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Development of an Android Application for 3D Animation of Basic Silat Techniques in the Art of Self-Defence

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Abstract: The rapid advancement of technology has had a significant impact on the field of education. One example is the utilization of Android-based mobile technology that harnesses multimedia as an effective tool to achieve learning objectives. This study aims to develop an Android application that combines 3D animation with the fundamental techniques of self-defence martial arts, specifically Silat, as an additional teaching resource for both teachers and students. The development of this application follows the ADDIE model, which consists of five main phases: analysis, design, development, implementation, and evaluation. Various software applications, such as Adobe Animate, Adobe Illustrator, Adobe Premiere Pro, and Blender, were employed to create this Android application. Six experts were selected to assess the application, including three content experts who are teachers involved in Silat co-curricular activities at secondary and primary school levels. The assessment instrument used was a checklist form designed specifically for expert evaluation. This form was utilized to assess the functionality of the Android application in terms of content, interaction, interface, and multimedia presentation design. The collected data was then analysed and presented using frequency ratings and feedback notes. The findings from the data revealed that all three content experts agreed on the content design. Similarly, consensus was reached among the experts regarding the interaction design. However, differences of opinion emerged among them concerning the interface design and multimedia presentation, which require improvements from the developer. Overall, this Android application has been successfully developed and has undergone thorough testing. It can serve as a valuable guide for students to enhance their understanding of the subject matter.

Keywords: 3D animation, Art of Self-defence, Silat, ADDIE Model

1. Introduction

In the evolution of technology, smartphones have created significant benefits for human life. Through the Android or iOS operating systems, every smartphone provides easy access to multimedia applications that facilitate work, learning, and entertainment. The use of smartphones and this technology has become an inseparable part of daily life, including in the field of education. The Android operating system, which is based on the Linux kernel, is widely used in smartphones such as those by Huawei and Xiaomi (Tan, 2015). Android applications display various visual designs, including 3D visual designs that effectively convey information by utilizing X, Y, and Z coordinates in space (Abildinova, *et al.*, 2016). This advantage allows for the use of 3D visual designs that can be implemented in co-curricular teaching, such as in-school Silat activities. In Malaysia, Silat is recognized as an official martial art that encourages the community to learn and engage in Silat as a national heritage (Elias et al., 2015).

1.1 Research Background

Currently, issues such as school truancy, vandalism, gangsterism, extortion, and drug abuse have become prevalent among teenage students. According to Asalal, Wahab, and Zakaria (2020), extortion and gangsterism can result in physical harm to individuals. Mat Isa, *et al.*, (2020) state that bullying victims in schools are often those who are physically weaker and reluctant to fight back. The martial arts discipline in co-curricular activities plays a crucial role in character development and problem-solving to address these problems. Furthermore, the integration of technology in co-curricular programmes can enhance the quality of education. The Ministry of Education Malaysia (2013) emphasizes the use of information and communication technology in education, as stated in the Malaysian Education Development Plan (2013-2025). In the context of Silat learning, the utilization of Android applications and 3D animations on smartphones can greatly aid the learning process. Basiron (2012) mentions that the use of applications in teaching can enhance a teacher's ability to deliver knowledge effectively. 3D animations are particularly suitable for teaching Silat within the school's co-curricular framework. Utami (2011) states that 3D animations can stimulate human brain memory and facilitate understanding. The combination of Android applications and 3D animations on smartphones can generate interest among students in learning Silat. These applications can be instrumental in facilitating learning and reducing confusion. Therefore, it is crucial to develop Android applications specifically designed for smartphones as learning resources in Silat club activities.

1.2 Problem Statement

Based on the stated problem background, the learning method used by the school's Silat club in the co-curricular activities still follows a traditional approach, where the teacher demonstrates the movements, and the students observe and memorize them. In a joint interview with the school's Maktab Mahmud Alor Star (MMAS) teacher, it was mentioned that no materials such as books or videos are utilized in the learning process. The teacher delivers the lessons involving various movements solely through demonstrations. Additionally, the teacher suggested the use of an application with visual elements as a learning resource for the students. An application with 3D animations is considered suitable for Silat learning. This is because every Silat technique needs to be remembered and implemented correctly to avoid injuries. The learning process can be facilitated, as 3D animations are moving images with diverse perspectives with a 3D animation application. According to Cahyani (2020), 3D animations make the learning process engaging, enhance students' motivation to continue learning, and facilitate their understanding of the lesson content.

1.3 Objectives

Three (3) main objectives of the study have been identified by the developer, and they are as follows:

- i. Designing a 3D Animation Android Application of Basic Silat Martial Arts Techniques
- ii. Developing 3D Animation Android Application of Basic Silat Martial Arts Techniques
- iii. Evaluating the functionality of the 3D Animation Android Application of Basic Silat Martial Arts Techniques.

2. Methodology

The developer has chosen the ADDIE methodology as a guide and reference for developing an Android application for basic self-defense techniques in Silat martial arts using 3D animation. The ADDIE model comprises five stages of work that need to be considered in the process of developing the Android application, which include analysis, design, development, implementation, and evaluation. Figure 2.1 shows the ADDIE Model Phases used in the development of the application.

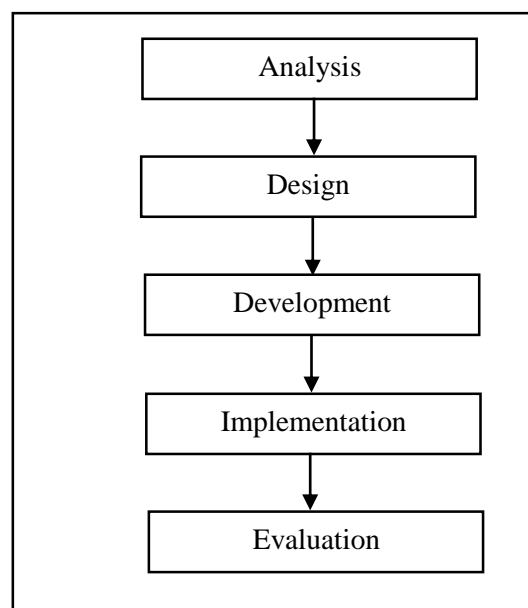


Figure 1: ADDIE Model Phases (Rossett, 1987)

2.1 Analysis Phase

In this phase, the developer conducts a detailed analysis of the requirements and objectives of the application. They gather information about the basic self-defence techniques in Silat that need to be conveyed through the 3D animations. User needs and content requirements are also identified during this phase.

2.2 Design Phase

After analysing the requirements, the developer moves on to the design phase. Here, they focus on creating a user-friendly and visually appealing interface. They carefully plan the layout and navigation of the pages in the 3D Animation Android Application for basic Silat Martial Arts techniques. Storyboards and appropriate navigation buttons are used to provide an overview of the developed pages. Throughout this phase, the usability aspects of the application are also given importance to ensure a smooth and secure user experience.

2.2.1 Content Design

Content design is important in developing an Android animation app. It includes learning material and learning theory selection. The app uses constructivist learning theory. It also incorporates basic techniques from martial arts, like stances, strikes, kicks, and blocks. 3D animation is a key feature, along with text and audio, to engage users. Users can see clear 3D depictions of martial arts movements, which helps them learn and practice.

2.2.2 Interaction Design

Interaction is important for users to communicate and interact with the developed app. When creating an Android animation app, developers need to pay attention to selecting buttons and icons that allow users to interact easily. Common buttons like home, back, next, and exit should be arranged in a consistent and organized manner. In the app, 3D animation is used along with appropriate buttons and icons to engage users and make the app user-friendly. User guidance is provided to help users understand the function of each button. By focusing on interaction design and using suitable buttons, users can easily navigate and interact with the Android app that has been developed.

2.2.3 Interface Design and Multimedia Presentation Elements

Interface design is the phase where developers create the app's appearance. They choose colours, layout, and multimedia elements like graphics, audio, and animations to make it attractive. The app uses 3D animations to show martial arts techniques. It's essential to make the design appealing so users stay interested and motivated to use the app.

2.3 Development Phase

The development phase is the third phase of this study, where all the main elements designed in the previous phase are translated into a more practical form and the actual development process begins. The storyboard designs created earlier are used to produce a working development prototype using the hardware and software planned during this phase. The primary objective of this phase is to develop a complete prototype for usability testing, and the development work for the Android application with 3D animation of basic self-defence techniques in Silat martial arts is carried out according to the predefined requirements.

2.4 Implementation Phase



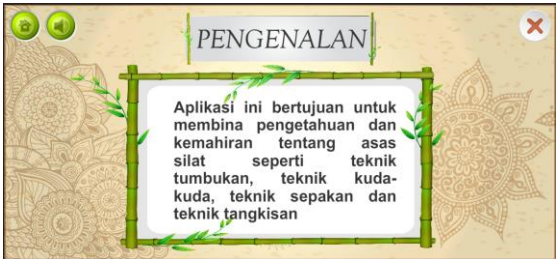
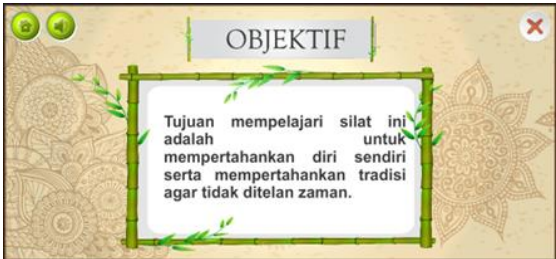
The completed Android application, which includes all the functionalities and movements developed during the development phase, proceeds to the implementation phase. The implementation phase involves testing the developed application to obtain feedback and identify any errors or issues related to the application's design and functionality. Therefore, the project supervisor has reviewed and utilized the developed application to identify any errors and defects that need to be addressed during the initial testing stage. The testing conducted also serves to improve the developed Android application. As such, this phase assists the developer in creating an application that meets user requirements and allows for the rectification of any mistakes or errors encountered during the development process.

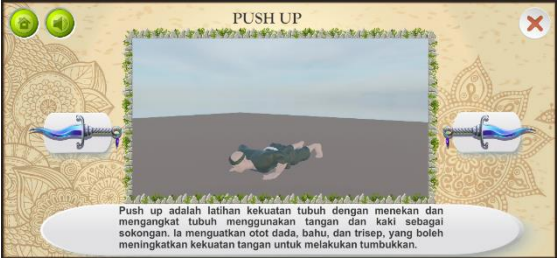

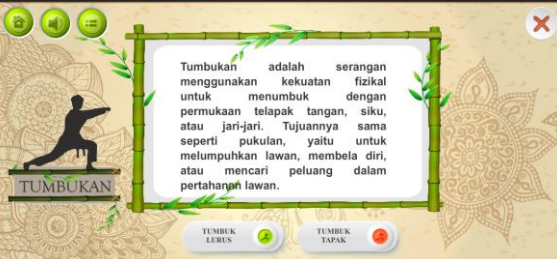


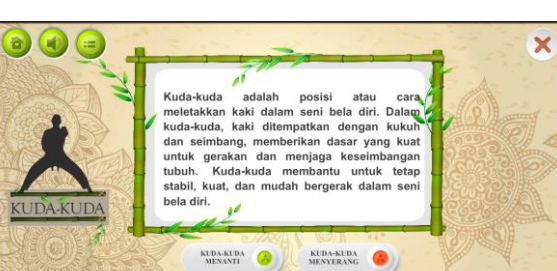
2.5 Evaluation Phase



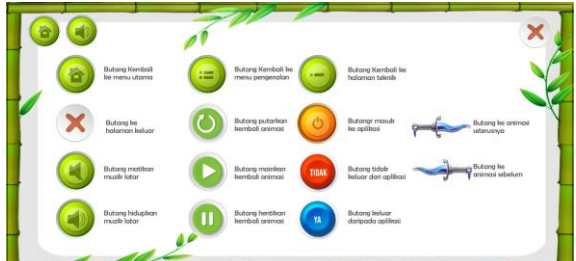

The evaluation phase evaluates whether the Android app functions well in delivering its content. Experts in multimedia and martial arts assess different aspects of the app, such as its design and content. Their feedback is analysed to improve the app and make it effective for users, especially martial arts club students.

2.6 The interface for the development of an Android Application for 3D Animation of Basic Silat Techniques in the Art of Self-Defence is shown in Table 1.

Table 1: Android Application Interface

Interface	Description
	<p>The home screen shows the use of text, graphics, audio and 3D animation. Text – Title of the application Graphic - Design of the background screen and interaction buttons 3D Animation - Animation of the character Audio – Background music</p>
	<p>The menu screen shows the use of text, graphics, and audio. Text – Title of the screen menu and button name Graphic – Design of the background page screen and interaction buttons Audio – Background music</p>
	<p>The introduction scene shows the use of text, graphic and audio. Text – Title of the introduction scene and button name Graphic - Design of the background page screen and interaction buttons Audio - Background music</p>
	<p>The objective screen shows the use of text, graphics, and audio. Text – Title of the objective scene and button name Graphic - Design of the background page screen and interaction buttons Audio - Background music</p>

	<p>The “Senaman” screen shows the use of text, graphics, and audio. Text – The exercise scene’s title and button name Graphic - Design of the background page screen and interaction buttons Audio - Background music</p>
	<p>The menu screen of “Teknik Silat” shows the use of text, graphics, and audio. Text – Title of the Silat techniques and button name Graphic - Design of the background page screen and interaction buttons Audio - Background music</p>
	<p>The content screen of “Tumbukan” shows the use of text, graphics, and audio. Text – Title of screen, content of “Tumbukan” and button name Graphic - Design of the background page screen and interaction buttons Audio - Background music</p>
	<p>The 3D animation content screen of “Tumbukan Lurus” shows the use of text, graphics, and audio. Text – Title of the “Tumbukan Lurus” screen and button name of the tutorial Graphic - Design of the background page screen and interaction buttons Audio - Background music</p>
	<p>The content screen in the tutorial for “Tumbukan Lurus” shows the use of text, graphics, and audio. Text – Title of every step, content of the step and button name Graphic - Design of the background page screen and interaction buttons Audio - Background music</p>
	<p>The content screen of “Kuda-Kuda” shows the use of text, graphics, and audio. Text – Title of the “Kuda-Kuda” screen, content of “Kuda-kuda” and button name of every step Graphic - Design of the background page screen and interaction buttons Audio - Background music</p>

	<p>The 3D animation content screen of “Kuda-Kuda Menanti” shows the use of text, graphics, and audio.</p> <p>Text – Title of the “Kuda-kuda” technique and button name</p> <p>Graphic - Design of the background page screen and interaction buttons</p> <p>Audio - Background music</p>
	<p>The content screen in the tutorial for “Kuda-Kuda Menanti” shows the use of text, graphics, and audio.</p> <p>Text – Title of every step for the “kuda-kuda” technique and button name</p> <p>Graphic - Design of the background page screen and interaction buttons.</p> <p>Audio - Background music</p>
	<p>The guideline screen shows the use of text, graphic and audio.</p> <p>Text – Title of guideline scene and button function explanation</p> <p>Graphic – Design of the background screen, design of buttons and interaction buttons</p> <p>Audio – Background music</p>
	<p>The exit screen shows the use of text, graphics and audio.</p> <p>Text – Title of exit scene and button name</p> <p>Graphic – Design of the background screen and interaction buttons.</p> <p>Audio – Background music</p>

3. Results and Discussion

Experts evaluate two aspects, which are content design and multimedia design. A content design assessment checks if the app's content aligns with learning objectives. Multimedia design assessment focuses on the suitability of multimedia components, including interaction and presentation. Experienced lecturers assess interaction design, interface, and multimedia presentation. Martial arts teachers with Silat expertise evaluate the content design. Table 2 shows the demographic information of content experts, and Table 3 shows the demographic information of interface and interaction experts. They both give an overview of their qualifications and experience.

Table 2: Demographics Expertise in Content Creation Design

Details	Expert 1	Expert 2	Expert 3
Gender	Male	Male	Female
Educational Level	Degree	Degree	Degree
Field of Specialization	History	Physical Education	Mathematics
Working Period	>15 years	5-10 years	>15 years
Sector	Government	Government	Government
Position	Teacher	Teacher	Teacher

Table 3: Demographics Expert in User Interface (UI) and Interaction Design

Details	Expert 1	Expert 2	Expert 3
Gender	Male	Female	Female
Education level	Degree	PhD	Master
Field of Specialization	Multimedia	Software Engineering	Software Engineering
Work Experience	More than 15 years	Educational Technology	More than 15 years
Sector	Government	Government	Government
Job Title	Lecturer	Lecturer	Lecturer

3.1 Content Expert Assessment Analysis

In the Content Design Assessment form, 15 statements were developed to evaluate the functionality of the product in terms of content design. The data obtained was analysed and presented using frequency values and percentages of acceptance, as shown in Table 4. The results of the expert assessment regarding the content design aspect can be found in Table 4.

Table 4: The Results of Expert Assessments in Content Design

Item	Statement	Frequency		Acceptance (%)
		Yes	No	
1	The display on the main page of this Android application adheres to the application's theme	3	0	100%
2	The content contained in this Android application aligns with the objectives	3	0	100%
3	The content provided is relevant to the title	3	0	100%
4	The content within this Android application is organized systematically.	3	0	100%
5	The information provided is relevant to the conveyed topic.	3	0	100%
6	The 3D animations of “Pergerakan Kuda-kuda” are easy to understand.	3	0	100%
7	The 3D animations of “Asas Tumbukkan” are easy to understand.	3	0	100%
8	The 3D animations of “Asas Sepakkan” are easy to understand.	3	0	100%
9	The 3D animations of “Asas Tangkisan” are easy to understand.	3	0	100%
10	The tutorial on basic techniques in this Android application is accurate.	3	0	100%
11	This Android application is suitable for the target user’s age group.	3	0	100%
12	This Android application is suitable for learning martial arts techniques.	3	0	100%
13	This Android application provides clear objectives.	3	0	100%
14	This Android application provides step-by-step tutorials that facilitate users in learning the basic techniques of self-defence martial arts.	3	0	100%
15	The user guide assists users in using this application.	3	0	100%

After reviewing the findings, content experts have reached a consensus that the information displayed on the main page of this Android app aligns with the app's theme. They also agree that the content provided in the app meets the objectives. The content is well organized and relevant to the topics conveyed, as unanimously agreed by all experts during their testing of the app. The 3D animations for movements like stances, strikes, kicks, and defenses are easily understandable, according to all the experts. They also concur that the app's basic technique tutorials are appropriate. Additionally, the app is deemed suitable for the target users' age group and for learning martial arts techniques.

Moreover, the app provides clear objectives, endorsed by all experts through the "yes" markings in the content design form. Finally, all experts agree that the Android app offers step-by-step tutorials that facilitate users in learning basic self-defense Silat techniques, and the user guide aids in using the app effectively.

3.2 Interface Expert Assessment Analysis

This section focuses on analysing the interface design of the developed application, which includes elements like text, audio, graphics, 3D animations, and other multimedia combinations. The goal of this analysis is to determine how well these elements fit into the app and make it visually appealing. The evaluation results are summarized in Table 5.

Table 5: The results of the Interface Expert Assessment Analysis

Item	Statement	Frequency		Acceptance (%)
		Yes	No	
A) Text				
1	The font type used is suitable.	3	0	100%
2	The text size used is appropriate.	3	0	100%
3	The text colour used contrasts with the background graphics.	3	0	100%
4	The use of text on navigation buttons is easily readable.	3	0	100%
B) Audio				
5	The use of audio in the section on Silat techniques is appropriate to the content.	3	0	100%
6	The background music used is suitable.	3	0	100%
7	The background music captures the attention of the target users.	3	0	100%
8	The background music in this Android application does not distract the focus of the target users.	3	0	100%
9	The design of the navigation buttons is attractive.	2	1	66.67%
10	The graphics used in this Android application are appealing.	2	1	66.67%
11	The interface of the application follows the theme of the application's title.	2	1	66.67%
12	The use of background graphics in this Android application does not distract the focus of the target users.	2	1	66.67%
(D) Animation in 3D				
13	The 3D animations produced are clear.	3	0	100%
14	The movements of the 3D animations produced are smooth.	3	0	100%
15	The 3D animations produced have good resolution.	3	0	100%
16	The 3D animations produced are attractive and suitable.	3	0	100%

Expert evaluations of the interface design data agree that the chosen font for text is suitable, although one expert suggests using a different font for button text. All experts also agree that the text size used is appropriate, and the text colour contrasts well with the background graphics. The readability of text on navigation buttons is also acknowledged. Regarding audio, all three experts agree that the use of audio for the Silat techniques section is relevant to the content of the application. Furthermore, they

concur that the background music used is suitable, capturing the attention of the target users without being distracting.

In terms of graphics, two experts agree that the navigation button design is attractive, and the graphics used in the Android application are visually appealing. However, one expert disagrees, suggesting that a more traditional button design related to cultural aspects would be more appealing and aligned with the application's theme. Similarly, two experts agree that the graphics used in the application are attractive and consistent with the application's theme, but one expert disagrees, citing a lack of traditional elements in the graphics. Regarding the background graphics, two experts agree that they do not distract the target users' focus. However, one expert suggests injecting elements of local culture to make the application more visually appealing and aligned with the theme. For 3D animations, all experts agree that the generated animations are clear. They also concur that the animation movements are smooth and have good resolution. Lastly, all experts acknowledge that the animations are visually appealing and appropriate.

Overall, the expert evaluations indicate positive feedback on the interface design elements, with some suggestions for improvements related to font choice, button design, and the inclusion of traditional elements in graphics. In the Interaction Design Analysis section, experts evaluated the interaction design using seven items. The goal was to assess the effectiveness of the interaction in the interactive application. The findings from the assessment are summarized in Table 6, showing the expert analysis of the interaction design.

Table 6: The Results of Expert Assessments in Interaction Design

Item	Statement	Frequency		Acceptance (%)
		Yes	No	
1	The navigation buttons in the main menu and technique menu function properly.	3	0	100%
2	The provided navigation buttons in each interface are easily recognizable for their functions.	3	0	100%
3	The navigation buttons are user-friendly and easy to control.	3	0	100%
4	The navigation buttons on each application screen led to the correct pages.	3	0	100%
5	The "Pause" button used for animations works well.	3	0	100%
6	The "Play" button used for animations functions properly.	3	0	100%
7	The "Repeat" button used for animations works well.	3	0	100%
8	The use of icons (home, exit, sound/silent mode, sub-menu) in the application is easily understandable for their functions.	3	0	100%
9	The application is user-friendly and easy to navigate.	3	0	100%
10	The positioning of icons is consistent on each page display.	3	0	100%
11	The "Yes" and "No" exit buttons function properly in the exit prompt.	3	0	100%

Based on the findings, all experts agreed that the navigation buttons in the main menu and technique menu functioned effectively. The navigation buttons provided on each interface were also easily recognizable by users, as indicated by the positive responses from the evaluators. The evaluators acknowledged that the navigation buttons were user-friendly. Furthermore, the item determining the functionality of the navigation buttons in each application screen successfully directed users to the correct pages, as agreed upon by the evaluators. Additionally, the evaluators agreed that the pause, play, and repeat buttons used for animations worked well. The icons for home, exit, sound mode, and sub-menu were also deemed easily understandable in their functions, as all evaluators responded positively to these items. Moreover, the evaluators unanimously agreed that the application was user-friendly, with consistent icon placement across all screen displays. Finally, all evaluators confirmed the effective functionality of the "yes" or "no" button on the exit screen.

3.3 Reviews and Feedback from the Expert

The expert evaluation for the Android application Basic Silat Techniques in the Art of Self-Defence received positive feedback. The developer will use the comments and suggestions from the experts to make improvements, as shown in Table 7 and Table 8.

Table 7: Content Design Expert Reviews and Feedback

Expert	Reviews and Feedback
Expert 1	<ol style="list-style-type: none"> 1. This application is a commendable effort to introduce the public to the basics of our national martial art, Silat. 2. The content within this application is concise, compact, and easily understandable. 3. It facilitates students' understanding of the subject matter independently.
Expert 2	<ol style="list-style-type: none"> 1. It is highly engaging and informative. 2. This application can overcome the limitations of a shortage of Silat instructors at present. 3. The community can learn Silat by downloading this application. 4. There are a few inconsistencies in the words or terms used for example (rectus abdominen) > (rectus abdominis). 5. An appropriate activity to improve flexibility is PNF (Proprioceptive Neuromuscular Facilitation).
Expert 3	<ol style="list-style-type: none"> 1. This application is suitable for use. 2. The content is precise and compact.

Table 8: Interface and Interaction Design Expert Reviews and Feedback

Expert	Reviews and Feedback
Expert 1	<ol style="list-style-type: none"> 1. Modify the autoplay on the displayed video
Expert 2	<ol style="list-style-type: none"> 1. Fix the application theme, for example: - <ul style="list-style-type: none"> • Malay background (songket) • Button elements should preferably use traditional objects. • Dagger-shaped cursor. • Customize colours to match the theme
Expert 3	<ol style="list-style-type: none"> 1. Text on the button: use a different font. 2. Exit menu yes or no, not related to the theme. Please change

3.4 Discussion

This section addresses three research issues which is design suitability, development method, and expert evaluation of the basic 3D animation application for Silat martial arts. The findings confirm that the application successfully addresses these research concerns.

3.4.1 Suitable Design for a 3D Animation Application on Basic Techniques of Silat, the Art of Self-Defence

Silat is a martial art taught in schools to foster personal integrity and address social issues among students. The development of the Silat basic techniques 3D animation application was driven by the need for interactive teaching tools. In line with the findings of the study by Ahmad *et al.* (2020), the ADDIE model guided the design and development process, ensuring a systematic and high-quality outcome. Storyboarding and interface design were used to position multimedia elements consistently (Tamrin and Azman, 2021). The positive feedback from experts indicates that the application successfully addresses the research question.

3.4.2 Development of a 3D Animation Application on Basic Techniques of Silat, the Art of Self-Defence

In developing this application, Adobe Illustrator was used for creating the graphics, while Adobe Animate was used for navigation buttons, 3D animation, and audio. Blender software was utilized for developing the main content, including 3D models and Silat animations. The development aimed to enhance learning and engagement. Challenges were faced with audio buttons, but they were resolved using coding and visual effects. Background music was added for a joyful learning experience. The text elements were carefully chosen for clarity, and font types and sizes were tailored to teachers and students. In line with Subramaniam *et al.*, (2018), that to ensure the text looks clearer, the use of contrasting text colours should be applied in the application. Overall, challenges were overcome with the help of supervisors, colleagues, and online resources.

3.4.3 Expert Assessment of the Functionality of the 3D Animation Application on Basic Techniques of Silat, the Art of Self-Defence

The evaluation by content and multimedia experts concluded that the app's content design aligns with the theme, with clear objectives and user-friendly tutorials and 3D animations for learning Silat techniques. The interface design received positive feedback for clear and smooth 3D animations, suitable resolution, and functional navigation buttons. Developers produce 3D animations based on the actual movements of Silat techniques to ensure that the content delivered is clear and correct. In line with the statement of Widjayanti *et al.*, (2019), that animation is an effective material that can convey learning clearly. Consistency and clear icons were emphasized for user-friendly interaction design. According to the statement of Anam and Abid (2020), users will find it easier to use an application if the application is consistent and has icons that have a clear function.

4. Conclusion

This paper aims to assist secondary school students, particularly those in the Silat co-curricular club, in improving their understanding of martial arts techniques. The interactive 3D Animation Basic Techniques of Self-Defence Silat app incorporates multimedia elements and allows for personalized learning and training. It has been evaluated in terms of content, interaction, and interface design, offering a user-friendly and engaging learning experience.

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