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TEACHERS' EVALUATION OF MALAYSIAN TRADITIONAL DRUM AUGMENTED REALITY APPLICATION

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Abstract. Malaysian Traditional Drum Augmented Reality (AR) is an application software developed to assist preschool children in recognizing traditional musical instruments. In Malaysia, fewer applications are developed to know the traditional Malaysian musical instruments. Therefore, this research investigates suitable AR learning applications for preschool children in Malaysia's National Child Development Research Centre (NCDRC). One of the methods used to evaluate the application is by examining the heuristics of the Malaysian Traditional Drum AR application (MT-Drum). The findings from the study on Malaysian Traditional Drum AR application revealed had provided digital learning content for Malaysian Traditional Drum AR application was limited before the study was conducted. The teachers agree with a high degree of the mean for the usability evaluation of the application. The implication of this study shows some potential for such Malaysian Traditional Drum AR application for Malaysian traditional musical instruments to be further developed to enrich learning for preschool children.

Keywords: Augmented reality, evaluation, preschool children, musical instruments.

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1 Introduction

Traditional music plays a vital role in Malaysian cultures. On the other hand, Augmented Reality (AR) has enabled learning traditional musical instruments, particularly for students worldwide to appreciate their own national culture. For example, in another country, a study about the use of AR has promoted Thai identity and culture through the triggering image in the postcard to present the video, 3D modelling and original sound. The application provided AR simulation for the learning benefits of the primary school students for classroom engagement (Suwichai, 2014).

Nowadays, music represents many aspects of our life, including mobile technologies in the Malaysian context (Ariffin, 2016). For instance, smartphones can become a platform for accessing music (Ariffin et al., 2020; 2018). Music knowledge has emerged as a learning process among children. Hashim (2016) proposed two elements that need to be addressed for learning activities using musical instruments for young children, i.e. developing creativity among children and a very high level of imagination at the early stage. Hence, the recognition of traditional musical instruments can be used as an element to support creativity building among children (Rambli et al., 2013). For instance, children can learn about different musical instruments and

the sounds of different instruments of traditional music (Králová & Kołodziejski, 2016). With these instruments, children can reduce their stress and make them feel more relaxed mentally, physically or emotionally.

1.1 Musical Education for Preschool Children

Although musical instruments are popular in Malaysia, Malaysian traditional musical instruments are still unfamiliar to many, including preschool children (Ariffin et al., 2018). Instead, some preschool children have been taught modern music education (Senan et al., 2009). Králová and Kałodziejski (2016) stated that children's motor skills are developed with musical instrument practices. The development of their personality and imagination are enhanced through music and physical movement activities.

In general, Malaysian parents emphasize more on science more than learning musical instruments. Meanwhile, Siagian et al. (2019) emphasized that parents must understand the child's best interest. In Malaysia, most parents focus on their children's academic results and tend to neglect their children's interests. Due to this reason, most children do not know how to play basic musical instruments because of a lack of exposure in this field. Even though it is not compulsory to learn musical instruments, it is worrying about learning that they do not recognize the differences and features between the musical instruments. For instance, they do not recognize the different sounds of Malaysian musical instruments, especially the traditional musical instruments such as in the Malay, Chinese and Indian cultures (Senan et al., 2009).

There is very little literature that specifies learning local traditional musical instruments. According to Yie and Ying (2017), there is not much attention given to the educational emphasis on local traditional music. Preschool children in Malaysia have shown a lack of interest in learning musical instruments. Since they do not know different musical instruments, they do not know the sound of those musical instruments. Likewise, Tan and Lim (2016) argued that one of the challenging scenarios in Malaysian music education is a lack of learning experience for traditional musical instruments.

With the Western musical style becoming a global trend worldwide, children nowadays are more familiar with Western-style musical elements than Malaysian musical instruments (Senan et al., 2009). Thus, preschool children in Malaysia appreciate Western music more compared the traditional music. Furthermore, one of the reasons that children do not have an interest in recognizing the instruments is because the approach of presenting the musical instrument to them is unattractive (Siagan et al., 2019)

1.2 Augmented Reality for Mobile Learning

Mobile learning is a relatively new approach in the educational paradigm for the Malaysian context. Mobile Augmented Reality is relatively new, particularly where mobile learning is concerned (Litts & Lewis, 2019; Garrett et al., 2018). The study area is still under research regarding the user interface design for mobile applications (Ariffin et al., 2018).

Augmented Reality (AR) is the technology that adds digital information to our physical world. The technology can view directly in an existing environment that is added on with graphics, sounds or videos. Likewise, the virtual object is presented in a real-time 2D or 3D natural environment. In AR, users participate interactively in the physical environment and with other users directly along with computer-simulated virtual objects embedded in the environment (Alhumaidan et al., 2018). AR users can experience an improved environment that is added on with virtual objects or information to assist daily activities (Oranç & Küntay, 2019). According to Krevelen and Poelman (2010), AR technologies offer an enhanced perception to help us see, hear and feel our environment in new and enriched ways that will benefit us in fields such as education, maintenance, design, and surveillance, to name some (Kesim & Ozarslan, 2012).

Mobile devices can access technology such as Augmented Reality (AR). Likewise, the emergence of AR develops an interesting and exciting way of creating teaching and learning tools (Rambli et al., 2013). AR is accessible through mobile devices integrated with the visual marker already embedded within the mobile application. Additionally, the visual markers represented the virtual elements of physical world objects.

AR is applicable for learning, entertainment or edutainment by enhancing a user's perception and interaction with the real world (Kesim & Ozarslan, 2012). Likewise, users can enhance the process of learning with AR technology. AR enables users to learn to experience things beyond their textbooks (Alhumaidan et al., 2018). Users will be more interested in a new topic and better understand it because AR can show them a better visualization (Ibanez et al., 2020; Kawas et al., 2019). Besides, using AR brings convenience to the users' learning process (Martins et al., 2015). Additionally, Industrial Revolution 4.0 (IR 4.0) has given a new impetus to educational transformation (Haseeb, 2020).

Additionally, IR 4.0 has made some changes in the educational field. AR is one of the technologies that can supplement reality through superimposing Virtual Media Content (VMC). Likewise, the Malaysian AR Traditional Drum learning application is augmented reality for learning Malaysian musical instruments in 3D view. This system allows users to interact with the VMC, such as 3D objects and sounds.

With AR, users can access learning activities anywhere, at any time and by anyone using mobile devices. So, it will reduce the limitation of assessing learning materials compared to traditional methods. This kind of learning material using AR makes users enjoy the learning process of recognizing musical instruments (Fernandez et al., 2014). Previous studies have proven that students are more engaged and motivated when using AR to learn musical instruments (Birch, 2017; Pan et al., 2018). Even if they have no prior knowledge of musical notes, they enjoyed using AR in learning music (Birch, 2017). Likewise, when the AR application is accessible via mobile devices, they can also appreciate the content of musical education (Pan et al., 2018).

Almost all previous studies have been developed based on Western music instruments foreign to the Malaysian culture (Senan et al., 2009). Meanwhile, preschool children will spend more time on mobile devices such as laptops or mobile phones, watching videos on YouTube (Ariffin, 2017). Since there is a lack of studies about traditional musical instruments, this study provides an opportunity to assist Malaysian preschool children by providing a learning environment to access musical sound instruments in Malaysia via AR application. Thus, this article elucidates the implementation of the Malaysian Traditional Drum AR application.

1.3 Design and Development in Augmented Reality

Several AR technologies help in creating an AR learning mobile application. Some existing research has reviewed identified software tools in this AR learning system. For instance, Unity 3D and Vuforia is the most common framework usually used as tools in AR development. ARToolkit is also a framework usually used to develop an AR system. These AR developments consist of engines and plugins used to design and develop an AR learning environment for Android and iOS-based systems. Likewise, an AR learning environment can be designed and developed for appropriate AR systems for learners of different types of learning purposes (Di Serio et al., 2013).

Heuristic evaluation is an informal method of usability analysis where several evaluators are presented with interface design guidelines to investigate users' feedback (O'Keefe & Benyon, 2015). On the other hand, non-expert users also can conduct usability evaluations (Ariffin et al., 2018). Previous research found that visual appearances for musical instruments can attract preschool children to learn musical instruments (Lemos et al., 2017). Previously, children could not see the complete visual appearance of those musical instruments. So, an AR learning application for musical instruments is suggested for them to learn the traditional musical instruments in Malaysia.

A study about using AR that promotes Thai identity and culture through the triggering image in the postcard to present the video, 3D modelling, and original sound has been conducted (Suwichai, 2014). Software development focused on developing Thailand's traditional musical instruments. The study found that AR simulation assisted primary school students' classroom engagement. It deepens students' knowledge due to the use of AR simulation. This application has limitations with Wi-Fi or a 3G connection to scan the trigger image.

In Brazil, few studies were conducted about AR software. A survey on AR software has been conducted. The software is embedded with virtual objects linked to sounds' attributes, such as sound intensity, duration of sound and timbre in learning music theory and sound concepts. Meanwhile, there is a lack of game attributes for Brazil's modern musical instruments (Martins et al., 2015). Another study in Brazil has been conducted to verify for modern musical instruments and children can colour the musical notes correctly based on the sequences in a printed pentagram using AR. The software focus on the Vuforia framework using Unity 3D Brazil and Music Notes application (Lemos et al., 2017).

In Japan, a study has been conducted about a mobile application that uses AR with google cardboard. The application allows users to visualize a virtual character and instructions for learning, playing keyboard instruments, and learning with animated 3D characters. However, the application is limited to only piano instruments. The application focus on modern musical instruments (Fernandez et al., 2016).

Meanwhile, a study has been conducted in Malaysia using mobile applications focused on the virtual application for 'Kompang' traditional equipment (Leng et al. 2018b). However, the study did not focus on AR Technology or the target group of school children.

Therefore, there is a limited discussion about the use of AR to learn the traditional musical instruments worldwide, including in Malaysia, as to previous studies (Fernandez et al., 2016; Lemos et al., 2017; Martins et al., 2015; Suwichai, 2014), and the user group is not children (Leng et al., 2018a; 2018b). Yet, many discussions focus on AR in digital piano learning for modern musical instruments (Fernandez et al., 2016; Li, 2018) or are unrelated to traditional Malaysian musical instruments (Lemos et al., 2017; Martins et al., 2015). Therefore, the literature findings affirm the lack of local content for traditional musical instruments in Malaysia.

Since there is minimal local content, the direction of this study is to develop mobile AR content for playing Malaysian traditional drumming music. The study focuses on the major races in Malaysia: Malay, Chinese and Indian, for pre-schoolers. Using AR-based applications in education can promote enhanced learning achievement (Akçayır & Akçayır, 2017).

1.4 Nielsen Design Principles

Features of the interface design usability according to international software interface design expert Nielsen, have outlined the key features that must be adhered to produce a good quality of software: Accessibility; Consistency; Ergonomics and Design Simplicity; Readability and Easy to Remember; Effective and Flexible; and Realistic Error Management. The ability to access software means that the content of mobile applications can be accessed anywhere by users using a mobile device. Consistency of the software content means that the content and elements of the software interface are consistently embedded in each content of the software interface design. The ergonomics and simplicity of the software design ensure that the applications are developed in a user-friendly and have simplicity in the design of the user interface elements. Readability and recall represent readable and the ability of the software content to be enlarged at the comfort of the reader's eye (Nielsen & Molich, 1990).

Consequently, each step of using the software is simple and easy to remember. Likewise, practical and flexible means that the application works efficiently to achieve the tasks required quickly. The features show that the application interface design can adjust the user interface design's size, position and elements according to software devices of various sizes for mobile devices. Realistic error management means the application will not automatically stop without

alerting the user. Additionally, the user's manual use of the software, such as 'How to Use the Software, is also important to briefly describe the application's purpose and how to use it step by step.

1.5 Cultural Appropriate Design Principles

The universal usability principles of universal interface design do not embed interface design principles concerning local culture, especially in the local community, particularly in Malaysia. At the same time, the National Cultural Policy, which is based on the culture of the people in the region, is aligned with the Malaysian Communications and Multimedia Commission's (MCMC) intention to create local content that identifies with the Malaysian culture.

Local usability features for software design that adapt to the National Cultural Policy are connected to the principles of the Malaysian National Pillars 'Rukun Negara'. By embedding the mobile software with local design elements, it can reduce the usability challenges of the software. Using local design elements is closer to the heart of local communities as they can understand the language better, for example, by using the local language Bahasa Melayu as the official language. Previously, more foreign languages software such as from the USA and European is available compared to the locally developed software, particularly for mobile applications in the Malaysian context.

It is essential to develop software that meets the needs of local users that the National Cultural Policy inspires. For example, the proposed usability principles for the local design principles of the software are as follows: Local contextual Content relevant to local culture; the value of aesthetics related to local culture; local philosophy related to local culture; and the use of local language.

The first principle of interface design relates to the context of the content of local culture-related software. This feature links cultural contexts to daily life in Malaysia as an example of being inspired by the local rural community to incorporate those local values into software interface design. Additionally, this helps the user more easily relate the local values to the situation in the local context of the relevant subject. Further, the second interface design principle is that the aesthetic value of software is inspired by local cultural aesthetic value and the beauty of local art. Examples of flora and fauna characteristics are relevant to the local community context in Malaysia, such as using local motifs that can be adapted to software interface design. In comparison, the use of colours is also related to the local community in Malaysia. For instance, the influences the aesthetic values of the local culture, such as the use of yellow, red, black and white, which have their meanings and values (Ariffin et al., 2018).

Similarly, using voice audio in software can also incorporate local cultural features. The software can also be used using local culture-related animations. It also distinguishes whether the software is manufactured in other Asian countries such as Indonesia, India, Japan, South Korea or China.

Meanwhile, the principle of local philosophy for local cultural software is one of the crucial aspects of the software that identifies local culture in Malaysia. For example, for the local wood carving philosophy, "Duck Returns" symbolizes loyalty to leaders. That is how the local carving art symbolizes embedded into the design of software interfaces that have meanings. Whereas the wood carving art, for flower motifs, has a local philosophy related to the principle of belief in God, one of the principles of the Rukun Negara. The use of the local, national language, Bahasa Melayu, to embed with the interface design software is also very important to establish the identity of a nation. Likewise, the software can be bi languages. Therefore, a previous study has already elucidated that universal design principles for usability with local cultural design principles benefited the usability of the software (Ariffin, 2014).

2 Methodology

The methodology is a systematic way to solve a problem and is a science of studying how research is conducted (Rajasekar et al., 2013). Software development needs to be carried out according to the stages stated in the selected method. The software is evaluated using the survey for usability evaluation. This application has been developed to enhance preschool children at NCDRC Malaysia age 4-6 in gaining knowledge to recognize traditional musical instruments and their sounds. In this study, the methods used are software development, heuristic evaluation and observation (Ciesielska et al., 2018).

NCDRC had obtained before the study was conducted. For ethical purposes, all the information about the participants will be de-identified (Ariffin, 2014). In this study, all participants need to sign consent forms; for the preschool children, their parents need to give consent for the study to be conducted with their children.

2.1 Development and Design

In this phase, data are collected from two preschool teachers from the National Child Development Research Centre (NCDRC) and one lecturer from the Faculty of Music and Performing Arts (FSMP) in Sultan Idris Education University (UPSI). The data are collected using the qualitative method through interviews. The duration of interviewing each teacher is about 20 to 30 minutes. The questions were adapted from Ariffin (2014).

a. What are the teacher's experiences and background?
b. What are the teacher's teaching approaches?
c. What are the software tools used for teaching?
d. What are the teacher's experiences in teaching musical instruments?
e. What are the teacher's opinions about using AR to teach traditional musical instruments?

The data are collected and then analyzed using the thematic analysis approach. The output is several demonstrated in the use case diagram for the AR application. However, for this article, the results of thematic analysis will not be discussed.

During this phase, the design is created as user interface mock-ups. All the needed elements are then arranged on different pages of the interface. The design features and functionality a decided and embedded in the interface according to the suitability of each section (Van Krevelen & Poelman, 2010; López-Faican, Jaén, 2020). Then, the activity diagrams are designed for AR applications according to the features and functionality. Additionally, storyboards are also created according to the user interfaces.

Figure 1a illustrates the main page of the software program. The program's functionalities come from interviews with five NCDRC teachers earlier for the Malaysian Traditional Drum AR application they want. It consists of Learn Button, Scan Button and Quiz Button. Figure 1b shows a Learning Page with buttons for Malay, Chinese and Indian (the primary races in Malaysia). Finally, the Quiz page is for the student to answer about their knowledge of traditional music.

The combination of mobile learning with Augmented Reality can make learning more enjoyable. In this study, an Android-based mobile application for AR has been developed (Buchori et al., 2017). The application functioned by scanning the provided flashcards using the mobile device's built-in camera. Then, the 3D virtual objects are displayed together with the sound clips. Children can view the virtual objects and recognize each of the Malaysian traditional music with different sound clips.

a) b) c)

Figure 1: *a.* Main Page; *b.* Learning Page; *c.* Quiz Page

a) b) c)

Figure 2: *a.* Scan the Malay Drum Flashcard; *b.* Scan the Chinese Drum Flashcard; *c.* Scan the Indian Drum Flashcard

Figure 2a shows the scan Malay Drum flash card. The program's functionalities come from interviews with five NCDRC teachers earlier for the AR mobile application they want. Figure 2b shows a scan of the Chinese Drum Flashcard, and Figure 2c shows a scan of the Indian Drum flashcard where the images of the Malaysian traditional Drum music will play its audible sound.

Figure 3 illustrates the architecture model from the users and mobile devices to the software applications. This diagram shows how the user controls the devices which integrate with the Malaysian AR Traditional Drum learning application environment.

Figure 4 demonstrates the output from the interview earlier with the teachers at NCDRC and illustrates the use case. These include all functionalities that the users want for the system. After the application has been developed (Buchori et al., 2017), the unit and integration testing are conducted.

After the developer has tested the application, the application is tested by users. This activity is carried out by involving the preschool children in NCDRC to test the mobile AR application. This phase tests the application's efficiency and identifies problems not yet found in the earlier phases of design and development. Since some errors are detected in this phase, the software application error correction will be carried out before the release. Likewise, the interface design is subject to change if the users disapprove.

This project is developed using Unity 3D and Vuforia Extension to create an AR environment. The use of Blender software has been used to create the 3D model. This project is an innovation

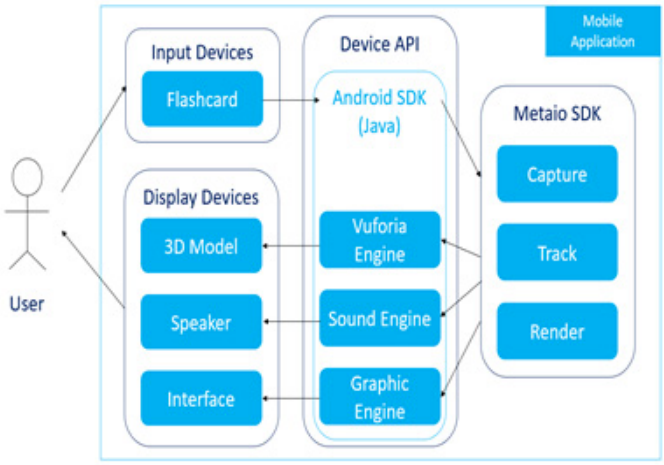

Figure 3: Architecture Model of "Drumming AR" System

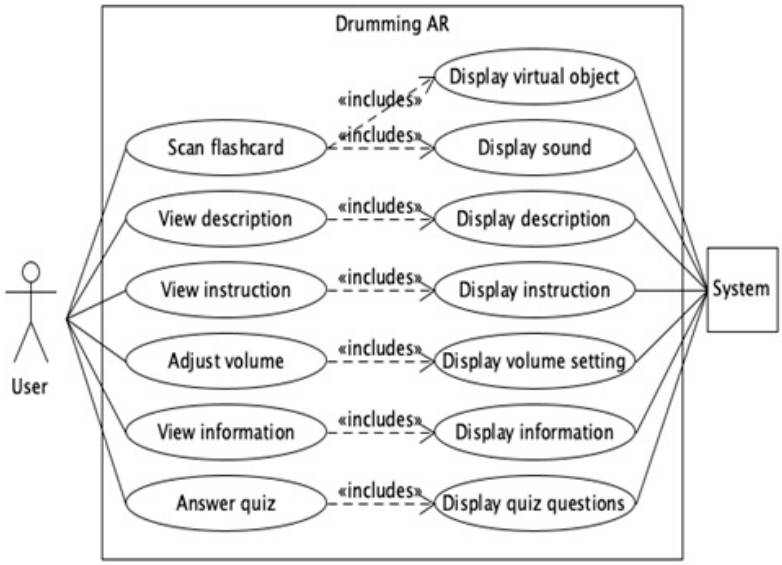

Figure 4: Use Case Diagram of "Drumming AR" System

from the current learning method in teaching traditional musical instruments in Malaysia. It involves hardware and software. Firstly, laptops are used as mobile devices to carry out the development phases. The developed project has been deployed on android-based mobile devices. Table 1 illustrates the list of software utilized for mobile AR.

The application is developed based on the designed user interfaces, and the activity diagrams are used to arrange the application flow. First, download all the media assets and materials to develop the new one further. This step is conducted by using Adobe Photoshop CC 2018. Next, all the media materials are utilized to create 3D objects by using Unity Editor. After the 3D objects have been created, the sound for each object is added distinctly. Subsequently, the Android Studio emulator is used to view the user interface content of the environment on mobile devices.

2.2 Usability Evaluation Survey

Usability evaluation has been deployed to gain user feedback about the design issues of the AR application for Malaysian traditional musical instruments. At this stage, a survey is conducted

Table 1: Software Specifications

Software	Descriptions
Unity 3D Editor	To build and run an application
Vuforia extension	To enable the creation of an AR environment
Blender	To create 3D objects
Adobe Photoshop CC 2018	To edit graphics and images
Audacity	To edit the audio for each object
UMLet	To draw diagrams (use case diagram, activity diagram etc.)
Microsoft Word	To create a storyboard

by using a questionnaire to evaluate the usability of the application (Ariffin et al, 2018a; 2018b). This questionnaire has required five preschool teachers to complete. The application is used among five preschool teachers.

The questionnaire is divided into 10 sections with the Likert scale: Accessibility (A), Consistency (C), Good Ergonomic and Minimalist User Interface Design (GEMUID), Readability and Ease of Recall (RER), Efficiency and Flexibility (EF), Realistic Error Management (REM), Suitable Content for Local Culture (SCLC), Aesthetic Value according to Local Culture (AVLC), Language used is suitable (L) and content has Local Culture Value (CLCV). Therefore, research methodology plays a significant role during a project's development, design, and evaluation.

3 Findings and Discussion

In this section, the findings elaborate further on the survey results of the usability evaluations from the Malaysian AR Traditional Drum learning application study. Additionally, this includes usability evaluation deployed from the heuristic survey.

Table 2. Mean and Standard Deviation for Questionnaire Rating for CADG

Evaluation Item	Details	Mean Rating	Standard Deviation
A	1(i)	4.2	0.83666
	1(ii)	4.4	0.54772
C	2(i)	4.2	0.83666
	2(ii)	4.8	0.44721
GEMUID	3(i)	4.8	0.44721
	3(ii)	4.6	0.54772
RER	4(i)	3.8	0.83666
	4(ii)	4.8	0.44721
	4(iii)	4.4	0.54772
EF	5(i)	4.6	0.54772
REM	6(i)	4.0	0.70711
	6(ii)	4.4	0.89443
SCLC	7(i)	5.0	0.00000
	7(ii)	4.6	0.54772
AVLC	8(i)	4.6	0.89443
	8(ii)	4.8	0.44721
	8(iii)	4.8	0.44721
L	9(i)	4.8	0.44721
	9(ii)	4.6	0.54772
	9(iii)	4.6	0.54772
CLCV	10(i)	4.8	0.44721
	10(ii)	4.6	0.54772

3.1 Usability Evaluation

The questionnaire to garner teachers' opinions was adapted from Ariffin et al. (2018a), based on Culturally Appropriate Design Guidelines (CADG). It is divided into 10 sections: Accessibility

(A), Consistency (C), Good Ergonomic and Minimalist User Interface Design (GEMUID), Readability and Ease of Recall (RER), Efficiency and Flexibility (EF), Realistic Error Management (REM), Suitable Content for Local Culture (SCLC), Aesthetic Value according to Local Culture (AVLC), Language used is suitable (L) and content has Local Culture Value (CLCV). Five teachers evaluated the application and responded to the questionnaire according to the Likert Scale: 5-Strongly Agree, 4-Agree, 3-Neutral, 2-Disagree, and 1-Strongly Disagree. During the evaluation, each teacher played approximately 10 minutes of the application. Afterwards, they answered the application for 15 minutes for each teacher.

Table 2 shows that all the items reach a positive value of more than 3.5 for the mean. The results from the teachers show the highest mean rating for the Local Culture Principle (SCLC) for questionnaire 7(i). On the other hand, Figure 9 shows teachers' responses to the questionnaires, and Figure 10 summarises the results in a graphical form.

Figure 5: Teachers answering the usability questionnaire

During the study, the advantages, suggestions and significance of the research for the Malaysian AR Traditional Drum learning application are identified. The discussions are based on the findings and the significant impact that informed the Malaysian AR Traditional Drum learning application for Malaysian preschool children at NCDRC. The teachers agreed that Malaysian AR Traditional Drum learning application is easy for children to understand, aligned with the study from Lemos et al. (2017).

The teachers of the preschool agreed the children use the Malaysian AR Traditional Drum learning application and have a meaningful learning experience as they can learn the new topic with the AR technologies more actively aligned with the study from Suwichai (2014) and Martins et al. (2015). Additionally, they feel motivated when learning through mobile applications (Kawas et al., 2019). This mobile application approach can enhance their skills in learning and engaging with the traditional musical drum instruments in Malaysia using the Malaysian AR Traditional Drum learning application.

3.2 Heuristic Evaluations

For the heuristic evaluators, five teachers from NCDRC have been using the Malaysian AR Traditional Drum learning application for the evaluations. They have 10 minutes to play with the application and 15 minutes to answer the survey.

3.2.1 Design Principle Accessibility

Accessibility (A) of the mobile content for quick interaction, with a mean of 4.2 and search with a mean of 4.4. This score indicates the high ranking of the Malaysian AR Traditional Drum learning application to access the digital content for the children. Additionally, the content for the software is easy to be located.

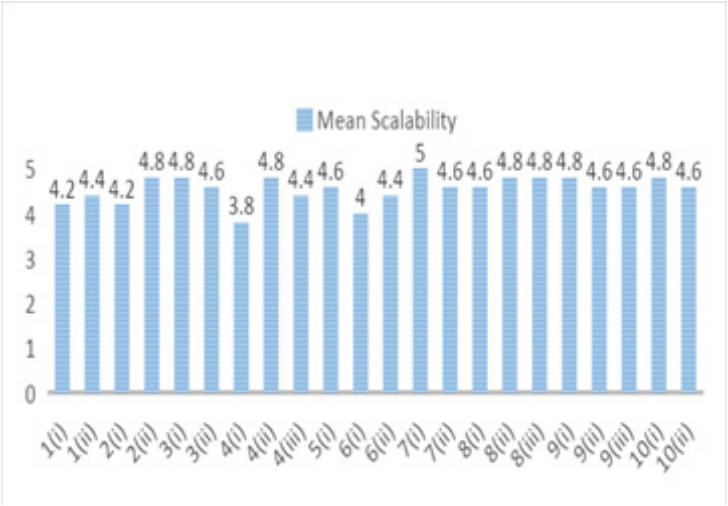

Figure 6: Summary of Mean Rating for Questionnaires Survey

3.2.2 Design Principle Consistency

Consistency (C) for fonts and buttons is high, with a mean of 4.2. Additionally, consistency for the images and icons is also high, with a mean of 4.8. This result illustrates that the Malaysian AR Traditional Drum learning application is stable in the form of consistency of the software design.

3.2.3 Design Principle for Good Ergonomic and Minimalist User Interface Design (GEMUID)

Good Ergonomic and Minimalist User Interface Design (GUID). Interface design is simple for Malaysian AR Traditional Drum learning application with a mean of 4.8. The touch screen interaction is also good, with a mean of 4.6. This application demonstrates the Malaysian AR Traditional Drum learning application's good ergonomic and minimalist user interface design.

3.2.4 Design Principle for Readability and Ease of Recall (RER)

The readability and ease of recall (RER) show a high mean degree. For example, the text contents are readable for the mean of 3.8. Graphics are clear with a mean of 4.8. Consequently, the navigation steps are easy to remember, with a mean of 4.4. Thus all these indicate that the Malaysian AR Traditional Drum learning application has good readability and ease of recall (RER).

3.2.5 Design Principle for Efficiency and Flexibility (EF)

The Malaysian AR Traditional Drum learning application demonstrates a high degree of mean with 4.6. This result illustrates that the software is efficient and flexible and favours evaluators. The application is also easily navigable via the buttons.

3.2.6 Design Principle for the Realistic Error Management (REM)

The Realistic Error Management (REM) for the Malaysian AR Traditional Drum learning application demonstrates that the application will not be closed immediately without warning with a mean of 4.0. Likewise, the application launches without error with a high degree of a mean of 4.4. Therefore, it shows the application is suitable for learning due to realistic error management.

3.2.7 Design Principle for Suitable Content for Local Culture (SCLC)

Design Principle for Suitable Content for Local Culture (SCLC) shows that the content for the Malaysian AR Traditional Drum learning application is suitable for local culture with a high degree of a mean of 5.0. Additionally, the content is easy to learn, with a high mean of 4.6, meaning the user can quickly comprehend the content for learning. Thus both items demonstrate the content is suitable for the local culture.

3.2.8 Design Principle for Aesthetic Value according to Local Culture (AVLC)

Aesthetic value according to Local Culture (AVLC) demonstrates that Malaysian AR Traditional Drum learning application for the text presentation is suitable for local culture and has a mean of 4.6. Likewise, the graphics presentation is suitable for local culture with a mean of 4.8. Consequently, the audio presentation is suitable for local culture with a mean of 4.8. Therefore this illustrates that the AVLC for the software is suitable for Malaysian culture.

3.2.9 Design Principles for Language used is suitable (L)

The language used is suitable (L) used for English is helpful for Malaysian AR Traditional Drum learning application in using the software functions with a mean of 4.8. Additionally, English help in learning local culture with a mean of 4.6. Also, English is helpful for educational purposes for local culture with a mean of 4.6. Therefore these items indicate that English is still understandable for the users, which are the educators.

3.2.10 Design Principles for Content has Local Culture Value (CLCV)

Design Principles for Content has Local Culture Value (CLCV) for Malaysian AR Traditional Drum learning application shows that the content reflects the local culture software with a mean of 4.8. Likewise, the content is suitable for local culture's educational purposes and has a high mean of 4.6. Therefore, this shows that the content for the Malaysian AR Traditional Drum learning application has a high mean for local cultural value.

3.3 The implication of the research to the stakeholders

This application's creation significantly impacts the Malaysian Traditional AR Drum application. This application is helpful for these stakeholders:

3.3.1 Government

This application can potentially be used by Malaysia's tourism and cultural heritage section. There is a department under the Ministry of Tourism, Arts and Culture in Malaysia. Since this application is designed and developed based on Malaysian traditional musical instruments, the content has the potential to fulfil the needs of the National Department for Culture and Arts.

3.3.2 Preschool Teachers

Preschool teachers can assist the children with western musical instruments. Then, they did not learn about traditional musical instruments. With this application, teachers can use this application in the teaching and learning process. Then they can teach the children to learn more about the traditional musical instruments excitingly.

3.3.3 Preschool Children

The preschool children have access to the traditional Malaysian drum. Through this application, preschool children can learn about traditional musical instruments. They can learn to recognize the traditional musical instruments and also the sound of each instrument. This type of learning is also a good opportunity for them to learn about Malaysian culture through AR software.

3.3.4 Parents

For parents, this application improves the relationship between their children and themselves. Parents can also learn with their children about traditional Malaysian musical instruments with the AR application. Hence, they can also learn about the children's traditional Malaysian drums application.

4 Conclusion

The application, Malaysian Traditional Drum AR application, initiates the idea of creating and experiencing AR in mobile platforms that provides an exciting environment for preschool children to learn the traditional musical instruments in Malaysia. This application also aligns with CADG principles that combine traditional and general usability. AR technology has made the topic "Traditional Musical Instruments" content more attractive and exciting to learn. Hence, using AR mobile applications helps improve the knowledge of recognizing the traditional musical instruments in Malaysian preschool children. Thus, the Malaysian Traditional Drumming AR application initiates the idea of creating and experiencing AR on mobile platforms, providing an exciting environment for preschool children to learn traditional musical instruments in Malaysia.

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