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## **REDISCOVER STORY OF MUHAMMADIYAH THROUGH 3D GAME BY APPLYING GAME DEVELOPMENT LIFE CYCLE**

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### **Abstract**

*Though specifically in Indonesia, Muhammadiyah is already well known but there are still some who do not know their history. This makes people that do not know about Muhammadiyah and the history behind it to make unfounded assumptions about the Islamic refined organization. The purpose is to make an educational game based on Muhammadiyah Museum to further increase the wisdom of players about Muhammadiyah's history and also to remember and know the history behind each artifact is visualized in form of a game to increase the player's knowledge. The game development for players will be developed using the Game Development Life Cycle (GDLC) methodology and mostly the modelling technique that will be used is mesh modelling technique in Blender. Each step of this methodology is fitting for the game development and the step might be skipped or swapped according to the needs of research. There are 2 black box tests conducted, the first black box test that has 15 functions result is 47% in accordance with several bugs found which was fixed in the second black box test that resulted 87% in accordance, 13% not in accordance because of the feature was not yet implemented but listed in the main menu. The second test conducted which results and practicality of this educational game using the System Usability Scale (SUS) which consists of 10 instrument statements were scored 85.3 which means that this educational game was declared excellent and acceptable.*

**Keywords:** Muhammadiyah, Game(s), Exploration, Quiz, Unity, Blender, GDLC, Education, SUS

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### **INTRODUCTION**

Video games, or simply called games, is a form of exemplar interactive experiences, and this straight player control over the form and content of on-screen information is one of the many causes that games are such entertaining and significant experiences for players [1]. One of the problems in educational game involves in whether the player of the game has improved critical thinking skills or not. There has been research done and it is indeed true when the player played the game, the critical thinking skills have been improved by exactly 11.77% [2]. One of the previous research is about Bandung Geology Museum educational 2D game in Android, which covers learning and educational form through virtual visit of elementary schooler, middle schooler, and visitors with the form of real mineral rocks pictured in the game with quizzes and puzzles that are played with scores as the base game form. After conducting tests about the 2D game, the respondents shows that a total of 90% the game is functional and shows improvement in learning about mineral rocks[3]. The other research that is the visualization of Muhammadiyah museum artifacts using augmented and virtual reality which covers the artifacts of the Muhammadiyah museum and turned them into 3D forms that can be accessed through virtual reality device and augmented reality by using smart phones. The research used Multimedia Development Life Cycle (MDLC) as the method which achieved 74.92% in system usability scale[4].

Muhammadiyah is an Islamic refined organization that has had a significant influence on the progress of Muslims in Indonesia. The reforms carried out by Muhammadiyah is multidimensional, such as in education, health, economy and culture[5]. Muhammadiyah museum is located in Yogyakarta and the contents of this museum are artifacts that is in correlation with Muhammadiyah's history.

Blender is a free and open-source 3D creation suite. Blender upholds the entirety of the 3D pipeline-modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation. It is cross-platform and runs equally well on Linux, Windows, and Macintosh computers. Its interface uses OpenGL to provide a consistent experience. Blender has been most frequently used for rendering high-quality images as it is a powerful ray-tracing software package. Fairly few publications have taken advantage of the power of Blender for mesh creation, manipulation, positioning and analyzing range of motion. The use of three-dimensional data to study materials are currently an increasingly popular and dynamic field of research including biomechanical, finite element and geometric morphometric all predicated on digital three-dimensional models. After an initial learning curve, Blender delivers versatile and user-friendly tools to work with three-dimensional data[6]. This 3D creation suite will be the main tool to use in modelling the artifacts of Muhammadiyah museum.

Game engine is needed to develop a game, there are several popular game engines such as Cry Engine, Unreal Engine, Anvil Engine, Unity, etc. In the making of this game, the research will use Unity as the game development application. In Unity there is an integrated development tool to develop 3D contents such as 3D video games, 3D animations and 3D visualization of an environment called Unity3D Game Engine. 3D games are presented in three dimensions of height, width, and depth. Even though Unity can only be run on Windows, Linux and Mac OS platforms. Unity could develop almost every platform such as Windows, Android, iOS, etc. Unity allows creators to create 2D or 3D cross-platform applications such as games, visualizations, commodity configurators, interactive exhibitions or even virtual museums[7].

Museum exhibits collections in physical space and create social discourses based on cultural diversity, following the collaboration of several stakeholders, such as the audience, conservators, curators, educators, and partners. Furthermore, museums contribute to social integration. In this respect, museums are a medium conveying culture; in other words, they are a mediator and facilitator of culture. Traditionally, museums, as a medium, exhibit their collections in a physical space, and the collections provide historical knowledge and aesthetic experiences for viewers. Various stakeholders collaborate to display their collections in exhibition halls and create a social discourse through diverse cultural expressions. Even when curators organise exhibitions, they focus on the appreciation of the collection and its interpretations. Traditionally, the exhibition hall is the medium in which the story of the museum begins. Therefore, the museum provides visitors with an interface, and its physical space is the mediator[8]. When the COVID-19 pandemic forced 90% of museums and galleries worldwide to close their doors in March 2020, cultural and heritage institutions were left in a difficult predicament. Despite the immediate loss of up to 80% of income and the fear of more long-term economic disruption, museums and galleries never the less saw themselves as community leaders, bringing people together. In practical terms, this meant moving resources and services online[9]. In other way the stakeholders of the museum found a way to make the museum or the artifacts of the museum more accessible through other means such as to make a game about the museum, an online website based museum and other digital forms.

Game is a form of exemplar interactive experiences, and this straight player control over the form and content of on-screen information is one of the many causes that games are such entertaining and significant experiences for players[1]. Video games weren't always a means of education tool, as the first video games were built from antiquated radar technology used to recreate table tennis matches. Until the mid-1980s, video games were little more than a collection of shapes shooting at or moving towards other shapes on a black and white screen, nothing more than reflex testing. They were unable to include any story due to a lack of appealing visuals and a story. Games, on the other hand, have gradually gotten more complicated in terms of gameplay and plot, and as a

result have become fantastic sources of passive, but increasingly active forms of almost everything whether it is an educational tool or an entertainment experience. As a result, they've grown into a multibillion-dollar enterprise[10].

Game genre is defined by game characteristics that is marked by the style, content, and gameplay. On a game, it is very possible to have more than one game characteristics[11]. Knowledge of structural game characteristics could enhance our understanding of not only why certain games are successful in entertaining and motivating people to play in general[12]. Educational game is distinguished as a learning way by the use of games and also a form of innovation from interactive multimedia containing educational content[13].

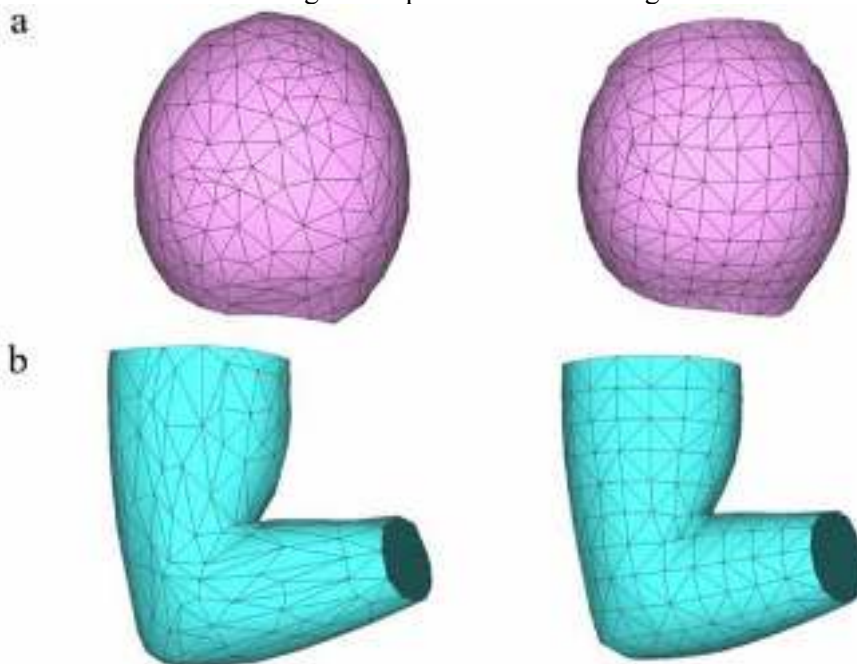
Game Development Life Cycle is an adjusted version of Software Development Life Cycle (SDLC) to be easier to apply in game development. There are several popular models of GDLC in game development, some of them were designed by Blitz Game Studios, Doppler Interactive, Arnold Hendrick, Penny De Byl, and Heather Chandler. Every developed GDLC model has its own different characteristics according to the requirement and condition of the game developer[14]. There are 6 development stages of GDLC[15]. The first one is initiation which is to make the base concept of the game and the characterization of it. The second one is pre-production, this stage is one of the main phase in production cycle because it involves conception, rectification, and prototype creation of the game which focuses on genre determination, gameplay, storyline, mechanic, etc. The third one is production which is the core foundation process that involves around asset making, program making, and combination of both elements. The fourth one is testing, on this substance is internal testing that is done to test operational function and gameplay ability. Formal detail testing is done by using playtest to value feature functionality and game difficulty (related with balancing). The fifth one is beta, this phase is to perform testing on external or third parties with the same testing method from before, because prototype related in beta testing are formal detail and perfection, the core difference is the testing individuals. The last one is release, on this stage the game is ready to be consumed by public and the game developers will do product launching, documentations, sharing knowledge, and plan to maintenance also expand the game[16]. The steps of GDLC can be seen in Figure 1.



**Fig. 1.** GDLC

Original 3D mesh models are usually fine detailed with a large number of polygons or triangles. Using the complex meshes is inefficient in unfolding and folding processes. Thus, it is substantial to have some pre-processing operations such as the meshes simplification and remeshing. The mesh simplification is a process of eliminating redundant information in the model to reduce the number of triangles and vertices of a mesh model by a balanced trade-off between accuracy and efficiency. Many of the used techniques in mesh simplification are Vertex clustering algorithms which is the most prevailing among single-pass algorithms to simplify an input mesh without an iterative process, Vertex Decimation technique is the most basic removal operations. The algorithm

iteratively operates on a candidate vertex for deleting and eliminating the loop of triangles around the selecting vertex and re-triangulating the hole. Another algorithm simplifies a mesh model in each vertex decimation operation with one vertex, two faces, and three edges. Besides the mesh simplification, isotropic surface remeshing is another approach to simplify uniform triangular or quad-dominant surfaces from high-density meshes. A related method is the Instant Filed-Aligned (IFA) meshes approach based on a local smoothing operator and sharp features control. This algorithm works fast with instantaneous data processing. However, there is a limitation in surface remeshing techniques called singularity where the regular grid structure is discontinued. Singularities are also generated when boundaries of a mesh surface enforce the grid to conform them, which finally results irregularities in the output mesh[17]. One of the samples taken to research about mesh modelling technique can be seen in Figure 2.



**Fig. 2.** Mesh Modelling Technique Sample

Black box testing has the purpose of showing focus on functional specification from the application (software), tester can define input condition and do testing on functional specification program. Black box testing is a reliability that produces button output and function that works according to the design and concept that has been made[18]. In order to achieve the objectives of the game, it is necessary to test and to ensure the correctness of the functional system and player needs. Testing on a game is important to do which aims to check all errors that exist in the game so to not to cause losses in the future, therefore testing is very important to do. The testing process is also carried out to identify parts of the application that are prone to errors with internal individual tester from the creator, a game is said to fail if the game does not meet specifications. When the needs of a system have been determined, there is already a test scenario that can be carried out, the testing instruments can be determined from what the game functions intend to do. When the final goal of the testing process has been achieved, the examiner can stop the test. Tests must be well designed so that they can find errors and can be corrected in a short time. Black Box testing seeks to find faulty functions, such as interface design errors, data structure errors and performance errors[19].

SUS is a usability testing that involves the end user of a software that will be tested on its working process. SUS on determining its respondents does not have a standard rule or there is no specific determination of the basic theory. This is because the respondents of SUS are the end user of a software that will be tested or evaluated. Test instrument in SUS consists of ten questions that will be the benchmark of testing. SUS testing can be done on website, information system, and

mobile based software[20]. Usability is one of the key factors for successful technology adoption. Research data have shown that the perceived usability of technological systems greatly determines the learning experience. However, adoption of usability studies in the field of educational technology was not observed until recently, despite the important role usability plays in the effectiveness of the educational technology systems[21].

This research will present and describe the experience of making Rediscover Story Of Muhammadiyah game to promote educational content through innovation with game development life cycle as the method. Because the game can be visualized and easily accepted, wishfully this game would educate and depict Muhammadiyah and the history behind Muhammadiyah also to make the game improve player's critical thinking and knowledge.

## METHODS

This game will use game development life cycle (GDLC) as the method, GDLC is a game building and development method which consist of initiation, pre-production, production, testing, beta, and release[22].

### Initiation

A concept is needed to well prepare what is needed in order to make the application as desired, swift and on point. There are two processes namely purpose for making the game is to educate general public about the history of Muhammadiyah accurately and precisely, so that people will not make bad remarks and understand about the Muhammadiyah history. The second one is player identification, the target players of this educational game are of every age without any restrictions.

### Design Of The Game (Pre-Production)

The design of game will include several design phases, those are:

1. System Development Requirement

Based on the analysis that has been done, system requirement analysis is divided into two, those are software requirement analysis and hardware requirement analysis.

- a. Software requirement analysis

Software requirement analysis is divided into two, those are required software to make the overall of game creation process and for debugging in scripting process.

In the process of scripting, there is a debugging to test the script that has been made. Debugging is done by running the script temporarily on the appropriate software. Software that are needed in the process of making the overall game are: Operating System that is need is Windows 10 or 11, blender is the application to do modelling and making figures, unity which is the final application to make the game, Visual Studio Code used for scripting the code with C# in accordance with Unity Whilst the required software for debugging is Windows operating system and Unity to compile and run the game.

- b. Hardware requirement analysis

Required hardware is made based on specifications of the software that will be needed to develop the overall game creation which is a computer that is eligible to run the applications needed to do game development which are: Processor with 64-bit quad core CPU with SSE2 support, 8GB RAM, Full HD display (resolution), mouse or trackpad and keyboard, graphics card with 2 GB RAM, OpenGL 4.3.

2. Content Design

In order for the game to be precisely made and to minimize risks of making an error or for the game to not change directions in the making, also to know what are the contents to be delivered to the player as follows: starting scene which there will be a description of what actually is the Muhammadiyah museum and the story of the game also how the game will be played by the player, menu scene that consist of buttons to navigate through the

game, those are start, gallery, options also exit, play scene will consist of 2 separate game mode, the first one will be in 3D first person point of view and the second one will be in 2D quiz.

### 3. Menu And Navigation Design

Menu and navigation design will be needed to determine the structure of how the game displays scenes needed for the game along with the order of the scenes in game. Menu design can be seen at figure 3.



Fig. 3. Menu Design

### 4. Game Design (2D and 3D)

For the 2D design, the writer took some inspiration of the previously made quiz game such as How To Be A Millionaire and Quiz Parampa also other quiz games. In the 3D design, the writer also took some inspiration of the previously made first person point of view game such as Layers Of Fear, and SCP: Containment Breach also other first person point of view games. The inspiration took from those games include how the game mechanics work and how the player plays the game. The quiz questions and answers list can be seen in the Table 1.

Table 1. Quiz questions and answers



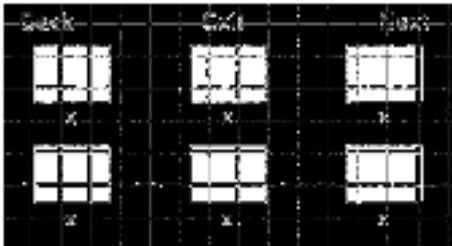

No	Question	Answer (the bold word is the correct answer)
1	What was the typewriter used for?	<b>Write translated version of Al-Qur'an and Hadith in Italics</b> , Write stories about Muhammadiyah struggle, Write Hadith, Write arabic words of Al-Qur'an and Hadith
2	<i>Peci</i> kh Bisri Ilyas, <i>Peci</i> is owned by an entrepreneur in what region of java?	<b>East Java</b> , west Java, central Java, Yogyakarta
3	Bench HIS Muhammadiyah, Bench that is now used in <i>SMP Muhammadiyah 1</i> Kudus was used in?	MULO Muhammadiyah, Volkschool Muhammadiyah, Vervolgschool Muhammadiyah, <b>HIS Muhammadiyah</b>
4	<i>Kitab fiqih</i> K.H. Faqih Usman, the jurisprudence Islamic book and Islamic boarding school learning	<b>K.H. Miskun</b> , K.H. Ahmad Dahlan, K.H. Hisyam, K.H. Ibrahim

No	Question	Answer (the bold word is the correct answer)
	notes that is written in Arabic dan Arabic “Pegon” is written by who?	
5	Guest Desk K.H. Ahmad Dahlan, the guest desk was usually used in mass general activities so the form is relatively simple. Below is all the correct activity, except ....	Annual meeting, Congress, regional meeting, <b>chair election meeting</b>

5. Storyboard

Storyboard is needed in every scene of the game to act as the guide of how the game works, how the game’s appearances are, and the plot of the game in each scene. The storyboard of the game can be seen in the Table 2, Table 3, and Table 4.

Table 2. Storyboard

No	Name	Scenario	Appearance	Content	Description
1	Game Starts	The player reads the game story then clicks start		Initial display is story text and button	The opening scene is the story of the game Rediscovery Story of Muhammadiyah
2	Main Menu	The player chooses desired available option		The view contains buttons	The players could select desired available feature from the menu
3	Gallery	The player clicks gallery to see images of the artifact featured in game		The view contains images of artifact featured in game	The player selects artifact images to inspect detailed view of them
4	Options	The player clicks option to set the game		The options contains Audio setting	The player selects options to set the audio of the game

No	Name	Scenario	Appearance	Content	Description
5	Start	The player clicks start to play the game		The start option contains instructions of how to play the game	The player reads instructions then clicks start to play the game

Table 3. Exploration Storyboard

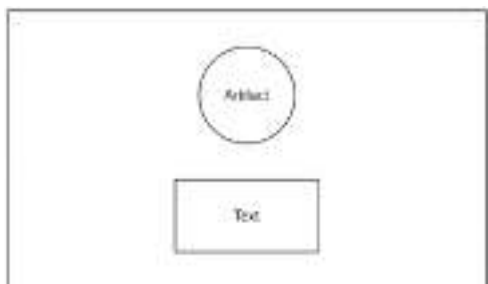


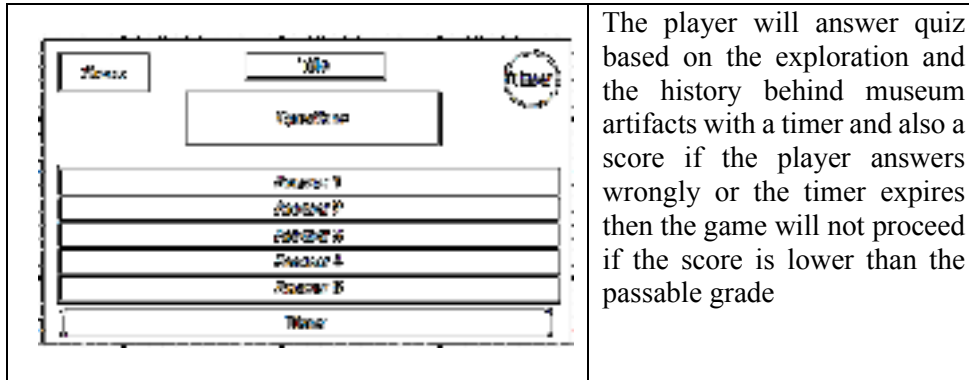
Storyboard	Gameplay
	The player explores the game until they find inspectable artifacts that has the detail and the history value of itself
	The player interacts with the terminal to proceed to the next stage of the game

Table 4. Quiz Storyboard

Storyboard	Gameplay
	The quiz will be with instructions of how to play it then the player clicks start















6. Asset Collection (Pre-Production)

Subsequent to the concept and design of the game, the next stage will be to collect all of the required asset to make the game. Materials that will be collected in this stage will include 3D version of the museum artifact, objects to support the exploration part of the game, buttons, and timer. Artifacts that are made in 3D form with blender mainly used mesh modelling technique collected from 2D form of the artifact (pictures) from Muhammadiyah museum can be seen in Table 5.

**Table 5.** Artifact

No	2D Form	3D Form	Art Na Type
1			

2			Peci
3			Fiqui
4			Desk

5			Benc
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7. Implementation (Production)

Every collected asset and concept that was made before will be implemented in this stage. The goal will be to implement everything so that the game will be playable according to the concepts. The implementation of the game can be seen below in Figure 4 and Figure 5.



Fig. 4. Game Exploration and Artifact Interaction



Fig. 5. Game Quiz Scene

8. Testing

The testing will be done in black box testing and system usability scale to determine whether the game is built successfully or not.

## RESULT AND DISCUSSIONS

### A. Black box Testing

Black box testing will show functional specification that shows which button output and function that is working accordingly. Test will be carried out by Ahmad Azhari, S.Kom., M.Eng. as the supervisor of the research then the respondent will fill questionnaires according to tested result of the game by placing checkmarks (✓) on questionnaires. The black box test will have 15 instruments to test and two of those features have not been implemented but listed because it can be seen at the main menu, those two are gallery and options. The black box test was done twice because there are several bugs found in the first test and were fixed in the later test. The black box test result can be seen in Table 6 and Table 7, illustrated in Figure 6 and Figure 7.

**Table 6.** Black Box Test Results I

BUTTON NAME	FUNCTION	TEST	
		ACCEPTABLE	NOT ACCEPTABLE
<b>SCENE (STORY INTRODUCTION)</b>			
Start button	Go to main menu	✓	
<b>SCENE (MAIN MENU)</b>			
Start button	Go to Game Instruction	✓	
Gallery button	Show gallery (artifact images)		✓
Options button	Go to game settings		✓
Exit button	Exit game	✓	
<b>SCENE (GAME INSTRUCTION)</b>			
Start button	Play exploration mode	✓	
<b>SCENE (EXPLORATION MODE)</b>			
Move cursor to artifact	Show description of the artifact	✓	
Open terminal (press E on keyboard)	Go to quiz instructions	✓	
<b>SCENE (QUIZ INSTRUCTION)</b>			
Start button	Go to quiz	✓	
<b>SCENE (QUIZ)</b>			
First answer button	Answer the quiz question		✓
Second answer button	Answer the quiz question		✓
Thirds answer button	Answer the quiz question		✓
Fourth answer button	Answer the quiz question		✓
Fifth answer button	Answer the quiz question		✓
<b>SCENE (END SCREEN)</b>			
Play again button	Replay the quiz scene		✓

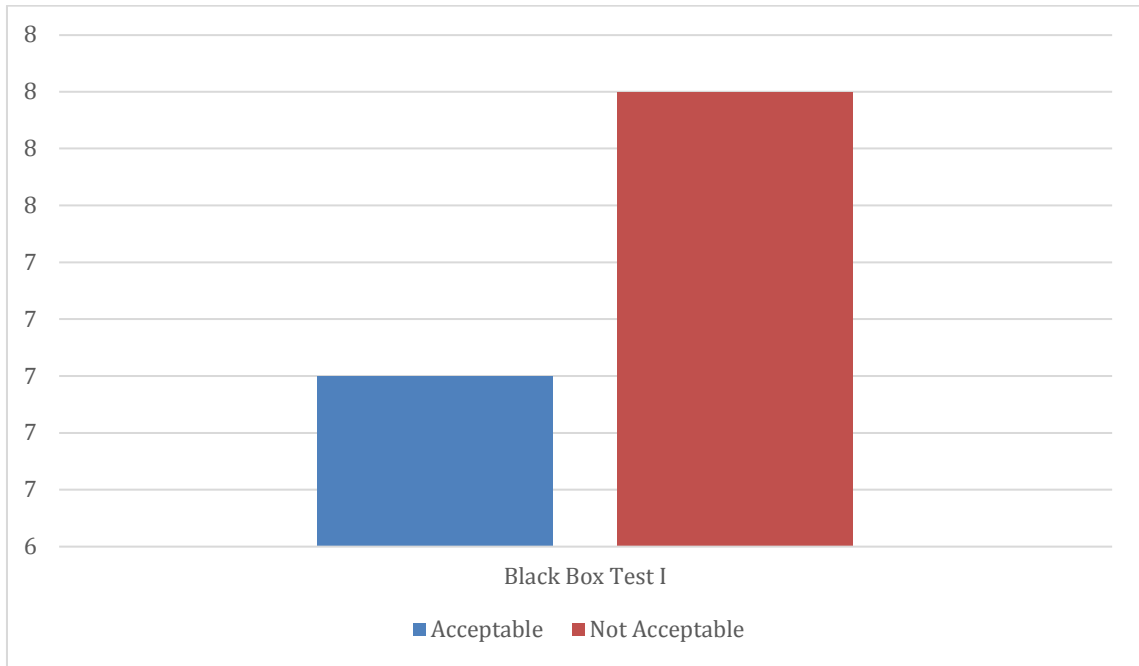
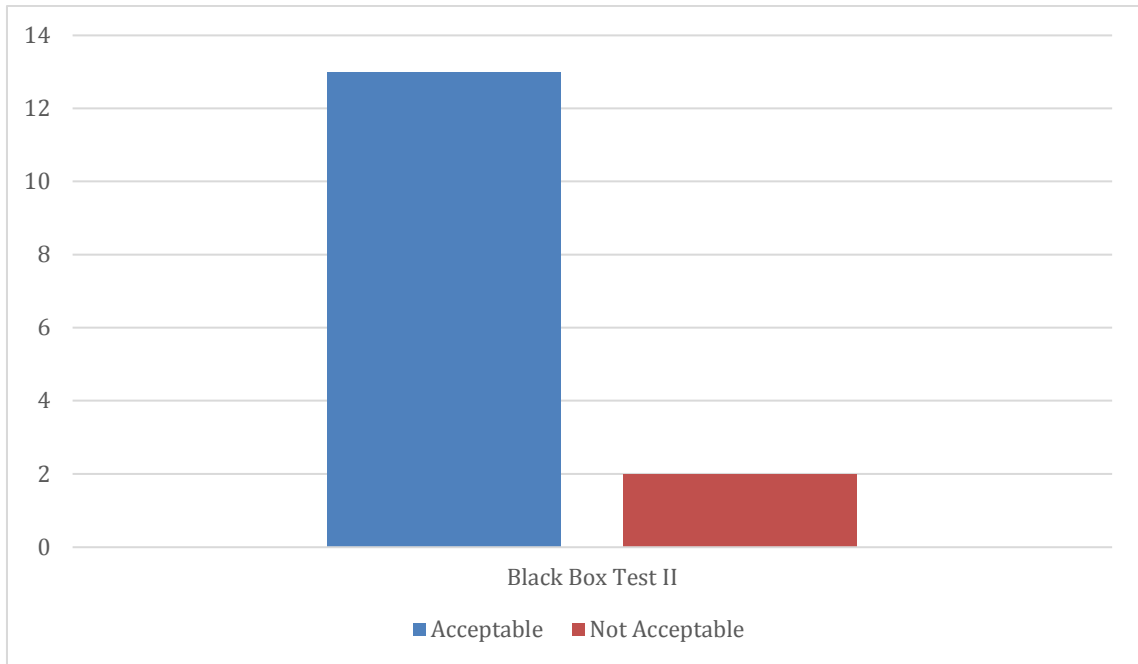


Fig. 6. Black Box Test I Illustration

Table 7. Black Box Test II

BUTTON NAME	FUNCTION	TEST	
		ACCEPTABLE	NOT ACCEPTABLE
<b>SCENE (STORY INTRODUCTION)</b>			
Start button	Go to main menu	✓	
<b>SCENE (MAIN MENU)</b>			
Start button	Go to Game Instruction	✓	
Gallery button	Show gallery (artifact images)		✓
Options button	Go to game settings		✓
Exit button	Exit game	✓	
<b>SCENE (GAME INSTRUCTION)</b>			
Start button	Play exploration mode	✓	
<b>SCENE (EXPLORATION MODE)</b>			
Move cursor to artifact	Show description of the artifact	✓	
Open terminal (press E on keyboard)	Go to quiz instructions	✓	
<b>SCENE (QUIZ INSTRUCTION)</b>			
Start button	Go to quiz	✓	
<b>SCENE (QUIZ)</b>			
First answer button	Answer the quiz question	✓	
Second answer button	Answer the quiz question	✓	
Thirds answer button	Answer the quiz question	✓	
Fourth answer button	Answer the quiz question	✓	
Fifth answer button	Answer the quiz question	✓	
<b>SCENE (END SCREEN)</b>			
Play again button	Replay the quiz scene	✓	



**Fig. 7.** Black Box Test II Illustration

**B. System Usability Scale (SUS)**

SUS test will be done by respondents who played the game from start until the end without extra instructions of how to play the game except for the in-game instructions. The instrument questions for SUS can be seen in Table 8.

**Table. 8** SUS Questions

No.	Questions	Scale
1	I think that I would like play this game frequently.	1-5
2	I found the game unnecessarily complex.	1-5
3	I thought the game was easy to use.	1-5
4	I think that I would need the support of a technical person to be able to play this game.	1-5
5	I found the various features in this game were well integrated.	1-5
6	I thought there was too much inconsistency in this game.	1-5
7	I would imagine that most people would learn to play this game very quickly.	1-5
8	I found the game is very cumbersome to play.	1-5
9	I felt very confident playing the game.	1-5
10	I needed to learn a lot of things before I could get going with playing this game.	1-5

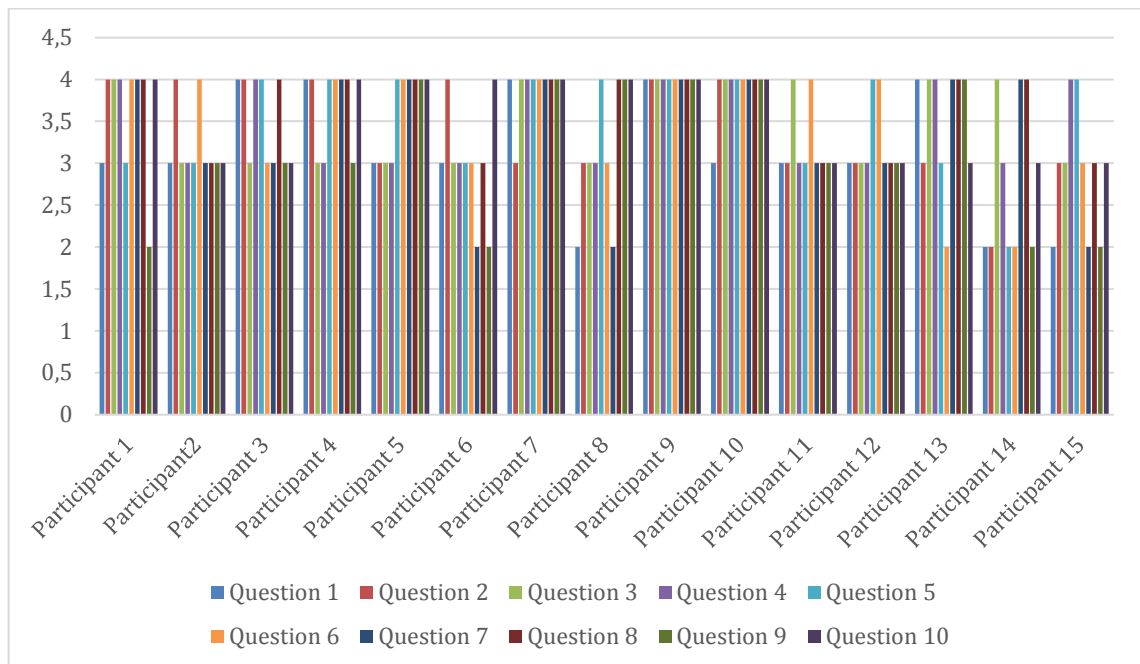
SUS questions were determined from adapting the SUS instruments used in website or application which has the same purpose of evaluating the usability of the game according to industry standards with a scale of 1-5 from 1 is very not agreeable and 5 very agreeable.

Respondents are found through offline and online means through downloading the game from Google drive and fill Google form by being asked if they are willing to play the game,

then fill the form questionnaires according to each of their own feelings and thoughts after finishing the game. The respondents score can be seen in Table 9 and Figure 8 for the illustration.

**Table 9.** SUS Respondent Score

Participant ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
01	3	4	4	4	3	4	4	4	2	4	90
02	3	4	3	3	3	4	3	3	3	3	80
03	4	4	3	4	4	3	3	4	3	3	87,5
04	4	4	3	3	4	4	4	4	3	4	92,5
05	3	3	3	3	4	4	4	4	4	4	90
06	3	4	3	3	3	3	2	3	2	4	75
07	4	3	4	4	4	4	4	4	4	4	97,5
08	2	3	3	3	4	3	2	4	4	4	80
09	4	4	4	4	4	4	4	4	4	4	100
10	3	4	4	4	4	4	4	4	4	4	97,5
11	3	3	4	3	3	4	3	3	3	3	80
12	3	3	3	3	4	4	3	3	3	3	80
13	4	3	4	4	3	2	4	4	4	3	87,5
14	2	2	4	3	2	2	4	4	2	3	70
15	2	3	3	4	4	3	2	3	2	3	72,5
<b>AVERAGE</b>											<b>85,33</b>



**Fig. 8.** SUS Respondent Illustration

After the respondents score were acquired, there will be a calculation done in order to determine the final score of the assessment. Instructions on how to do the calculation will be shown below:

1. The instrument statement with odd numbers on the filled scale is reduced by one (X-1).
2. Do subtraction on the instrument statement with even numbers on the filled scale with five (5-X).

3. The scale result should be zero to four (four being the highest).
4. Total all newly calculated scale results, then multiply them by two point five.
5. Count the average value of the test instrument answers for all respondents.
6. Assessment of the game can be determined by seeing Figure 9 SUS Assessment.

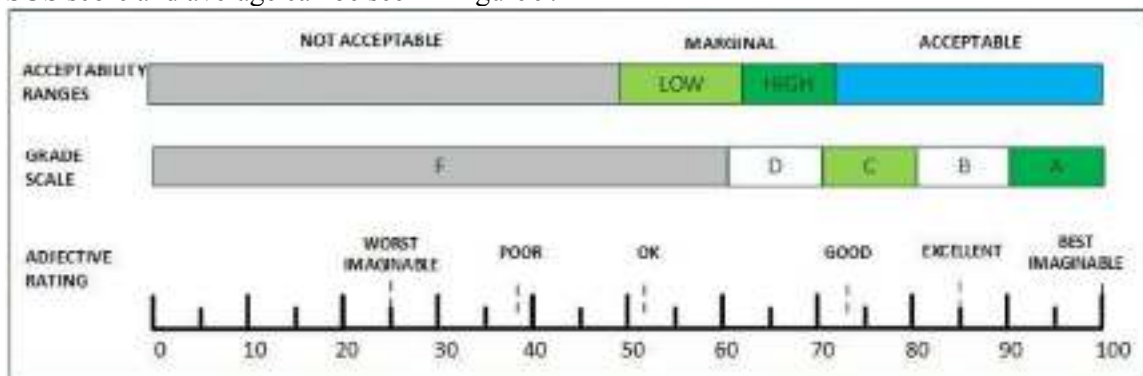
Total Score Calculation from already subtracted points:

- a.  $3+4+4+4+3+4+4+4+2+4= 36 \times 2.5 = 90$
- b.  $3+4+3+3+3+4+3+3+3+3= 32 \times 2.5 = 80$
- c.  $4+4+3+4+4+3+3+4+3+3= 35 \times 2.5 = 87.5$
- d.  $4+4+3+3+4+4+4+4+3+4= 37 \times 2.5 = 92.5$
- e.  $3+3+3+3+4+4+4+4+4+4= 36 \times 2.5 = 90$
- f.  $3+4+3+3+3+3+2+3+2+4= 30 \times 2.5 = 75$
- g.  $4+3+4+4+4+4+4+4+4+4= 39 \times 2.5 = 97.5$
- h.  $2+3+3+3+4+3+2+4+4+4= 32 \times 2.5 = 80$
- i.  $4+4+4+4+4+4+4+4+4+4= 40 \times 2.5 = 100$
- j.  $3+4+4+4+4+4+4+4+4+4= 39 \times 2.5 = 97.5$
- k.  $3+3+4+3+3+4+3+3+3+3= 32 \times 2.5 = 80$
- l.  $3+3+3+3+4+4+3+3+3+3= 32 \times 2.5 = 80$
- m.  $4+3+4+4+3+2+4+4+4+3= 35 \times 2.5 = 87.5$
- n.  $2+2+4+3+2+2+4+4+2+3= 28 \times 2.5 = 70$
- o.  $2+3+3+4+4+3+2+3+2+3= 29 \times 2.5 = 72.5$

The total Average of the calculation is:

$$90+80+87.5+92.5+90+75+97.5+80+100+97.5+80+80+87.5+70+72.5 = 1280/15 = 85.3$$

SUS score and average can be seen in figure 9.



**Fig. 9.** SUS Assessment

Based on the result of SUS calculation assessment from Figure 9, the score of the game can be determined as 85,3. Which means it has crossed over the standard value boundary limit of 68 also meaning that the assessment score is acceptable and excellent.

## CONCLUSIONS

The game Rediscover Story Of Muhammadiyah has been successfully developed that consists of Muhammadiyah's artifacts background and two form of gameplay though several supporting features have not been developed and implemented yet, such as gallery and options with also lacking levels of the game.

The outcome of testing with black box and viability of the game was surveyed with System Usability Scale (SUS) which consists of 10 instrument statements and 15 Respondents with the final result of 85.3, which is declared excellent and acceptable.

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