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EXPLORING THE ACCEPTANCE OF 360° VIDEOS IN VIRTUAL REALITY SETTINGS FOR TEACHING AND LEARNING

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ABSTRACT

Virtual Reality (VR) is a technology that has been widely adopted in supporting learning and educational purposes over recent years. It has shown enormous potential to pioneer education in the future, mainly through its immersive learning environments provided in 360° settings. We explore the possibility of using VR technology in supporting teaching and learning experience in class. This paper reports the perception of trainee teachers towards the acceptance of the use of 360° videos in VR settings for teaching and learning. Forty trainee teachers were grouped to create learning content using available 360° videos and rendering and processing them into a VR format. They viewed and experienced the content they developed using the ClassVR headset. The findings showed positive feedback on the use of 360° videos in facilitating immersive learning experiences.

Keywords**:** virtual reality, 360° video, immersive learning, VR content development, teaching and learning.

INTRODUCTION

The use of Virtual Reality (VR) technology in education attracts educators and scholars' attention to enhance students' learning experience and engagement (Radianti et al., 2019). Using interactive learning materials is quite common in the 21st century. VR technology has the potential to support and transform the way content is delivered in the classroom, whereby learners can not only view the content, but also interact with it immersively. Immersive learning places users in a simulated, interactive virtual world that provide them with the opportunity to experience a more engaging practice-oriented approach in comparison to standard theory-based lessons. Spherical videos, known as 360º videos, is one of the newest innovations of the VR experience. The use of 360° videos is a new way to make learning more interesting and learner-driven as it provides users with a full 360° first-person point of view (Majid et al., 2020).

Researchers have investigated the potential and benefits of VR in the education field to accommodate different kinds of learning scenarios. However, little is known about the perception of using 360° videos for teaching and learning and how this technology can cater to learners' requirements and their preferred learning settings. This paper reports the findings of the study aimed at investigating the perception and the acceptance of the use of 360° videos in VR settings for teaching and learning purposes at schools. The evaluation was based on users' satisfaction and opinions on their experience with the learning materials in the VR setting. This study distinguishes in the sense of target participants. Compared to existing published works (Majid et al., 2020; Adnan, 2020; Adnan et al., 2020; Ahmad et al., 2019; Ibhar et al., 2018), which focus on experienced and practising teachers, this paper was conducted with a group of trainee teachers who will be assigned as educators/teachers at local schools. This paper first

presents the background, followed by the methodology used in the study, the results and the discussion based on issues found. Lastly, the conclusion and future work is presented.

BACKGROUND

Major challenge educators face in the classroom is delivering information that students find easy to understand. Most students may find it difficult to concentrate in class due to disinterest and shorter attention spans. Therefore, educators need to find an effective alternative method of teaching in order to gain students' motivation, attention and engagement, and no longer rely on traditional methods (Ahmad et al., 2019; Yusof et al., 2019). VR technology has shown promising capabilities of being the next mainstream tool in immersive learning. According to Adnan et al. (2020) with the help of VR and AR in learning settings, students can experience lessons interactively (Yusof et al., 2019).

VR technology is a fully digital experience that provides a way for viewers to view the content immersively. VR transports people to the setting, making the viewer feel they are present in the portrayal setting by viewing the immersive content using a dedicated VR device. Viewing devices that are available in the market for VR settings include: (a) Mobile VR headset (e.g., Google Cardboard and Samsung Gear VR); (b) Desktop VR headset (e.g., Oculus Rift and HTC Vive); and (c) Console VR headset (e.g., Playstation VR). Even though VR technology is not new, low-budget VR devices such as Google Cardboard and Samsung Gear allow users to experience and interact with the immersive settings via gaze control or magnetic switches. However, high-end VR devices such as Oculus Rift and HTC Vive (which are a bit pricey and normally equipped with dedicated controllers to support interaction) provide users with a high level of immersive experience (Radianti et al., 2019).

The use of 360° videos as educational material has become increasingly common among educators as they allow learners to view 'real life' video recordings like a panorama (wide-angle view) (Yusof et al., 2019). For example, educators used the 360° videos to conduct reading lessons, leading to better comprehension (Majid et al., 2020). The 360° videos were also used to deliver lesson content for teaching difficult skills in English for professionals (Adnan, 2020; Ahmad et al., 2019) and improve vocabulary usage (Ibhar et al., 2018). Creating the 360° footage required a dedicated 360° camera with multiple camera lenses and software that could be used to capture, render, and combine all recorded footage with overlapping angles into one spherical video file via video stitching. 360° videos can be navigated by moving the VR headset around (Adnan, 2020). The advantages of using 360° videos for learning include (Adnan et al., 2020): (a) Providing learners with a sense of physically being at the scene; (b) Enabling learners to learn first-hand; (c) Allowing learners to control the viewing direction; (d) Letting learners dedicate their attention and focus on the learning materials immersively; (e) Connecting learners closely to the content. However, in order to implement the VR technology in their teaching and learning settings, there will be obstacles and challenges that educators will face (Yusof et al., 2019) including (a) preparing the VR materials; (b) ensuring the suitability of the VR device, and (c) providing the device readily at schools.

THE USE OF 360- DEGREE VIDEOS IN VR SETTINGS FOR TEACHING AND LEARNING

The study was conducted as part of the community-based learning activity event under the Language Pedagogy Digitalisation Program 2020 3.0 organised by the Faculty of Educational Studies, Universiti Putra Malaysia (UPM). The purpose of the program is: (a) to introduce the potential of virtual reality settings for teaching and learning purposes; and (b) to introduce virtual reality content development to potential educators. During the event, the Fargoes

Infotech Sdn Bhd that offers virtual reality equipment and software for teaching and learning came to demonstrate the technology at the faculty.

A total of 40 trainee teachers (12 male and 28 female between 21-23 years old; with mean = 22, standard deviation = 0.39) in a course entitled Computer Application in Malay Language Teaching (LHE3116) from the Faculty of Educational Studies, UPM major in Bachelor of Education (Malay Language) participated in the study. Participants were divided into eight groups (5 participants per group). Note that all the participants had no prior experience using a head-mounted VR device but have heard about its high potential for teaching and learning usage.

MATERIALS

The study was conducted at the Putra Future Classroom, Faculty of Educational Studies UPM, equipped with five screens mirrored the main screen used for the evaluation. Two mounted cameras and two portable digital cameras were set up to capture the general behaviour of the participants (Figure 1). A ClassVR headset consists of a combo of a head-mounted VR device, and cloud-based software was provided for each group to view 360° videos in a VR setting (Figure 2).

FIGURE 1. Class Setting

FIGURE 2. Class VR Headset

PROCEDURES

The study consisted of three phases: (a) Pre-Demonstration session, (b) Demonstration session, and (c) Post-Demonstration session (Figure 3).

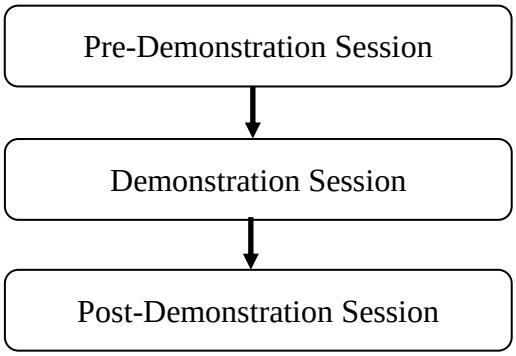

FIGURE 3. The Study Phases

PRE-DEMONSTRATION SESSION

Eight themes were assigned to eight groups: (a) Sports; (b) Recreation; (c) Patriotism; (d) Health and Hygiene; (e) Unity; (f) Environment; (g) Agriculture; (h) History; and (i) Science, Technology and Innovation. These themes were covered in the syllabus for Bahasa Melayu subject at secondary public schools in Malaysia (Form 1-5; around 13 until 17 years old). Then, each group was asked to search for available 360° videos from Youtube according to the assigned themes. The materials were shared with the instructor prior to the study for content approval.

DEMONSTRATION SESSION

Participants were invited to participate in the demonstration session. The flow of the demonstration session was divided into four parts:

Part 1: Introduction and registration (30 minutes)

At the beginning of the session, participants were assigned to their tables based on their group. Then, the consent forms were distributed among participants for confirmation of participation.

Part 2: VR product briefing from the trainer (90 minutes)

The VR company's representative briefed the participants about the VR product and a demonstration of the ClassVR headset, including its features, examples of 3D objects and 360° videos. The demonstrator also introduced a 360° camera device to capture 360° video. Each group was provided with a VR headset, and they needed to share and rotate among team members during the session. After the demo session, participants were taught how to register their group's VR account set up and view the VR materials at the ThingLink website. Each group's 360° video created prior to the session, was uploaded on the ThingLink website (Thinglink, n.d).

Part 3: Morning break

Participants were given a 20-minute break before moving to the next session.

Part 4: VR content development and group presentation (75 minutes)

Each group was asked to view and experience their uploaded materials on the ClassVR headset. Then, each group was invited to present their 360° video for about a 5 minutes presentation to the class. After each group's presentation, all groups were invited to view the content via the ClassVR headset. The summary of all the groups' materials is presented in Table 1.

TABLE 1. 360° Video Presentation by Each Group

Group 1: Sports & Recreation - 360° video of a basketball game (NBA, 2018)	
Group 2: Health & Hygiene - 360° video of a rural area that lack of clean water supply (World Bank, 2019)	
Group 3: Environment -360° video of pollution (National Geographic, 2019)	
Group 4: History - 360° video of Tugu Negara, KLCC, Thean Hou Temple and Batu Caves (OMNI 360, 2017)	
Group 5: Patriotism - 360° video of a Malaysian Independence Day celebration (An Inspiring Eye, 2019)	
Group 6: Unity - 360° video of Upin & Ipin cartoon series (Les' Copaque Production, 2016)	
Group 7: Agriculture - 360° video of a farm setting (East Bay Regional Park District, 2016)	
Group 8: Science, Technology & Innovation - 360° video of the inside of a surgery theatre & an ambulance (UTSWMed, 2018)	

POST-DEMONSTRATION SESSION

The participants answered questionnaires via the Google Form associated with their experience at the end of the demonstration session. The questionnaire consisted of three sections:

1. Part A: Demographics (name, age and gender).
2. Part B: Experience with the use of VR for learning based on six categories: (a) Technology model acceptance (TAM) criteria that consists of Perceived Ease of Use, Perceived Usefulness, Attitude, Behavioural Intention to use (Ghani et al., 2019); and (b) Learning Satisfaction and Learning Effectiveness (Li & Liang, 2020). The details of measurement items for technology acceptance measurements items as described in Table 2.

TABLE 2. Measurements Items of the Construct - Technology Acceptance

Construct	Operational Definition	Measured Items
Perceived Ease of Use (PEU)	Participants' perception is that using VR technology in learning will require minimal effort.	PEU1: I find learning how to use VR technology easy. PEU2: I think it is easy to become skillful in using VR technology.
Perceived Usefulness (PU)	Participants' perception is whether the use of VR technology will enhance learning performance.	PU1: I think VR technology will improve learning performance. PU2: I think VR technology will increase academic activity. PU3: I think VR technology could make it easier to study course content. PU4: I find VR technology is useful.
Attitude (AT)	Participants' judgement on is whether the use of VR technology is beneficial in learning.	AT1: I feel positive towards the use of VR technology. AT2: I believe that VR technology helps to be more engaged in learning. AT3: I generally favour the use of VR technology for learning.
Behavioural Intention (BI)	Participants' intention is to use the VR technology in learning at present and in the future.	BI1: I intend to use the VR technology to assist my learning frequently.

Table 3 describes the details of measurement items for learning satisfaction and learning effectiveness measurements items.

TABLE 3. Measurements Items of the Construct - Learning Satisfaction and Learning Effectiveness

Construct	Operational Definition	Measured Items
Learning Satisfaction (LS)	Participants' attitude is towards the VR demonstration session.	LS1: I am satisfied with the VR technology usage in the course. LS2: I think that the classroom atmosphere in the course of VR technology is lively. LS3: I was able to experience a sense of achievement during the VR technology course.

Learning Effectiveness (LE)	Participants' learning results after completed the VR demonstration session.	LE1: My experience of using VR technology has deepened my knowledge.

3. Part C: Participants' view on the overall feedback on issues/limitations of VR technology and suggestions on how VR technology can be used most effectively in learning.

RESULTS

In general, positive feedback was gained from the participants as reported in Table 4. The mean and the standard deviation of the scoring was based on the 5 Likert-scale ratings of 6 categories (14 questions in total). The mean values of 2.5 and above were graded as positive and values below 2.5 were graded as negative.

TABLE 4. Summary of Questionnaire Results

Category	Mean	Std Dev
Perceived Ease of Use	4.35	0.08
Perceived Usefulness	4.77	0.02
Attitude	4.68	0.02
Behavioural Intention to Use	4.43	0.75
Learning Satisfaction	4.68	0.04
Learning Effectiveness	4.55	0.6

Each of the six categories consisted of sub-categories. Ratings assigned by participants for each sub-category were weighted as the mean values (refer Figure 4-9).

PERCEIVED EASE OF USE

Regarding the perceived ease of use, participants were pleased with the minimal effort needed to use the technology as it is easy to use and easy to master (Figure 4).

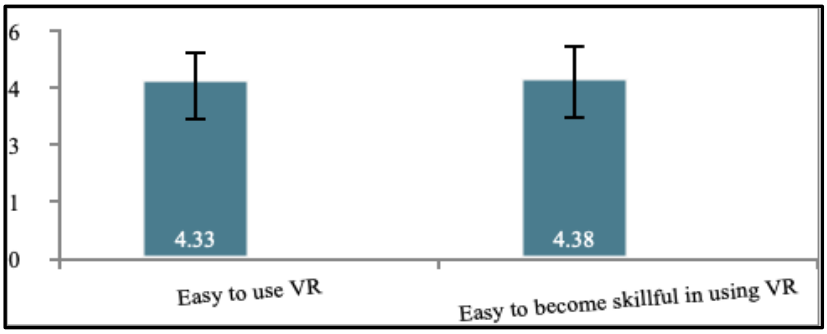

FIGURE 4. The Mean and Standard Deviation (Error Bar) of Perceived Ease of Use

PERCEIVED USEFULNESS

In general, participants agreed that VR technology is useful and that it will help enhance learning performance as it can improve learning, increase academic activity, and make it easy to study the materials provided (Figure 5).

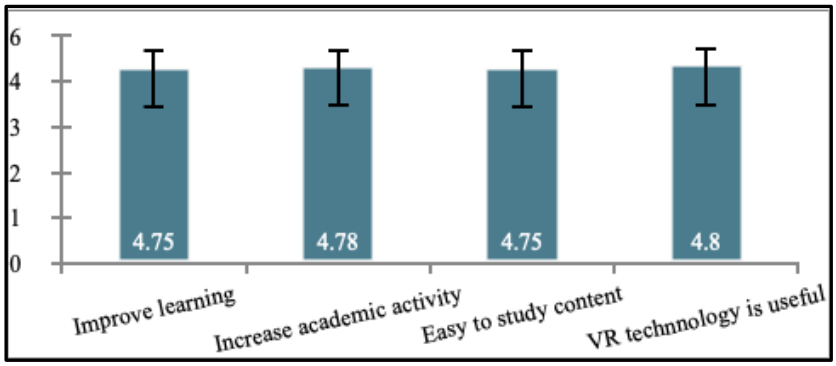

FIGURE 5. The Mean and Standard Deviation (Error Bar) of Perceived Usefulness

ATTITUDE

Participants also believed VR technology is beneficial in learning as they felt positively towards the use of VR. They felt that VR helps learners be more engaged and favoured the use of the technology for learning purposes (Figure 6).

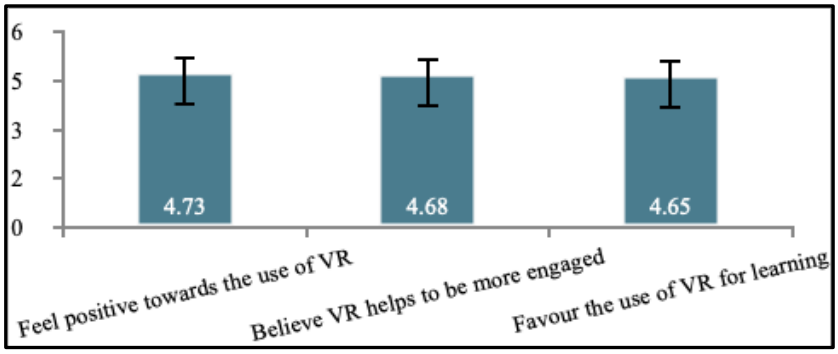

FIGURE 6. The Mean and Standard Deviation (Error Bar) of Attitude

4. Behavioural intention to use

Participants were asked to provide their views on their intention to use the VR, and they expressed their intention to use it frequently to assist their learning experience (Figure 7).

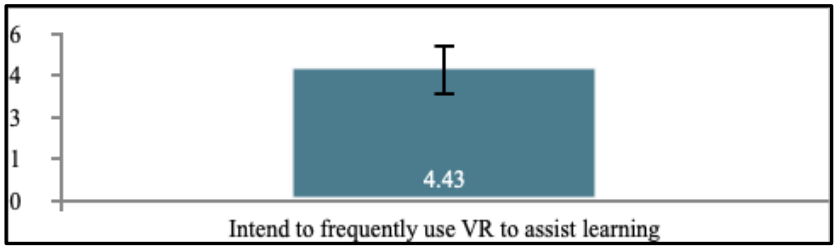

FIGURE 7. The Mean and Standard Deviation (Error Bar) of Behavioural Intention to Use

LEARNING SATISFACTION

Overall, participants were satisfied with the VR demonstration session as most of them enjoyed using VR technology in the session; they felt lively and experienced a positive learning ambience, and they also experienced a sense of achievement in the session (Figure 8).

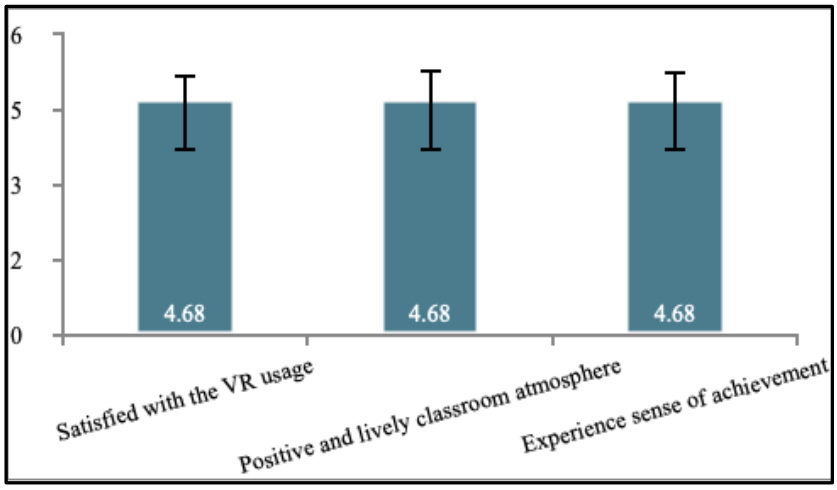

FIGURE 8. The Mean and Standard Deviation (Error Bar) of Learning Satisfaction

LEARNING EFFECTIVENESS

Lastly, participants were asked about their learning achievements after completing the session. The survey concluded that their experience of using VR in the session deepened their knowledge on the topic (Figure 9).

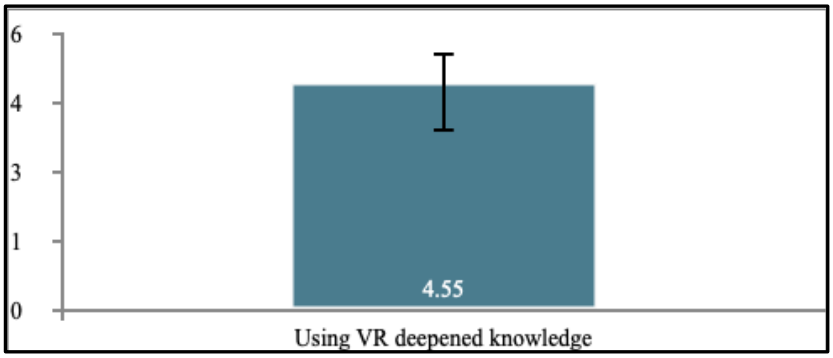

FIGURE 9. The Mean and Standard Deviation (Error Bar) of Learning Effectiveness

OVERALL FEEDBACK

Participants were asked to share their opinions on issues or limitations regarding the use of VR technology (Figure 10). Three respondents (8%) reported no issues. Three respondents (8%) reported they were satisfied with the technology. Five respondents (13%) expressed their concern regarding the price of the VR gadgets, stating that it would be too expensive for some schools, especially rural schools, to provide. Eleven respondents (28%) reported discomfort while using the VR device due to the weight of the device, as well as it being inconvenient for those wearing glasses or headscarves, and for those with eyesight issues. Eight respondents (20%) raised device availability at school and funding available from the government for schools. Six respondents (15%) highlighted the teaching and learning issues teachers may face,

such as preparing or searching for suitable materials. Students may experience limited time to use the device, having to share it with classmates. Finally, four respondents (10%) raised the issue of internet and wi-fi connectivity teachers and students may face while assessing the VR materials.

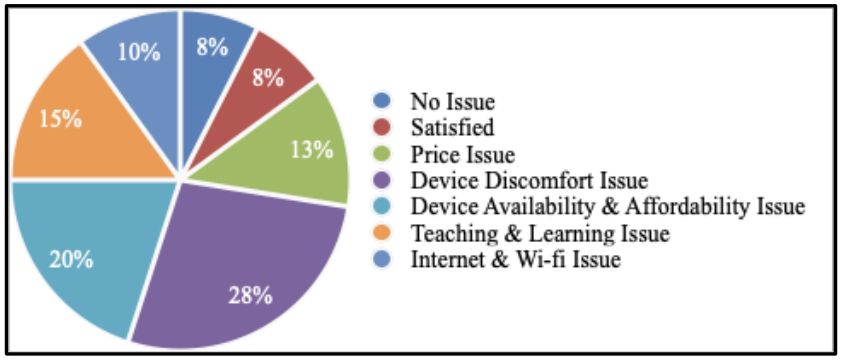

FIGURE 10. Issues and Limitations Reported Regarding the use of VR Technology

Participants were also asked to express how VR technology can be used most effectively in learning (Figure 11). Three respondents (8%) reported no suggestions. About 24 respondents (60%) agreed on the use of VR technology in improving learning experience. They suggested that VR could attract students' attention in the classroom; could be used to experience a special or specific setting; help students to motivate their learning interests; and assist teachers in visualising materials in an interesting output. One respondent (3%) suggested schools be required to use fast internet connectivity, while two (5%) respondents suggested enabling users to view the VR materials in an offline setting as well. Another six respondents (15%) suggested supplying a device for each student at school for a better learning experience. Furthemore, two respondents (5%) raised their concerns on how to cater to users with glasses. Two respondents also (5%) suggested using thicker materials for the VR device's protector in order to increase comfort.

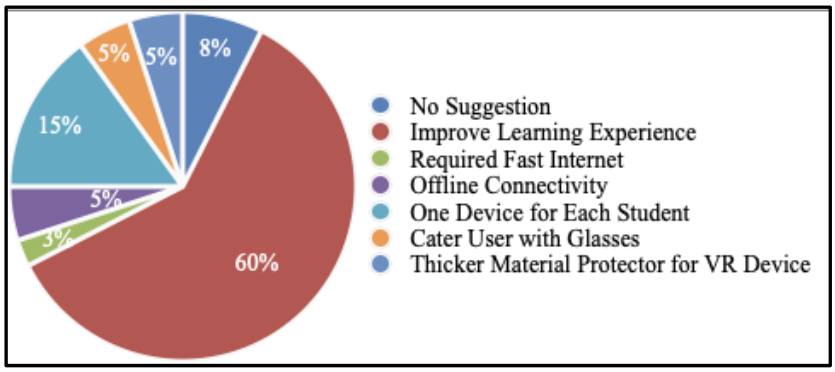

FIGURE 11. Feedback on How VR Technology Could Be Used in Learning

Based on the observation, when participants were asked to view the learning materials for their first attempt in a VR setting, the room was a bit noisy as participants expressed high excitement while trying the VR device. Participants also shared enthusiastic comments with their team members and encouraged them to try the device again in order to experience more. After each group's presentation, participants were also able to view other groups' VR materials. Therefore, they got more chances to view various 360° VR videos of different topics as opposed to other studies in which participants were given only certain topics to experiment

with. Furthermore, the excitement and their interest increased when Group 6 presented 360° videos of the cartoon Upin & Ipin, which portrayed another different mode of materials in 3D animation compared to real live videos presented by other groups.

DISCUSSION

Overall, the results reflect that participants showed their positive feedback towards VR technology in teaching and learning settings. The findings showed that perceived ease of use could predict perceived usefulness. Furthermore, perceived ease of use and perceived usefulness can predict users' intentions to use the VR technology. Feedback from participants also showed that 360° videos could be beneficial for teaching and learning settings as teachers will be able to transport their students to difficult scenario to explain in words, pictures or videos, and inaccessible to their class (Majid et al., 2020). With the exposure of the techniques on how to create the 360° videos, educators will be able to create their own to suit the teaching syllabus, learning settings and students' needs. Besides that, educators can also expose and encourage their students to create learning content together via producing short films in 360° as part of their learning activities. However, the study also highlighted some issues that must be accounted for before VR implementation into educational settings, usability, cost and technology support. Furthermore, some participants raised their views about the limited time to experience and explore the VR settings as they needed to share one device per group. Additionally, some groups experienced technical difficulties as the resolution of their 360° videos were low and thus affected the quality of the VR experience.

CONCLUSION

This study investigated the use of 360° videos in a VR setting for teaching and learning with a group of trainee teachers. Participants were taught how to create 360° videos in VR settings using the application provided by the host company connected to their cloud server. Data was collected quantitatively and qualitatively from the questionnaire and the general observations obtained during the session. In general, participants were pleased and excited with the use of VR technology in creating and delivering teaching materials to support an 360 experience. In conclusion, VR technologies have a very positive impact and are well accepted to assist teaching and enhance the learning experience. For future work, the study will focus on different types of VR settings and materials. Therefore, participants will get more exposure to the current VR technology available in the market. Also, a longer period and more chances will be given to participants to use the VR device.

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