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Android-Based Halal Product Educational Game To Improve Student Skills In Learning Islamic Religious Education At School

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Abstract

Educational games are fun activities that contain educational content, which is considered very important. Knowing halal food is very important for a Muslim, so this should be introduced early, especially in elementary school. The aim is to form children's personalities who always prioritize halal things and are familiar with various halal products. This research aims to design and build an educational game application about halal products for young children, which will be run on the Android platform. The test results show: 1) Application functionality, tested using black-box testing, provides valid results. 2) Performance efficiency shows no memory leaks and CPU usage is stable between 7% - 17% after 9 seconds of use. 3) Application compatibility runs well on Android 7.0 Nougat to Android 10 devices.

Keyword: Technology, Android, Educational Games, Halal Products.

INTRODUCTION

The dynamic development of information and communication technology today has caused significant changes in various aspects of life, including education. On the one hand, this has a positive impact because educators can improve the quality of learning by utilizing technological facilities, such as obtaining various information and learning materials. However, technological advances pose challenges for educators, namely in using this technology wisely and choosing educative learning materials based on their students' moral and religious values (Hasbi et al., 2020). Today's generation of children lives in a very sophisticated digital world. Digital devices such as smartphones, tablets, laptops, smartwatches, or sophisticated browsers

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such as Google, Mozilla, Opera, and Internet Explorer have become part of this generation's daily life. It can be said that digital devices are part of the lifestyle in this era. The Indonesian Pediatrician Association (IDAI) calls this generation digital natives, namely children exposed to digital media since birth (Hasbi et al., 2020).

Today's rapid technological developments certainly impact learning at the elementary school level, affecting the material and how it is delivered. At this level of education, students are more interested in games that are easy to play but challenging, with a combination of colors, images, and animations that attract attention. Elementary school-age children tend to remember more about shapes in the form of objects or writing in books or digitally that have exciting combinations of colors and shapes that can attract attention and be fun (Putra et al., 2018).

Educational games are fun activities containing educational content (Sari et al., 2014), and their use is considered very important (Muhajarah & Rachmawati, 2019). This is in line with research by UN Pratama & Haryanto (2017), which shows that 91.02% of teachers and students have a favorable view of the use of educational games in learning, while 8.98% of respondents are less interested because games can have an addictive appeal. It makes the players addicted. According to Syamsuar & Refliyanto (2018), concepts such as the scientist's code of ethics, academic integrity code, and scientific ethics help build an environment that is conducive to the development of knowledge and morality in obtaining and utilizing that knowledge (Syamsuar & Refliyanto, 2018).

The educational game model was developed based on the principle of fun learning, where students will follow several instructions and game rules (Sanjaya et al., 2016). A game is a system or program in which one or more players make decisions by controlling objects in the game to achieve specific goals (Marlina et al., 2019). In other words, games are additional activities for classroom learning that provide positive and significant effects for students (Wolfman, 2013).

According to Computer Technology Research (Munir, 2012), people can remember 20% of what they see and 30% of what they hear. However, most people can remember 50% of what they see and hear and 80% of what they see, hear, and do simultaneously. Another advantage is its multisensory nature (it can be seen, heard, and done), which connects more senses simultaneously. This makes learning more effective and efficient in attracting attention and interest in learning and increasing motivation.

Multimedia comprises images, text, audio, animation, and video components. It allows users to process information verbally and visually (Mayer, 1997). This diversity of elements

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makes multimedia more interactive and exciting. Educational games can be presented on computers, tablets, laptops, and other portable gaming devices. This type of media is very interesting for children as a learning tool. This media is highly recommended for use in the classroom because it helps learning in a fun and visually exciting way (Laghos, 2010).

Early childhood is closely related to learning packaged in the form of games. At this age, learning emphasizes that children develop various skills through play (Akman & Özgül, 2015). Therefore, using digital educational games provides an interactive and fun learning experience and supports social interaction according to their developmental needs. First, children need stimulation to develop fine motor skills before reaching the cognitive realm. They can interact by touching the screen or pressing buttons, then learn skills such as understanding simple rules or making choices. This game can expand children's imagination and experience, create solutions, build knowledge, and form a digital play culture appropriate to their development.

Along with the increasing Muslim population in Indonesia, this country's halal food and beverage industry is also growing. Halal areas are clusters on a particular scale designated for halal industries. Consuming halal food and drinks is an obligation for Muslims and is a recommendation for believers to eat halal food (Subianto, 2018).

Current developments in science and technology in the food sector make determining halal or haram status increasingly complex. Processed food products, whose distribution is increasingly widespread, require an assessment of their halalness from raw materials and includes stages such as providing ingredients, processing, storage, packaging, distribution, sales, and product presentation. Therefore, adequate knowledge of Islamic legal guidelines or standards is required to determine the halal and haram of a product.

As the leading Muslim guideline in the Koran, Allah provides clear instructions regarding food and drink orders. This is found in the word of Allah in Surah Al-Baqarah verse 168 and Surah Al-Maidah verse 88. This verse teaches that it is essential for a person to consume halal food and drinks with nutritional benefits (Mardesci, 2013). Allah commands His servants to eat the halal and sound sustenance in this verse. Therefore, knowledge about halal food is essential for a Muslim. The importance of this also needs to be introduced from an early age, especially in elementary school, so that children can form a personality that prioritizes halal and learn more about various types of halal products.

Based on the background and literature studies that have been put forward, this research problem is formulated as follows: "What is the process of developing Android-based halal product game applications?" and "How to test the functionality, performance efficiency, and compatibility of Android-based halal product educational game applications?". From the

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formulation of the problem, the objectives of this research are: "Developing an Android-based halal product educational game application" and "Conducting functionality, performance efficiency, and compatibility testing of an Android-based halal product educational game application."

Previously, research had been conducted on Android-based halal product educational game applications, as carried out by Sanjaya et al. (2016) with the research title "Learning Application for Composing Verses as a Method for Memorizing the Al-Qur'an (Juz 30)". This research develops an application to make memorizing the Koran easier, which can be accessed from anywhere. This application has features that align with existing methods, such as the ability to read and listen repeatedly (muraja'ah).

For the development of this application, Macromedia Flash 8 Professional software was used for programming and creating animation, as well as Adobe Photoshop CS3 for editing images and text in the application. Total Video Converter changes the sound (audio) format, while Nero WaveEditor cuts or edits sound (audio) in .mp3 or .wav format. Creating this application can help simplify memorizing the Al-Qur'an.

Putra et al. (2018) conducted research with the title "Development of an Educational Multimedia Game About the Diversity of Typical Regional Cuisine in Indonesia for Class V Elementary School." This research aims to develop an educational game product that is attractive to learners and can provide motivation during the learning process so that learning objectives can be achieved without making users feel bored. This educational multimedia game is specifically for grade 5 elementary school students on theme six about "Typical Foods from Various Regions in Indonesia." The research method used is Multimedia-Based Instructional Design. Based on the validation results, this educational game has proven valid in its use as a learning medium. The trials show that this media is suitable and appropriate for learning. This educational game has several advantages, such as attracting interest and providing motivation to deliver learning material so that the learning process is exciting and students feel happy using this application.

Andika et al., (2015) conducted research entitled "Design and Creation of the Adventure Game Application 'Gatotkaca in the Baratayuda War.'" This game offers a cultural story factor that allows players to master the storyline. This game was developed using Adobe Flash. The results of the research show that players feel satisfied playing the adventure game "Gatotkaca Dalam Baratayuda War" because there are different game patterns at each level.

Mobile applications are software designed to run on tablets or smartphones (Edy et al., 2014). According to Suyanto (2003), games refer to a type of game or competition. Games can

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be structured or semi-structured activities, often played for fun and sometimes used as an educational tool. Education or upbringing involves accumulating knowledge and skills through a learning process or instruction to understand reality or a particular situation. This approach encourages self-direction, actively sharing information, and generating new ideas (Uha, 2002). Educational games are learning media that aim to educate, where their use can stimulate the user's creative thoughts. This type of game is generally aimed at children, where the color aspect is more important than the level of difficulty (Hanafri et al., 2015). The Android operating system develops this educational game application for Halal products. According to Bagus and Krisnawan (2014), Android is a platform for mobile devices based on Linux. Game Engine is software created to develop and create video games (Pratama, 2014).

METHOD

This research will produce a product application. In developing this application, computer hardware was used with Intel Pentium Gold G5400 Processor specifications, 8GB RAM, 128GB SSD storage, and several other supporting hardware. The software used includes the Windows 10 operating system, Adobe Photoshop CC 2017, Corel Draw X5, JDK (Java et al.), Microsoft Office 2016, Visual Studio, SDK (Software Development Kit), and Unity 2018. This research has a systematic plan, flow and work steps that have been carefully prepared as seen in Figure 1.

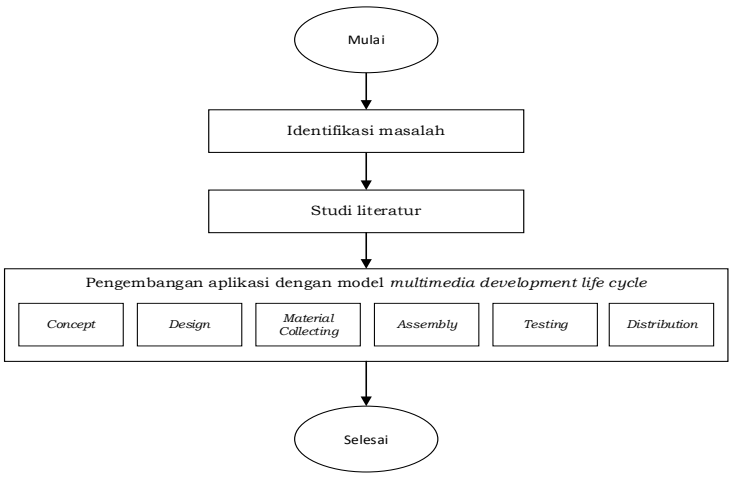


Figure 1. Research Work Steps

a. Identification of problems
   At this stage, the research problem is identified and the boundaries of the problem to be discussed in the research are determined.
b. Study of literature

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At this stage, information is collected as a theoretical basis for research. The literature in question can come from journals, books, online articles, and other sources relevant to the research topic. Apart from that, this stage also includes searching for information regarding the impact and benefits of developing this application in the future.

c. Application Development Process

In developing the planned educational game application (Halal Product), the development method used is the Multimedia Development Life Cycle (MDLC). In this method, there are stages of Concept, Design, Material Collecting, Assembly, Testing, and Distribution.

The data collection method used is literature study, which involves collecting data from various library sources, reading, taking notes, and managing research materials. A questionnaire was also used to evaluate the application's testing functionality and user acceptance of the educational application being developed. The data sample for the Halal Product application acceptance questionnaire was grade 5 students at SDIT Nurul Ilmi Jambi, totaling 21 students, as respondents in this research.

RESULTS AND DISCUSSION

This research is software development research that adopts the MDLC (Multimedia Development Life Cycle) development model, which involves stages such as Concept, Design, Material Collection, Assembly, Testing, and Distribution. After completing the application development, the next step is to test the software quality using the black box testing method. Apart from that, performance efficiency and compatibility testing were also carried out for the educational game applications that had been built. The design of the navigation structure and use case diagram of this Halal Product educational game application is in pictures 2 and 3.



Figure 2. Navigation Structure

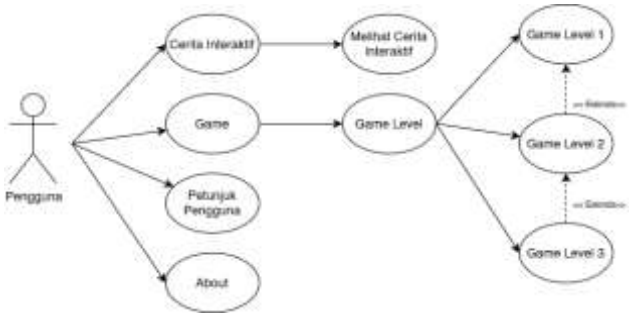


Figure 3. Use Case Diagrams

Development of a Halal Product educational game application based on the planned

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navigation structure and use case diagram. The following is a display of the results of the Halal Product educational application. Figure 4 shows the main page of the Halal Product educational game application, which contains a menu of interactive stories, games, information about the application, and instructions for use. In Figure 5, you can see the story page containing interactive story content about Halal Products with narration and animation. Figure 3 shows the game page with three levels (level 1 to level 3). Each level offers different challenges to the user



Figure 4. Main page



Figure 5. Game Folder Selection Page

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Figure 6. Games Page

Table1. Blackbox testing results

Cases and Test Results			
Action/input data	**Which are expected**	**Succeed**	
		Yes	**No**
Interactive Story Button	Move to the Halal Products story page	4	
Game Button	Moves to the game level selection page	4	
About button	Displays a pop up about	4	
User Guide Button	Displays a pop up user guide	4	
Home button	Move to the main menu page	4	
Level 1 Button	Move to level 1 obstacle page	4	
Level 2 Button	Move to level 2 obstacle page	4	
Level 3 Button	Move to level 3 obstacle page	4	
Player Control Button Right Way	Player moves to the right	4	
Left Road Player Control Button	Player moves left	4	
Player Control Button Jump	Player makes a jump	4	
Next Story button	Moving on to the next storyline	4	
Prev Story Button	Moving on to the previous storyline	4	
Repeat Story Button	Moving on to the first storyline	4	
Next Level button	Move to the next level obstacle page	4	
Game Repeat button	Displays game obstacles based on previously	4	

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	run levels	
Game Menu Button	Displays to game menu to select level	4

After the educational game application is created, functionality testing is carried out using black box testing. Based on the results of the functionality testing, all functions in the Halal Product educational game application run well and meet the expectations set. The results of this functionality testing are in line with research conducted by (Rozi & Kristari, 2020; Fajri, 2020 Septian, Hidayat, and Rahmatulloh, 2018), where they also tested the functionality of the application they developed and obtained results that were as expected.

In performance efficiency testing, CPU usage and RAM memory are two things that will be observed. When testing performance efficiency, the author uses Firebase Test Lab.

1. Memory

   From the results of performance efficiency testing carried out using the Firebase test lab, it can be seen in Figure 7 that RAM usage increases when the game application is opened and loads data in the time range of 0 to 15 seconds. After 15 seconds, RAM usage stabilizes, ranging between 200kb to 300kb. Memory usage on original Android devices shows an average RAM usage of around 200KB, with maximum RAM usage reaching 90MB. Comparatively, figure 8 shows that the difference in memory usage between Firebase Test Lab and native Android is insignificant, with an average of around 200KB.

   Memory leak or memory leak is one factor that can reduce an application's performance (Aditya, 2013). This occurs when the application does not manage memory allocation properly, which can cause problems such as forced closing of the game. From the results of the tests carried out, it can be seen in Figure 40 and Figure 41 that there was no memory leak or sudden stop (force close) in the efficiency performance test of the Android-based Halal Product educational game application.

2. CPU

   The results of efficiency performance testing in terms of CPU usage can be seen in Figure 9. From the efficiency performance testing carried out using the Firebase Test Lab, it can be seen that CPU usage reaches its peak between 7 seconds and 9 seconds, at which time the CPU almost reaches 27%. After that time, CPU usage was in the 7% to 17% range.

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Figure 7. Memory usage



Figure 8. Memory usage



Figure 9. CPU Usage

Based on the results of testing memory usage in the Halal Product application, it was found that memory usage was in the range of 200kb-300kb, and there was no memory leak. Meanwhile, the CPU usage test shows the highest value of 27%. From these results, it can be concluded that the performance efficiency testing has met the expected standards. This conclusion is based on research conducted by (Rozi & Kristari, 2020), who found that their application had a CPU performance of 55% and did not consume large amounts of memory and CPU, so it did not interfere with the performance of other applications. The results of performance efficiency and compatibility testing are in line with research conducted by (Rozi & Kristari, 2020; Ridwan & Prasetyawan, 2017), who carried out similar tests on the applications they developed. Researchers conducted application compatibility tests by installing applications from Android devices version 7.0 Nougat to Android 10.

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Table2. Compatibility Testing Results

No	Type		OS version	Results	Installation Process
1	Huawei Mate 9 (Firebase Test Lab)		Android 7.0 Nougat		Installation successful
2	Sony Xperia XZ3 (Firebase Test Lab)		Android 9.0 Pie		Installation successful
3	Samsung J4		Android 10		Installation successful
4	Redmi A5		Android 8.0 Oreo		Installation successful

After all stages of application testing have been completed and the application is running well, researchers evaluate the user's acceptance of the application. The evaluation was conducted by giving questionnaires to 21 respondents, namely class V student Nurul Ilmi. This questionnaire was adopted from previous research by Ahsanur Rafiq (2017), who developed a mobile-based game application to recognize Hijaiyah letters using Construct 2, using a Likert scale. The questionnaire covers three variables: application appearance, application purpose, and ease of use. The recapitulation results of student answers can be seen in Table 3.

Table3. Application acceptance testing data

		Score	Amount	Total X Score
App View	Strongly agree	5	45	225
	Agree	4	39	156
	Hesitant	3	0	0
	Don't agree	2	0	0
	Strongly Disagree	1	0	0
	Total Score			**381**
Application Purpose	Strongly agree	5	16	80
	Agree	4	34	136

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	Hesitant	3	13	39
	Don't agree	2	0	0
	Strongly Disagree	1	0	0
	Total Score			**255**
User Ease ***(User Friendly)***	Strongly agree	5	33	165
	Agree	4	30	120
	Hesitant	3	0	0
	Don't agree	2	0	0
	Strongly Disagree	1	0	0
	Total Score			**285**

User Interface (UI) is an interface that allows users to interact with a game. Every element, including images, text, instructions, and menus, is part of the interface (Nunung et al., 2019). Evaluation of user acceptance of the application display shows a total score of 381 from 4 statements. The optimal score will be obtained if all respondents answer "Strongly Agree" with a score of 5, so the maximum score that can be obtained is 420 (calculated from the number of respondents, number of statements, and the highest score answer: 21 x 4 x 5 = 420). This result is then calculated as a percentage as follows.

$$\text{Percentage} = \frac{Skor\ Total}{Skor\ Maksimal}\ x\ 100\%$$

$$\text{Percentage} = \frac{381}{420}\ x\ 100\%$$

$$\text{Percentage} = 90,7\%$$

A score of 255 was obtained from the three statements to evaluate the application objectives. The maximum score that can be obtained is 315 if all respondents answer "Strongly Agree" with a score of 5, calculated from the number of respondents, number of statements, and the highest score answer: 21 x 3 x 5 = 315.

$$\text{Percentage} = \frac{Skor\ Total}{Skor\ Maksimal}\ x\ 100\%$$

$$\text{Percentage} = \frac{255}{315}\ x\ 100\%$$

$$\text{Percentage} = 80,9\%$$

User-friendliness refers to the ease of use of a tool or application (Anisa et al.. Saiful Bahri, 2019). A user-friendly interface is an interface that helps users, is easy to learn, and is easy to use (Murtado, 2011). Evaluation of the ease of use of this application resulted in a total score of 285 from the three statements given. The maximum score that can be obtained is 315 if all

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respondents answer "Strongly Agree" with a score of 5, calculated from the number of respondents, number of statements, and the highest score answer: 21 x 3 x 5 = 315.

Percentage = $\frac{Skor\ Total}{Skor\ Maksimal}\ x\ 100\%$

Percentage = $\frac{285}{315}\ x\ 100\%$

Percentage = $90,5\%$

Based on the test results, a percentage of 90.7% was obtained for application purposes, 80.9% for application purposes, and 90.5% for user-friendliness. After expressing it in percentage form, the next step is to analyze and conclude the feasibility value using a percentage-based assessment scale (Arikanto, 2009).

Table4. Rating Percentage Scale

No.	Category	Mark
1	Very worthy	81% - 100%
2	Worthy	61% - 80%
3	Decent enough	41% - 60%
4	Not feasible	21% - 40%
5	Not really worth it	< 20%

From these results, a quality evaluation can be obtained from the Android-based Halal Product application acceptance testing, as shown in Table 5 below:

Table5. Quality Scale Results

App View	90.7%	Very Worth It
Application Purpose	80.9%	**Very Worth It**
User Ease (user friendly)	90.5%	**Very Worth It**

CONCLUSION

Based on the discussion outlined in the results of this research, conclusions can be drawn regarding the design and development of Android-based Halal Product educational game applications as follows: The Halal Product educational game application was developed using the Multimedia Development Life Cycle (MDLC) development model which consists of six stages as follows: Concept stage, where the educational game application system is defined including the concept and gameplay to be implemented. The design stage involves creating storyboards,

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navigation structures, use case diagrams and activity diagrams for game applications. The material collection stage involves collecting materials such as images and audio that will be used to create Halal Product educational game applications. In the assembly stage, all objects or multimedia materials are combined into a game application. In the testing stage, functional testing is carried out using black-box testing techniques to validate the application function as expected. Efficiency and compatibility performance testing was carried out using the Firebase test lab. Distribution stage, where the Halal Product educational game application is produced in .apk format, which can be installed on Android smartphones. After that, an evaluation is carried out to ensure whether the game application that is built is as expected. The game application was tested to evaluate user acceptance of the Halal Product educational game application.

The results of testing the Halal Product educational game application are as follows: Functionality testing was carried out using black-box testing with a test case involving four testers. The results show that all test cases were executed according to the predetermined scenarios, indicating that the application features ran as well as expected. Performance efficiency testing using the Firebase test lab shows no memory leak, and CPU usage after 9 seconds is up and down between 7% and 17%. Compatibility testing also uses the Firebase test lab, and the results show that the application can run smoothly on devices with the Android operating system version 7.0 Nougat to version 10. Evaluation of the acceptance of the Halal Product educational game application shows that out of a total of 21 student respondents, the application was assessed as follows: appearance the application got 90.7% (Very Decent), the application goal got 80.9% (Very Decent), and user-friendliness got 90.5% (Very Decent).

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