INTERNATIONAL JOURNAL IN INFORMATION TECHNOLOGY IN GOVERNANCE, EDUCATION AND BUSINESS
Vol. 2, No. 1, 2020
ISSN 2686-0694 (Print)
e-ISSN 2721-0030 (Online)

Virtualizing a University Campus Tour: A Pilot Study on its Usability and User Experience, and Perception

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Abstract: In-person campus tours given to prospective students is an essential undertaking by universities. Such tours offer new faculty and students an overview of expectations and norms in the university community as a whole. The International Christian University (ICU) has been utilizing in-person campus tours in open campus activities as part of its normal daily operations but due to limited human and temporal resources, along with the unforeseen unexpected outbreak of the COVID-19 pandemic in 2019, there has developed a need to provide prospective students, family members, and other visitors alternative ways to learn about the campus. In this regard, the proliferation of 360° or virtual reality (VR) photo cameras and the ever-increasing supply of low-cost technologies for experiencing VR applications provide a practical and virtual alternative. This paper describes a pilot project utilizing a VR photo-based tour as an alternative to ICU's traditional physical campus tours. It presents a usability analysis and a preliminary draft measure of user experience arrived at after conducting correlation analysis, t-test, and text analysis, and obtaining preliminary results such as the effect of spatial presence on usability, desire to visit, and variables related to interest and intrinsic motivation. The key findings show how a VR campus tour can, if used correctly, complement and augment in-person campus tours, while opening up opportunities for further investigating spatial presence and motivation in educational contexts.

Keywords: virtual reality, VR photo-based tour, virtual tour, usability, 360° technology

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INTRODUCTION

BACKGROUND OF THE STUDY

Campus facilities play a key role in the decision-making process of choosing a university, especially for those individuals who seek suitable avenues to obtain their tertiary or post-graduate degrees; they can either give a fresh and warm welcome or conjure up a cloud of doubt and anxiety in the hearts of new students and staff members alike. For this reason, in-person campus tours are often organized as part of the ritual of a university's orientation period. These highly organized in-person campus tours, however, require human resources and time. The recent pandemic situation of COVID-19 has caused many universities to cancel in-person campus tours for the health, safety and wellbeing of both the participants and campus tour guides. Universities in Japan are no exception, particularly in Tokyo where the increase in recorded infections seems to be continuous; ICU has taken the necessary safety measure of restricting access to the physical campus, including cancelling in-person campus tours. With the development and adoption of VR technologies such as VR photos or photospheres, many notable universities such as Harvard University, Yale University and Stanford University have made virtual tours available on their websites. This paper describes the creation and evaluation of a pilot project that makes use of a free virtual tour platform which enables creators to link VR photos to one another to form paths and add audio layers to simulate an in-person campus tour.

VIRTUAL CAMPUS TOURS

Among many university rituals, the campus tour functions as a tool for the transmission of an organization's culture as it reveals beliefs, values, as well as social and cultural conditions of the same organization (Magolda, 2000). Such tours help to introduce prospective students to an idealized picture of the university campus, faculty and staff members, as well as a vision of student life. A good example of an effective virtual tour is that of Harvard University. Initially developed to reach and recruit international students not able to visit the campus before enrolling, Harvard's virtual campus tour offers prospective students, parents and new faculty members, a variety of options; such as scheduled campus visits, self-guided walking tours with tour pamphlets, virtual online guided tours with web-enabled smartphones or personal computers, enabling a virtual visitor to explore the Harvard campus at any time, from any location.

Harvard university's virtual tour, which can be accessed at URL: https://college.harvard.edu/admissions/visit/, includes interactive panoramas, photos and videos that can personalize the visitors' experiences. The tour starts with a "tour guide," which explains each area from the screen's bottom right corner. It then leads the visitors through the learning and living places on campus. Visitors can pause the tour and enhance their insight into campus life by clicking photos, panoramic views, and videos of each area supplied at the top of the screen.

Effective Campus tours, such as that of Harvard University, can be of great benefit to shareholders and stakeholders of academic institutions. According to "YouVisit," an outsourcing company that helps organizations engage target audiences through interactive VR photo-based tour experiences, students who took Harvard's virtual campus tours were nearly twice as likely to enroll than those who did not. In addition, the company claims that it has helped boost yield rates of schools by up to 28 percent (Virtual Campus Tour Solutions, n.d., para. 2).

The effectiveness of such virtual campus tours to attract prospective students could be attributed to their capability to trigger schemas related to individuals' understandings and experiences from the physical world. Yee, Bailenson, Urbanek, Chang, and Merget (2007), after they analyzed data of 8418 unique avatar dyads for seven weeks in a 3D virtual world, observed that many social interactions in virtual environments were governed by similar social norms and interactions from the physical world. Moreover, Stromer-Galley and Martey (2009) claim that physical spaces carry social information based on their physical properties of a space and the spatial knowledge that participants develop about themselves. This knowledge, acquired from social meaning and spatial experiences, allows individuals to create mental models of spaces that influence their subsequent behavior (Höll, Leplow, Schönfeld, & Mehdorn, 2002). Therefore, when students achieve a certain level of campus familiarity through a virtual tour, they may feel more familiarized and involved in institutional activities.

Despite the increasing number of virtual tours introduced by universities across Japan, little research has been done regarding experience-related factors such as usability, perceived learning and spatial presence. Furthermore, most of these tours are bespoke or created using a costly platform. In contrast, this study, took a mixed research approach to explore how experiencing a VR photo-based tour, created using a free platform, could complement in-person activities such as campus tours. The paper examines the degree of its success in terms of usability, perceived

usefulness, and the participants' future intention to visit or study at the university. This exploratory study is a part of a bigger design-based research (DBR) project which aims at contributing to filling this research gap, supporting the development of VR photo-based campus tours and creating alternative opportunities to promote Japanese universities among international students, especially during uncertain times such as the outbreak of COVID-19 infection.

Having mentioned all the premises, the goal of this study is to answer three research questions:

1. How usable is the VR photo-based tour for participants?
2. How does the participants' VR photo-based tour experience relate to their perception of the university?
3. How did the participants feel once actually participating in the VR photo-based tour?

RESEARCH DESIGN & METHODS

The first phase of the project started with ideation and brainstorming sessions that brought about detailed content, as well as technologies suitable for developing the virtual tour and from these activities, a storyboard was created. It was decided that the prototype would use VR photos having interactive elements such as an audio layer and links to other VR photos serving as simulated paths. To accomplish all this the decision was taken to employ Story Spheres, a web-based free platform as it allows creators to upload a VR photo and overlay sound files to enable either brief or detailed explanations on certain parts of the image; known as a story sphere. A clickable arrow can also be overlaid to link one story sphere to another. A story sphere can be viewed using a personal computer or a mobile device. Each story sphere can also be experienced in VR using a mobile device and a special viewer like Google Cardboard. Figure 1, below, shows a sample of a story sphere in the virtual tour that was subsequently created.

The audio explanation hotspots, which replace the explanations tour guide would give during an actual campus tour, were produced as MP3 files for compression and platform compatibility purposes. A well-reviewed, but not exorbitantly expensive VR photo capturing device was also acquired for taking VR photos of the main areas of the campus. The story sphere was then embedded into the authors' seminar website, which can be accessed through this URL: http://www.edtechgroup.org.

Figure 1. Mobile screenshot of Honkan or Main Building story sphere's main section.

PARTICIPANTS

The prototype virtual tour was initially tested for usability using an online survey that was distributed to several students attending a private university in Japan, this was followed by distribution to students in other countries such as; Argentina, Egypt, Malaysia, Papua New Guinea, Philippines, The United Kingdom, and Vietnam.

There were 162 respondents, but only 130 were counted as valid responses. Sixty-nine were female, and 61 were male. In addition to computing the usability among all respondents and descriptive statistics, differences between demographic, device-related, and experience-related variables were determined using t-test and ANOVA. Correlational analysis was also conducted to determine relationships between usability, experience-, and perception-related variables. Finally, a simple text analysis was conducted to answers of open-ended questions in the survey.

As shown in Figure 2, below, the many of the participants (47%) used a PC or laptop. Android phone users came second at 39%, and iPhone users came third at 11%.

Most participants had no relation to the university and had not yet heard of it before (82%). The rest either knew about the university but were not yet part of it (10%) or were already part of it (8%).

INSTRUMENTS

The principal instrument used to collect quantitative data was the System Usability Scale (SUS), which was developed by John Brooke (2013). Questions relating to relevant demographic and device-related, experience, and usefulness of the tour were also asked in the survey. Open-ended questions involving their experience and suggestions for improvement were also solicited from the participants.

Besides the ease of operation gleaned through the SUS computed score, five-point scale questions or statements were developed to operationalize relevant variables. Experience-related variables were identified as dizziness and spatial presence. In contrast, perception-related variables were identified as a desire to visit the campus, increased interest in the university, and perceived learning. Dizziness was operationalized by the question: "Did you feel dizzy while doing the virtual tour?". Desire to visit the campus was operationalized by the statement: "I would like to visit ICU because of my experience in the virtual tour." Increased interest in the university was operationalized by the statement: "The virtual tour increased my interest in the university." Finally, perceived learning was operationalized by the statement: "The virtual tour helped me to learn about the campus." The binary question: "Did the tour make you feel as if you are in the environment?" operationalized spatial presence.

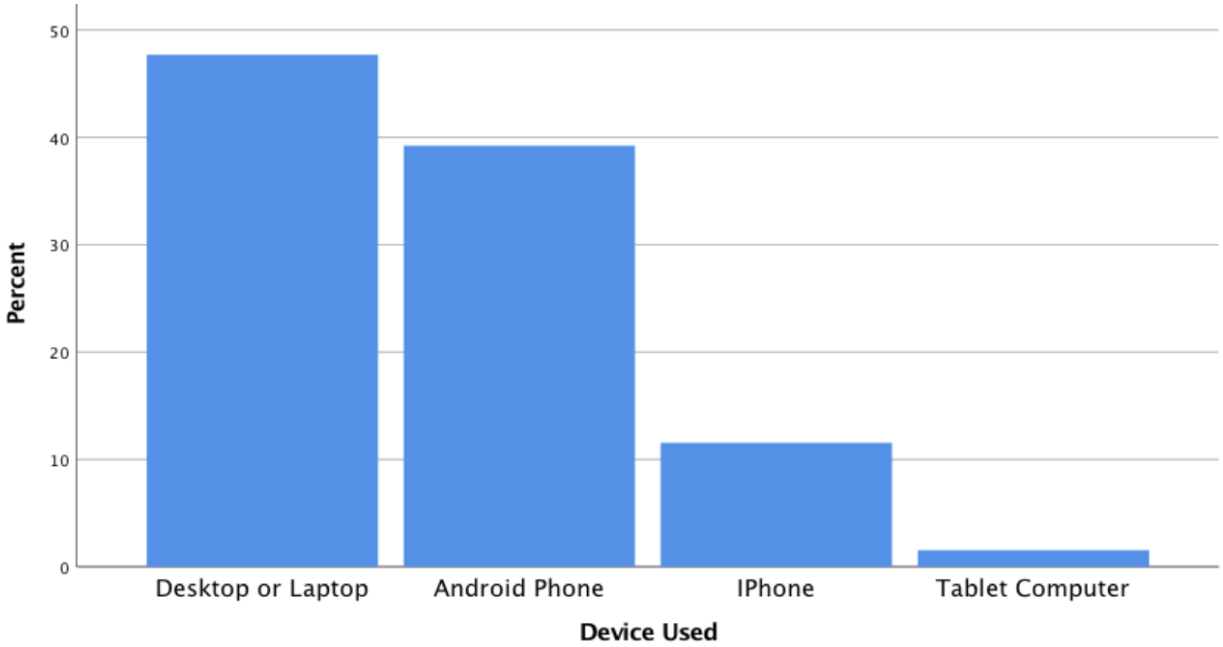

Figure 2. Frequencies of responses classified according to the device used

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DATA-RELATED PROCEDURES AND RESULTS

GENERAL USABILITY AND VARIABLE DIFFERENCES

The first research question was answered by obtaining the usability score. The mean usability score computed from 130 responses was 67.29, which was slightly less than the world average of 68.

The second research question was answered by looking at differences in terms of devices used and spatial presence as well as correlations among relevant variables. Results from the ANOVA did not show any statistically significant difference in how the participants felt or how they perceived the tour's usability when they used different devices. However, as shown in Table 1, below, those who felt present in the tour had a statistically significant mean difference vis-à-vis usability, desire to visit the campus, increased interest in the university and perceived learning after experiencing the virtual tour at .01 significance level. Here, Sp_y refers to *yes* responses when asked if they felt present in the environment during the tour, while Sp_n refers to *no* responses to the same question. More specifically, it was noted that those who felt present in the environment, on average, rated the virtual tour nine units higher in usability.

Table 1

Difference According to Perceived Spatial Presence.

Variable	Mean Difference (Sp_y-Sp_n)	Level of Significance
Usability	9.0	$p < 0.01$
Dizziness	-0.26	Not statistically significant
Desire to visit the campus	.96	$p < 0.01$
Increased interest in the university	.89	$p < 0.01$

Table 2 shows the results of the Pearson Correlation Analysis conducted across variables of interest. From them, usability was found to be strongly correlated with perceived learning and weakly correlated with the desire to visit the campus as well as increased interest in the university after experiencing the virtual tour at .01 level of significance. There was also a weak negative correlation found between usability and dizziness at .05 level of significance.

Table 2

Correlation Analysis Between Usability and Experience-related Variables

Variable	Pearson's r	Level of Significance
Perceived Learning	.604	$p < 0.01$
Dizziness	-.189	$p < 0.05$
Desire to visit the campus	.376	$p < 0.01$
Increased interest in the university	.403	$p < 0.01$

TEXT ANALYSIS

The third research question was answered by the results from the text analysis conducted on the open-ended questions in the survey. Answers to the question: *What did you feel while exploring the virtual campus?* were collected and analyzed. A quick text analysis using Voyant tools (Sinclair & Rockwell, 2016) was conducted and revealed the

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words that occurred most in answers were *felt* with 40 occurrences, followed by *like*, *campus*, and *tour*. Table 3 shows the collocates of the words and sample phrases that contained them.

Table 3

Most Frequently Occurring Words, their Collocates, and Sample Phrases.

Word (Frequency)	Collocates (Frequency)	Sample Phrases
Felt (40)	Like (15); Really (7); Amazed (6)	“felt like I was really there”; “felt like I was actually...”;
Like (34)	Campus (8); Really (8); ICU (7)	“like I was really there exploring”; “like I am there”;
Campus (28)	Like (9); Felt (6); Tour (5)	**“**amazed at the campus"; "feel like standing on campus."
Tour (22)	Campus (5); Felt (4); Guide (4)	**“**imagined myself having a tour"; "like I was really on tour with a guide."

Figure 3. Word cloud of answers to how participants felt during the virtual tour

Upon revisiting the word cloud, shown in Figure 3, the adjectives *amazed* and *lost* were found to be the most frequent. Word links were examined: "Amazed" occurred in answers containing *felt*, *campus*, *really*, and *great*. Example phrases were *amazed because it was realistic* and *amazed and felt, I was really there.* The word *Lost* occurred in answers containing *actually*, *confused*, and *felt.* Some example phrases include *lost because I don't know where the arrows are pointing to* and *confused and lost.*

DISCUSSION

The general usability score of 67.29 indicates that the user interface and experience provided to participants need to be improved and further shows the limitations of using a free platform to create virtual tours in contrast with the bespoke virtual tours as created by universities mentioned in the literature. It doesn't, however, discount the fact that low-cost virtual tours like the above can still serve a purpose complementing in-person tours. The significant statistical gains in those who felt that they were in the environment showed that there was something about spatial presence, which is a feature unique to virtual tours, that can affect psychological variables; such as interest and perceived learning. Making participants feel more present in the environment could also indicate higher usability ratings. The correlation results between usability and perceived learning, interest, and desire to visit leads to a new hypothesis; that improving the usability of the virtual tour could increase the values of these variables. Though more empirical studies need to be done, these preliminary results show that spatial presence and usability could influence a person's intention to study at a university. According to Ajzen (1991), we can assume that intentions capture the motivational factors that affect behaviour) and therefore the aforementioned results support previously mentioned studies by Holl and colleagues (2002) regarding spatial experiences of individuals and future behaviour. This study's results did however highlight that spatial presence may be a driving factor for the variability in a VR photo-based tour.

The result of the textual analysis revealed that positive feelings of enjoyment and amazement were related to the feeling of being in the environment or spatial presence. This points to the need for conducting more research on the relationship between spatial presence and intrinsic motivational variables such as interest and enjoyment in the context of a virtual tour; as this could energize learning (Harackiewicz, Smith, & Priniski, 2016) and lead to increased learning performance (Ryan & Deci, 2000). The analysis also revealed that participants lacked guidance as to which part of the campus they were currently navigating. A two-dimensional mini-map could be added to show participants their location while being immersed in the virtual tour. Placing labels on path arrows was also suggested as a way to improve the ease of navigation for first timers. The researchers also realize that a multilingual version of the tour would be useful as the subject is an international university.

As of this paper's writing, a prototype of the multilingual version has been released.

CONCLUSION

Preliminary findings indicate that spatial presence in the virtual tour caused participants to feel more interested in the university and in actually visiting the campus. The tour itself was also a useful tool in teaching visitors about the university. The SUS scores show that the tour itself needs to be improved, but unfortunately, the limitations of the beta version of Story Sphere will make it impossible to apply the requested and required improvements. The news is not all grim however, as the preliminary results of this study show that a virtual tour, made on a free platform and with meagre resources can be useful in complementing in-person tours. It is to be hoped that the findings of this research will inform future researchers with regards to indicators that could determine the utility of a virtual tour, such as usability, intention to visit, and perceived usefulness in learning about the university.

A multilingual tour employing a more advanced platform, which it is hoped will address the pointers for improvement collected from participant data is already in the works. The virtual tour will be improved through the use of text layers on the initial scene, explaining certain icons in the tour and guidance on operating the tour using a mobile device and a VR viewer. Furthermore, in the 2.0 version, constructs such as immersive capability and spatial presence will be explored further as will how they affect interest and other motivational variables. Findings from the present study can help other implementers in maximizing the benefits obtained by target audiences in virtual tour-based activities. It has also raised new questions for research in the field of VR photo-based learning activities.

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