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DESIGN OF 2D ANIMATION ON EARTHQUAKE MITIGATION FOR EARLY CHILHOOD STUDENTS AT KUSUMA DHARMA KINDERGARTEN

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Abstract:
Purpose: Realization of a 2D animation on earthquake mitigation tailored for children aged 4–6 years at Kusuma Dharma Kindergarten.
Research methods: The method involved data collection (observation, interview), followed by 2D animation design (Pre-, Pro-, Post-production stages), and feasibility validation by Content, Media, and Language experts
Findings: The 2D animation was successfully developed (Pre-, Pro-, Post-production) and rated "Very Good" by Content, Media, and Language experts (all scores exceeding 85%).
Implications: Future animations should incorporate other languages and musical elements to enhance learning retention and vocabulary acquisition, also to expand media development on other natural disasters.

Keywords: 2D animation, earthquake mitigation, early childhood, educational media, disaster education

1. INTRODUCTION

Geographically, Indonesia is situated in a seismically active region characterized by the convergence of three major tectonic plates: the Indo-Australian, Eurasian, and Pacific plates. This geological configuration renders the entire Indonesian archipelago highly vulnerable to earthquakes [1]. This condition is also evident in Bali, where the BMKG (Meteorology, Climatology, and Geophysics Agency) reported that during the fourth week of September 2024 alone, 63 earthquake events with varying magnitudes occurred in Bali and its surrounding areas. Given the high frequency of seismic activity, efforts to reduce earthquake risks are critically important. One effective measure for disaster risk reduction is through disaster mitigation education. Earthquake mitigation is essential in Indonesia to foster comprehensive awareness across all segments of society [2]. Disaster mitigation itself is defined as a preventive action undertaken to reduce disaster risk [3]. This is further reinforced by Law No. 24 of 2007, which defines mitigation as a series of efforts to reduce disaster risk, one of which is achieved through increasing public awareness via socialization and education.

Awareness regarding the importance of disaster mitigation is not exclusive to adults; it is equally relevant for early childhood. The NAEYC (National Association for the Education of Young Children) defines early childhood as the age range of 4–6 years. This demographic falls into a vulnerable group that more frequently experiences disruptions

and impacts from natural disasters, such as the emergence of various traumas and sleep disorders [4], [5]. UNESCO [2] states that young children need to understand concepts of risk, danger, and safety, know appropriate actions during a disaster, distinguish needs from wants, and be capable of cooperation in emergency situations. Earthquake mitigation education is crucial from an early age, considering that this group is entering the golden age—a period of growth where cognitive absorption and memory retention are at their peak [6].

At an early age, children possess the ability to absorb information more effectively if it is conveyed through engaging media. One effective method for delivering disaster mitigation material to children is through 2-dimensional (2D) animation. 2D animation is a visual medium designed with simple, attractive, and educational elements, aimed at introducing basic concepts through stories or characters [7]. The advantage of animation over static media lies in its ability to demonstrate dynamic changes, explain procedures step-by-step, and depict sequences of events in a manner that is both more engaging and easier to comprehend [8].

Although animation is effective for earthquake mitigation education, its implementation is often not tailored to early childhood needs. The lack of interactive and personalized media for young children means that teaching earthquake mitigation understanding requires extra effort [9], [10]. This issue was highlighted in interviews with teachers at Kusuma Dharma kindergarten, namely Ni Luh Kadek Wiwik Wiyatiani, S.Pd (Kindergarten B teacher) and Juni Artini, S.Pd (Kindergarten A teacher). It was explained that available earthquake-related learning media are insufficiently attractive to children, making it difficult to sustain their attention. Existing 2D animations often fail to align with early childhood needs, utilizing language that is too technical for children to grasp and lacking interactive elements to encourage active participation. This is corroborated by observational data collected at Kusuma Dharma Kindergarten, which showed that children lost focus after watching 2D animation for only a few minutes. This was primarily caused by the use of overly technical language, resulting in a lack of comprehension regarding the material delivered. Consequently, learning objectives appeared unachieved as children diverted their attention to other activities, such as playing or talking with friends.

Therefore, based on the aforementioned points, there is a distinct need for earthquake disaster mitigation media that focuses on the early childhood market segmentation. Such media must feature attractive animation, utilize language that is easily understood through simplification, and incorporate interactive elements to maintain children's attention. This media is also expected to assist children in recognizing basic mitigation steps through a fun and educational visual approach. Accordingly, the titled of the research is “DESIGN OF 2D ANIMATION ON EARTHQUAKE MITIGATION FOR EARLY CHILHOOD STUDENTS AT KUSUMA DHARMA KINDERGARTEN”.

2. RESEARCH METHODS

This research was conducted at Kusuma Dharma Kindergarten Jimbaran, Bali. The research process followed the stages of 2D animated media design, which included pre-production, production, and post-production. These stages were aimed at designing earthquake mitigation learning media that aligns with the characteristics of early childhood students. The data collection methods used included :

1) Observation**,** Direct observation of the learning process at Kusuma Dharma Kindergarten was conducted to identify the appropriate learning media needs.

2) Interview**,** Interviews were conducted with two teachers at Kusuma Dharma Kindergarten to gather information regarding the effectiveness of previously used media and their expectations for the media to be developed.
3) Documentation**,** documentation, in the form of images and activity notes, was carried out during the observation and interviews, as well as throughout the animation production process.
4) Literature Review, This study was conducted by reviewing literature related to earthquake mitigation, early childhood education, and animation production techniques

Subsequently, the animation design was carried out through the following stages:

1) Pre-production: This stage included the creation of the story idea, script, storyboard, and the design of characters and backgrounds.
2) Production: This involved the creation of visual and audio assets, voice recording (dubbing), and animation using software such as Moho and After Effects.
3) Post-production: This stage encompassed final editing, the integration of audio and visual elements, rendering, and the compilation of the final output into an animated video.

The media feasibility testing was conducted through validation by three categories of experts:
1) Content Expert: To assess the accuracy and suitability of the earthquake mitigation material.
2) Media Expert**:** To evaluate the visual and technical aspects of the animation.
3) Language Expert: To ensure the language utilized is appropriate for the comprehension level of early childhood students.

3. FINDINGS

3.1 Data Collection Results

1. **Observation** The observation was conducted on September 11, 2024, at Kusuma Dharma kindergarten. It was observed that the children rapidly lost focus when viewing animations containing technical language. Conversely, they demonstrated increased activity and engagement when participating in simple simulations. Although the classroom is equipped with visual facilities such as a projector and speakers, interactive animated media is currently lacking. The observation results highlight the critical necessity for media featuring appealing visuals, simplified language, and interactive elements.

2. **Interview** Interviews were conducted on November 2–3, 2024, with two teachers at Kusuma Dharma kindergarten: Ni Luh Kadek Wiwik Wiyatiani, S.Pd. and Juni Artini, S.Pd. The objective was to ascertain how children comprehend the material and to identify challenges encountered during the learning process. It was noted that children tend to lose focus if the animation lacks dynamism. Consequently, both teachers recommended the development of more engaging and interactive media to facilitate easier comprehension of the material by the children.

3. **Documentation** The documentation encompasses the results of the interviews and observations conducted at Kusuma Dharma kindergarten. The data collected includes learning records and classroom conditions. This information serves as

the foundation for the development of the storyline and animation content. All documentation will be included in the appendices.

4. **Literature Review** The author collected additional data from relevant journals, e-books, and undergraduate theses. This method was employed to substantiate the theoretical framework and research approach. The selected references are specifically relevant to the theme of disaster mitigation for early childhood.

3.2 Earthquake Mitigation Animation Content

The material in this animation is based on the book of Tanggap Tangkas Tangguh Darurat Gempa Bumi published by the BNPB (Badan Nasional Penanggulangan Bencana)

Figure 3.1The book of Tanggap Tangkas Tangguh Darurat Gempa Bumi
[Source: Krisario, 2025]

The content was selected based on its suitability for early childhood and is presented using simple and engaging visuals. The animation content covers fundamental mitigation steps, specifically:

1. **Steps during an earthquake** a. If indoors, execute the **drop, cover, and hold** technique: protect the body from debris by hiding under a table or other sturdy object, seek shelter away from windows or potentially falling objects, and evacuate the building immediately if possible. b. If outdoors, avoid buildings, utility poles, trees, and other tall structures.

2. **Steps after an earthquake** a. If still inside a building, evacuate in an orderly manner and continue to protect the head during evacuation; check yourself and those nearby for injuries, and immediately seek assistance from others if injured. b. Avoid damaged buildings due to the risk of further collapse, especially in the event of aftershocks. c. Remain calm and follow the directions of authorized personnel, such as teachers (if at school) or officials from the BNPB (National Disaster Management Agency), Basarnas, and other relevant bodies.

The entire content is delivered using language easily understood by kindergarten children and is supported by illustrations that correspond to typical school settings. The selection of this material aims to build awareness and preparedness in children for facing earthquake disasters from an early age.

3.3 Animation Production Process

The production process resulted in an animated media piece lasting 3 minutes and 45 seconds, featuring a cheerful visual style, characters consisting of kindergarten children and 'Miss' (the teacher), and the use of simplified language.

1. Pre-Production, The following are illustrations of the character and background designs used in the animation:

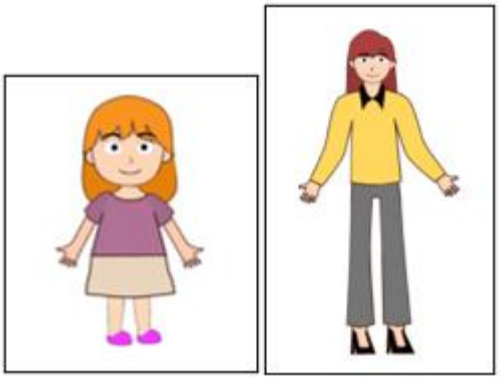

Figure 3.2 Ilustration character kindergarten children and Miss
[Source: Krisario, 2025]

Figure 3.3 Illustration of School Front View
[Source: Krisario, 2025]

The following uses the color palette used in this animation :

Table 1: Color Palette
[Source: Krisario, 2025]

Number	Color	Code
1		# 8E392A
2		# 70ABE3
3		#436B35
4		#FFCEE1

5		#92E6F7
6		#FEDA57
7		#A55723
8		#FF6241

The fonts used in the animation include the sans-serif type “Poppins” and the display type “Candy Beans”. The rationale behind selecting these font types is their high readability and their support for a "fun" concept.

2. Production, Character and background assets were animated using the Moho software for the rigging process and the assignment of bones to the characters. Voice recording (dubbing) was conducted for the character of Miss and the narrator, utilizing simple sentences and clear articulation. This can be seen in the following image:

Figure 3.4 The making process in Moho Animation
[Source: Krisario, 2025]

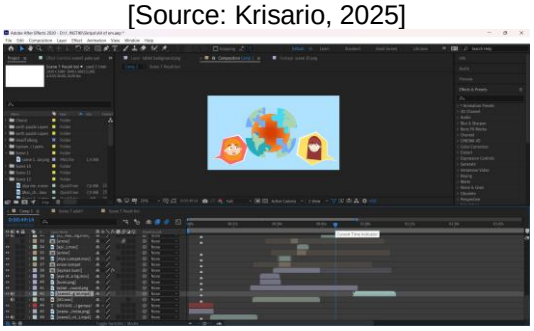

Figure 3.5 The making process in After Effect
[Source: Krisario, 2025]

3. Post-production, final editing, combining sound and visual elements, rendering, and compiling the final output in the form of animated video is done in the Premiere Pro application, as can be seen in the following image :

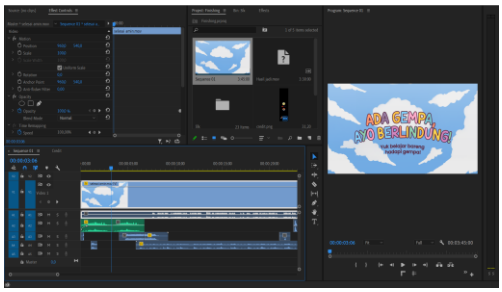

Figure 3.6 Post-production in Premiere Pro
[Source: Krisario, 2025]

3.4 Media Evaluation and Feasibility Testing

The media feasibility assessment was conducted by three categories of experts: content experts (kindergarten teachers and a representative from the BPBD), media experts (lecturers specializing in graphic design and animation), and language experts (elementary school Indonesian language teachers). The assessment utilized a Likert scale-based questionnaire with five evaluation levels

Based on the recapitulated results, all three expert categories provided an average score exceeding 85%. Every category qualified as "Very Good," indicating that the designed animated media is deemed suitable for use as an educational tool for disaster mitigation among early childhood students.

Table 2: Evaluation Experts
[Source: Krisario, 2025]

Number	Experts	Percentage	Qualification
1	Content Experts	86,67%	Very good
2	Media Experts	87,33%	Very good
3	Language Experts	92%	Very good
Total		88,67%	Very good

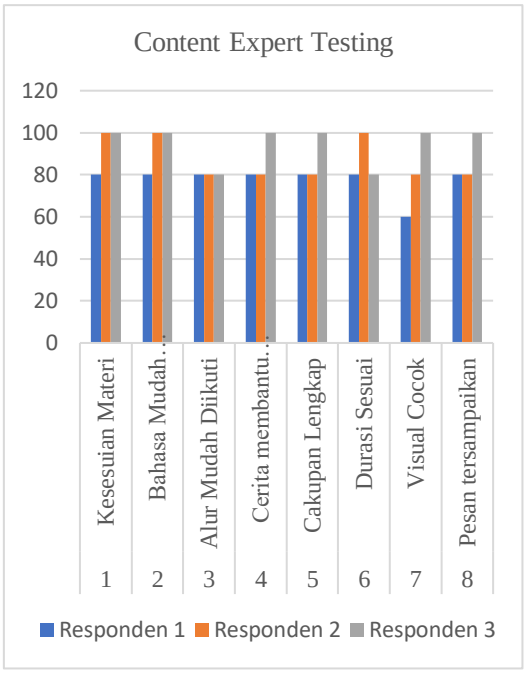

Figure 3.7 Content Expert Assessment Graph per Respondent (100 Scale)
[Source: Krisario, 2025]

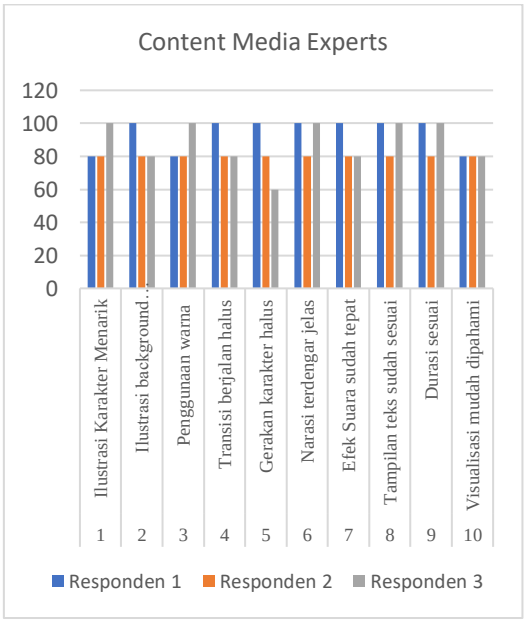

Figure 3.8 Media Expert Assessment Graph per Respondent (100 Scale)
[Source: Krisario, 2025]

3.5 Distribution

Upon the completion of all production and editing stages, the animation was distributed to Kusuma Dharma Kindergarten to serve as supplementary teaching material for learning activities. The distribution process was executed through three primary methods. First, the animation file was directly copied onto the school's flash drive, enabling offline access and playback using the devices available in the classroom environment. Second, the animation file was also stored in the author's personal Google Drive account as a form of digital backup. The access link to this file was then shared with the teachers, allowing them to

download or stream the animation as needed. Third, the final animation result will be uploaded to the author's personal YouTube platform.

4. CONCLUSION

Based on the design and implementation of the 2D animation, the results indicate that the 2D earthquake disaster mitigation animated media is suitable for use and distribution. This media has received a "Very Good" response from teachers, media and content experts, thus establishing it as an effective future learning aid. The following results from the evaluation and testing demonstrate the high quality of this animation: :

1. The 2D earthquake mitigation animation was designed to introduce early childhood students at Kusuma Dharma Kindergarten to the concept of earthquakes and self-rescue steps in a simple and enjoyable manner. The approach utilized emphasizes bright visuals, child-friendly language, and interactive elements allowing for choice of action. This animation does not only present information passively but also actively engages the children, moving beyond mere spectatorship to create an active and meaningful learning experience.

2. The production process of this animation involved three key stages: (a) Pre-production, which included generating ideas, scripting, and storyboarding. (b) Production, covering asset creation, animation with rigging, and voice acting. (c) Post-Production, consisting of editing, audio-visual adjustments, and final rendering using the Full HD video format at a frame rate of 25 fps, resulting in a total duration of 3 minutes and 45 seconds.

3. Based on the testing results, the animation was rated "Very Good" by the media experts with a percentage of 87.33%. The animation was rated "Very Good" by the content experts with a percentage of 86.67%. Furthermore, the language experts rated the animation at 92%, and testing on the kindergarten children showed that the majority demonstrated a better understanding of earthquakes and the correct way to seek shelter. The children also largely expressed enjoyment of the characters in the animation and found the story easy to understand.

For future development, the following recommendations are suggested :

1. Development of similar learning media focusing on different natural disaster mitigation themes, such as tsunamis, forest fires, or floods, with the aim of broadening the scope of disaster education from an early age.
2. Incorporation of other languages, such as English or local languages. The use of additional languages could help children learn new vocabulary while reinforcing their knowledge of disasters and their mitigation.
3. Future development could consider including musical elements or sing-alongs to strengthen children's memory retention regarding mitigation steps.

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