

Mixed Reality Based User Acceptance Measurement on Primary School Age Children (Case Study: Introduction to Indonesian Native Fauna)

Dimas Wahyu Wibowo^{*1}, Muhammad Shulhan Khairy², Septian Enggar Sukmana³

Politeknik Negeri Malang, Jalan Soekarno Hatta No. 9 Malang, (0341) 404424

E-mail : dimas.w@polinema.ac.id^{*1}, khairy@polinema.ac.id², enggar@polinema.ac.id³

**Corresponding author*

Abstract – One aspect of learning media technology sustainability is the level of user acceptance of the learning media itself. It is related to the user loyalty or willingness to continuously use the learning media application. For primary school age children, analyzing the level of acceptance of learning media using the unified theory of acceptance and use of technology (UTAUT) is challenging. In its application, the formulation of the questions is carried out in a simple way therefore children can understand each meaning of the questions. In this study, the object of technology used is a mixed reality-based learning application, which contains introduction to Indonesia Native fauna material. To ensure that the inter-view questions meet the children's psychological, the reliability and validity measure were taken as the initial step. Secondly, hypothesis testing was carried out to analyze the children behavioral intentions based on the variables contained in UTAUT. The results of this study indicate that students do not find difficulties in using this mixed reality-based learning media application, both on the technical and psychological (techno-stress) sides.

Keywords – student experience, UTAUT, Mixed-reality, sustainability

1. INTRODUCTION

Development of technology in mobile devices has risen significantly (Rosli et al., 2016). It has significant impacts to learning activities that utilize this technology. The development of learning application, similar to game development, it requires exciting experience to engage its users. Many innovations have been developed for learning media technology, such as development of autism learning media to assist give children with autism with a media to prevent them from sexual abuse[1]. An innovative learning evaluation using computation technology is also developed to identify students' understanding on a particular material[2]. However, focusing mainly on developing fun and exciting learning media application is away from a rewarding achievement for a researcher and/or a developer. The acceptance of user is one of keys to gain customer satisfaction and to keep his/her interest in using this application in the future [3]–[5]. User acceptance testing is a type of testing that is used to find out any behavioral and psychological effects from application usage[6]–[8].

Unified theory of acceptance analysis and use of technology (UTAUT) application is very limited, especially for children. Oke et.al [9] mentions that analysis study on the correlation between children and the use of technology is significant, especially in 4.0 industrial revolution. Animation is employed to determine UTAUT in primary school age children behavior based on gender and experience level [10]. There are not many literatures focusing in UTAUT in children available. This is a common condition since interviewing children is challenging, especially for advance research activity.

2. APPLICATION DEVELOPMENT AND TESTING CONCEPT

There are two main steps involve in this research i.e., the application development and testing. The first step thing is development the mixed reality application which it exploits a low-cost VR Glasses (about 2 USD), an Android smartphone, a leap motion, and a laptop that serves a purpose as a server. The research did not use a high-end VR gear like Oculus or HTC-Vive since the research follows is aimed providing a low-cost mixed reality technology for both the students and the institutions. In order to meet this objective, the second step were taken i.e., analyzing student acceptance based on their perspective in using mixed reality technology which is significant to measure the advantageous. This application uses 3D Indonesian native animals as the object which categorized based on their habitats i.e. the six largest islands in Indonesia, such as: Java, Sumatra, Borneo, Celebes, Nusa Tenggara, and Papua.

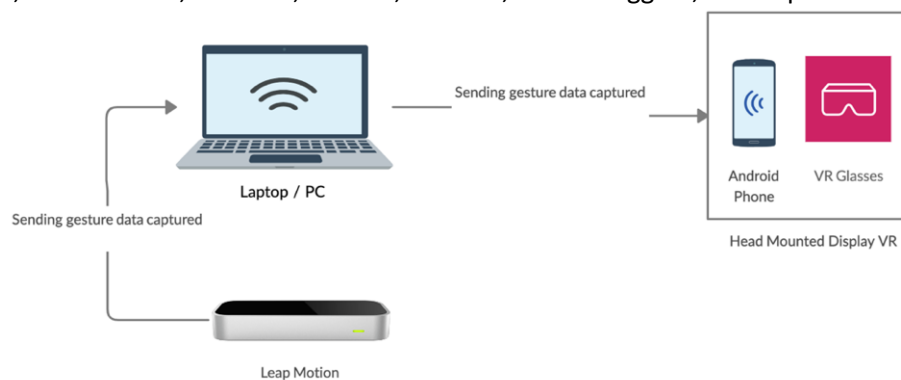


Figure 1. The architecture of system that is implemented in Nusantara Animal Introduction based Mixed Reality

Figure 1 shows two kinds of application that runs in the system: 1) server application runs on PC that accommodate the running of system and simultaneously distribute the leap motion data to mobile device, and 2) VR application that runs in mobile and VR device. Leap motion is also applied as a mean to create interactivity in the application. Basically, leap motion cannot run on mobile device directly. Therefore, a particular technique is applied in order to make leap motion-VR device-mobile device connected properly. Interaction process begins when leap motion device reads hand and finger movement then converts it to a coordinate data. The data will then be processed by laptop/PC in the form of data frame which later transmitted to mobile device that is equipped with put in VR glasses through network socket. Synchronization between VR environment and mobile device is done through initializing the client socket in the mobile device with port and IP that have been previously set in the server (laptop/PC).

This research employs UTAUT. The obtained data were a result of guided interview in which the teachers assisted the students understanding each and every interview question. After the students tried the VR-based learning application, they were then given a set of questions in order to find out their opinions as well as the behavioral intention in the future. The research employs 5-factors UTAUT in which list of questions are referring to Lee's and is modified from Venkatesh [11]. The questions reflect mixed reality-based education game characteristics. (Table 1).

Table 1. Items for Survey

Variable	Item #	Questions
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Performance expectancy	A1	This technology is useful to support my study.
	A2	This technology helps me to identify any native fauna that lived in Indonesia
	A3	This technology is more entertaining to support my study.
Effort expectancy	A4	Learning to use this technology is simple and easy.
	A5	The UI is understandable.
	A6	This technology is easy to use.
Social influence	A7	I will recommend my friend to try this technology.
	A8	I would share my experience with my friend
	A9	I would make my friends want to try this technology
Facilitating condition	A10	Having an adaptable ability to use this technology
	A11	Having a background knowledge is necessary to use this technology.
	A12	I have a helping support when I have difficulties in using the technology.
Hindering condition	A13	The menu content in this technology is confusing.
	A14	The more I learn the menu and its controller, the harder the technology is to use
	A15	There are too many options in the menu which make it more confusing.
Behavioral intention	B1	Willing to use this technology in the near future.
	B2	Willingly use this as a learning media.
	B3	Willingly continue using this technology.
Potential use behavior	B4	Evaluation of potential usage

To measure the reliability of data, Cronbach Alpha test is used to identify the consistency of the data (1). The equation is as follows,

$$Cronbach\ Alpha = \frac{n^2 * mean(COV)}{\sum \left(\frac{VAR}{COV} \right)} \quad (1)$$

Where n is number of items, VAR is inter-item variance, and COV is inter-item co-variance. Further, for validity measure, principal component analysis (PCA) is used with exploratory factor analysis (EFA). SEM technique is used as hypotheses testing to analyze the data.

3. RESULTS AND DISCUSSION

Before this learning media is implemented to student, several scenarios for Black-box testing were conducted to ensure that this application is well-performed. Tabel 2 shows several positive results of Blackbox testing meaning that this learning media is ready to be implemented to student.

Table 2. The blackbox testing result

No	Features	Expected Result	Result	Performed
1	IP & port input	Able to input score to field IP & port	As expected	Yes
2	Server connection	Connected to server	As expected	Yes
3	Exit	Student can exit the program	As expected	Yes
4	Back	Student can go back to previous scene.	As expected	Yes
5	Setting	Go to setting	As expected	Yes
6	Button click	Clicking button by hand	As expected	Yes
7	Holding the box	Student can hold the virtual object	As expected	Yes
8	Game level switching	Go to another level if student accomplished the game/quiz in certain	As expected	Yes

		level		
9	Size handler setting	Adaptable to user/student hand size	As expected	Yes

There is no problem found when the application is performed for Blackbox testing and student implementation, no trouble connection between the application and the server, the interactions between user/student and its UI also runs well (Figure 2).



(a)



(b)

Figure 2. Testing the application: a) connecting the application to server; b) the application runs as expected, user can interact to the UI and several levels are locked before user accomplished the current level.

One hundred and fifty (150) students of 1st year elementary school in Malang, Indonesia were used as the subjects to the experiment. In general evaluation (pre-test and post-test), the pre-test score is 68 and post-test score is 93.33, showing higher score is acquired in post-test. After all of student tried the mixed reality technology, some testing-evaluation questions were given as a follow up in the form of an interview. The questions, as mentioned earlier, are derived from Lee et.al[12]. Validity measurement shows that the model is fit with the data from each factor (78.62% of total variance). Based on Cronbach Alpha test result, students found no confusions when using this technology (hindering condition factor) in spite of consistency in all variables (Table 2). The principal component analysis (PCA) result shows that the next analysis can be performed because of GFI, CFI, and NFI measurement results are suitable with 0.900 as index value. It indicates that implementation of UTAUT to children is no different with adult, no significant treatment is required to perform UTAUT in children.

Table 3. The blackbox testing result

Variable	Alpha Score	Average	Questionnaire Point Amount
<i>Performance expectancy</i>	0,822	3,877	3
<i>Effort Expectancy</i>	0,878	3,545	3

<i>Social Influence</i>	0,903	3,877	3
<i>Facilitating Condition</i>	0,788	3,432	3
<i>Hindering Condition</i>	0,802	2,854	3

Table 4. The blackbox testing result

Variable	Q th	Estimation (p < 0,05)	Average variance extracted (AVE)	Reliability
<i>Performance expectancy</i>	A1	0,976	0,671	0,765
	A2	0,701		
	A3	0,434		
<i>Effort Expectancy</i>	A4	0,867	0,788	0,833
	A5	0,925		
	A6	0,903		
<i>Social Influence</i>	A7	0,935	0,824	0,879
	A8	0,911		
	A9	0,932		
<i>Facilitating Condition</i>	A10	0,972	0,600	0,802
	A11	0,834		
	A12	0,526		
<i>Hindering Condition</i>	A13	0,822	0,621	0,920
	A14	0,734		
	A15	0,677		
$\chi^2 = 153,925$; deg.of.freedom = 80; p = . 0,000; GFI = 0,953; CFI = 0,965; NFI = 0,933				

Based on table 4, the factors in H1, H3, and H4 influenced student behavioral intention positively and H5 shows negative influence to student behavioral intention (this learning media did not trigger stress as students use it). Only H2 shows no factor influences to behavioral intention, therefore, H2 is rejected. However, the rejected hypothesis is not showing a complete bad result since it also shows that this learning media is easy to use for student. Facilitation condition (H4) becomes the strongest factor for the student which means that this learning media helped them to understand the material of the subject. Also, this learning media led them to voluntarily asked their friends to try this learning media. This explanation is based on H3 analysis on behavioral intention. Students were happy, entertained and had proper understanding on the topic being discussed using this learning media, therefore, they are most probably use this learning media more often in the future including consider it to be applied for another subject.

Table 5. The blackbox testing result

Hipotesis	Estimasi	S.E	C.R	p-value
H1 -> behavioural intention	0,833	0,109	7,655	0,000
H2 -> behavioural intention	-0,437	0,083	-0,442	0,888
H3 -> behavioural intention	0,256	0,071	4,876	0,011
H4 -> behavioural intention	0,188	0,060	3,392	0,018
H5 -> behavioural intention	-0,300	0,066	-1,328	0,123
Behavioural intention -> potential of student to use this learning media	0,856	0,070	5,477	0,000

4. CONCLUSION

To conclude, Mixed Reality Based User Acceptance Measurement on Primary School Age Children for near future learning media has received significantly positive results and is considered offers generous benefits. Teachers has played a significant role as a communicator in employing teacher talks therefore students, as the interviewees, could easily grab the understanding on the topic being discussed i.e., UTAUT. To further explore the values of reward-punishment visual gameplay learning media, Game Experience Questionnaire (GEQ) and 5-Factor UTAUT will be utilize to technically measure user experiences well as to identify whether the user experience offers expected results and is in accordance with the user acceptance measurement results using UTAUT.

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