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Innovative Learning Media: Interactive Game of Waste Management with Construct 2 Based on Mobile (Android)

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Abstract: The waste problem in Depok is getting worse with the volume of waste at the Cipayung landfill that has exceeded capacity. The lack of public awareness, despite the already existing regulations and sanctions, exacerbates this situation. The research to create an Android-based waste management learning game application for children aged 7-12 years to increase awareness of waste management in a shorter game usage time to make it interesting to use. The learning game application manages waste using android-based construct 2, including learning materials, practice questions, waste sorting, and river cleaning with an interactive and attractive display. The method used is the Multimedia Development Life Cycle (MDLC) which includes the stages of conception, display, material collection, manufacturing, testing, and distribution. Waste management learning game applications are effective in educating children about the types of waste and how to manage them. From the testing of 3 smartphones containing 16 features, the average total time on the Samsung A3 Smartphone brand is 4.32 minutes, Realme 5 Pro is 3.31 minutes and Redmi Note 10 Pro is 2.18 minutes. It is evident that all the features of the game can work properly, despite the difference in total response time caused by the device specifications.

Keywords: Construct 2, Interactive Game, Android

INTRODUCTION

Garbage is a big problem for Indonesia, especially in the city of Depok.Volumewaste at the Cipayung Final Disposal Site (TPA), Depok, has exceeded its capacity or holding capacity. Head of the Regional Technical Implementation Unit (UPTD) of the Cipayung TPA, Arda Kurniawan said that ideally the TPA's capacity is 1.3 million cubic meters. However, whenvolumewaste has reached 2.5 million cubic meters. This problem occurs because of the lack of concern of each person to throw away waste in its place. Awareness of throwing away waste in its place is still lacking even though there are many slogans without waste, even sanctions for those who violate or who throw away waste in the wrong place. In accordance with Depok City Regulation Number 5 of 2014 concerning Waste Management, every school has taught its students to throw away waste in its place, but

there are still many who do not care about the environment by throwing away waste in its place. Children's habits in maintaining the environment and maintaining cleanliness must be instilled from an early age, but it is not easy to get used to being applied to the environment, therefore the applicationgamelearning in managing organic, inorganic and B3 waste tries to be a solution to the importance of a healthy and clean environment free from waste.

Learning in it. Of course it has a negative impact, namely children tend to be lazy to learn and only like to play. Multimedia technology is chosen so that the learning material delivered is more interactive, can be easily understood and increases interest in learning. For life, technology is useful for making it easier for humans to know and get new things about communication and information. Applications that are suitable for children are learning game applications, which contain elements of the learning material. Applicationsgamelearning provides an indirect learning process that occurs because it occurs when children play, so that the learning process will be more interesting and enjoyable.

Application gameWaste management learning is designed to provide children with knowledge about the types of waste in their environment, supported byperformance speed gamewhich is played in the form of a multiple-choice quiz and will get a score if you answer the question correctly. If the player answers incorrectly, they have to repeat it. Therefore, the author uses softwareConstruct 2which is one of the software that is widely used to create applications. gamelearning, thus can foster concern for the environment from an early age and indirectly help government programs in handling waste problems. Applicationgamewaste management learning is poured into a computer-based operating systemmobile android.

RESEARCH METHOD

The use and combination of images, sound, audio, animation in multimedia attracts many children or students' interest in learning. Multi media is also able to facilitate the delivery of certain materials to students. The method used in the study is to use the Method*Multimedia Development Life Cycle (MDLC).*The following are the stages in*Multimedia Development Life Cycle* which is in figure 1.

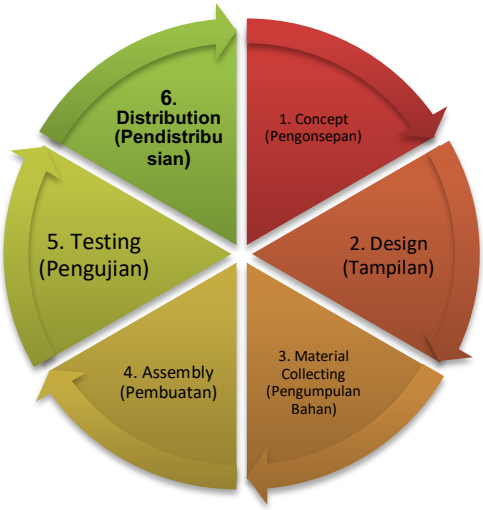

Figure 1. Method*Multimedia Development Life Cycle (MDLC).*

1. *Concept*(Conceptualization) Create stages to determine the objectives and identify the application users and the concept of the application to be created. At this stage*User*Those who use it are children aged 7 to 12 years or elementary school education.
2. *Design*(View) At the stage of creating specifications regarding the project architecture, style, appearance, and material requirements for the project. Creating navigation structures and*Storyboard*.
3. *Material Collecting*(Collection of Materials) The stage of collecting materials that are in accordance with the needs of the work being done. Creating and searching for supporting materials for the application*game*learning including images, audio, animation.
4. *Assembly*(Manufacture), the stage of making materials that have been collected based on the manufacture that has been arranged at the design stage, namely based on the navigation structure and*Storyboard*.
5. *Testing*(Testing) Test each page and the resulting button functions, if any.*malfunction*the application will be fixed first.
6. *Distribution*(Distribution) application stages are stored in a storage medium. Stages can also be called evaluation stages for the development of finished products to make them better. Evaluation results can be used as input for the stage*Concept*on the next product. However, the method stages are only carried out up to Testing because the application is not disseminated to the general public.

RESULT AND DISCUSSION

Application *game*waste management learning made for children aged 7 - 12 years based on*android*which contains material on recognizing types of waste according to their place, multiple choice quizzes. children will get a score based on the answers given by the user, if the user answers correctly, the user will get a score, but if the answer is wrong, then they will not get a score. For scores below 80 users must retake the quiz and for above 80 it is successful in passing the quiz. Playing by sorting waste users must*drag* (drag) and *drop*(put) the rubbish in its place, playing clean the river is a bit difficult because the rubbish flows in the river, time goes backwards and if the rubbish...*drop*(throw it) in the wrong trash it can reduce*score*.

Mixed Navigation Structure On*User*

Navigation structure*User*explains that at the moment*User*open the application, the initial display is opening The user is directed to the home page, after starting to enter the home page on the home page there are options such as info, profile, learn, play, and exit. For users before using the application, it would be good to choose info because they know the application information. Next, the user chooses a profile to get to know the admin. There is a learn option to find out material about garbage that is useful for playing. Next, there is a play option to practice learning practice questions, playing sorting garbage, playing cleaning the river. There is an option to exit to end the application. Navigation structure*User*on the application*game*learning to manage waste can be seen in Figure 3.

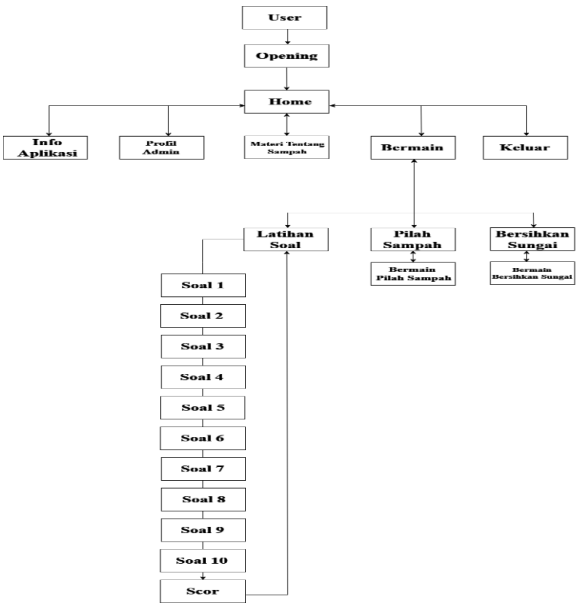

Figure 2. Mixed Navigation Structure On*User*

Mixed Navigation Structure On Admin

The admin navigation structure starts from Admin login to*construct 2*, then it will go to the opening, continue to the home page on the page*home*Admin can access five pages, namely: info, admin profile, learn, play, exit, and admin can add, change and delete.*object, asset*which has been created. Admin navigation structure on the application*game*learning to manage waste can be seen in Figure 3.

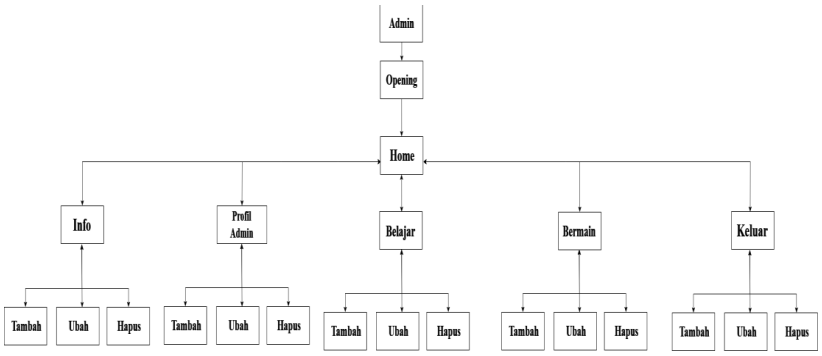

Figure 3. Admin Mixed Navigation Structure

Use CaseDiagram OnUser

*Use Case*diagram on*User*shows that after*User*open the application (*Opening*), The user will be taken to the main page (*Home*). From the page*home, User*can access various features such as application information, admin profile, exit the application, learn, and play. Each of these features is expanded from the page*home*, indicating that they are part of a menu or feature available on the page.*home* application. *Base Use Case* That *home*, So *extend*is an extension of the function*Use Case home*. For *home*The extension is application info, admin profile, exit, learn, play. The difference with*include, extend Use Case*does not need to be done first because of the expansion of the function of*home*, we can not do everything, just do some or do just one depending on our needs. *Use Case diagram User* can be seen in Figure 4

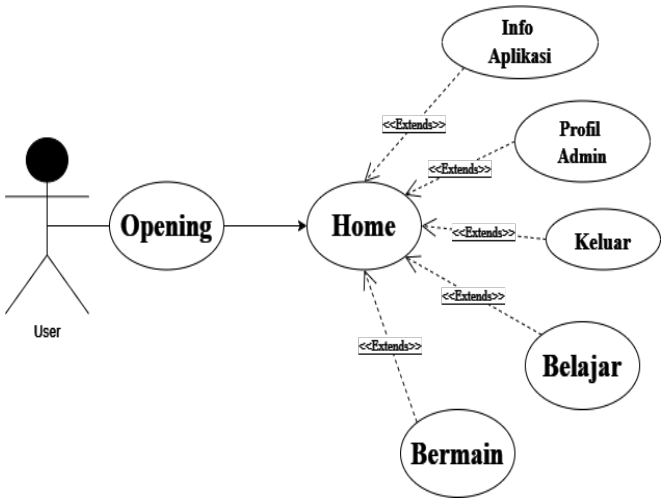

Figure 4. *Use Case Diagram* On *User*.

Use Case DiagramOn Admin

*Use Case*diagram on admin relationship <<*include*>> shows that the three specific activities are part of the overall application management process performed by the admin. The diagram helps visualize how the admin interacts with the system in terms of application feature management.*Use Case*The admin diagram can be seen in the Figure. 5.

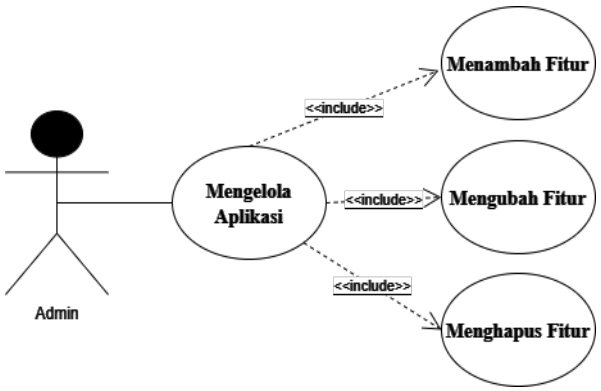

Figure 5. *Use Case*Diagram On Admin

Activity Diagram User

On *Activity Diagram User* application, describing the sequence of actions that may be performed*User* when trying to open and use the application.*User* select the play, info, profile, exit, learn, and play buttons.*User* can interact with the application using the available buttons, and the system will respond to the actions taken by the user.*User* according to the selected button.*User* can return to page*home* by clicking the button*home* and cross(on *pop up* admin profile).*Activity Diagram User* The application only shows the basic process of opening and using an application. The

actual process may be more complex and involve many decisions. In*Activity Diagram User* The application can be seen in Figure 6.

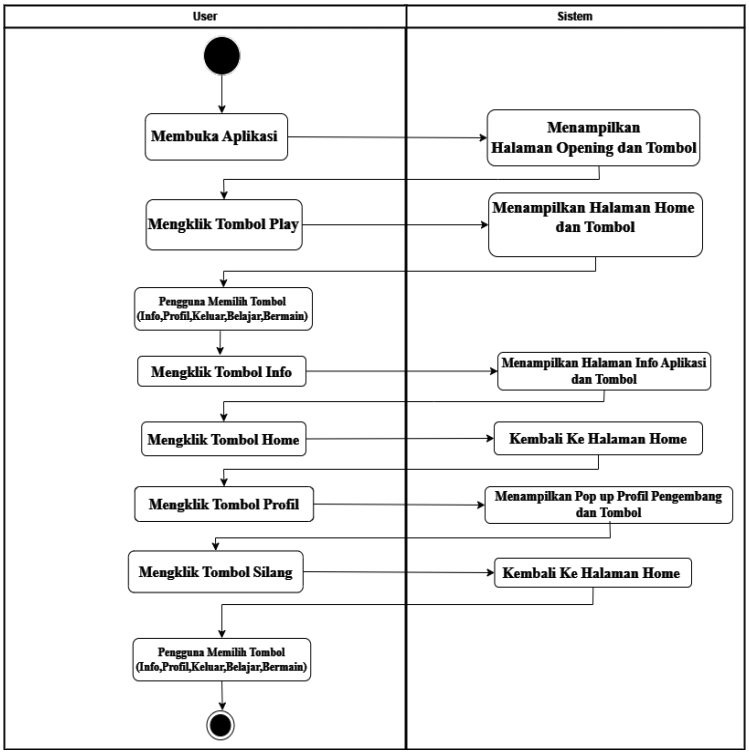

Figure 6. *Activity Diagram User*

Activity Diagram User Selecting Practice Questions

On *Activity Diagram* practice questions, *User* choose a question exercise, describing a possible sequence of actions *User* when trying to play practice questions, the game involves learning to practice answering questions. Explanation of the flow,*User* start by clicking the "Practice Questions" button, the system will display the question page and answer buttons,*User* read the questions carefully to understand the questions being asked and*User* select the correct answer by clicking the appropriate answer button (A, B, C, or D), the system will check the answer*User* by displaying the score and back button,*User* clicking the back button, the system will display the play menu, and*User* can re-select the practice questions button, sort the trash, and clean the river.*Activity Diagram* practice questions can be seen in Figure 7.

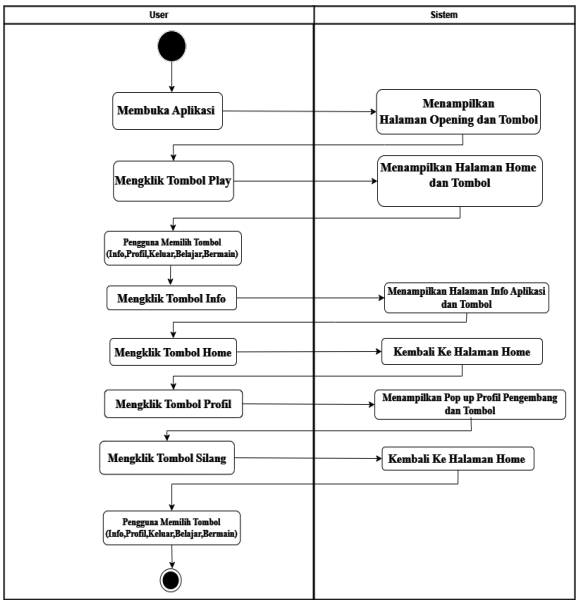

Figure 7. *Activity Diagram User*Selecting Practice Questions

Activity Diagram UserSelecting Waste Sorting

On *Activity Diagram* sort garbage, *User* choose the trash, describe the sequence of possible actions *User* when trying to play sorting trash, the game involves moving trash to designated trash bins based on its type. Explanation of the flow, if*User* move the trash to the correct trash can, the system will provide a particle effect that confirms that the trash entered is correct, if*User* moving trash to the wrong trash can, the system will notify by giving an effect*sound* wrong and return the trash to the grass. After*User* After sorting the trash, the system will display the message "Game Over", and there is a "back" button. By clicking the back button,*User* will return to the page*home* and can select the practice questions, sort, trash, or clean the river buttons.*Activity Diagram* sorting garbage can be seen in Figure 8.

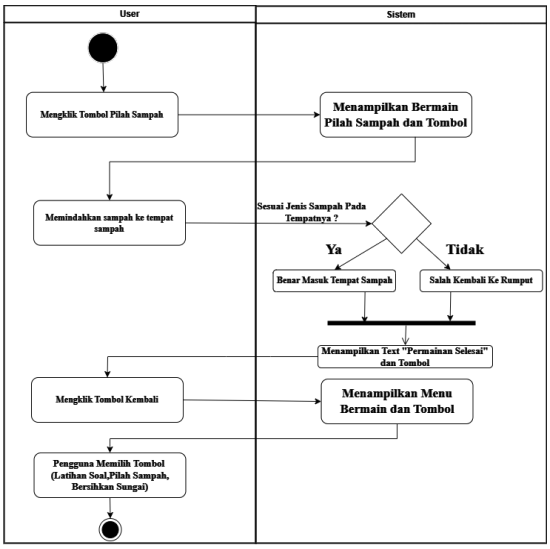

Figure 8. *Activity Diagram User*Selecting Waste Sorting

Layout dan Event Sheets Home

After finishing making*Layout* opening, the next thing to do is make*Layout* And *EventSheets Home*, change "*Layout* 2" becomes "*Home*" And "*Event Sheets* 2" is also changed to " *EventSheets*_Home". After that right click then select "*Insert new object*", then select the general section "*Sprite*" to enter one by one *object* pictures. Enter one asset at a time *object*starting from the background, application logo, buttons and others, which have been collected in the asset folder, into "*Sprite*". The quick way is to drag*object* images from the computer folder to construct 2. The images that have been*import* to construct 2 then arrange the position according to the design that has been designed. There are additional ones for*pop up* profile and exit the application there is a shadow of how to right click out of size *Layout*, then select "*Insert new object*", choose *sprite* again, the next box will appear, color it with*tool fill* black color. After that measure the size according to*Layout*, then in the properties section the opacity is changed to 80 to display the shadow effect when the user clicks on the admin profile and exits the application. The creation of the opening can be seen in Figure 9.

Figure 9. *Layout dan Event Sheets Home*

Layout dan Event Sheets Play Menu

After finishing making*Layout* learning, the next thing to do is make*Layout* And *EventSheets* play menu, change "*Layout* 5" becomes "play" and "*EventSheets*3"also changed to" *EventSheets*_Play Menu". After that right click then select "*Insert new object*", then select the general section "*Sprite*" to enter one by one *object* pictures. Enter one asset at a time *objects*tarting from the background, buttons and others, which have been collected in the asset folder, into "*Sprite*". The quick way is to drag*object* images from the computer folder to construct 2. The images that have been imported to construct 2 are then arranged according to the design that has been designed. The creation of the game menu can be seen in Figure 10.

Figure 10. Layout and Event Sheets Play Menu

Layout dan Event Sheets Practice Questions 1-10

After finishing making*Layout* play menu, the next thing to do is create*Layout* And *EventSheets* exercise questions 1-10, change "*Layout* 6" becomes "Question 1" and "*Event Sheets* 6-16" is also changed to "Question1-10_ES". After that, right click then select "*Insert new object*", then select the general section "*Sprite*" to insert one image object. Insert one asset *object*starting from the background, question images in png format, buttons and others, which have been collected in the asset folder, into "Sprite", then right click again and select*insert new object text* And *sprite font*+ for information statements about scores and how to play. The quick way is to drag*object* images from the computer folder to construct 2. The images that have been imported to construct 2 are then arranged according to the design that has been designed. There is an additional way to right-click outside the size*Layout*, then select "*Insert new object*", the next box will appear, select the sprite, don't just color it transparently, which will be used as an area to click when answering, the area is adjusted according to the length of the answer options, the book gives the transparent object a name, which is 1A, which indicates that 1 is for question 1 and A is for option A, and gives*object* transparent 1 is for options b, c, and d. It is recommended not to copy it because we will make it*object* which will be different later. Then it is done thoroughly until*Layout* question 10. The making of question practice can be seen in Figure 11.

Figure 11. *Layout* Exercise Questions

Layout dan Event Sheets Sort the Trash

After finishing making*Layout* question, the next thing to do is to make*Layout* And *EventSheets* sort the trash, change it"*Layout* 18" becomes "Separate Garbage" and

"*Event Sheets* 18" is also changed to "*EventSheets*_Sort Trash" After that right click then select "*Insert new object*", then select the general section "*Sprite*" to enter one by one *object* pictures. Enter one asset at a time *object*starting from the background, buttons and others, which have been collected in the asset folder, into "*Sprite*", then right click again select *insert new object text* And *sprite font*+ for information statements about how to play and the game is finished. The quick way is to drag*object* images from the computer folder to construct 2. The images that have been imported to construct 2 are then arranged according to the design that has been designed. Add*particles* how to right click*insert new objec*t find *particles* no *spawner* select the brush size 50 hardness 10, to have an effect when inserting the trash in its place. The process of sorting trash can be seen in Figure 12.

Figure 12. *Layout* Sort the Trash

Layout dan Event Sheets Scor_Question

After finishing making*Layout* question, the next thing to do is to make*Layout* And *EventSheets scor*_question , change "*Layout* 17" becomes "*Scor*" And "*Event Sheets* 17" is also changed to "Scor_LS", After that right click then select "*Insert new object*", then select the general section "*Sprite*" to enter one by one *object* pictures. Enter one asset at a time *object*starting from the background, buttons and others, which have been collected in the asset folder, into "*Sprite*", then right click again select *insert new object text* And *sprite font*+ for information statements about scores, passing and retaking. The quick way is to drag*object* images from the computer folder to construct 2. The images that have been imported to construct 2 are then arranged according to

the design that has been designed. The creation of question scores can be seen in Figure 13.

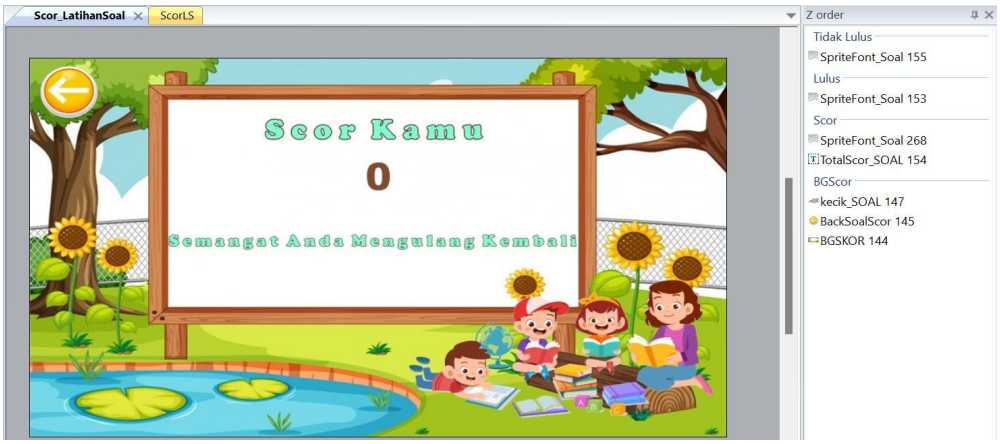

Figure 13. *Layout* Score

Testing

In testing***black box***, the test results on different smartphone brands, show that all buttons and features have functioned well, thus providing an optimal user experience. The test results can be seen in Table 1 below:

Table 1. Comparison of Testing Duration On *Smartphones*

No	Testing Features	Time (Duration)			Test Results
		Realme 5 Pro	Redmi Note 10 Pro	Samsung A32	
1.	Knob *Music*	0.12 seconds	0.11 seconds	0.20 seconds	Works
2.	Play Button	0.15 seconds	0.16 seconds	0.56 seconds	Works
3.	Info Button	0.13 seconds	0.14 seconds	0.52 seconds	Works
4.	Home Button	0.13 seconds	0.19 seconds	0.58 seconds	Works
5.	Profile Button	0.14 seconds	0.15 seconds	0.33 seconds	Works
6.	Cross Button	0.34 seconds	0.12 seconds	0.32 seconds	Works
7.	Learn Button	0.23 seconds	0.15 seconds	0.23 seconds	Works
8.	Right and Left Buttons	0.15 seconds	0.12 seconds	0.13 seconds	Works
9.	Play Button	0.23 seconds	0.10 seconds	0.15 seconds	Works
10.	Practice Questions Button	0.15 seconds	0.12 seconds	0.19 seconds	Works
11.	Button A B C D	0.14 seconds	0.9 seconds	0.10 seconds	Works
12.	Back Button	0.16 seconds	0.10 seconds	0.13 seconds	Works
13.	Trash Sort Button	0.17 seconds	0.11 seconds	0.17 seconds	Works
14.	Clean River Button	0.25 seconds	0.11 seconds	0.35 seconds	Works
15.	Restart Button	0.14 seconds	0.11 seconds	0.18 seconds	Works
16.	Exit Button	0.17 seconds	0.12 seconds	0.18 seconds	Works
	Total Time	**3.31 minutes**	**2.18 minutes**	**4.32 minutes**	

Test three*smartphones* : Samsung A32, Realme 5 Pro, and Redmi Note 10 Pro, showing different times to click all buttons in the app. All tests were successful, meaning the app works well on all devices. The time difference could be due to specifications, software optimization, and operating system. Redmi Note 10 Pro shows the fastest total time, as it has better specifications. Educational game app rating in the category**"Very good"**usually covers several aspects, including response time, session duration, and learning efficiency. Here are some time indicators commonly used to determine whether an educational game is included in the "Very Good" category, especially in terms of time can be seen in table 2 below:

Table 2. Assessment of Educational Game Applications in the Very Good Category

Time	Duration	Information
Application Response	< 1 second	Response to user input (clicks, touches, voice commands) should be fast so as not to disrupt the learning experience.
Loading Time	< 2–3 seconds	Educational game apps that take too long to load can make children or users impatient and lose interest.

CONCLUSION

The waste management learning game application using android-based construct 2 has been successfully created. The waste management learning game application is effective in educating children about the types of waste and how to manage it. From testing 3 smartphones containing 16 features, the total time for each brand is as follows:Smartphone Samsung A3is 4.32 minutes,Realme 5 Prois 3.31 minutes andRedmi Note 10 Prois 2.18 minutes. It is proven that all game features can function properly, although there are differences in total response time on each smartphone brand caused by device specifications.

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