

Design of First Aid Educational Game for Two-Wheeled Accident Victims For Students Aged 17-23 Years

Muhamad Athar Ramadhan^{1*}, Ai Rosita^{2*}

* Department of Informatics Engineering, Universitas Widyatama
muhamad.athar@widyatama.ac.id¹, ai.rosita@widyatama.ac.id²

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ABSTRACT

Traffic accidents remain a significant public safety issue, particularly involving two-wheeled vehicles. Limited knowledge of appropriate first aid procedures among adolescents and young adults highlights the need for accessible educational media. This study aims to design and develop an interactive first aid educational game for two-wheeled accident victims targeting students aged 15–23 years. The game was developed for the Android platform using the Multimedia Development Life Cycle (MDLC) method, which consists of concept, design, material collecting, assembly, and testing stages. Data were collected through literature review and a user survey involving 35 respondents. The evaluation instrument consisted of a Likert-scale questionnaire measuring gameplay mechanics, educational content, visual design, user interface, and overall satisfaction. The results showed that 84% of respondents agreed and strongly agreed that the game was engaging and supported the learning of first aid procedures. Although the study focused on user perception rather than objective learning measurement, the findings indicate that educational games have potential as alternative media for first aid learning among students.



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I. INTRODUCTION

Accidents are one of the biggest reasons for serious injuries and deaths, whether at home, school, or work. In Indonesia, traffic accidents rank super high as a killer for people in their productive years—like high school and college students. Plus, everyday stuff like burns, fainting, broken bones, and choking happens all the time around us, which really shows why quick, spot-on first aid skills are a must.

High schoolers and college kids face these risks constantly, from sports, lab work, or field trips. One study found only a tiny fraction of students really get first aid [1]. That same research on five students at SMAN 1 revealed 100% had never gotten any guidance on helping flood victims. Out of those five, three had dealt with flooding themselves but felt totally lost on what to do next.

First aid for accidents (P3K) is that immediate help you give victims before medical professional arrive. The principle "time saving is life and limb saving" drives home how speed and accuracy can stop things from getting worse. Sadly, lots

of folks—including students—don't grasp the right steps, and screwing up the procedure can make injuries worse or even lead to lifelong disabilities

Knowledge is crucial for proper action, and it can be improved through education [2]. For instance, [3] educated 52 students on burn care. The number who correctly rinsed burns under cool water for 5 minutes jumped from 48% to 94% after the training.

The P3K-KIDS application by [4], which uses the MDLC development approach enables users to learn first aid through interactive random accident simulations which create an enjoyable and effective learning experience. Similarly, the Smart Link app [5] uses videos, texts, and quizzes for flexible, offline learning.

By developing interactive Android-based educational games, students are expected to better understand first aid theory and practice. These games provide hands-on learning through emergency simulations, empowering young people to reduce the risk of serious injuries around them.

Educational first aid games are a fantastic way to learn, especially since they're way more engaging than old-school methods like lectures or straight-up explanations. You get to learn by playing, tackling challenges, running simulations, and earning rewards that keep things fun and lively.

These games shine for first aid training because they throw in interactive, realistic emergency scenarios. Players pick up key steps—like stopping bleeding, doing basic life support (BLS), or handling burns—in a safe, enjoyable way. Best part? You can practice over and over without any real-world risks to actual victims. Also, animations in educational games make it easier for students to understand and remember what they learn for longer periods of time. [6]

According to [7], educational games about first aid improve first aid knowledge and make users very happy. The games also make learning more fun by giving players interesting challenges, rewards, and storylines. Users find it easier to learn and remember first aid procedures when they are simulated than when they are taught in a traditional way. So, educational games are great for helping students learn how to deal with emergencies and improve their skills.

More diverse learning methods can enhance students' understanding, as they do not merely receive information passively but are directly involved in constructing their own knowledge through active learning experiences. Consequently, learning is no longer teacher-centered but shifts toward students as the primary subjects in constructing meaning from the material being studied. One approach that embodies this concept is Game Based Learning (GBL), a learning method that integrates game elements into the educational process, encouraging students to become more active, creative, and motivated in understanding the material more deeply [8]. Learning methods designed with greater variety have been proven to improve students' comprehension because they actively engage in building their own knowledge—an approach aligned with the principles of active constructivist learning. For example, [9] reported improvements in learning outcomes and mastery among Grade XI science students at SMA Negeri 1 Kuta Utara following the implementation of GBL in biology classes. The average student score increased from 74.45 to 87.06, and the mastery rate rose from 54.34% to 86.95% over several evaluation cycles. Therefore, GBL is not merely an alternative method but an effective pedagogical approach that fosters active participation, creativity, and learning motivation while significantly improving students' academic achievement.

Educational games significantly help students understand material, especially for topics requiring hands-on practice like first aid. Through active and repetitive play, students more easily grasp and retain information. Educational games in the context of health and first aid have demonstrated a significant role in improving students' understanding. The study *Learning First Aid with a Video Game* explains that a mobile game designed using the PWA (Protect, Warn, Aid) protocol was able to enhance conceptual understanding, learning

motivation, and engagement among students aged 18–26 in learning first aid [10].

Game-based learning effectively boosts student motivation and achievement. Interactive elements like competition, rewards, simulations, and adaptive challenges create engaging experiences. Games allow self-paced learning and cater to various learning styles, though challenges like development costs, technology readiness, and distraction risks exist. Overall, game-based learning offers many benefits, and further research is needed for more accessible technology [11]. Experiments by [12] showed learning outcomes increased by 53.9% using puzzle RPG games, 41.7% with RPGs, and 33.9% with puzzle games. Research by [13] comparing game-based learning to lectures found average scores of 75.35% for the game class versus 63.21% for the lecture class.

Previous studies have developed educational games for general first aid training, CPR education, and emergency response learning. However, limited studies specifically focus on first aid procedures for two-wheeled vehicle accident victims, despite the high number of motorcycle accidents in Indonesia. Therefore, this study contributes by designing a scenario-based educational game that focuses on motorcycle accident first aid procedures for users aged 17–23 years.

Based on these considerations, this study aims to design and develop an Android-based educational game using Unity game engine that introduces first aid procedures for two-wheeled accident victims targeted at high school and university students aged 17–23 years. The objectives of this study are:

- to design and develop an interactive first aid educational game using the MDLC method.
- to implement realistic motorcycle accident scenarios and procedural learning interactions
- to evaluate the functional performance and usability of first aid for two-wheeled accident victims game

The expected contribution of this study is an accessible and engaging digital learning medium that improves first aid knowledge and awareness among adolescents and young adults.

II. METHOD

A. Research Approach

This study employs a multimedia development approach method Multimedia Development Life Cycle (MDLC) development model. The Multimedia Development Life Cycle (MDLC) is a method used to design and develop multimedia-based applications. MDLC consists of six stages: concept, design, material collecting, assembly, and testing [14]. This model was chosen because it is suitable for designing multimedia-based applications such as interactive educational games.

The Multimedia Development Life Cycle (MDLC) model was selected because it focuses on interactive multimedia products (2D graphics, audio, animation, user interaction),

aligning with the needs of educational game development. Compared to Waterfall, which tends to be linear, and ADDIE, which is generic for instructional design, MDLC provides more operational stages for integrating multimedia assets and enables rapid iteration during the assembly and testing phases. This is crucial when balancing the accuracy of first aid content with the gameplay experience.

In this study, the process of developing an educational game about first aid for two-wheeled vehicle accident victims was carried out through several structured MDLC stages. These stages were designed to ensure the research proceeded systematically, from identifying user needs and designing the game concept to the final evaluation phase. With a clear research flow, each step can be carried out in a directed manner so that the resulting game development not only meets technical aspects but also possesses educational value aligned with the research objectives. This flow also assists researchers in ensuring that the created game truly fits user needs and can enhance their understanding of first aid.

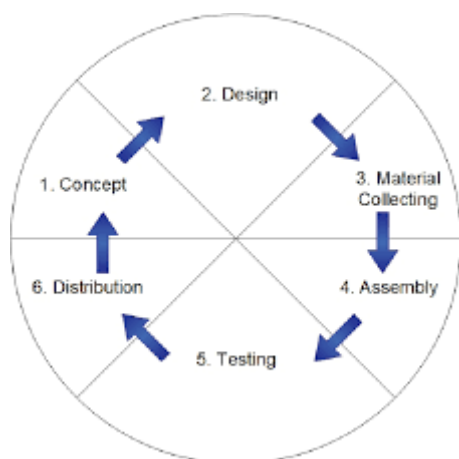


Figure 1. MDLC Diagram

B. Concept Stage

The concept stage established three primary elements which included learning objectives and target user demographics and the operational system to be used. The game adopts a Game-Based Learning (GBL) approach where the game's main objective teaches players how to perform basic first aid through an interactive simulation which simulates motorcycle accident scenarios. Learning is delivered through scenario-based interaction, procedural decision making, immediate feedback, and task completion mechanisms. Players learn first aid concepts by actively applying procedures within simulated accident situations rather than passively receiving information.

Young people between 17 and 23 years old who attend high school or college will form the main user base for this application. We selected Android because it has widespread use and users find it convenient to carry their devices while it provides excellent educational experiences through its mobile platform.

The training program teaches students about typical motorcycle collision injuries which affect the head and body and legs of riders. The game teaches players to spot dangerous situations while they learn proper safety procedures and emergency care techniques through commonly available items in their environment.

C. Design Stage

The design phase aims to create the structure and visualization of the game, starting with a mockup of the game as a preview to visualize of what the game would look like, storyboard to illustrate the game flow, emergency scenarios, and the first aid steps taken by the player. The user interface is designed to be simple, engaging, and easy to understand.

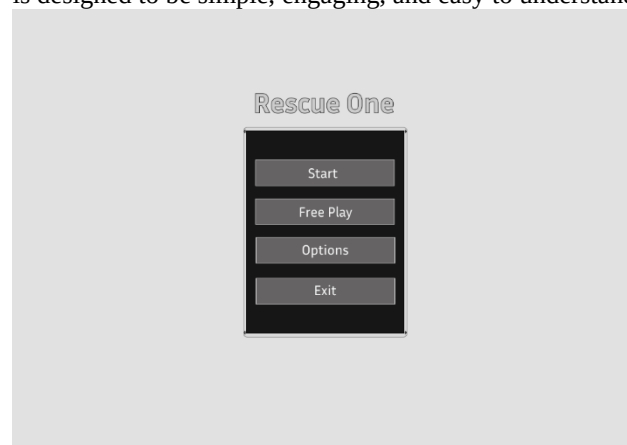


Figure 2. Main menu mockup



Figure 3. Gameplay mockup

After creating the mockup, the next step is to construct a scene flow diagram. This diagram is designed to illustrate the overall transition flow between scenes in the game. The scene flow serves as a visual representation that shows how each scene is interconnected, starting from the main menu to the gameplay flow in each previously designed level.

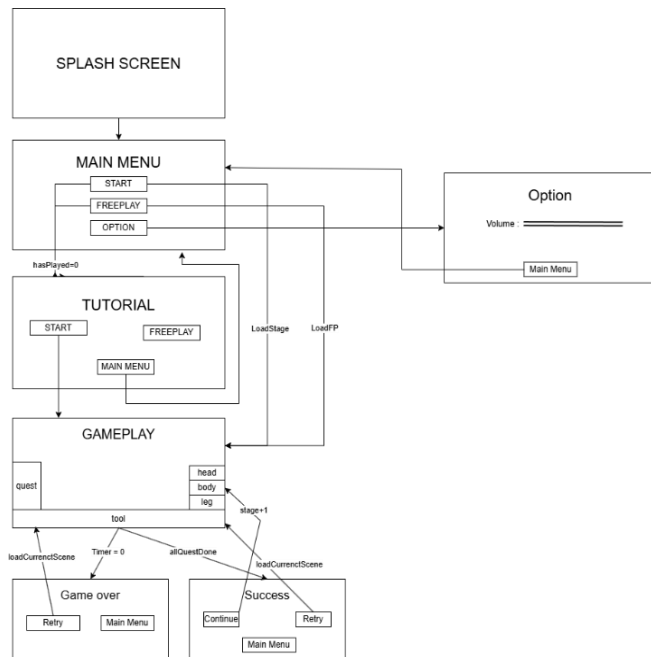


Figure 4. Scene flow diagram

The scenarios and first aid procedure included in this game was constructed into three progressive scenarios representing typical motorcycle accidents conditions based on the book [15] and interviews with health program trainers (TPPK).

Based on the results of the data collection, it was found that laypersons should possess several essential skills in handling victims of two-wheeled vehicle accidents, including the following:

- The ability to contact professional medical assistance by calling the emergency medical service number 119.
- The ability to perform Basic Life Support (BLS), such as checking whether the victim is conscious or unconscious, positioning the victim in a supine position, assessing and assisting breathing if necessary, examining visible injuries, and providing initial treatment for minor bleeding wounds using a clean cloth.

In the development of this game, the authors implemented several scenario limitations as part of the research scope. The constraints applied in the game include assuming that the victim is already in a supine position; therefore, players are not required to perform body positioning procedures. Additionally, the victim is assumed to have been confirmed as breathing normally, eliminating the need for initial airway and breathing assessments or cardiopulmonary resuscitation (CPR) procedures.

With these limitations, players can focus directly on first aid actions related to wound management and physical injury treatment, such as controlling bleeding, cleaning wounds, and providing appropriate initial care according to proper procedures.

TABEL I
DESIGN LEVEL

Level	Injury Condition	Scenario
Level 1	Body injuries, conscious	Motorcycle skids, falls by itself, minor impact
Level 2	Leg injuries, body bruises, conscious	Leg scraped against the asphalt, pinned by the motorcycle when falling
Level 3	Body & leg injuries, head bruises, unconscious	Collision with another vehicle, severe impact to the head, thrown from the motorcycle

Based on these considerations, the following level design was developed for implementation in the game:

- Level 1: In this level, the victim has an open wound on the torso and remains conscious. This scenario represents a mild to moderate collision in which the victim is still able to respond to the surrounding environment.
- Level 2: In this level, the victim has a leg injury and bruises on the torso while remaining conscious. This scenario represents an accident caused by being dragged or struck by a vehicle.
- Level 3: This level presents the most severe condition. The victim suffers multiple injuries to the torso and legs, as well as a head contusion, and is unconscious.

These scenario limitations are intended to ensure that the gameplay remains simple, structured, and easy to understand, particularly for students who have no prior experience in handling accident victims. Furthermore, these limitations facilitate the design of gameplay flow, educational content, and assessment systems within the game, thereby ensuring that the primary objective of the study—improving basic first aid knowledge—can be achieved effectively.

D. Material Collection

The development process prioritized realism and clarity through the acquisition of specific multimedia assets. These materials included highly detailed 3D character models of victims (see Fig. 3) and meticulously recreated environmental objects. To ensure the authenticity of the medical interaction, accurate 3D models of essential first aid tools were also produced (see Fig. 4). In addition to these visual assets, sound effects were gathered to build an immersive atmosphere, and comprehensive educational content was drafted to describe the procedures step-by-step. The procedural information within this content was rigorously validated against current first aid guidelines and authoritative health education sources.



Figure 5. Victims Sprite



Figure 6. First Aid Tools Sprite

E. Assembly Stage

This stage involves the process of integrating all the elements that have been gathered into the game, ranging from the creation of visual assets, material processing, to the development of the game systems. In this phase, the author conducted preliminary research as a foundation for asset creation to ensure that every visual displayed accurately represents the real-life condition of accident victims. This research covered the general characteristics of two-vehicle accident victims, such as open wounds, bleeding, the position of the victim's body, and the environmental conditions surrounding the incident. The findings from this research were then applied in the process of creating character assets, supporting objects, and the environment to ensure the game's visuals appear realistic and appropriate for the context of first aid education.

In addition to asset creation, this stage also involved the game development process using Unity software as the main game engine. All the assets that had been created were integrated into Unity, then assembled into a complete gameplay flow according to the storyboard and scenario designs established during the design phase. This process includes scene management, user interface layout, placement of the victim characters, and setting up interactions between objects within the game.

The development stage also encompasses the writing and implementation of various scripts that function to regulate the game's flow. Scripts are used to manage the player interaction system, the mechanics of using first aid tools, the dialogue

system, the scoring system, as well as the progression of the victim's condition during the aid process. With these scripts in place, the game can operate interactively and responsively in accordance with the intended learning objectives.

F. Testing Stage

Testing was carried out to evaluate the game's quality and effectiveness, encompassing the following aspects:

- **Functional Testing:** An internal assessment to ensure the game runs smoothly and is free from errors.
- **Usability Testing:** Aims to confirm that the game is easy to understand and that all its features are clearly presented.
- **Educational Testing:** Ensures the game qualifies as an educational tool by using reliable data, verified by medical experts.

G. Distribution Stage

The final application was exported as an Android APK file and distributed to respondents for evaluation in the form of a questionnaire consisting of 25 statements covering gameplay aspects, educational aspects, art style and visual aspects, user interface aspects, and overall user experience using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The distribution stage ensured the game could be installed and executed on common Android smartphones and to evaluate the effectiveness of the game as an alternative education.

III. RESULTS AND DISCUSSION

A. Game Implementation

The developed game presents interactive accident scenarios in which users act as first responders assisting motorcycle accident victims. Players observe victim conditions, identify injuries, select appropriate tools, and apply first aid actions. Tools represent items commonly available to bystanders, such as cloth or bandages.

The game features a simple and user-friendly main interface with "Start," "Freeplay," "Option," and "Quit" menus, where Start mode provides three fixed linear stages with predetermined scenarios and time limits, while Freeplay mode applies a randomized victim condition with a consistent time duration. The Option menu allows players to adjust the background music volume using a slider and return to the main menu via a Back button. When entering the game for the first time through Start or Freeplay, players must complete a tutorial that introduces the initial scenario, gameplay mechanics, and tools such as cloth to stop bleeding and a mobile phone to contact paramedics, both accessible through the Tool HUD. In the tutorial, players are required to call an ambulance first, identify symptoms using the checklist book, treat the wound by dragging and holding the cloth on the injury, and examine other body parts such as the torso and legs until the success panel appears. The gameplay interface displays the tool HUD at the bottom, quest objectives on the

left, accessible body parts at the top right, and a timer above the victim character. After completing all quests and correctly filling in the checklist book, players receive a score based on the scoring system: +100 points for correct checklist entries, -50 points for failing to perform a required checklist, and -100 points for incorrect checklist selections

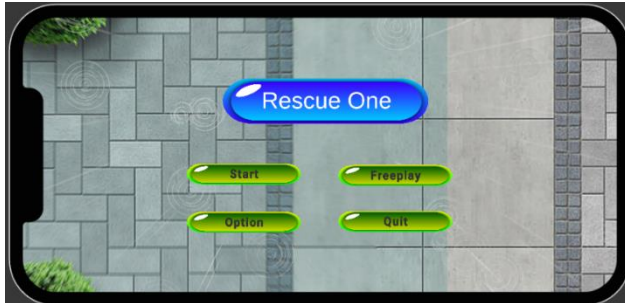


Figure 7. Main Menu

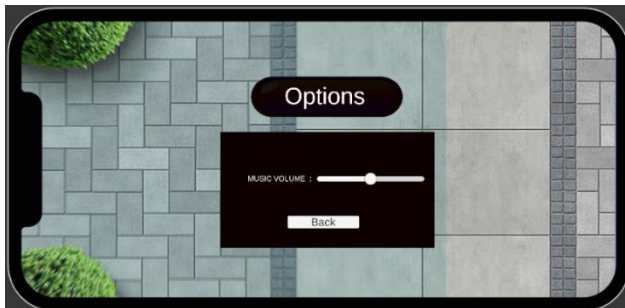


Figure 8. Option Menu



Figure 9. Tutorial Scene

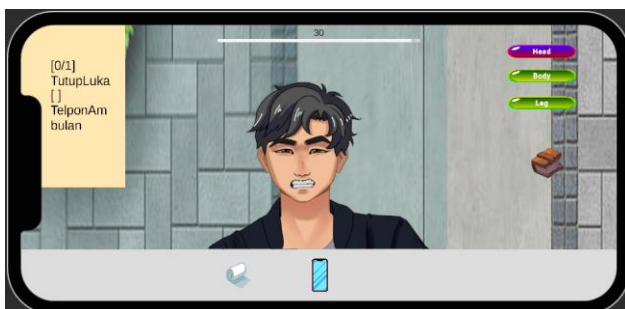


Figure 10. Gameplay Scene

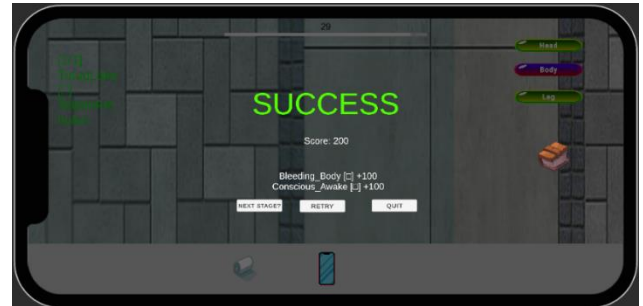


Figure 9. Success Panel

Each scenario introduces different injury combinations and levels of victim consciousness, increasing learning complexity progressively. Feedback is provided through scoring and visual confirmation of correct or incorrect actions. This structure supports experiential learning and procedural understanding.

B. Testing Results

Through internal testing that's conducted by the developer using the black box method. Testing confirmed that the game functions reliably, with all features operating as intended, including accurate tool interactions with the victims and consistent scoring and feedback. Furthermore, the application proved to be highly usable. Overall, the system met both technical and operational requirements and received very good usability ratings.

TABEL II
TESTING RESULT

No	Tested Aspect	Test Description	Success Indicator
1	HUD Button (Tool)	Tools such as cloth and mobile phone can be selected	Tool can be clicked and activated
2	Drag and Drop Tool	Tool can be dragged from the UI to the patient	Progress bar appears and patient sprite changes
3	Patient Detection Collider	System correctly detects the target patient	No "no target hit" error appears
4	Scoring System	Score increases when the correct action is taken	Score matches the player's action
5	Stage/Scene Transition	Scene transition runs normally	Scene transitions without crash
6	Checklist Book Toggle	Toggle can be checked and registered	Toggle status is saved and displayed
7	APK Build	All text and features appear on Android	No missing text or bugs in APK

C. Evaluation Results

A questionnaire analysis was conducted to evaluate the effectiveness of the game as a learning medium, its ease of use, and its appeal to users. Data were collected from 35 respondents who had tried this educational game.

TABEL III
RESPONDENT

No	Aspect	Sangat setuju (%)	Setuju (%)	Netral (%)	Tidak Setuju (%)	Sangat Tidak Setuju (%)
1	Gameplay	34.29	47.14	11.43	4.29	2.86
2	Education	40.48	39.05	16.67	3.81	0
3	Art Style & Visual	50.86	32	13.14	4	0
4	User Interface	52.57	30.29	12	5.14	0
5	Overall	46.86	37.14	12.57	3.43	0

Overall, the questionnaire results indicate that the developed educational game demonstrates good quality in terms of gameplay mechanics, educational aspects, visuals, interface, and user satisfaction. Of the 35 respondents who completed this questionnaire, 84% provided answers indicating agreement or strong agreement, and the minimal negative responses suggest that the data obtained is consistent and valid for use as undergraduate thesis research data. With an adequate number of respondents and a structured Likert-scale instrument, this data is suitable as a basis for academic analysis and scientifically supports the research conclusions.

D. Discussion

The study shows an educational game is an effective way for teens and young adults to learn first aid. By simulating real accidents with interactive tools and instant feedback, it promotes hands-on learning. Users learn the correct steps, timing, and methods.

Although this study did not directly compare the educational game with conventional learning methods, previous Game-Based Learning studies have reported higher engagement and learner motivation compared to traditional instructional approaches.

The age range of 17–23 years was selected because individuals within this group are among the most frequent users of two-wheeled vehicles and are familiar with digital learning media. Furthermore, they possess sufficient cognitive abilities to understand procedural first aid instructions and interactive learning content.

The Android platform enables learning anytime, anywhere, which is ideal for smartphone-using youth. These results support previous findings that mobile games improve learning and engagement in health topics.

The game's success also highlights the importance of a simple interface and clear visuals. Intuitive design helps users

focus on the material, while realistic items and injury depictions strengthen situational understanding.

Data suggests simulation games can improve emergency preparedness. By making decisions in a safe virtual space, users gain confidence in handling real accidents. This has potential for community safety training.

E. Limitations

This study has several limitations. First, the number of respondents (35 participants) limits the generalizability of the findings. Second, the evaluation focused on user perception rather than objective measurement of knowledge improvement through pre-test and post-test assessments. Third, statistical validity and reliability testing of the questionnaire were not conducted. Future research should involve larger samples, apply statistical analysis, and measure learning effectiveness objectively.

IV. CONCLUSION

This research successfully designed an Android-based educational game focused on first aid for two-wheeled vehicle accident victims, targeting high school and university students. The game presents interactive emergency simulations through scenarios, gameplay mechanics, and supporting visual elements. User evaluations indicate that the game was positively perceived as a learning medium for introducing first aid procedures for two-wheeled vehicle accident victims.

Users were able to follow the first aid procedures well through the interactive gameplay simulations. The game's mechanics, which require identifying the victim's condition, selecting the appropriate tools, and completing quests based on proper procedures, effectively train users to follow systematic action steps. Features such as time limits, checklists, and scoring encourage quick and accurate responses, demonstrating the gameplay's effectiveness as a tool for practicing first aid sequences.

The evaluation of the game's effectiveness as a learning medium showed positive user reception. Questionnaire results regarding gameplay, educational content, interface, and user satisfaction were predominantly positive. Gameplay was found to be engaging and easy to understand, the interface user-friendly, and the visuals and content supportive of learning. The high level of user satisfaction confirms the game's viability as a first aid learning tool with potential for sustained use.

Furthermore this first-aid educational game for motorcycle accident victims is expected to serve as a supplementary learning medium to enhance users' understanding and preparedness in responding to emergency situations. Future research may expand this work by incorporating additional features, introducing more diverse accident scenarios, collaborating directly with paramedic institutions or educational organizations, and increasing the number of

respondents to evaluate the game's effectiveness on a larger scale.

From a technical perspective, further improvements are recommended in terms of visual quality, sound effects, and victim reaction animations during treatment procedures to increase user engagement and overall learning experience.

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