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Examining Kindergarten Students' Motivation on Augmented Reality Apps: A Survey using Emoticons

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Previous studies showed that augmented reality (AR) interventions were mostly investigated in higher education institutions. While one of the main advantages of AR is promoting motivation, most instruments are not suitable to measure young children's motivation on AR. Therefore, the purpose of this paper is to describe a motivation survey called Young Children Motivation Survey using Emoticons and report the use of this survey to examine kindergarten students' motivation on AR. The Young Children Motivation Survey using Emoticons was developed based on the Instructional Materials Motivation Survey (Keller, 2009) and Persuasive Learning Material Motivation Survey (Salam & Ismail, 2015). A total of 60 kindergarten students were involved in this study. This study applied a counterbalanced research design where an AR mobile apps was compared to a conventional mobile apps on learning alphabets. The findings showed that kindergarten students' motivation in the AR mobile apps group was significantly higher than students in the conventional mobile apps group. Furthermore, the results suggested that the Young Children Motivation Survey using Emoticons was capable to measure kindergarten students' motivation. However, it is also proposed that the five types of Emoticons should be reduced to only three types of Emoticons to decrease confusion among young children. Thus, future research should be conducted on using this survey in another context and further improve the instrument.

Keywords: augmented reality; motivation; emoticons survey; kindergarten students

I. INTRODUCTION

The Ministry of Education Malaysia initiated various programme to enhance students' literacy skills in schools such as Early Intervention Class for Reading and Writing *(Kelas Intervensi Awalan Membaca dan Menulis)* (KIA2M) in 2006 (Puteh & Ranti, 2009) and Literacy and Numeracy Programme (LINUS) in 2010 (Wan Ahmad, 2019). However, a study found that primary school students aged between 10 to 11 years old had problems to differentiate between lower and uppercase alphabet as well as understanding the content of the text provided to them (Jamian, 2011). It was reported that students had difficulty to acquire basic knowledge on reading and writing due to their learning environment and teaching method used by the teachers. The use of augmented reality (AR) intervention before entering primary schools could help these students.

Past literature reviews on AR reported that the intervention promoted students' understanding and retention as well as enhanced collaboration and motivation (Radu, 2012; Radu, 2014). In a study on the use of AR book among children aged five to six years old conducted by Yilmaz, Kucuk, & Goktas, (2017), it was found that children enjoyed the AR book as it was fun and interesting. The children perceived the AR book as magic and their happiness using the AR book affected their performance on story comprehension. Another study investigated the use of AR book for kindergarten students to learn about animals (Markamah, Subiyanto, & Murnomo, 2018). They found that the AR book improved students' learning and students in the experimental group had better performance than students in the control group. Safar, Al-Jafar and Al-Yousefi (2017) investigated the effectiveness of AR apps on kindergarten students' achievement to learn English alphabet as their native language was Arabic, which

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had different types of alphabets. They reported that the experimental group had statistically higher score on their achievement test than the control group. Previous studies showed that AR book or apps can be used to enhance kindergarten students' learning and performance.

Educational AR was commonly investigated in primary education (Yilmaz, 2018) and higher education setting (Bacca *et al.,* 2014; Sirakaya & Sirakaya, 2018). A systematic review of trends in educational AR conducted by Sirakaya & Sirakaya (2018) reported that only three studies of AR were conducted in the field of preschool education from the year of 2011 to 2016. The same trend was found by Yilmaz (2018), which indicated only four studies focused on kindergarten students that were published from 2016 to 2017. These trends suggested that more studies on AR should be targeting early childhood education. Therefore, the aim of this current study was to investigate the effects of AR among kindergarten students.

Furthermore, previous studies among kindergarten students on AR only compared AR with traditional instruction (e.g. Barreira, Bessa, Pereira, Adao, Peres & Magalhaes, 2012; Safar *et al.,* 2017) and described the use of AR (e.g. Rambli, Matcha & Sulaiman, 2013; Thiengtham & Sriboonruang, 2012). Hence, rather than comparing AR with traditional teaching, this current study compared AR mobile apps with a conventional mobile apps on learning alphabets.

In addition, based on the literature, there were various evaluation tools for collecting data from children. For examples, the Fun Toolkit to measure children's computer interaction (Read & MacFarlane, 2006), the Soremo to obtain children's feedback on educational software (Girard & Johnson, 2009), and the self-assessment manikin that measured affective reaction (Bradley & Lang, 1994). However, these instruments were not designed to measure young children's motivation.

Salam & Ismail (2015) proposed a motivation survey instrument for young children called Persuasive Learning Material Motivation Survey (PLMMS) with Emoticons. There were 10 items in the survey, which was intended to measure children's motivation from the age of seven to nine years old. A total of seventeen schoolteachers reviewed and provided content validity of the instrument. Then, the instrument was revised based on the teachers' feedback. But, the reliability of the instrument was not reported, and it was not clear how the items were categorized into attention, relevance, confidence, and satisfaction (i.e. ARCS). Therefore, based on the Instructional Materials Motivation Survey (Keller, 2009) and the Persuasive Learning Material Motivation Survey (PLMMS), we constructed and proposed the Young Children Motivation Survey using Emoticons to measure kindergarten students' motivation on AR. The research question of this study was "Are there statistically significant differences between the AR mobile apps group and the conventional mobile apps group on their motivation?"

II. METHOD

This study employed a counterbalanced research design. Figure 1 presents the research design of this study. This type of research design enabled the researcher to control the effect of treatments by separating the sample into two groups and each group received the same treatment but in different order.

G1: AR → O → CM → O
G2: CM → O → AR → O

Notes:
G1: Group 1
G2: Group 2
AR: AR mobile apps treatment
CM: Conventional mobile apps treatment
O: Young Children Motivation Survey using Emoticons

Figure 1. Counterbalanced research design of this study

The independent variable of this study was different types of treatment namely an augmented reality mobile apps (AR) and a conventional mobile apps (MA). While the dependent variable of this study was motivation of the participants. The content of both treatments is the same, which was learning alphabets.

The participants were 60 kindergarten students aged between four to six years old from a rural area in the Northern part of Malaysia.

A. Research Procedure

The research was conducted after obtaining consent letters from the children's parents. The participants were divided into two groups. On the first day of the study, Group 1 which consists of 30 students received the AR mobile apps treatment first and completed the Young Children Motivation Survey using Emoticons. Then, Group 2 with 30 students received the conventional apps treatment first and completed the Young Children Motivation Survey using Emoticons.

On the second day of the study, Group 1 then received the conventional apps treatment first and completed the Young Children Motivation Survey using Emoticons, whereas Group 2 received the AR mobile apps treatment followed by the Young Children Motivation Survey using Emoticons. Refer to Figure 1 for more information. With the assumptions that the children could not read yet, the survey was read aloud by the teacher and the emoticons were printed in a larger cardboard where the participants can easily point out their answers.

B. Young Children Motivation Survey using Emoticons

The Young Children Motivation Survey using Emoticons was developed based on the Instructional Materials Motivation Survey (IMMS) (Keller, 2009) and the Persuasive Learning Material Motivation Survey (Salam & Ismail, 2015). The current survey was consisted of 12 questions categorized into attention, relevance, confidence, and satisfaction (i.e. ARCS). Each category contains three questions.

Table 1 presents the questions based on the ARCS category. The survey was in Bahasa Malaysia and contained less items with shorter statements to suit the participants of this study, which was kindergarten students. A subject matter expert validated the survey before the study was conducted.

Table 1. ARCS category for the questions in the survey

NO.	ARCS category	Questions	English translation of the questions
1	Attention	*Saya belajar sesuatu yang baru dalam latihan ini*	I learned something new in this lesson
2	Attention	*Saya rasa gambar dan audio dalam latihan ini menarik perhatian*	I think the picture and audio in this lesson were attractive
3	Attention	*Saya rasa latihan ini membosankan*	I think this lesson was boring
4	Relevance	*Saya rasa berbaloi belajar menggunakan teknologi ini*	I think it was worthy to learn using this technology
5	Relevance	*Saya rasa isi latihan ini berguna untuk saya*	I think the content of this lesson was useful
6	Relevance	*Saya rasa tidak penting untuk menghabiskan latihan ini*	I think it was unimportant to complete this lesson
7	Confidence	*Saya yakin boleh mengenal huruf besar selepas latihan ini*	I am confident that I can identify capital letters after this lesson
8	Confidence	*Semasa latihan, saya yakin boleh faham lati- han ini*	During the lesson, I am confident that I can understand the lesson
9	Confidence	*Saya rasa latihan ini susah daripada yang saya sangkakan*	I think the lesson was harder than I expected
10	Satisfaction	*Saya seronok dengan isi latihan ini*	I enjoyed the content of the lesson
11	Satisfaction	*Saya rasa puas hati dengan suara (audio) da- lam latihan ini*	I am satisfied with the voice (audio) in this lesson
12	Satisfaction	*Saya rasa puas hati menghabiskan latihan ini*	I am satisfied to complete this lesson

There were five types of Emoticons or smiley faces used in this study. Type one referred to Strongly Disagree scale whereas type five referred to Strongly Agree scale. Table 2 shows the summary of the Emoticons in the Young Children Motivation Survey using Emoticons. The Cronbach's Alpha of the survey was 0.65, which was lower than expected. This may due to the small number of items. However, since the participants were kindergarten students, a long list of questions may lead to confusion and boredom to the students. This may also cause threat to the study.

Table 2. Summary of the Emoticons

Scale	Emoticons
Strongly Agree	
Agree	
Neutral	
Disagree	
Strongly Disagree	

III. RESULT AND DISCUSSION

There were 36 males and 24 female's kindergarten students that involved in this study. Table 3 shows the demographic profile of the participants.

Table 3. The demographic profile of the participants

Age group (years old)	Gender	
	Male	Female
6	19	16
5	17	8
N	36	24

Following the counterbalanced research design applied in this study, a repeated measure ANOVA was conducted. The research question was "Are there statistically significant differences between the AR mobile apps group and the conventional mobile apps group on their motivation? Table 4 presents the descriptive statistics. The results on Table 4 showed that the mean of kindergarten students' motivation in the AR mobile apps group was higher (M= 41.32) than students in the conventional mobile apps group (M=38.47).

Table 4. The descriptive statistics of kindergarten students' motivation

Mobile Apps Group	Mean	Standard Deviation	N
AR	41.32	5.11	60
Conventional	38.47	6.18	60

Table 5 shows the Test of Within-Subjects Effects. The results showed that there was a significant difference between students' motivation in the AR mobile apps group and conventional mobile apps group [$F(1,59)=5.28$, $p<.05$].

Table 5. The Test of Within-Subjects Effects

Source	Value	F	df	Error df	Sig.
Sphericity Assumed	243.68	5.28	1	59	.025

IV. DISCUSSIONS AND CONCLUSION

The results indicated that AR mobile apps promoted kindergarten students' motivation on learning alphabets. Based on the literature, most of the studies that investigated the effects of AR among young children only compared AR to traditional instruction. In a previous study investigating the impact of AR to learn foreign words, the results also showed that children found the AR application fun and easy to use compared to the traditional instruction (Barreira *et al.,* 2012). It was also found that children's learning progress was better in the experimental group. Another study that investigated AR against a traditional face-to-face method reported that the AR intervention helped children to score better on alphabet test (Safar *et al.,* 2017). In contrast, this current study contributed on the knowledge of the effects of AR mobile apps compared to a conventional mobile app. Kindergarten student preferred the AR mobile apps than the conventional mobile apps and increased their motivation to learn alphabets.

In addition, the results suggested that the Young Children Motivation Survey using Emoticons was capable on measuring kindergarten students' motivation. However, it is proposed that the five types of Emoticons used should be reduced to only three types (i.e. type two, three, and four as shown in Table 2) to decrease confusion among young children. Similarly, a study on the use of fun semantic differential scale using children's photographs also proposed that fewer scales should be included on children's survey for easier recognizing and differentiating between the scales (Yusoff, Ruthven, & Landoni, 2011). They also suggested that the images should be presented in large sizes so that children can just point out to the images that reflect their opinions.

In conclusion, AR mobile apps could be used to teach alphabets among young children. Furthermore, future research should be conducted on using the Young Children Motivation Survey using Emoticons in other contexts and further improve the instrument.

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