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(PANDEMIC Covid-19): A Shooter Game for Education -Measuring The Impact of War Games on Virus Eradication Lessons for Students

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Abstract— (PANDEMIC Covid-19) is an educational shooter game inspired by the Covid-19 pandemic which occurred from the end of 2019 until early 2022. There are 2 game modes, namely Third-Person Shooter, or TPS, and First-Person Shooter, or FPS. This study was carried out to highlight the absence of a shooter genre game used in the student learning process. The research methodology in the development of this game applied the pressman method, and the stages include planning, analysis, game development and artificial intelligence, implementation, as well as evaluation. Furthermore, the testing phase used software testing techniques based on the ISO 9126 standard and involved a total of 100 participants. The age range was between 17 and 20 years, while the participants' gender percentages were 55% male and 45% female. Some of the factors tested include functionality, reliability, portability, usability, efficiency, and maintainability. There were 2 choices only in this test, i.e. agree and disagree. The functionality factor had an agreed rate of 85%; reliability 79%, portability 86%, usability 83%, efficiency 79%, and maintainability 87%. Therefore, it was concluded that this game is suitable for use in student learning in the shooter genre. Furthermore, this research was inspired because shooter games have not been developed for the student learning process. This game genre is currently used for hobbies and for profit by developers and professional players. Further research should develop game levels, enable features to play online together with other users, and should be extended to Android and IOS.

Keywords— Pandemic; game; Covid-19; ISO 9126.

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I. INTRODUCTION

The Covid-19 pandemic occurred from the end of 2019 until early 2022 which caused significant impacts on human life in both the economic and education sectors. In early 2022, the pandemic began to recede, alongside its effects. However, students adapted to new educational methods during the pandemic due to several factors affecting the learning process. One of the most significant is the psychological factor.

During the pandemic, it was necessary for education to evolve into online methods such as blended learning, and face-to-face following health protocols. Therefore, a game is an alternative method to solve that problem both during and after the Covid-19 pandemic. There are several gaming genres that can help students to learn when they are bored [1]–[3]. One is the shooter genre which has 2 modes, i.e. the Third Person Shooter or TPS, and the First-Person Shooter or FPS. Both can be developed on several devices including a desktop. An example of a game that uses both TPS and FPS is counter-strike which contains missions to fight for both the police and criminals. Players choose to play either as the police or a criminal in either FPS or TPS, and this genre-themed game increases students' adrenaline. Consequently, shooter games have the capability to enhance a student's psychology [4], [5]. The novelty of this study inspired the development of this pandemic game and constitutes a reference source of learning in the shooter genre.

Games are one of the most effective tools for student learning. Several games can be used to communicate the knowledge of sciences, including the subject of diseases. Furthermore, the use of games is considered adequate for the learning process. Many types have been developed to enhance interactive learning. It can also have a positive impact on the physical and mental health of students [6], [7] Therefore, this study explains the importance of a game for introducing Covid-19 to students to learn about the dangers of the virus. Through this game, students also increase health compliance to avoid the exposure and spread of Covid-19. Several participants filled out the game form, questionnaires, Covid-19 information form, and game usage form, and the analysis was carried out before and after the test. Therefore, in this study, the game was developed to educate students about the pandemic as well as maintain their mental health.

II. MATERIALS AND METHOD

A. Materials

1) Unity: Unity 3D is a cross-platform game engine used to develop and publish games on a variety of operating systems including Windows, Android, Linux, and more. The Unity game development platform has been extensively used for many years in the creation of 3D games and animations that take the form of virtual objects in cyberspace. Currently, Unity supports a wide variety of games that run across many platforms [8]. Unity is the most popular proper game application framework, with a wide variety of applications [9]. Unity 3D makes the game design task easier. The assessment of the combination technique's effectiveness for children's and college illustrates, where the relations among Augmented reality and the responsive design [10]. The immersive experience framework provides a one-of-a-kind chance to investigate both objects in depth and view the others around each other [11]. The structure framework involves a gui tier, where the chosen advancement machine will create the frontend and the sequence of commands that the user is able to communicate [12]. Unity's strength as a properly connected, development of new applications lies in its well-rounded plug-ins, and its great constructed elements like physics, animation, and pathfinding. These characteristics can greatly enhance the effectiveness of construction process [13]. Students are experimenting with games development systems (Scratch, GDevelop, or Unity) as customization options [14].

2) Blender: Blender is an open-source VFX complete package with a large community that provides an array of characteristics, such as 3D modeling [8]. Blender is an opensource 3D computer graphics software used to create animated films, visual effects, 3D printed models, interactive 3D applications, and video games. This software can be used to design airplane wings, car bodies, shoes, textiles, and several other 3D designs. In the process of making 3D and 2D shapes, the unfolding and folding processes are very easy. There are three basic commands when modifying an object: Shift (G) = moving objects, Rotate (R) = rotating objects, and Scale (S) = changing the size of objects. Other types of software used to design 3D and 2D include Pepakura Designer, Blender, and Sketchup [15]. However, this study used blender software to design 3D objects due to its high reliability.

B. State of The Art

Previous studies show that game-based learning or GBL methods improve motivation and learning in the context of higher education. However, the extent to which GBL can be utilized in project management and education remains unknown [16]. These games contain and make use of maps, multiplayer, videos, and systems that are closely related to human life [17]. In previous research, a game was developed and used to hone beauty skills. The process involved the making of 2D and 3D which was carried out by the students and tested by checking several game factors, of which the results were favourable [18]. In another study, a physics board and a free app were used by students to review and reinforce concepts related to stereochemistry by answering questions from a question bank [19].

A study examined the relationship between technological literacy, game-based learning, and student achievement using a quantitative approach with SEMPLS. The participants were high school students from several locations in East Java, Indonesia. The results showed that the knowledge of technology as well as pedagogical and computer skills played an important role in supporting learning using technology. However, it was observed that game-based learning in distance education cannot act as a mediator in improving student achievement. The study provided decision-makers with the use of games during synchronous learning using technology [20]. Furthermore, the theoretical tools of a game have been used to analyze the severity of the Covid-19 pandemic in 3 countries, i.e. South Korea, Italy, and Turkey [21]. Another study used two mobile games namely PES and Genshin Impact, to observe the user experience in the Enhanced Cognitive Walkthrough method [22], [23]. In a self-developed game entitled Selera Nusantara which introduced archipelagic culture to users, this method was also applied to analyze user experience. Other factors analyzed included Goals, Game Mechanism, Interaction, Fantasy Game, Narrative, Sensation, and Game Value. The results showed that games about Indonesian culture are very good in terms of user experience [24].

In another study, the skills of a player when playing games were determined using factors namely historical success, luck, and circumstances. The game developed and used was the RPG Lite game, which was analyzed to identify possible shortcomings [25]. The perceived ease-ofuse (PEOU), perceived usefulness (PU), attitude against use (ATU), intention to use (ITU), and actual use (AU), alongside additional variables of social influence (SI), personal (P), and excitement have also been used to identify online game factors for students [26]. Furthermore, game features were monitored in a study through strategy play, simulation, and resource management. The games analyzed were Arrival: Village Kasike and When Rivers, with players monitoring the state of the game. The historical storyline was highly considered by the designers while optimizing the game size to manage space and in-game resources [27]. This study looks at games with a war theme [28], [29], [30]. In addition, it was implemented in tug-of-war game [31],[32].

In this study, the novelty describes a shooter game that contains the police, and enemies in form of viruses. This game is developed with 2 modes namely FPS and TPS, with a mission to save the citizens. Furthermore, its gameplay applies artificial intelligence which determines the direction of a player when he has successfully saved the citizens. This functions by the appearance of an arrow when a citizen has been saved. The main contribution of this study is the development of a shooter genre game for the learning process of students about the dangers of Covid-19 to the community.

C. Method

The methodology in the development of this game applied the pressman method which involves a systematic and sequential approach [33]. This study was conducted through several stages which include planning, analysis, game development, artificial intelligence, and implementation. These were carried out in sequence and detail to produce good game quality. Furthermore, this method enables researchers to develop the game step by step while reviewing game factors, before advancing to the next stage. The illustration of this method is shown in Figure 1.



Fig. 1 Research Methodology

1) Planning: This stage specifies a description of the game being developed. The (PANDEMIC Covid-19) game is to be developed as a war, action, shooter, and open-world genre. The setting is in the middle of an urban area that is falling apart due to this virulent attack. The plot of the story involves the main actor, a police officer named Bob, tasked with saving the citizens from the Covid-19 virus attack. Furthermore, there are rules that regulate and set limits on the gameplay to ensure a good, immersive flow, namely 1). If Officer Bob is attacked physically by a virus, his blood will experience a gradual reduction; 2). If Officer Bob is attacked continuously by the virus until his blood bar runs out, Bob will die of blood loss; 3) If Officer Bob takes heal for healing on the way, then Bob's blood points will increase; 4). If Officer Bob is directly exposed to the Covid-19 virus, Bob's movement will slow down for a few seconds.

2) Analysis

The analytical stage is carried out before a game is designed to implement the requirements of the user. A game must pay attention to the functionality, reliability, portability, usability, efficiency, and maintainability factors based on the ISO 9126 standards [34]. These factors are further described:

- a. Functionality: A game has to function according to the needs of the user to produce an interaction between the user and the game. This significantly affects the level of game quality and experience.
- b. Reliability: A game must provide straightforward, accurate results that are in agreement with the needs of the user. This is because this game will be played by students on their laptops. Therefore, this game should easily adapt to the user and provide an enjoyable experience.
- c. Portability: A game must be modifiable, have the expected test results, and allow easy transfer of programs from one place to another. This will enable the game to adapt to different environments such as the type of laptop, operating system, antivirus, etc.
- d. Usability: A game must be able to operate properly, smoothly, and be easy to use. When a game is built with a high level of complexity, it becomes a symbol of pride for game developers if the game has good quality. However, when the user plays the game, the more difficult it is to operate, the higher the level of user difficulty.
- e. Efficiency: A game must be efficient towards computer resources that are able to carry out its functions and achieve the goals of this game optimally. This will help to achieve the wishes of users while saving time and resources.
- f. Maintainability: A game must be maintained properly through regular updates to make improvements to a specific component to improve performance and quality [34].

3) Game Development and Artificial Intelligence

The idea of this game is how to evade the virus on a city street. In the design process, a storyboard was used before the game is developed. Storyboards are made using hand drawings on a sheet of white paper. This is highly necessary for the design stage where it displays the initial appearance before the game starts, as shown in Figure 2. Image (b) shows the second storyboard display when entering the game or when you press the play button. Image (c) shows the screen while playing the game, along with the background of the city street. Furthermore, Image (d) is displayed when you stop playing the game, which provides a resume button to restart and a quit button to end it. This process was produced using the Unity software assets of Polygon Apocalypse and Playmaker. The acquisition of this asset was carried out after the storyboard idea was created. Furthermore, the user utilizes a map to play in the game environment and must have a suitable player and enemy. Game developers also designed the main actor to interact in the game environment as the main character controlled by the user or player. Moreover, mechanisms are created for players and enemies in the game to enhance the quality of the gameplay, while the keyboard settings manage and control the direction and movement of the player in the environment.

The menu display is an essential element in this section. The menu is the main entrance that consists of resume, quit, play, and options buttons. The resume button is used to repeat the game, while the quit is used to end the game. On the other hand, the play menu is used to start the game, while the options are used to adjust the gameplay according to the user's request. Both Unity 3D and Blender software were required to develop them, and each had a different function, Blender was used to create 3D objects, while Unity is used to build the foundational functions of the (PANDEMIC Covid-19) game. An illustration of the game development stage is shown in Figure 2.



Fig. 2 Game Design (a) storyboard (b) initial view during game design (c) city atmosphere display (d) the player attacked by a virus

Artificial intelligence is one of the essential features in developing this game, which was used to create grooves. This is illustrated in Figure 3.



Fig. 3 Motion Flow

The results of artificial intelligence produced a pattern in form of an arrow that has a yellow color. This arrow flashes at intervals to help the main actor in sending the citizens to a safe, predetermined place, which is the core objective of this game. Furthermore, this arrow will appear if the main actor can bring in at least 5 people to be saved. In making this artificial intelligence, computations were used to determine movements and actions. This enables smart decisions in directing players which also enables them to finish this game quickly and easily. An illustration of the Artificial Intelligence stage is shown in Figure 4.



Fig. 4 Artificial Intelligence stage

4) Implementation and Evaluation

After the design process, implementation was necessary to test the project. Students were assembled and briefed about the game before starting to play. They were required to install this game on their respective laptops according to the software installation procedure. After installation, the game will appear on the main page which shows play, options and quit buttons. Students were also shown the function of each menu and button: the play button is used to start the game, while keyboard keys such as W is used to walk towards the front, A is used to walk to the left of the Player, and D key which is used to walk to the right. The player then uses these keys to walk to all corners of the city and changes the view using the mouse.

There are 2 game modes, namely Third Person Shooter or TPS, and First-Person Shooter or FPS. In TPS mode, the monitor will point to the entire player's body, while in FPS, the monitor points forward, and only visible weapons are used to fight viruses. One game that is currently highly wellliked by the general public is third-person shooter (TPS), which can be played on a computer or a mobile device and is both simple and inexpensive [35]. Playing in any of these modes will not change the rules of the game. However, the user experience will be different based on the comfort of each user.



(c) (d) Fig. 5 In-Game Features (a) PickupHealth (b) Poison (c) Rocket, and (d) Pickup Vaccine.

The game designers developed 4 features that were used to enhance gameplay which include Pickup Health, Poison, Rocket, and Pickup Vaccine. These features were placed in the game environment to execute different functions: The Pickup Health feature is used to increase the player's life. Furthermore, the Poison feature needs to be avoided because it reduces the player's life slowly. The Rocket feature is used to add special abilities to the player, i.e being able to launch rockets to defeat the Covid-19 virus. Finally, the Pickup Vaccine feature is used by the player to heal citizens infected with the virus. These four features are shown in Figure 5.

In this game, the player runs to explore all the streets of the city. Players are required to save the citizens standing on the side of the road. When the player approaches, the citizens will follow wherever the player runs. During the rescue process, players will be faced with viruses that attack continuously. The virus attacks until the player runs out of blood and dies. Therefore, the player must shoot the virus until it dies. Furthermore, this game does not have any specific duration, therefore players can save citizens without being limited by time. Players must take the citizens to a predetermined safe place by following the instructions in form of yellow arrows on city streets. The player then wins the game if this is successfully accomplished. However, if the player runs out of blood while attempting to save citizens, the player loses the game. Some of the displays in which the player either completes or fails to complete the mission are shown in Figure 6.



Fig. 6 Game Process within the Game

III. RESULTS AND DISCUSSION

A. Research Questionnaire

Data was collected from a questionnaire that was distributed online. All required question data were entered using Google Forms and distributed to students using the link. The question is taken from software quality testing [24]. The factors that influence game quality are Functionality, Reliability, Portability, Usability, Efficiency, and Maintainability [16], as listed in Table 1.

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GAME FACTORS					
No	Game Factors	Questions			
1.	Functionality	Is the game functionality appropriate for students to learn about the Covid- 19 pandemic?			
		Does the game produce results that are precise and accurate based on the needs of students?			
2	Reliability	Does the game have a flop?			
		Is the game able to maintain its			

No	Game Factors	Questions
		performance if students use it
		continuously?
3	Portability	Can the game be installed on all
		students' laptops?
		Does the existence of the game not
		affect other software?
4	Usability	Is the game easy for students to
		understand?
		Are the games easy for students to
		operate?
5	Efficiency	Can the game provide feedback?
		Does the game use up all resources
		while doing its job?
6	Maintainability	Can the game be properly maintained?
		Can the game be updated properly?

B. Participants

The study sample totaled 100 participants from the Semarang State Polytechnic who were aged between 17 to 20 years. The gender percentage was 55% male and 45% female drawn from several classes. Furthermore, participants carried out a predetermined procedure: First, install it on a laptop, and attempt the game functions. Second, the game was tested and played to completion by all participants for a duration of 5 minutes. Third, the participants filled out the questionnaire via Google Form for a duration of 3 minutes. This was aimed to ensure that the participants gave a reflex answer based on what they felt.

C. Results and Discussion

In the testing phase of the (PANDEMIC Covid-19) game, 12 questions represented 6 factors in software testing [34]. The number of participants totaled 100 people that played the game and filled out the questionnaire. This ensured that the game can be easily used, understood, and operated during student learning activities and follows the ISO 9126 standard. The results for each factor that was tested are shown in Figure 5. where the graphic illustrates the metrics of game factors. which include Functionality, Reliability, Portability, Usability, Efficiency, and Maintainability.

Each question consisted of two answers, namely "Yes" and "No". For example, if the participant chose "Yes" to the functionality question, this improves the percentage. The questionnaire results showed that the functionality factor reached an acceptance percentage of 85%, therefore the (PANDEMIC Covid-19) game enabled students to learn about the covid-19 pandemic. The remaining 15% of students disagreed with this factor that the shooter genre game did not represent learning. However, the results showed that this game is useful to introduce students to the dangers of the Covid-19 pandemic which occurred from the end of 2019 to early 2022.

The reliability factor totaled 79%, which means that the participants agreed that the (PANDEMIC Covid-19) game had no failures and sufficiently maintained performance when students used it continuously. The game was played for 2 hours continuously by students to verify this factor. Therefore, it was concluded that the game can run well without disturbances either in the game or on the laptop.



Fig. 7 Game factor based on ISO 9126

However, other participants disagreed with this factor as they believed that this game couldn't run well if played continuously. These students experienced hitches in gameplay after 2 hours. This was revised by the developer to make the game more durable.

The portability factor had 86% acceptance which showed that this game can be installed on several devices without affecting other software. However, 14% of participants disagreed with this factor as some believed that the game was running slowly. This occurred due to differences in laptop specifications, therefore developers are to improve on this factor.

This game did not work properly on a laptop with Windows 7 operating system. It was more effective when installed on a laptop with Windows 10 or above as the performance was faster compared to the previous devices. Furthermore, some devices with antivirus installed recognized games with exe files as viruses. This can be solved by turning off the antivirus on the student's laptop before installing the game.

The usability factor was lower than portability at 83%. This shows that the game is easy for students to understand, operate and control. The menus offered are based on the function and there are no fatal errors. This is because, during the process of planning, analysis, design, and implementation, it was designed according to the student's requirements. Furthermore, 17% of participants disagreed because some do not quite understand the shooter genre. They felt confused starting from the installation process to the use of game functions. This showed that the usability factor was not standard.

The efficiency factor had 79% acceptance which showed that this game has good feedback and uses optimum resources during the performance. However, 21% disagreed with this factor as it requires a lot of power which causes battery consumption. Finally, the maintainability factor was accepted by 87% of participants, which indicates that the game can be maintained and updated properly. However, 13% disagreed as they believed that the maintenance done by students will not have good quality.

IV. CONCLUSION

This study evaluated the (PANDEMIC Covid-19) game using ISO 9126 software by testing the functionality, portability, reliability, usability, efficiency, and maintainability factors. The results showed that the game had an acceptance above 76%. This was derived from the average of 6 quality testing factors that were measured using a questionnaire on the participants. Therefore, the results signify that the design is suitable according to the ISO 9126 standard. The study objectives were achieved as all six factors showed that the game is able to introduce students to the dangers of the Covid-19 pandemic. Furthermore, the game highlighted the effectiveness of shooter genre games in the student learning process.

This study was carried out to highlight the absence of a shooter genre game used in the learning process. Currently, this genre is used either for hobbies or for profit by developers and professional players, which has an unfavorable impact on student development. Therefore, it is necessary to develop games in the shooter genre that can be used in the student learning process. In this context, the (PANDEMIC Covid-19) game was inspired by the pandemic that occurred in early 2020 as a student learning medium. As a learning media, this is to be played with the aim of introducing the dangers of Covid-19 to the students. An understanding of the pandemic according to this game has the capacity to equip students with knowledge that can help to prevent the spread of the virus. In the development of this game, there is a lot of knowledge that can be obtained, including how to develop games whether based on desktop, Android, or iPhone Operating Systems (IOS). Therefore, students can also learn how to utilize a programming language, create 3-dimensional objects, design and test software, as well as understand business processes. In addition, this game has the function of improving students' psychomotor skills. Psychomotor is essential because playing this game can improve the thinking skills of a user. Thinking skills are enhanced when a user thinks of saving the citizens. To do this, a player must fight against enemies and save the city, which influences the pattern of brain work for students as users. One of the novelties of this game is the application of artificial intelligence in giving directions to players to complete the game.

There is only one game level developed in the software. Therefore, an addition of game levels is needed to increase the ability of the player. The levels progressively become more difficult when the player successfully completes the previous level, and the difficulty will continue to increase until level 10 to 20. Furthermore, another shortcoming is that it can only be played with one user as there are no online or multiplayer modes. Some desktop-based games can be played by multiple players, such as counter-strike (CS). Future development should enable features to play online together with other users, as this will increase cooperation, thereby rendering it more attractive and interesting. In addition, this game was developed only on desktop, and should be extended to Android and IOS. This will boost the game accessibility to all levels of society, especially students, and facilitate easy installation at any time via the Play Store application.

Furthermore, this research can be expanded by examining sources other than ISO 9126. To discover other outcomes for pandemic games, a comparative analysis is required. With this comparison, game developers will be able to identify the game's flaws. As a result, the game can be improved further.

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