which led them to pay attention to details and aesthetics of these sites. This shows the advantage of situating VR creation into the real world with authentic tasks and highlights the importance of a well-designed educational context in exploiting the pedagogical potential of VR technology Mikropoulos & Natsis, 2011.

The issues raised were mostly on technical aspects of the tools used, including difficulty in taking spherical photos

using regular smartphones, slow loading speed, inflexible operation, and lack of advanced functions of the online VR creation platform, *Stories360*. In fact, some more tech-savvy students made suggestions for alternative tools/devices to mitigate these problems. However, these tools may involve steeper learning curves and/or financial cost. Whether or not they are suitable for general education courses will need further exploration. In sum, from the preliminary findings it seems that the benefits on learning new technologies and being motivated to delve into cultural heritage, the subject of the course, overweighed such technical issues.

CONCLUSION AND FUTURE WORK

The preliminary findings from this on-going study show that students were largely satisfied with their experience, particularly on the opportunity of learning VR technology and the process of visiting and taking spherical photos of the actual cultural heritage sites. Technical issues in spherical photo taking and the VR story-making tool were raised. These preliminary findings highlight the importance of a low-tech barrier approach in offering the experience of VR content creation in an educational setting and showcase the educational benefits in implementation of VR in the cultural heritage domain. As an ongoing study, we are conducting interviews with students to gather more in-depth data about their experience and opinions. To triangulate results on how VR creation impacts cultural heritage education, multiple sources of data including students' performance scores will also be collected and analyzed in our future study.

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