Developing a Virtual Reality (VR) App for Theory of Flight & Control as a Teaching & Learning Aid

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Abstract: This research focuses on how a group of lecturers, specialists, and final-year undergraduates developed a virtual-reality app from scratch. By utilizing a combination of software (Autodesk Maya and Unity 3D) and hardware (custom-made VR goggle and an Android-based smartphone), an app was designed to be used a s teaching / learning aid for the Theory of Flight & Control course for aircraft maintenance undergraduates in Malaysian Institute of Aviation Technology. A concept of pre-test-post-test analysis was carried out with the custom app being the treatment for the 46 students involved after they have taken their pre-test. The results attained from their post-test were then compared to pre-test results. The comparative analysis has indicated that the undergraduates were not only satisfied with the advantages of the app (saves learning aid costs, reduce learning time while increasing effectiveness of learning acquisition, provide extra, digital, demonstrative knowledge), but they also highly recommended for digital apps like this to be developed for other courses as well. This is in line with the IR4.0 demands not only throughout Malaysia, but also worldwide.

Keywords: Theory of flight & control, virtual reality, android app, Autodesk Maya, Unity 3D

I. INTRODUCTION

In Malaysia, there are still research of using VR technology in education but there are enormous used of VR technology for gaming, and tourism purposes. Nevertheless, it is important to investigate the technological and social issues underlying VR before its spread through global community. Conventional teaching methods and learning aids are still being largely practiced among educators and students respectively in this country. As globalization and developments wait for no one, this study prioritizes on how to initiate and popularize VR app as an alternative for learning acquisition and teaching processes.

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Although our current teaching and learning (T&L) technology includes realia which have been proven to be effective for educational(Johari & Jamil, 2014) and commercial purposes(Bardai, Er, Johari, & Mohd Noor, 2017)(Zainal Ariffin, Johari, & Ibrahim, 2018) such as smartboards, designing software(Ya'acob, et al., 2018)(Ya'acob, et al., 2017), live and non-airworthiness aircrafts(Ishak, Johari, & Dolah, 2018), operational aircraft parts(Johari, Jalil, & Mohd Shariff, 2018), etc. VR is an excellent alternative for in-class tutorial or demonstrations to complement certain processes that cannot be done by the current T&L technology.

For this study, the aims are to develop a virtual reality, android app as a T&L aid for Theory & Flight Control course and subsequently carry out a survey to measure students' satisfactory levels for using this technology. Although it is a trial version and the actual VR content is only a few minutes long, both lecturer and students can use their android smartphones for this technology.

II. LITERATURE

Currently in Malaysia, there have been several attempts of using VR in the field of tourism, sports, theme park, health research, and others. Examples such as VR/AR theme park in Midvalley Megamall (Fun, 2017), VR roller coaster(The Star, 2017), badminton (Zahari, Yashim, Muhammad, Yap, & Wee, 2018) and games for disabled-friendly people (Devinder, et al., 2017), and preserving heritage values (Swinburne University, 2018) to promote cultural tourism.

Not excluding education, ongoing research in developing VR technology is heard among the academia community(Diwan, 2017). Hence, our team has decided to focus on the T&L of the Theory of Flight & Control course (Yusof, 2018)for undergraduates. Theory of Flight Control subject was chosen because there is some crucial part for student to remember which is the movement or position of primary flight control such as aileron, rudder and elevator during take-off, landing, turning aircraft to right or to the left. It is more efficient if student can actually see the movement parts of primary flight control as in reality. Instead of using self-imagination, which is more tiring and possibilities of becoming more confusing in remembering the facts learnt, the VR platform will help student through visual aids and more interactive way by transferring reality into virtual.

III. METHODOLOGY

a. Software

Autodesk Maya was used to create the background and surrounding to visualize the virtual reality. The background showed the airport area with runway, buildings and one aircraft was built following an actual model of a small aircraft. This aircraft could be moved to visualize scenes during take-off, landing, aircraft turning to the right and to the left. Unity 3D was used to transfer scene done in Autodesk Maya to android phone as an app. After the VR app has been completed, it was agreed to be named as "Virtual Reality Aircraft Flight" or VRAF for short.

b. Hardware

Typically, VR goggles with android phones were used to act as VR platform and execute virtual reality scene. Lecturer used an LCD projector as a medium for initial briefing of the VR app.

c. Research Instrument

This research utilized qualitative research methodology. Experimental questionnaire was used as a data collective instruments. A set of 10 question was self-developed based on knowledge enhancement after experienced using VR platform. Different question-type were use in the survey questionnaire such as Likert-scale and open-ended.

d. Survey procedure and analysis

The respondents of the study were from two bachelor degree courses from UniKL MIAT, Sepang campuses which are Bachelor of Aircraft Engineering Technology (Hons.) in Avionics and Bachelor of Aircraft Engineering Technology (Hons.) in Mechanical. The questionnaire, which has 46 questions, were distributed to students in the two classes of different course and all of them were returned.

The specific questionnaire in survey form was distributed among students in class. They were required to answer the question after learning the topic in class and using VR platform after the formal class session ended. Each student was given the VR platform to experience an interactive way of learning the same topic. The survey forms were distributed and collected after 30 minutes.

To analyses the data, all respondents needed to score from *Strongly Agree, Agree, Neutral, Disagree* and *Strongly Disagree*. By comparing marks in Likert-scale, the data were entered into computer using Microsoft Excel software. The results were presented through frequency count and other descriptive statistics.

IV. DATA ANALYSIS

Advantages of VRAF

Figure 1 below highlights the advantages of android apps VRAF. Ten of them agree that they are familiar with Virtual Reality apps. Out of twenty-five respondents, sixteen (64%) agreed that the apps can reduce cost for learning. Besides, fifteen (60%) respondents strongly agree that VRAF can attract student's interest in learning something new. The same number of respondents agreed that the apps can reduce time for learning. Then, fourteen (56%) strongly agree that VRAF helps students in understanding the subject. The

same number of respondents agree that VRAF can be use as learning platform. Next, eleven (44%) strongly agree that VRAF can be used as learning tools and the same number of respondents also agree that it is suitable for all education level. Lastly, ten (40%) agree that VRAF will provide sufficient knowledge for communication between pilot and ATC.
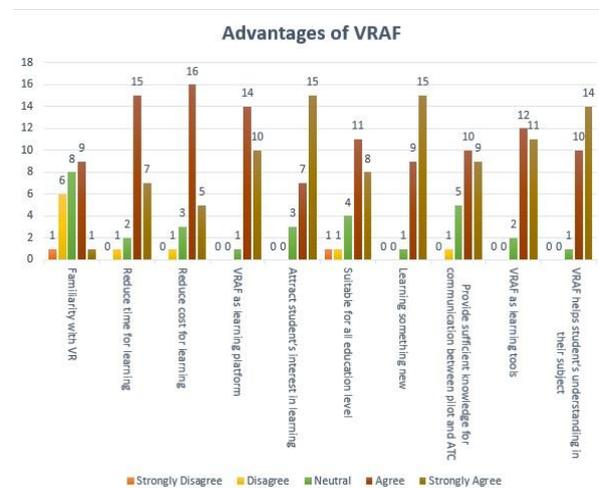

Fig. 1 Advantages of VRAF

1.1 Discussion

Based on Figure 1, 64% agreed that the app can reduce cost for learning. A typical Theory of Flight Control textbook such as Jeppesen General Book can easily cost up to RM 250. As for this project, by buying the e-learn book that only cost RM 60 per book, both students and lecturers can get the access to VRAF. Not only it is cheaper in price, but it has the add-on value which is the android app that will enhance students' understanding in the course and at the same time further motivating their willingness to learn effectively.

Meanwhile, 60% of the respondents firmly agreed that VRAF can attract students' interest in learning something new. VRAF is available for everyone who has passion in aviation, specifically in this app in which users can learn and experience the actual communication procedure between pilots and ATCs in fan interesting way. It is more interesting than a book since it has the real feel.

Wu and Wang (2008) once stated that the perceived 'boring' knowledge about history would gain a lot of traction in terms of interest and likability among younger generations if the contents are taught with interactive T&L aids like VR(Wu & Wang, 2008). If the T&L of history subjects can be improvised significantly with VR, it would be even more so for aviation courses that involve more technical theories(Omar, Johari, & Abdul Samad, 2018), calculations, parts, and practical work (Abdul Samad, Johari, & Omar, 2018)among the educators and the students alike.

Besides that, another 60% of the respondents confirmed that the app can reduce learning time (*face-to-face learning* or *F2F learning*).

A typical aviation course textbook for undergraduates would have at least a few thousand words depending on the nature and depth of the contents. In this case, the textbook for Theory of Flight and Control would normally require students around one to two hours to study from time to time. VRAF actually assisted in not only shortening the period of studying time, but also incorporated experiential learning where learning acquisition can succeed better. In addition, the apps can be used anywhere and anytime since it is available in the phone, thus users can revise or study with flexibility in time and place.

Then, 56% solidly acknowledged that VRAF helps students in understanding the subject better. For example, lecturers would give lectures according to the syllabus and students learn these contents theoretically – where cognitive abilities would be utilized to the max. VRAF consists of the communication process by the pilot captain instructing for aircraft manoeuvre (e.g. to turn, take off or land). The corporation of visual, aural and kinaesthetic learning with lecture-based method will strengthen students' comprehension.

Moreover, 44% and 56% acknowledged that VRAF can be used as learning tools and platform respectively. Respondents may think that the use of VRAF can advance the techniques of learning using technology. These results concur the findings that Dede (2009) once discussed a decade ago; where collaborative learning's nature would shift to more complicated skill sets in due time(Dede, 2009). A more recent study by Maha&Heba (2015) also concurred that extensive distribution of computers and communication technologies significantly easier and more interesting(Maha & Heba, 2015).

Furthermore, 44% of the respondents also agreed that the app is suitable for all education levels. There are several education levels in a normal cycle of human beings; usually it starts with kindergarten, where it continues with primary and secondary levels before reaching tertiary levels where higher learning institutes are involved. Since this app showed the actual events of taking off and landing, it does not involve a lot of jargons such as name of turbine parts or how the aerodynamic principles work and explained. Hence, it is more than suitable for all ages of users.

Lastly, 40% agreed that VRAF will provide sufficient knowledge for communication between pilots and ATCs. This is because the voice over used in VRAF are recorded by a real pilot captain and the script of communication was also constructed based on the daily events of flying aircrafts.

V. CONCLUSION

It can be concluded that by the end of the study, the researchers have not only successfully developed a VR android app for educational purposes, but also testing its effectiveness for T&L in an actual classroom at a technical university with students specializing in aircraft maintenance programs.

The following recommendations have been listed for future undertakings by academicians for educational purposes or even industry researchers for commercial purposes:

i. Make another view for control surfaces so that each time the aircraft change the altitude or changing the direction, the users knows the position of the control surfaces following the syllabi
ii. Add a hand control function such as joystick to resemble control column in aircraft so that the users can feel the actual aircraft flight command
iii. Include more contents based on the e-books so that more knowledge can be potrayed in an interactive way and attract students in learning the subject effectively

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