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2D Platformer Game Prototype on Indonesian History Using Scratch

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Abstract: In this study, we would like to share a prototype of a 2D platformer game in Scratch centered on the development of Indonesian history that can increase students' interest and motivation in learning history. In search of a more entertaining and successful alternative to the bad lecture situation, the demand for interactive learning media. Visual programming is chosen with Scratch because it is easier to create educational games in this language. Its creation involves the implementation of visual components such as characters, background environments, UI, etc. Data Evaluation provides a positive level of acceptance to students with an average student evaluation score of 4.1/5 Positive responses were obtained for game elements, story content, and ease of operation First, the results of the evaluation of the Validation of 2D Platformer Games in Indonesian History as a Learning Tool. Through student activeness, a more active way of responding to historical material is being implemented by use. Game development has the ability to become a new educational media if it is well structured and organized.

Keywords: Educational Game; Scratch; Indonesian History; Interactive Learning; 2D Platformer Game.

1. Introduction

Crucial human components of the world are greatly affected by the digital revolution, especially education and entertainment. Games that were initially developed as digital past-times now contain complex features, skill building and are cognitive tools. This change is consistent with a larger trend of how technology links to educational practices [1]. The global gaming industry has grown in proportion to ever-increasing societal prestige, the museum industry has marched hand-in-hand with video game growth in recent years indicating its influence on modern society. Digital games have made a step forward in recent years in the field of educational. Research has shown how game-based learning can enhance student interest and learning retention [2] Game (Example) in the field of various games,2D platformer games have continued to be a favourite option as they provide an easy to use mechanics. In such character twodimensional environment, obstacle environment and item-collection framework these video games are a perfect fit for the incorporation of educational content [3].

Gaming, as a medium, provides new ways of engaging unique student interests and allows educators with new opportunities to try creative approaches for learning styles. While foundational, traditional teaching mode might not be so successful (and boring) when it comes to capturing students attention, especially with the history subjects. This problem is motivating educators and creators to look into possible educational paradigms (in etc.) that can speak more to modern day learners [4] EDUTECH'18: Digital games — especially those with an educational design perspective — appear to be among those propositions which addresses this essential pedagogical problem. A lot of the different development tools required for creating an educational game are often very important. Scratch - a specially recommended platform for making educational games by the MIT Media Lab. Its interface because of block-based programming allows developer of every standard to set up creative interactive experiences while preserving the capacity [5]. The visual programming aspect of the platform is a good match to 2D platformer game development, providing a correct balance between simplicity and reach [6].

Educational game development is no different: The opportunity and challenge lies in the rich narrative and cultural weight of Indonesian history. Transforming historical content into compelling gameplay mechanics is the problem we face — but we should not it to ruin educational value [7]. Research has repeatedly shown that students perceive history as an isolated and text-based subject, therefore they are more likely to lose their engagement and understanding [8]. That is why interactive digital games serve as the solution by transforming learning into an interactive and engaging experience. Creating educational video games is a confluence to multiple factors. As research has proven that educational games need to marry fun with educational objectives [9]. This balance is essential primarily on disciplines like history education; where one metric mandates the other to be present [10].

The addition of historical components into game mechanics has to be so good that players would be interested in and tech history to play such games despite the educational value [12]. In his studies, previous research has demonstrated that history students are rarely interested in history [14], and the performance of them in understanding and remembering the facts is not significant [8]. Required Delivery The incorporation of historical attention elements into game mechanics have to be based on seamless content delivery and engaging user interaction [11]. Technology has advanced tremendously over the years which allows multiple possibilities to make educational games. Research has demonstrated that well-designed educational games could be as much as 40% more effective in regards to learning outcomes than traditional teaching methods [12]. The other is the availability for buildings games platform like Scratch, meaning educators are now able to create directly educational content directly [13]. This research is centered on the creation of a prototype 2D platformer game based off themes from Indonesian History using Scratch. The project aims to respond the increasing demand of new and emerging educational alternatives [1], this time with proven game-based learning methodology [14]. Can this research be developed as a useful learning aid which enhances students' understanding and tourism appreciation of Indonesian history by merging both historical education and fun gameplay mechanics.

This research has the significance to map out its contribution in the sections created by dynamic Educational technology. With the future of educational minorities becoming the earliest demographic at educational institutions, the necessity for technology-centered learning solutions is more important than ever. This project endeavors to fill the abovementioned gap between traditional history and contemporary ways of learning, otherwise a model of subsequent educational game proposal development initiatives.

2. Research Method

The research methodology employed in this thesis utilizes the waterfall method, which consists of several sequential stages. This approach ensures a systematic and structured development process for the proposed system. The first stage focuses on Requirements Analysis. During this phase, user and stakeholder needs analysis is conducted to determine system requirements. This includes identifying desired features, content to be displayed, and how integration with Scratch will be implemented. The goal of this stage is to comprehensively understand what is expected from the system through interviews, surveys, and literature studies. The System Design stage represents a crucial phase in software development. After understanding the system requirements from the analysis phase, the next step involves system design. This encompasses system architecture design, user interface, game mechanics, and storyboard workflow for the Indonesian History 2D Platformer prototype using Scratch. Detailed plans and specifications about how the system will be built are created in the form of diagrams and initial prototypes.

The Implementation stage begins once the system design is complete. At this point, the designed system starts to be implemented. This includes game programming in Scratch, game level creation, and user interface development. Each system component is developed and tested separately before being integrated into the complete system. Following implementation, the Testing phase is conducted to ensure the system operates properly and meets requirements. Testing includes functionality testing (to ensure all features work), performance testing (to evaluate system responsiveness and performance), and security testing (if required).

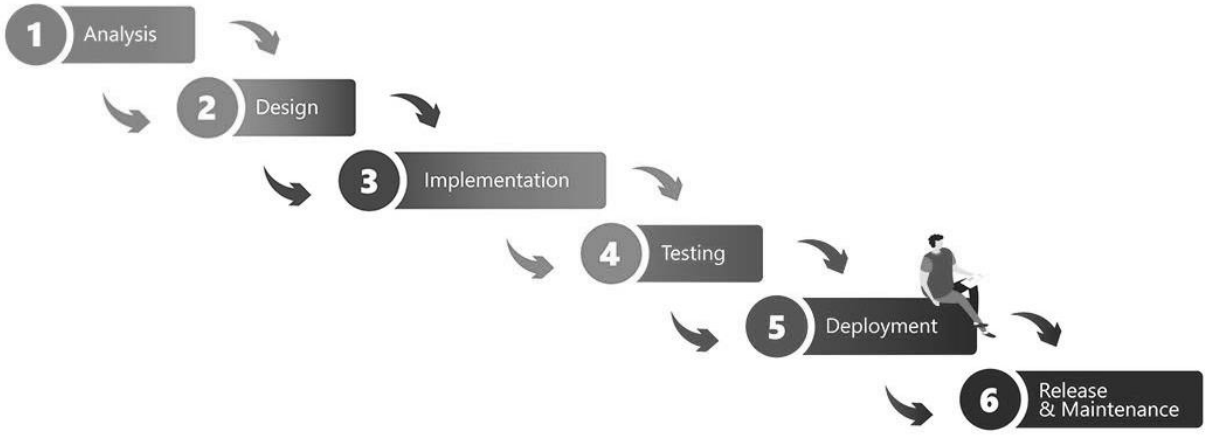


Figure 1. Waterfall Method

The final stage involves Deployment and Maintenance. After the system passes testing, deployment is carried out to install the system in the production environment or make it available to users. Subsequently, the system will be maintained through updates, bug fixes, and functionality improvements as needs arise. User feedback will be collected and used for further improvements and refinements. The waterfall method follows a linear and alternating sequence of stages, where each phase must be completed before proceeding to the next. This ensures thorough completion and validation of each development stage before moving forward. Figure 1 illustrates the waterfall method stages used in this research.

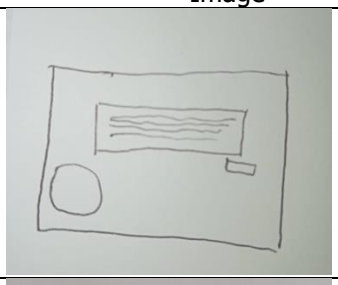
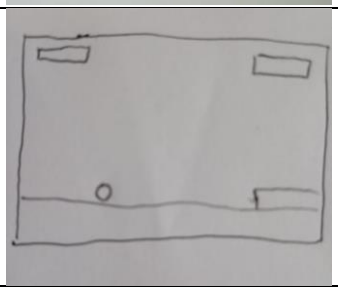
3. Result and Discussion

3.1 Results

3.1.1 Implementation of Preparation

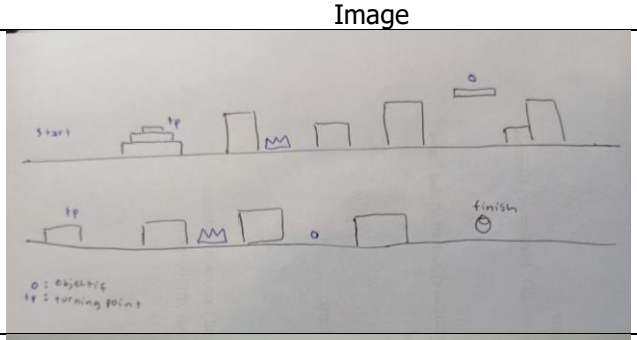
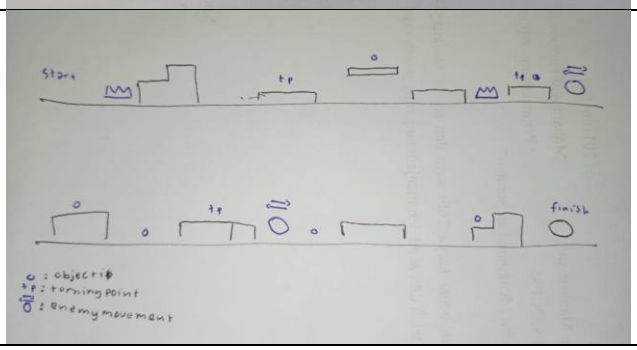
The preparation implementation phase is a fundamental step in the development of a 2D platformer game. This phase includes thorough planning and the compilation of basic elements that will be the foundation for further game development. Thorough preparation is needed to ensure the development process runs efficiently and in a focused manner. This is an example of a basic scenario of the game to be created.

Table 1. Basic scenario

No	Image	Description
1		Story/narrative scene When the game starts
2		Scene when the game has started

Because the game to be created is a platformer genre game, it is also necessary to design the platform that will be used in the game, here are the details.

Table 2. Game Scenarios

No	Image	Description
1		Game scenario for level 1
2		Game scenario for level 2

3.1.2 Game Design Implementation

The initial phase of game development in Scratch begins with a comprehensive asset implementation process. After creating detailed designs in Figma, these assets are systematically exported and imported into Scratch to establish the foundation for game development. This crucial step involves careful preparation and organization of various game elements to ensure smooth implementation throughout the development process. The asset import process encompasses multiple categories of game elements. Character sprites, including the main protagonist and supporting characters, are imported with their complete animation sets covering actions such as idle poses, running sequences, and jumping movements. Environmental assets, which form the game's visual backdrop, include platform designs, background elements, and interactive objects that players will encounter throughout their gameplay experience. Additionally, the implementation includes user interface (UI) elements such as menu buttons, health indicators, score displays, and various icons that enhance

player interaction and game feedback. These UI components are carefully optimized to maintain visual consistency while ensuring responsive gameplay mechanics.

To maintain efficient workflow and organization, all imported assets are systematically categorized within Scratch's library system. This organizational structure allows for easy access and modification during the development process, with assets grouped by function (characters, environments, UI elements) and type (sprites, backgrounds, sounds). Each asset is properly scaled and positioned to ensure optimal performance and visual harmony within the game environment. The implementation process also involves setting up proper file management protocols, ensuring that all assets maintain their quality while being optimized for Scratch's platform requirements. This includes appropriate file formatting, size optimization, and resolution adjustments to achieve the best balance between visual quality and performance. Furthermore, the asset implementation phase includes establishing animation frameworks and interaction systems that will be utilized throughout the game development process. This groundwork ensures that all visual elements can be effectively integrated with the game's mechanics and programming logic in subsequent development stages.

Figure 2. Game Assets (Sprites)

The first step in implementing it in scratch is to import assets into Scratch to be used in game development. And to do that I exported the assets that had been created in figma into Scratch.

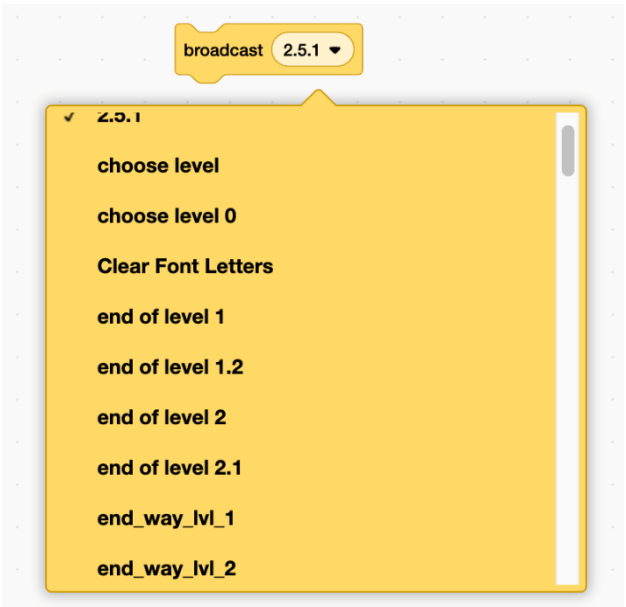


Figure 3. All Scenes

In the implementation of the 2D platformer game prototype, each scene in scratch is set using a broadcast message program to set the order in which it will be displayed, which will differ depending on which scene will be run. Once all the features in the game have been tested and are working properly, the final step is to publish the Scratch project for others to access and play.

3.1.3 User Interface Implementation

In the scratch there is a thumbnail for the part that will be seen at the beginning before the program is run (Figure 4).

Figure 4. Thumbnail

Figure 5. Narrator Scene when the program is run

When the program is first run, there will be a narrator who will talk to the player about the game and later the narrator will also appear if we are trapped and fail to survive (Figure 5). When we collide with an obstacle or enemy, a scene/display will appear stating that we have crashed and asked to restart to the beginning of the game (Figure 6).

Figure 6. Narrator scene when hitting an obstacle

Figure 7. Main menu

On this main menu will be a point for the game level selection and also for navigation regarding game information (Figure 7). In this section, the things listed here are information about the gameplay and objectives/obstacles in this game later (Figure 8).

Figure 8. Gameplay information, objectives and obstacles

Figure 9. Game scene

After the main menu, where we can choose to enter the game or see information about the historical 2D platformer game about gameplay, objectives and obstacles (Figure 9). After we have tried to play and successfully reached the final point of this platformer, there will be an animation based on the historical time we chose (Figure 10).

Figure 10. Finish Scene

3.1.4 Testing

Player Control Testing Player control testing involves evaluating each button function used to move the character in the game. The testing results are documented in Table 3.

Table 3. Player Control Testing

No	Control Input	Function	Result
1	W, Up Arrow	Jump	Successful
2	A, Left Arrow	Move Left	Successful
3	D, Right Arrow	Move Right	Successful

Functionality Testing comprehensive functionality test was conducted to ensure all game features work as intended. The results are presented in Table 4.

Table 4. Functionality Testing Results

No	Feature Tested	Result
1	Opening Scene	Successful
2	Main Menu	Successful
3	Level Selection Buttons	Successful
4	Level 1 Access	Successful

5	Level 2 Access	Successful
6	Game Info Access and Return	Successful
7	Ground Platform Mechanics	Successful
8	Obstacle Collision	Successful
9	Enemy Collision	Successful
10	Objective Collection	Successful
11	Timer Function	Successful
12	Complete Objective Finish Scene	Successful
13	Incomplete Objective Finish Scene	Successful

User Testing The final phase involved user testing with 10 participants aged 8-12 years, where 8 participants had prior gaming experience. The results are documented in Table 5.

Table 5. User Experience Testing Results

No	Testing Criteria	Poor	Adequate	Good
1	Game Design Appeal	-	-	10
2	Main Menu Functionality	-	-	10
3	Control Responsiveness	-	-	10
4	Overall Game Performance	-	-	10
5	Finish Scene Presentation	-	3	7
6	Narrator Audio Integration	-	4	6
Average Percentage		0%	12%	88%

Likert Scale Evaluation Additional testing was conducted using the Likert scale, where T × Pn (T = total respondents, Pn = Likert score) was used with the following scoring criteria:

1) Score 1: Very Unappealing
2) Score 2: Unappealing
3) Score 3: Adequate
4) Score 4: Very Appealing

Table 6. Likert Scale Testing Results

No	Criteria	Response Distribution	Average Score
1	Game Features Appeal	0/0/1/5/4	4.3
2	Historical Content Interest	0/0/0/6/4	4.4
3	Game Playability	0/0/3/5/2	3.9
4	Learning Curve	0/0/2/4/4	4.2
5	Control Accessibility	0/0/1/6/3	4.2
6	Instruction Clarity	0/0/2/5/3	4.1
7	Visual Appeal	0/0/1/5/4	4.3
8	Replay Value	0/0/2/5/3	4.1
Overall Average			4.1

The overall average score of 4.1 on the Likert scale indicates highly positive user reception. This score, approaching the maximum value of 5, demonstrates that the Indonesian history platformer game has been very well received by the test participants, with strong positive feedback across all evaluated aspects.

3.2 Discussion

The overall results of the 2D platformer game testing and evaluation illustrated a great success in various aspects of the implementation. The preparation and foundation for the core of each game served as a good basis for the game development, then the implementation of assets through the beginning showed good sprite management (background/UI in general) on how items were loaded. Technical performance testing showed a very high complete success rate, all fundamental movement controls operate well such as jump, left movement and right movement. Functional testing detected a phenomenal 100% success rate for 13 core game elements including platform mechanics, collision detection and objective system. This technical quality resulted in a fast and intuitive user experience for the players. The user perception analysis was very good, with only 12% of responses in the "Poor" category and 88% rated it as "Good" with most falling in between. Unsurprisingly, no elements had a "Poor" rating, which is a very strong performance especially on the

attractiveness of the game design, usability of the main menu and overall game controls & mechanics. The Likert scale evaluation showed significant scores with the highest average being 4.1 out of 5, especially indicating important areas such as historical content interest as 4.4 and interesting game features (4.3) and Visualization (4.3). Remarkably, the game succeeded with the target demographic (ages 8-12) because the engagement was high, the level progression was refined, the historical content was smoothly integrated into a functional and educational system and the controls and mechanics were easy to understand. An important achievement in educational game design is to engage young players while still being useful. Although overall everything is very positive, we need to continue to work on improving some of these segments. The ending scene was quite good because the audio mix of the player and narrator only failed slightly on a scale of 1 to five -- although it did not give an average behavior of 3.9. Although not a major negative in this experience, it does indicate certain areas for future quality work. The test results show that the reservation of a 2D platformer game successfully met its goals and appealed to the target audience. The high level of functional success, positive feedback from users, and high Likert scale scores all point to a good educational game that not only presents historical content, but also engages players through entertainment. The lower scores given in some areas only provide opportunities for the next version, but if judged by its success, the overall implementation.

4. Related Work

There have been a number of studies investigating the integration of educational games and historical content delivery, which fits well with the scope of this study. Recent trends in gamification of learning, especially in Indonesia, have explored various approaches to the creation and use of educational games. Research on Werewolf: The Apocalypse ("Coin Hunter") using the Godot Engine has proven that platformer game mechanics are an effective way to teach with your IDE, in this case a platformer game. Our implementation focuses on standard game mechanics and player interaction pipelining, but differs in its integration of educational content [14]. Behavior Tree implementation for the 2D platformer "Cyberun" The behavior of the NPC enemies also matches their interaction mechanics helping to attract attention but places more emphasis on the use of techniques than the injection of educational content [13].

Educational Game Development in Indonesia has begun efforts towards learning integration. The development of Construct 3 for educational games that integrate educational content and game mechanics well [16]. Although their educational content is focused on mathematics and not history itself, in particular how they combine educational benefits with engaging gameplay so well that we should use educational content in our implementations as well. Another example that is close to our work is the work of Ramdhany *et al.* (2021) who developed an educational game about the Srivijaya Kingdom using RPG Maker MV. Their delivery of history through a game speaks closely to our goals, although the way we tried to implement it is focused on using platformer mechanics and not RPG elements [20].

We have an example of a survival horror RPG game about a national hero that shows another way to deliver historical content through game development [21]. This technical implementation has been studied in a number of studies that discuss the various APIs adopted for game development methodologies. The implementation of Finite State Machines in "Santri on the Road", and the publication of a horror adventure game implementation of our game state management insights, although most of them are relevant to educational content delivery rather than complex state management [17][18]. Recent works in the field of VR technology towards interactive learning media have explored alternative technological ways to deliver educational content (Rahman Hakim *et al.*, 2023). They apply more sophisticated technology than we do in our focus on 2D platformer mechanics that are easier to use in various environments [19].

Based on previous research, the robustness of platformer mechanics for educational use, the various ways of delivering historical content in games, and about the balance of content and style and technical implementation of game development. Side by side, this work builds on these foundations and contributes an innovative approach to delivering historical content in the form of platformer games. While previous works only target platformer mechanics [14], or by different genres [20][21], such as our study, our solution combines challenging and dangerous platformer mechanics with a reliable integration of historical content. The success model of these previous works across their research in games together with our study clearly shows, learning through games is possible even when applied in teaching historical content specifically to younger children. Further findings suggest that platformer mechanisms can be successfully used for educational purposes while engaging the target age group through consistent engagement.

5. Conclusion and Recommendations

The development of a 2D educational game based on Scratch has shown a positive impact in increasing students' interest and motivation in learning Indonesian history. The average assessment score of 4.1 out of 5 shows that this game is effective as a learning tool. Respondents gave high ratings to various aspects of the game, including features, storyline, and ease of play, indicating that this game has succeeded in attracting students' attention and providing a fun educational experience. In the development process, the use of Scratch as the main platform, as well as well-designed visual assets, has succeeded in creating a functional and visually appealing game. Elements such as characters, backgrounds, and user interfaces are designed in detail to create an immersive gaming experience. The use of Scratch also allows flexibility in the development of game mechanics and facilitates the implementation of educational features in the game. The results of the test on respondents showed that the majority of participants gave a positive assessment of this educational game. Most respondents showed an increase in interest and motivation in learning Indonesian history after interacting with this game. This shows that this game has succeeded in attracting interest and increasing students' understanding through an interactive and fun learning approach.

Based on the research results and feedback from users, there are several development suggestions to improve the effectiveness and appeal of this educational game. First, increasing the content of the history of the journey before or after Indonesian independence, or developing other historical game series such as Islamic history content or the history of the kingdom era in Indonesia. Second, improving the quality of game graphics and adding player or enemy animations to enhance the attractive playing experience. Third, developing other game platforms for flexibility of use on various platforms. These suggestions are expected to be a reference for the development of better educational games in the future.

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