



# MOBILE EDUCATIONAL GAME FOR EARTHQUAKE DISASTER PREPAREDNESS IN ELEMENTARY SCHOOL

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## ABSTRACT

Prevention of victims and losses due to earthquake disaster can be done earlier through the use of information media that are currently popular and widely used by the community, such as mobile phone communication. Educational game is a game-based learning. The game has a fantasy element that involves players in learning activities through an narration or storyline. Application of earthquake disaster mitigation is an educational game that is useful to add insight, knowledge, and understanding of children in the effort to overcome the impact of earthquake disaster. This study aims to build an educational game application on the Android platform as a learning medium for earthquake disaster mitigation and the basics of safety in the face of earthquake disaster in a more interesting and fun way. This edugame application has a video about the simulation of earthquake and earthquake mitigation video accompanied by game consisting of 3 stage that is before, during and after earthquake. This edugame application is expected to provide basic safety information in dealing with earthquake disaster for elementary school students.

**Keywords:** natural disaster, mobile application, educational game, disaster mitigation, earthquake.

## INTRODUCTION

Natural disasters are events that can be threatening at any time and causing damages to the environment. Indonesia is a susceptible country to earthquake disaster. This is because its located within the collision zone of three tectonic plates, namely Eurasia, India-Australia and the Pacific plate [1]. The impact of earthquake brought great harm to the people. Therefore, there is an effort to provide knowledge about the earthquake disaster mitigation especially on elementary school children, and to grow the "Safety Culture" [2].

Disaster Risk Reduction Program (DRRP) in primary schools aims to nurture: (1) humanitarian values and attitudes towards disaster risk, (2) understanding of disaster risk and motivation, (3) knowledge and skills for disaster prevention and disaster risk reduction both individually or collective; (4) emergency response capability [2]. Prevention of victims and losses caused by the earthquake disaster can early be done through the use of information media that is currently popular and widely used by the community, such as mobile phone communications.

This study aims to build an educational game application on the Android platform as a learning medium for earthquake disaster mitigation and the basics of safety in the face of earthquake disaster in a more interesting and fun way. The user target for this app is elementary school students. The interface and navigation in this application using Bahasa Indonesia. In this research, we make the following contributions: (1) obtain information on disaster mitigation that can be brought anytime and anywhere in a more interesting way that is playing while learning; (2) we developed 3 self-sustaining stage ie the stage before the earthquake, the stage during the earthquake, and the stage after the earthquake; (2) we developed the exercises for each different stage as a self-sustaining step.

Some apps use educational games as learning media. Bouzid [3] develops educational games in sign language learning for learners with special needs. Onencan [4] develops a location-based game to enhancing citizen capacity in flood prevention, risk reduction, and preparedness. Bae [5] designed a smart game based on Unity3D in multi-platform game engine. Bandrova [6] purpose the conceptual framework for establishing an Educational Disaster Center (EDC) that was named "Save the Children Life". This framework provides specific information about disaster preparedness and emergency for children educational materials. Majid [7] develop a mobile application iSains for science subject in primary school in Malaysia by integrating Augmented Reality, so students can view 3D moon models through their text book. Handojo [8] proposed mobile based learning application for nation history especially heroic battle 10 November 1945 in Surabaya. This application provides information, video, sound, and quiz from the events surrounding the battle. Kalisa [9] find that mobile learning within higher education institutions increased student and lecturer collaboration and provide distant communication, increased student participation and engagement, facilitating authentic learning and reflective practice.

Reducing disaster risk through proper risk management is a cost effective investment in preventing future losses. Students and children have to be educated in disaster preparedness and relevant special topics [6]. It is very important to use the proper tools to develop and improve the spatial thinking skills of the young people. Being at home, at school or playing outside, children are exposed to different risks associated with natural disasters (e.g., buildings' resistance to earthquakes, fires, floods). Therefore, it is needed to take special care for children 'education and training to strengthen their resilience in case of emergencies. In this article an idea for establishing education game of natural disaster mitigation for



earthquakes. This application is expected to increase the children resilience and the ability for response in an emergency situation.

### EDUCATION GAME (EDUGAME)

Educational games are special games designed to teach users a particular learning, developing concepts and understanding and guiding them in training their abilities, and motivating them to play them. One of the advantages of educational games is the animation that can improve memory so that children can store the material lessons in a long time compared with conventional teaching methods. Game Based Learning (GBL) is designed to balance the material with the game and the player's ability to retain and apply real-world subject matter. The game has an element of fantasy involving players in learning activities through narration or storyline. Edugame can provide stimulus in learning that is Emotional, Intellectual, Psycomotoric. Edugame is one of the methods of digital learning because (1) Create a fun learning environment and make students more motivated to learn; (2) Competition and teamwork in completing missions can

add student motivation; (3) Quick and specific feedback makes it easy for students to think of the right solutions. Four key elements of a game [10] that enable them to engage players for a long period of time:

- captivating goal that keeps players focused on the challenge, motivates the players to continue playing and make them to be more persistent to master the required skills.
- Voluntary participation of players in contrast to the real life learning systems, builds persistence. This is because when players voluntarily play a game, they perceive it as entertaining, even when the challenges become very complex and hard to solve.
- Game rules that encourage players to come out of their comfort zones and explore new territories that they would normally not do in real life situations. In many instances, when the players leave their comfort zones, they develop better solutions and bring new innovations to the game.
- A strong and continuous feedback mechanism that informs the players where they are and what remains to reach their goal.

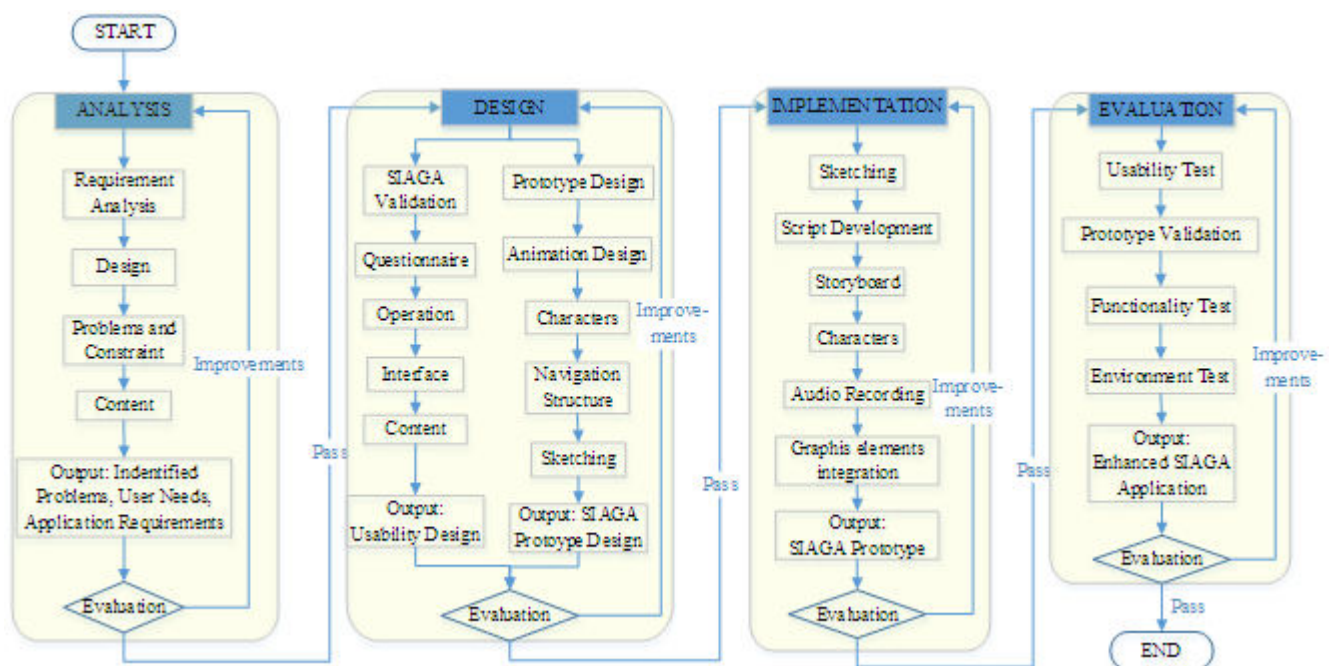


Figure-1. SIAGA development life cycle.

### METHODOLOGY

This study is an implementation of educational game development as a means of learning media and education science development aimed to improve the cognitive development of children. The target user of this app is the students in the elementary school.

Development method for this research use prototyping model. Prototyping model is a technique to collect certain information about user information needs quickly. This application is called SIAGA which is an abbreviation of SIap Antisipasi GempA.

Process on SIAGA development life cycle in Figure-1, as follows:

#### a) Analysis

Developers and Clients determine the needs of system users, goals, issues, application boundaries, and educational content gaming features that will be needed for the next design stage.



### b) Design

This stage begins by creating a prototype design for the game to be created. Any content contained in games, animated designs, characters, game paths from start to finish, game scenarios using storyboards, navigation structures, and animated sketching.

Storyboard is the initial image of the application to be built, so it can provide an overview of the application to be generated. It aims to analyze whether the position of the picture or button is appropriate and can be recognized by the user.

Then the navigation menu selection as well as buttons to be used and the position of the page that will display the contents of the system because this game prioritizes ease when processing data and the ease of students in playing the game.

At this stage also compiled SIAGA application validation by using questionnaire to test system usability. This usability testing design includes: operation test, interface test, and content test.

### c) Implementation

At this stage started making animated sketches with the help of Corel Draw software. Then compose an animated storyline script, storyboard creation, and character creation. Sound recording process or voice dubbing aims to create animations that are more dynamic and interactive Furthermore all the data is integrated into one with Adobe Flash CS6 software into prototype SIAGA application.

### d) Evaluation

Clients evaluate and validate prototypes created and used to clarify software requirements. The game will be tested, is it qualified to be a full game, free of errors and meet the needs of the purpose of making the game. Testing this educational game through functionality test and environment test. The result of this stage is the revised application or enhanced SIAGA application.

## RESULT AND DISCUSSIONS

### Game specifications

This application is an educational game application about the mitigation of natural disaster based on Android. Edugame application of earthquake disaster mitigation presents the game of earthquake-themed earthquake which is accompanied by the video of earthquake stages, the types of earthquakes and how to mitigate them. This game consists of 3 stages of the stage before the earthquake, the stage when the earthquake and stage after the earthquake.

The concept of this game is easy, fun, educative. Easy because this game does not have to take a long time to play it. Fun because it is interactive in terms of game play and media used. Educative because the content delivered is about earthquake disaster mitigation.

### Interface Implementation

After the user clicks the Application icon found on the smartphone it will show the opening page to start and run the Application, can be seen in Figure-2.



Figure-2. Game start.

This opening page will appear at the time this Application was first opened. After clicking the start button it will enter on the main menu page which consists of 2 pieces of main menu. The first is the video menu. The second is the game menu. It can be seen in Figure-3.



Figure-3. Main menu page: Video and game.

The main menu page will appear after clicking the start button on the previous opening menu page. If the user clicks the video button, then the video menu option there are 2 more video options, the first choice of simulated earthquake video that contains how the stages of the earthquake and the types of earthquakes of any kind. A second choice on earthquake mitigation video material. With this material the children can learn about what an earthquake, how the process of the earthquake and what kind of earthquake that often happens and how to deal with the earthquake before it happened, when it happened and after the earthquake (see Figure-4). The material can help children in an early-saving effort, so children can easily remember and understand the lessons learned about earthquakes and disaster mitigation in a more interesting and fun way.





Figure-4. Earthquake education contents.

When the user has watched the simulation and mitigation video of the earthquake, he can further play the game contained on the game button. If the user clicks the game button in Figure-3 then will display the menu page game options can be seen in Figure-5.



Figure-5. Menu for before earthquake game.

In Figures 5 there are 3 game stages involving before, during, and after the earthquake occurred. Users can start the game by clicking on the stage before the earthquake first, in order to proceed to the next stage the user must complete the first stage until successfully can proceed to the next stage. And so on until the game is over. When the user clicks on a stage before an earthquake, the next two stages are still locked; the stage will open when the user successfully completes the previous stage. If the user has not succeeded then the game will be repeated until the user succeeds.

Educational games for earthquakes and after the earthquake can be seen in Figure-6. In this game the user must choose a place where the safe location to shelter when an earthquake occurs in school. Then after the earthquake, students must choose where the best gathering point location by following the evacuation path of the earthquake.



Figure-6. Games during and after earthquake.

By way of playing and learning using edugame application will make children remember what has been delivered because they comfortably learn. Presentation of materials that have been equipped with animated moving images, brief explanation and interactive voice dubbing

aims to in the learning process children do not feel bored and easy to remember lesson. This edugame material can help students in an early rescue effort, so that children can easily remember and understand the learning about earthquake disaster and disaster mitigation in a more interesting and fun way.

### System usability testing

System Feasibility Testing aims to get a direct assessment of the feasibility of the system which has been made. The system's feasibility test consists of the operating variables of the App display, and the contents of the Application. In this test, the questionnaire is intended to assess application variables of operation, display variables, and application content variables. Respondents in this questionnaire are elementary school students. The calculation of this questionnaire using Likert scale with a scale of 1-4. The results of the calculation process is presented in table to obtain the value of feasibility test for the system. Here is the equation of questionnaire data calculation using Likert scale:

$$i = \frac{m-n}{k} \quad (1)$$

Where

- $i$  = class interval
- $m$  = maximum score
- $n$  = minimum score
- $k$  = classes

Before to calculate using Likert scale, first it was determined interval by using equation (1). It is known that the maximum score ( $m$ ) = 4; minimum score ( $n$ ) = 1; and classes ( $k$ ) = 4. Then with equation (3.2) it was found the class interval ( $i$ ) 0.75. The minimum scale is set to 1.00. Then the resulting category can be seen in Table-1.

Table-1. Categories interval.

Interval	Categories
3,28 - 4,03	Excellent (E)
2,52 - 3,27	Good (G)
1,76 - 2,51	Poorly (P)
1,00 - 1,75	Bad (B)

The likert scale was analyzed by calculating the score of each interval from the statement given to the respondent. The following is the result of the assessment of the test against the user with each variable.

### a) Application operation variable

In Table-2 it can be seen that the assessment of the Application Operation variable has an average of 3.72. Based on the rating categories listed in Table 1, the average score of 3.72 lies between the intervals of 3.28-4.03. It can be concluded that the assessment of display variables belongs to the category "EXCELLENT".

**Table-2.** Test result of application operation variable.

Application operation	M	Frequency			
		E	G	P	B
Application installation in Android	3,43	16	11	3	0
Convenience to play the application	3,93	28	2	0	0
Easiness to understand the contents	3,8	24	6	0	0
Sum of frequency		68	19	3	0
Mean of percentage		76%	21%	3%	0%
Sum of all categories	3,72				
Category	EXCELLENT				

**b) Display variable**

According to Table-3, application display variable has an average of 3.64. Based on the rating categories listed in Table-1, the mean scores are between

the intervals of 3.28-4.03. It can be concluded that the assessment of display variables belongs to the category "EXCELLENT".

**Table-3.** Test result of display variable.

Display variable	M	Frequency			
		E	G	P	B
Clarity of application contents	3,73	22	8	0	0
Clarity of application display	3,7	22	7	1	0
Moving of pictures dan sounds	3,5	17	11	2	0
Colourness of application	3,63	20	9	1	0
Clarity of instruction buttons	3,63	20	9	1	0
Sum of frequency		101	44	5	0
Mean of percentage		67%	29%	3%	0%
Sum of all categories	3,64				
Category	EXCELLENT				

**c) Application fill variables**

According to Table-4, variable content application has an average of 3.74. Based on the rating categories listed in Table-1, the mean scores are between

the intervals of 3.28-4.03. It can be concluded that the assessment of display variables belongs to the category "EXCELLENT".

**Table-4.** Test result of content application variable.

Content application	M	Frequency			
		E	G	P	B
Clarity on earthquake material and self-preparedness	3,83	25	5	0	0
Material completeness about earthquake	3,76	23	7	0	0
Conformity between education material and game	3,7	21	9	0	0
The order of education material and game	3,66	20	10	0	0
Sum of frequency		89	31	0	0
Mean of percentage		74%	26%	0%	0%
Sum of all categories	3,74				
Category	EXCELLENT				

Based on the usability testing data, this application was included in the excellent category for application operation, display, and content of the application variables. User opinion during the use of this application were very positive. They showed strong motivation and enthusiasm to learn while playing through this app. Because the application is easy to use, and friendly, so as to increase user interest to learn.

System test results showed that this education game is (1) easy to use, and fun; (2) acceptable to elementary school students as a more satisfying and pleasureable source of self-preservation learning than conventional methods without animation; (3) can be downloaded and can be studied anytime without being tied to space and time; (4) offers a more interactive learning approach that is very useful in earthquake disaster mitigation learning. Overall, the application of natural disaster mitigation education game for this earthquake is moderately effective to assist students to understand the steps of self-rescue before, during, and after the earthquake happened.

## CONCLUSIONS

An earthquake is a natural disaster that can happen anytime and anywhere, and can not be predicted so much to take casualties, whether it be property and even soul. the prevention of the number of victims is needed, especially for the victims of the vulnerable age or children because they do not know what an earthquake and how to deal with it. Based on the results obtained from the application feasibility test, it can be concluded that the edugame application of the earthquake-based disaster mitigation of Android is included in the "EXCELLENT" category the application operation with an average value of 3.72 with a percentage of 76% in terms of display with average value 3.64 with a percentage of 67% and the contents application with an average of 3.74 with a percentage of 74%.

Earthquake disaster is a natural disaster that often occurs in Indonesia. Education mitigation or prevention is certainly needed by children in elementary school. With earthquake disaster educational game is very useful to be

introduced to elementary school students, in order to protect themselves and can anticipate when facing earthquake disaster. This educational game application consists of 3 main stages in the self-rescue, namely before, during, and after the earthquake occurred. Each stage has a variety of multimedia elements have been loaded, for example, text, graphics, animation, character, audio and interactivity.

We aim to conduct more topics in disaster mitigation for other forms of natural disasters such as floods, volcanoes, typhoons, landslides. Further, we want to develop educational games that are more interactive and broad-based users to the public than just elementary school students only. This application is a viable option for students in a primary technology platform. This application can be accessed in smartphone. Overall, the application of natural disaster mitigation education game for this earthquake is effective in assisting students to understand the earthquake rescue measures.

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## REFERENCES

- [1] Winarno, Setya. 2011. House Seismic Vulnerability and Mitigation Strategies. Jurnal Penanggulangan Bencana. 2(2): 1-8. Yogyakarta : Badan Nasional Penanggulangan Bencana.
- [2] Winarni, Endang Widi. 2016. Pengaruh Pelaksanaan Program Pengurangan Risiko Bencana Terintegrasi Menggunakan Model Problem Based Learning Berbasis ICT Bagi Siswa Kelas IV SD IT Iqra 1 di Kota Bengkulu. Jurnal Inovasi Pembelajaran Vol 2, No 2. Universitas Muhammadiyah Malang.



- [3] Bouzid, Yosra, Mohamed Ali Khenissi, Fathi Essalmi, Mohamed Jemni. 2016. Using Educational Games for Sign Language Learning - A Sign Writing Learning Game: Case Study. Journal of Educational Technology & Society. 19(1): 129-141. ISSN 1436-4522.
- [4] Onecan, Abby, Rens Kortmann Felix Kulei, Bert Enserin. 2016. MANUFURIKO: Design of Nzoia Basin Location Based Flood Game. Science Direct, Procedia Engineering. 159(2016): 133-140. Elsevier. ISSN 1877-7058.
- [5] Bae Jae Hwan. 2016. Development of Smart Game Based on Multi-Platform Game Engine. International Journal of Multimedia and Ubiquitous Engineering (IJMUE). 11(3): 345-350. ISSN 1975-0080.
- [6] Bandrova T, M. Kouteva, L.Pashlova, D. Savova, S. Marinova. 2015. Conceptual Framework for Educational Disaster Centre save The Children Life. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-3/W3, 28 Sep- 03Oct 2015. La Grande Motte, France.
- [7] Majid Nazatul Aini Abdul and Nooraidah Kamarudin Husain. 2014. Mobile Learning Application Based on Augmented Reality for Science Subject: ISAINS. ARPJ Journal of Engineering and Applied Sciences. 9(9). ISSN 1819-6608.
- [8] Handojo Andreas, Justinus Andjarwirawan, Sandy Sunaryo and Resmana Lim. 2014. Heroic Battle of Surabaya Application Based On Android. ARPJ Journal of Engineering and Applied Sciences. 9(12). ISSN 1819-6608.
- [9] Kalisa Rogers and Michelle Picard. 2017. A Systematic Review on Mobile Learning in Higher Education: The African Perspective. TOJET: The Turkish Online Journal of Educational Technology. 16(1). Turkey. ISSN: 2146-7242 <http://www.tojet.net>.
- [10] McGonigal J. 2011. Reality Is Broken: Why Games Make Us Better and How They Can Change the World. US. Penguin Group.