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Enhancing Historical Learning Using Role-Playing Game on Mobile Platform

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Abstract

Learning history means to learn what caused the world around us to become the way it is right now. For decades, historical events were recorded and taught to younger generations to learn from them. However, most students found that learning history is boring because they could not feel or understand the moment of those historical events. This paper aims to investigate how a game-based learning approach influences the achievement and motivation of historical learning through a mobile learning environment. We propose game-based historical learning using the role-playing game on a mobile platform. The implementation is based on the history of the first army general in Indonesia, General Sudirman. The game was tested to 63 Junior High School students in Jakarta. Based on the evaluation, using the game can increase student learning motivation and learning achievement.

Keywords: Game-Based Learning; Historical Learning; Role-Playing Game; Mobile Platform; Statistical Analysis

1. Introduction

For decades, students learn history from schools where teachers taught them. This method has many weaknesses, such as students became passive because they must 'rely' on the teacher, and not every teacher could deliver the learning material to students well.

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Aside from in-class learning, field trip by visiting the historical location or a museum could be possibly used [1,2]. However, this method requires a lot of time and resources. Therefore, a new learning method is needed to support teachers and students to learn history effectively and efficiently. The important thing that must be in mind is to increase the motivation of students to learn history. By increasing motivation, it is possible to improve performance as well.

To increase learning motivation, some researchers suggested applying gamification. Gamification adds game elements into non-game contexts[3]. For example, players could gain experience points to level up and continuing their progress, points that reflect the player's in-game performance and reward system where the game rewards players with various items after finishing a task. Despite the variation of game elements, some game elements are not meant for historical learning in a certain situation. For example, the gamification application that requires the user to visit a real-world location must be time-consuming and for some students, it would reduce their endurance as well[4,5,6].

This research aims to create a serious game that requires minimal resources and enable students to learn effectively. Therefore, this research will cover which gamification model should be used on historical learning. Other gamification models used for other subjects are also included to gain more insight. This research also tries to prove our hypotheses that different learning strategies would give a different level of learning motivation and learning achievement as well.

2. Related Works

Many kinds of research have successfully integrated education into digital games to attract student's attention and motivate them to improve their study. For example, a mobile app called The City[4] offers a gamified history lesson about Barcelona. Participants will compete to finish activities as much as possible while exploring the real locations. Participants with the best performance will receive badges as a reward and will be shown on a leaderboard. Akkerman et al.[5] introduced a game called Frequentie 1550 to learn about the medieval history of Amsterdam by exploring the city. The result showed that the game affected participants to be active and motivated. In Adventours[6], participants must explore the museum in Milan to answer questions given. 'Adventours' uses Whatsapp or Facebook Messenger that offer two different gaming experience. Chowanda & Chowanda[7] proposed two role-playing games where the player can do in-game exploration, called 'The Keris of Vengeance' and 'Tap for Battle'. The former tells about the story of Ken Arok from the Singhasari Kingdom and the latter tells about the Bible story of Moses. They found that serious games could improve student's scores compared to book readers. Both games help students to remember difficult names and timelines in historical events. Haesler et al.[8] proposed an app that involved a virtual 3D model of a medieval castle from the 9th century and the origin of Hamburg. The app uses a multi-touch table that displays the city of Hamburg in bird-view and a Head-Mounted Display (HMD) which displays the city in first-person-view. Although this one seems unique, this method requires a high cost for VR tools. The last example comes from Lee et al.[9] which proposed a role-playing game about Malaysian warrior, Merong Mahawangsa. The game consists of 5 quests for each stage followed by a quiz at the end of the stage. The results gathered through 13 participants show that the game can motivate and attract students' attention to learn.

Digital games have spread to various fields of education aside from history, such as STEM (Science, Technology, Engineering, and Mathematics), and language. Tinati et al.[10] proposed Eyewire, which is a web-based game that aims to create a detailed map of the human brain by asking participants to identify connected areas in 3D transformed fMRI (Functional Magnetic Resonance Imaging) images. Tsalikidis & Pavlidis[11] presented a turn-based role-playing game to improve JavaScript programming skills called Jlegends. Participants need to write JavaScript codes to perform various actions in the game. Peng et al.[12] presented an exploration game based on the Apollo 16 mission. Participants will use DCC (Display and Console Control) to control LRV (Lunar Roving Vehicle) to explore Moon's surface virtually. The results showed that participants feel excited yet struggled when they drive the LRV. Participants gain more knowledge and understand the challenges the astronauts faced in the moon. Pedersen et al. DiffGame[13], game-based mathematics for learning differentiation used in an experiment involving 117 high school students in Danish. Evaluation results showed that they enjoyed and felt motivated when playing the game.

GamEducation[14] included forum discussion and points gaining by giving correct answers. Points will be shown on a leaderboard to increase competition between participants. GeoGebra[15] provided repeatable missions for

learning math. Teachers will give pre-game instruction to students and let them proceed on their own while the teacher watches over them. The higher the level, the harder the challenge offered to the players. Math-City[16], a management-simulation (tycoon) game where the participant can design their manageable business place using in-game resources, and the final objective are to make the successful business. Each participant could use their creativity and express themselves via the design of the business place inside the game. Lytell Inventors[17] focused to assist learners in a science project. The game took several gamification elements such as enemies and obstacles that participants must defeat and gathering objects to complete tasks along with the story and finish the game.

Perry[18] introduced Explorez which contains missions to explore real locations inside the campus and do something after arriving at the location, such as taking certain pictures at the location and the app will automatically detect if it is the correct picture. All in-game contents are written using the French language so participants could learn French while playing. Lingokids[19] helped children to learn English where they could choose any mission to play by tapping cute char-acters or objects inside the game. The app also provided drag and drop mechanic for a mission that involves object collecting. The game also gives feedback to the collected object. All missions are repeatable, so children can enjoy their favorite mission repeatedly.

Based on the literature review above, we could identify game elements used in each study as stated in Table 1. It could be seen that the most used game element in gamification is the missions/quests.

Table 1. Game elements used in gamification study

Game Elements	Previous Studies
Missions/quests	[4] [5] [6] [7] [8] [9] [15] [17] [18] [19]
Scores	[4] [7] [9] [10] [12] [13] [14] [15] [16] [18]
Map	[4] [5] [6] [7] [8] [9] [12]
Mini games	[8] [9] [10] [13] [14] [16] [17]
Background story	[4] [5] [6] [7] [8] [9]
Feedback	[11] [15] [16] [18] [19]
Characters	[4] [7] [9] [18]
Achievement	[4] [10] [14] [18]
Leaderboard	[4] [9] [10] [14]
GPS	[4] [5] [18]
Social interaction	[6] [10] [14]
Unique controllers	[8] [11] [12]
Level	[7] [18]
Obstacles/enemies	[7] [11] [17]
Items	[4] [7]
Difficulty level	[7] [15]
Augmented reality	[4] [18]
Simulation	[12] [16]
Tutorial (video, animation)	[18] [19]
Virtual reality	[8]
Tooltips & hints	[13]
Drag and drop	[19]

We could also identify the most used gameplay model from our literature review Table 2, which is role-playing.

Table 2. Gameplay models used in gamification study

Gameplay Model	Previous Studies
Role-playing	[7] [9] [11] [17] [18]
Real exploration	[4] [5] [6] [18]
Receive badges	[4] [10] [14] [18]
Non-linear progression	[12] [15] [18] [19]
In-game exploration	[8] [12] [17]
Puzzle-solving	[10] [15] [17]
Difficulty adjustment	[13] [19]
Turn-based	[11]
Simulation	[12] [16]

3. Methodology

Before making the game, a literature study was conducted to find out which gamification model is suitable to learn history. The second step is to decide which historical lesson will be covered in the game. The story of General Sudirman was chosen because there are not many papers that cover this lesson. Also, Sudirman was the first general of the Indonesian National Army to fight invaders using guerrilla tactics during the Second Dutch Military Aggression. The third step is to design the game script which covers the history of Sudirman by gathering information from biography books about Sudirman.

The game script consists of 3 parts: Prologue, Interlude, and Epilogue. Prologue covers Sudirman's birth until he becomes the general who led the Indonesian National Army during The Second Dutch Military Aggression in a cutscene. The cutscene is divided into several sections where at the end of each section, a random pop quiz will be given to the player. If the player fails to answer correctly, that cutscene section will be repeated until the player answers it right. Inter-lude covers the Second Dutch Military Aggression. Each chapter in Interlude represents events when Sudirman and his army visit various places during the warfare. At this stage, the player will play as Sudirman. At the end of each chapter, there will be a random pop quiz given to the player with the same penalty in prologue quizzes. The epilogue covers the aftermath of Second Dutch Military Aggression until Sudirman died in a cutscene. At the of the epilogue, a score will be shown which reflects how many times the player answers all quizzes correctly.

Based on Table 2, we chose role-playing as the gameplay model to be implemented, as role-playing allowed the user to play from the historical character's point of view to understand the historical event better[9]. From Table 1, we chose several game elements used in gamification to be integrated into the role-playing model, such as missions/quests, scores, maps, mini-games, background story, characters, enemies, items, and leaderboard. Role-playing is identic with the main character's background story, missions/quests to be done, map to encourage in-game exploration, characters that would cross their path with the main character, enemies that should be defeated by the player for the story and character development, and items to help the player progress and clear the game[9]. Meanwhile, when the player played a mini-game, regardless of its form and challenge, the player would get scores based on the player's performance and it will be shown on the leaderboard. Therefore, it could be said that the score in the leaderboard is the indicator of the player's performance while playing mini games[9]. Table 3 mentions the game elements implemented in this study.

Table 3. Game elements of our game "Jenderal Sudirman"

Game Elements	Brief Description
Missions/quests	The game will give missions to the player displayed on the top right of the screen to advance through the story. The missions vary from find items, defeat enemies, or meet a certain character.
Scores	Reflects how well the player answers all quizzes. The score will be displayed at the end of the game and stored in the leaderboard.
Map	The player could move around the map to explore the region of Sudirman's location. The map was made according to the location of Sudirman's route while in the war against Dutch soldiers in the past.
Mini-games	There are mini-games in the form of quizzes for each chapter about Sudirman or events around him. Failing to answer the quiz will make the player repeat the last chapter of the game.
Background Story	The game will narrate Sudirman's early life along with the events that make Sudirman become a General of the Indonesian Army.
Characters	Historical characters that had some interactions with Sudirman, either Indonesian government officials, troops that fought alongside Sudirman, or Dutch officers.
Enemies	At some point, the player must fight the Dutch army to progress further. Enemies could also be the requirement to clear a mission.
Items	Items could help players to progress or win battles. Items could also be the requirement to clear a mission.
Leaderboard	Displays the top 12 highest scores the player has achieved after the game ends.

When using the game, players are expected to feel aesthetics such as sensation (the new way of learning), challenge (get the highest score as possible and defeat lots of enemies), discovery (explore locations to find hidden items), fantasy (imagine themselves commanding troops as Sudirman), narrative (following Sudirman's journey through conversation), expression (defeat enemies by various skills), and submission (the willingness to complete the game).

We developed the game using RPG Maker MV and in-game contents are written in Indonesian. Although this game engine is specifically designed to make RPG games, it is highly customizable thanks to JavaScript programming language as the core. After finishing the game and testing it, the game is deployed to be installed on Android phones.

The next step is evaluation of the game-based learning through a quasi-experimental. This study also proposes a research framework to measure the effect of the proposed learning model in improving students' learning motivation and achievement. Therefore, we set up two sets of hypotheses according to the research purpose:

1. Regarding learning strategies and learning motivation:
   H_0: Different learning strategies do not affect learning motivation.
   H_1: Different learning strategies affect learning motivation.
2. Regarding learning strategies and learning achievement:
   H_0: Different learning strategies do not affect learning achievement.
   H_1: Different learning strategies affect learning achievement.

The flow of this study could be seen in Fig. 1.

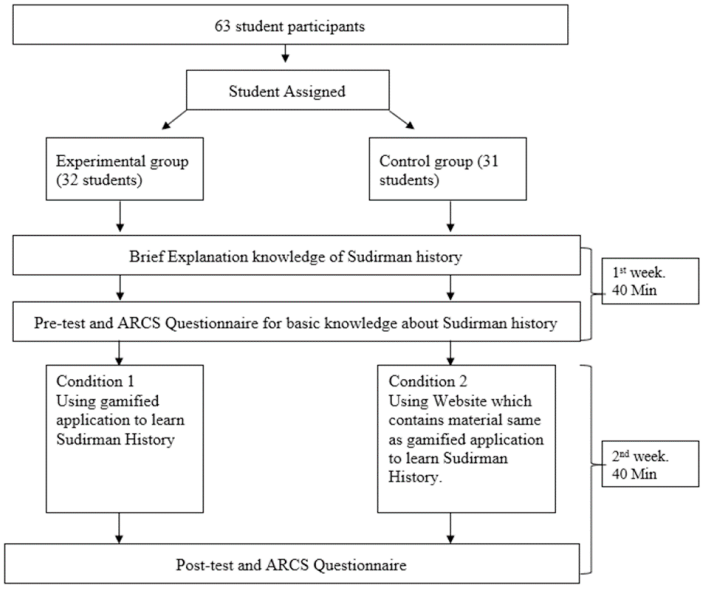

Fig. 1. Overview of the experimental procedure

In the first week of the experiment, participants will be assigned randomly into one of two groups, either the experimental group that will use the game to study or the control group that will use a website that contains lessons about the same content as the game. After that, participants should do the pretest consisted of two tests, which are knowledge test (called Pre-Knowledge) and motivation test (called Pre-ARCS, which is based on IMMS by Keller[20]) to determine their current historical knowledge and how motivated they are to use each learning strategy respectively. Following the test, each participant would receive the media to assist the respondent's learning activity, either game installer for the game group or web link for the web group. Participants should use their respective learning media to learn in one week. After one week of the learning process, the posttest will take place. In the posttest, participants were asked to fill two tests, which are knowledge test (called Post-Knowledge) and motivation test (called Post-ARCS) to determine their historical knowledge and motivation to learn after using each learning strategy respectively. The data will be analyzed and will be used to prove our hypotheses.

4. Data Analysis and Result

The experiment was conducted by involving 63 participants, with the proportion of 34 university students and 29 7th grade junior high school students. Each participant was randomly assigned to use one of the learning media either game or web. After the random assignment process, 32 participants used the game and 31 participants used the web.

Before conducting the necessary tests to prove the hypothesis, we conducted a validity and reliability test using Cronbach's Alpha to determine whether data gathered are useful. As mentioned before, there are 63 participants in this test. The result's Cronbach's Alpha is 0.938 which means the data is very reliable. Despite that, the results for questions number 22, 26, and 31 are invalid as the Cronbach's Alpha for #22 = 0.174, #26 = 0.760, and #31 = 0.440. These questions' results will be removed to gain a better result.

Shapiro-Wilk is used for the normality test as seen in Table 4. The data are not normally distributed because some of their Shapiro-Wilk scores (Sig.) were higher than 0.05. This requires us to use the non-parametric test to evaluate our hypotheses.

Table 4. Normality test result

Criteria	Group	Shapiro-Wilk (Sig.)
Post-Knowledge	Game	.029
	Web	.032
Post-ARCS	Game	.426
	Web	.694
Pre-Knowledge	Game	.001
	Web	.000
Pre-ARCS	Game	.433
	Web	.111

To analyze all data, we use Ranked Analysis of Covariance (ANCOVA) to test hypotheses set 1 and 2. For hypothesis set 1, Learning Strategies (the learning media used) are set as the independent variables, Post-ARCS (the result from motivation posttest) as the dependent variable, and Pre-ARCS (the result from motivation pretest) as the covariate. Table 5 showed that Learning Strategies could affect student motivation that is proved by the p-value of 0.049 ($p < 0.05$).

Table 5. Hypothesis 1 test result

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p-value)
Corrected Model	9331.201[a]	2	4665.600	23.552	.000
Intercept	2183.842	1	2183.842	11.024	.002
RPreARCS	8462.664	1	8462.664	42.719	.000
Group	800.177	1	800.177	4.039	**.049**
Error	11886.021	60	198.100		
Total	86178.000	63			
Corrected Total	21217.222	62			

For hypothesis set 2, Learning Strategies (the learning media used) are set as the independent variable, Post-Knowledge (the result from knowledge posttest) as the dependent variable, and Pre-Knowledge (the result from knowledge pretest) as the covariate. Table 6 showed that Learning Strategies could affect student learning achievement that is proved by the p-value of 0.033 ($p < 0.05$).

Table 6. Hypothesis 2 test result

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p-value)
Corrected Model	1567.793[a]	2	783.896	2.462	.094
Intercept	14751.147	1	14751.147	46.332	.000
RPreKnow	6.653	1	6.653	.021	.886
Group	1509.710	1	1509.710	4.742	**.033**
Error	19102.636	60	318.377		
Total	88980.750	63			
Corrected Total	20670.429	62			

Based on Table 5, it could be said that the accepted hypothesis from hypothesis set 1 is "the different learning strategies affect learning motivation". Moreover, based on Table 6, the accepted hypothesis from hypothesis set 2 is "the different learning strategies affect learning achievement".

5. Conclusion and Future Works

This study has investigated how game-based learning affect student motivation and learning achievement by using a game called "Jenderal Sudirman". The results show that using gamification for historical learning can significantly increase the learning motivation and learning achievement of students. Despite that, learning materials in this study are covered only in cutscenes, quizzes, and a small number of missions. The gameplay core of the role-playing game is still dominant compared to learning material such as grinding for experience points so the characters' status could be improved, doing transactions at the shop, fighting enemies, and unlocking skills along the playing time. Those things could make players focused only on how to beat the game and not how to understand the covered learning materials. This study also focused on the offline game which could give some players boredom after a while.

In the future, the game will receive some improvement to reduce deficiencies and satisfy students such as adding more features to enhance learning experiences like real-world exploration, online leaderboard, or co-op missions. The learning materials also will be blended with the gameplay core so players could absorb learning materials while enjoying the gameplay. The game also might be adapted into another genre since genre variation could have different effects in terms of motivation and achievement. By doing this, it is hoped that students' motivation and achievement in historical learning will be greatly improved after using the game.

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