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# Interactive e-comic based on traditional games as a disaster mitigation educational media for elementary school students

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**Abstract:** Indonesia is a disaster-prone country; however, disaster mitigation education in elementary schools remains limited in innovation and less engaging for students. This study aims to develop an Interactive E-Comic based on traditional games as an educational medium for disaster mitigation for elementary school students. The research employed a Research and Development (R&D) method using an adapted Borg & Gall development model. The research subjects consisted of material experts, media experts, one teacher, and 30 fourth-grade students of SDN Kunciran 4 Tangerang. Data were collected through expert validation, teacher and student response questionnaires, and an effectiveness test on disaster mitigation knowledge. The validation results showed an average score of 15.5 from the material expert (very feasible category) and 11.5 from the media expert (feasible category). The teacher's response to the media obtained a score of 74 (feasible), while students' responses reached an average score of 15.15 (very feasible). The operational trial indicated an increase in students' disaster mitigation knowledge, from an average pretest score of 48.20 to a posttest score of 82.50, with an N-gain of 0.66 (medium category). These findings indicate that the Interactive E-Comic based on traditional games is effective in improving students' understanding of disaster mitigation and can serve as an engaging and contextual learning medium.
**Keywords:** Interactive E-Comic; Traditional Games; Disaster Mitigation; Elementary School; Learning Media.



## INTRODUCTION

Indonesia is a country with a high level of vulnerability to various natural disasters, such as earthquakes, floods, and tsunamis (Rijanta et al., 2018). Children, particularly elementary school students, are among the most vulnerable groups due to their limited understanding and preparedness in facing emergency situations (Bakhriansyah et al., 2025). However, disaster mitigation education at the elementary school level is still dominated by conventional methods that are less engaging (Suarmika & Utama, 2017). lacks standardized guidelines and curriculum, and demonstrates low awareness of the importance of educational approaches in disaster education (Suroso et al., 2021).

Consequently, efforts to enhance students' awareness and preparedness have been less effective.

At SDN Kunciran 4, learning media remain limited to conventional forms such as pictures, posters, and information sheets in classrooms or reading corners. In fact, the use of innovative learning media can significantly improve the effectiveness of disaster mitigation education (Wahyuningtyas et al., 2021). Elementary students tend to prefer reading materials accompanied by attractive illustrations (Paranoan et al., 2024), and they are particularly interested in picture storybooks (Daristin & Fajarina, 2022). Comics have been proven effective in enhancing students' understanding of disaster mitigation concepts (Amin & Bahri, 2024), while also capturing their interest and motivating them to take action in emergency situations (Lin et al., 2015; Wang et al., 2019). The advantage of comics lies in their combination of interactive visuals and relevant storylines (Matuk et al., 2021), making the material easier to comprehend when presented visually and verbally together (Cohn, 2013). This feature helps students grasp complex information such as disaster mitigation (Pujaanti & Isnah, 2023).

Moreover, traditional games have been shown to serve as psychosocial support media for child survivors of disasters (Madyawati & Sulistyaningtyas, 2020). Activities such as *engklek*, *ular naga*, *batu taba*, *gembatan*, and *gobag sodor* help in the recovery of children's psychosocial conditions (Nasution et al., 2023). Integrating traditional games into comics is believed to increase emotional engagement while reinforcing students' connection with local content (Wewengkang et al., 2024). Traditional games are rich in cultural values, collaboration, and agility, which are relevant to be transformed into educational simulations in the context of disaster mitigation. Learning media based on local culture are considered effective in strengthening students' understanding of preparedness values (Danar, 2020). Furthermore, previous studies have shown that the use of comics in elementary school science learning significantly improved learning outcomes compared to conventional printed media (Auliya et al., 2023; Safirah & Suhartiningsih, 2023)

Based on these findings, the development of interactive e-comics integrating traditional games holds great potential to enhance students' cognitive knowledge of disaster mitigation. This approach not only leverages digital technology favored by children but also revitalizes local wisdom, making the learning process more contextual and meaningful. Therefore, this study aims to develop and test the effectiveness of an interactive e-comic based on traditional games as a disaster mitigation educational medium for elementary school students.

Research related to disaster mitigation education has been widely conducted; however, packaging the material in the form of engaging and interactive comics remains relatively rare. Several studies indicate that interactive digital media, such as comics and educational games, are more effective in improving students' understanding compared to conventional learning methods (Hardiansyah et al., 2024). This effectiveness is attributed to the characteristics of media that are visual, interactive, and more aligned with children's interests (Muktadir & Darmansyah, 2021). On the other hand, a number of studies also emphasize that traditional games can function as educational media that develop students' social and cognitive skills (Susanti et al., 2023), while also supporting the psychological recovery of children affected by disasters. Nevertheless, the integration of interactive e-comics and traditional games as disaster

mitigation education media has rarely been investigated. This condition presents a significant research gap that needs to be further explored in this study.

This research introduces an innovative approach by combining interactive e-comics based on digital technology with traditional games as a strategy for disaster mitigation learning. The main novelty of this study lies in the integration of traditional games into interactive e-comics. Beyond utilizing digital comics as an educational medium, this study adapts traditional games such as engklek, jump rope, and gobak sodor as part of the storyline. In this way, disaster mitigation concepts are presented in a more contextual, engaging, and relevant manner to the lives of elementary school students.

## METHOD

The type of research employed in this study is Research and Development (R&D), referring to the Borg & Gall model. According to Borg & Gall (Sugiyono, 2019), there are two main objectives in research and development procedures: (1) to produce a product, and (2) to test the effectiveness of the product in achieving its objectives. The implementation of this research followed the ten steps of Borg & Gall's R&D model. For clarity, the Figure 1 illustrates the flow of R&D using the Borg & Gall model.

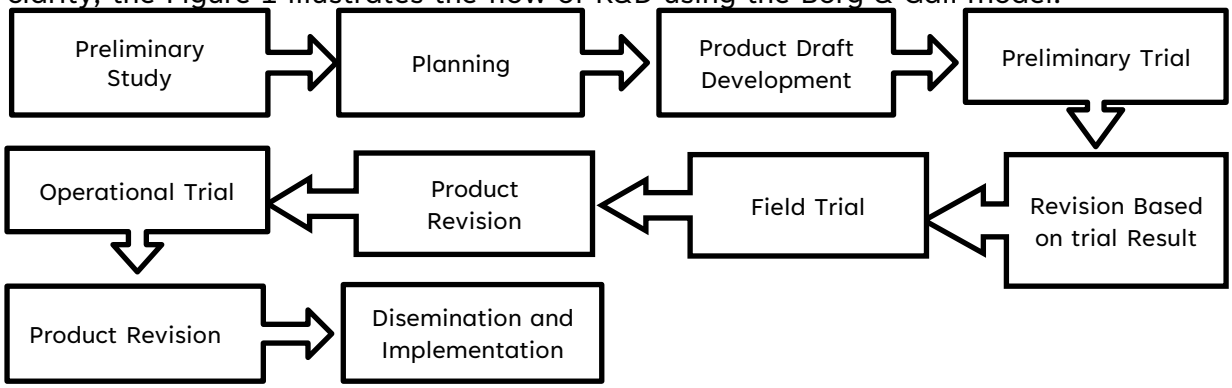



**Figure 1.** Steps of Product Development Based on Borg and Gall

This study developed an Interactive E-Comic based on traditional games as a disaster mitigation educational medium for elementary school students. The development stages included a preliminary study, planning, product creation and validation, initial and main field trials, as well as operational trials using a quasi-experimental design with pretest–posttest. The research instruments were developed based on indicators derived from disaster mitigation competency standards and elementary science learning objectives, which were further aligned with Bloom's revised taxonomy (Anderson & Krathwohl, 2001) at the cognitive levels C3 (Applying), C4 (Analyzing), C5 (Evaluating). These indicators were then operationalized into test items and expert-validated to ensure content validity and alignment with the intended competencies.

To evaluate product effectiveness, this study initially used the N-Gain score to measure relative improvement in students' learning outcomes. However, the interpretation of N-Gain was strengthened by referencing Hake's classification (1998), which categorizes learning gains into high, medium, and low levels. In addition, supporting statistical analyses were included by comparing pretest and posttest scores using descriptive statistics and theoretical interpretation to provide a more comprehensive assessment of effectiveness beyond the N-Gain metric.

### Data Collection Techniques

The data collection techniques used in this interactive e-comic media development research were observation, interviews, questionnaires, product rating scales, and tests.

### Data Collection Instruments

#### Product Validation Sheet

The validation instrument served to gather feedback in the form of evaluations, comments, critiques, and recommendations related to the developed interactive e-comic media. The validation process for grade IV elementary students involved both material experts and media experts. To measure the degree of validity, this study utilized an assessment rubric sheet.

#### Teacher and Student Response Questionnaires

Questionnaires for teachers and students were employed to obtain data regarding their perceptions of the developed media. After receiving the media, teachers were asked to complete the questionnaires distributed by the researcher.

### Data Analysis Techniques

The data analysis techniques used in this study consisted of qualitative descriptive analysis and descriptive statistical analysis.

#### Qualitative Descriptive Analysis

This method was applied to analyze data consisting of notes, suggestions, and feedback from expert validators of the interactive e-comic media, derived from validation assessments and limited trials. The results of this analysis then became the foundation for revising the interactive e-comic product.

#### Descriptive Statistical Analysis

Descriptive statistical techniques were employed to examine the data obtained from expert validation scores.

## RESULTS AND DISCUSSION

### Result

#### Research and Information Collecting

The preliminary study was conducted through field studies and literature reviews. This stage aims to identify the potential, problems, and actual needs in the field.

##### *Field Study*

The field study was conducted at SDN Kunciran 4 Tangerang through observation activities, interviews with teachers, and the distribution of needs analysis questionnaires to fourth-grade teachers and students.

##### *Observation*

The observation was carried out to examine the condition of disaster mitigation learning in the classroom, the learning media used, and students' interest in interactive media. The results of the observation showed that the media used were still conventional, such as pictures, posters, and information sheets posted in the classroom.

### *Teacher Interview*

The interview was conducted with the fourth-grade teacher. The results indicated that the teacher emphasized the importance of presenting disaster mitigation learning in a more engaging way, particularly by integrating elements of traditional games. The teacher agreed that interactive digital-based learning media could enhance students' motivation while also fostering early awareness of disaster mitigation.

## Needs Analysis Questionnaire

### *Teacher Questionnaire*

The results show that all three teachers feel the need for innovative learning media that can combine disaster mitigation education with traditional games to make it more relevant and contextual for students.

### *Student Questionnarie*

A total of 84% of students stated that they are more interested in interactive electronic-based media. However, 72% admitted that they had never had a learning experience in disaster mitigation that utilized traditional games. In addition, 83% of students considered it important to have innovative learning media capable of integrating traditional games with disaster mitigation education.

## Literature Review

Based on the literature review, disaster mitigation learning media currently available are generally still limited to text, images, or posters, making them less interactive and less engaging for students. Therefore, the researcher gathered theories related to disaster mitigation in elementary schools, the integration of traditional games in learning, local cultural literacy, as well as the characteristics of fourth-grade elementary school students as the foundation for product developmen.

## Planning

The planning stage aimed to formulate the research direction and development steps for an interactive e-comic based on traditional games as a medium for disaster mitigation education. The research objectives were established as follows: (1) to produce a feasible e-comic for use, and (2) to test its effectiveness in improving the knowledge and preparedness of fourth-grade elementary school students regarding disasters. A curriculum learning outcomes analysis for grade IV was conducted to determine the materials and content of the e-comic, particularly focusing on science and social studies (IPAS) competencies related to disaster mitigation and impact reduction. Next, an initial draft of the e-comic was created in the form of a storyline framework that combined disaster mitigation concepts with traditional games such as *engklek*, jump rope, and *gobak sodor*, enabling students to gain contextual and enjoyable learning experiences while also developing social skills. Sketches of character illustrations, settings, and the integration of traditional games were also prepared.

To strengthen the design, a Focus Group Discussion (FGD) was conducted with teachers, media experts, subject matter experts, and peers. Teachers emphasized the importance of both group and independent learning, media experts suggested making the e-comic interactive and easily accessible, subject matter experts highlighted the need for clear disaster mitigation narratives, while peers provided technical suggest-

ions for making the illustrations proportional and communicative. All feedback was used as the basis for refining the draft. The research instruments were also prepared, including product evaluation sheets by subject matter and media experts, teacher and student response questionnaires, as well as a student disaster mitigation knowledge test. The trial was planned to be carried out at SDN Kunciran 4 Tangerang with fourth-grade students, after obtaining permission and conducting discussions with the principal and teachers regarding the timing and technical aspects of the research implementation

### Develop Preliminary Form of Product

The product draft development was carried out by structuring the framework of the interactive e-comic that had been designed during the planning stage. The storyline material was developed by taking into account the thematic learning content integrated into the IPAS subject. The main objective of this development was to produce an interactive e-comic as an effective medium for disaster mitigation education based on traditional games for elementary school students.

### Development of Interactive E-Comic Media Based on Traditional Games

The development of this interactive e-comic was designed using digital design applications such as Adobe Illustrator and Clip Studio Paint, and then integrated into an interactive mobile-based application platform. The following outlines the media development process: **First**, the storyline was developed by determining the main elements, including theme, characters, characterization, and setting. The story takes the form of children's adventure plots in which they face disaster situations by utilizing elements of traditional games such as *engklek* (hopscotch), jump rope, and *gobak sodor* (a traditional tag game). These games serve as analogies and strategies for disaster mitigation that are more contextual for elementary school students. **Second**, Digital illustrations were created by the multimedia development team using an educational cartoon style that is visually engaging and appropriate for children's characteristics. **Third**, the interactive e-comic was developed in two forms. First, a digital version accessible via tablets or laptops with interactive features (clicks, animations, and short quizzes). Second, a companion printed book containing core competencies, basic competencies, usage guidelines, a summary of disaster mitigation materials, and the full story script. Fourth, the interactive e-comic consists of three story episodes, each presenting a different disaster scenario (flood, earthquake, and tsunami). In each story, traditional games are integrated as strategies for self-rescue and cooperation. At the end of each story, a summary is provided that emphasizes the values of togetherness, social care, and concrete steps for disaster mitigation. And **fifth**, the final section of the e-comic includes a bibliography and developer profiles

### Validation of Interactive E-Comic Media by Experts

The media validation was conducted to determine the feasibility of the developed product. The validation process involved subject matter experts (Science and Social Studies) as well as media experts (educational technology). The evaluation focused on the aspects of content and media design.

The feasibility assessment was carried out by two subject matter experts and two media experts. The validation results consisted of scores for each assessed aspect,

which were then calculated and converted into product feasibility categories. The conversion of total feasibility scores is presented in Table 1.

**Table 1.** Conversion of Total Product Feasibility Scores by Experts

| Quantitative Score Range | Empirical Score Range | | Qualitative Criteria |
|---|---|---|---|
| | Subject Matter Expert Validation | Media Expert Validation | |
| $X_i$ + 1,8 SBi | X > 13.6 | X > 10.2 | Highly Feasible |
| $X_i$ + 0,6 SBi < X ≤ $X_i$ + 1,8 SBi | 11.20 < X <= 13.6 | 8.40 < X <= 10.2 | Feasible |
| $X_i$ – 0,6 SBi < X ≤ $X_i$ + 0,6 SBi | 8.80 < X <= 11.20 | 6.60 < X <= 8.40 | Fairly Feasible |
| $X_i$ – 1,8 SBi < X ≤ $X_i$ – 0,6 SBi | 6.4 < X <= 8.80 | 4.8 < X <= 6.60 | Less Feasible |
| X ≤ ($X_i$ – 1,8 SBi) | X <= 6.4 | X <= 4.8 | Very Less Feasible |

The interactive e-comic media is considered feasible if it obtains a total score within the qualitative category of *"Feasible"* or higher. The following are the validation results provided by the subject matter experts and media experts.

## Assessment Results by Subject Matter Experts

The subject matter expert assessment was carried out by evaluating five aspects, namely: (1) The relevance of the content in the disaster mitigation e-comic based on traditional games; (2) The accuracy of the material in the disaster mitigation e-comic based on traditional games; (3) The appropriateness of the material presented in the disaster mitigation e-comic based on traditional games; (4) The disaster mitigation e-comic based on traditional games encourages students' curiosity. The assessment was conducted in two stages.

**Table 2.** Product Assessment Results – Material Aspect

| No. | Indicator | Score | |
|---|---|---|---|
| | | Matter Expert 1 | Subject Expert 2 |
| 1. | Relevance of the content in the disaster mitigation e-comic based on traditional games | 4 | 3 |
| 2. | Accuracy of the material in the disaster mitigation e-comic based on traditional games | 3 | 3 |
| 3. | The disaster mitigation e-comic based on traditional games presents appropriate material | 4 | 4 |
| 4. | The disaster mitigation e-comic based on traditional games encourages students' curiosity | 4 | 4 |
| | Total Score | 15 | 14 |

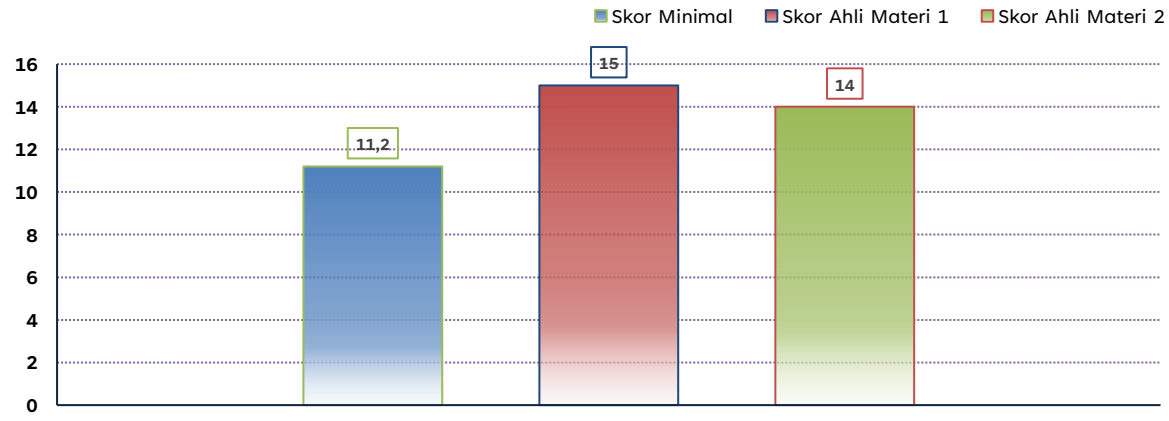



**Figure 2.** Material Expert Validation Results

Based on Table 2 and the guidelines for converting total product feasibility scores, the validation results from subject matter experts for the disaster mitigation e-comic based on traditional games show a total score of 15 from Subject Matter Expert 1 and 14 from Subject Matter Expert 2. These scores fall into the *"Highly Feasible"* category according to the empirical score range for subject matter experts (>13.6), indicating that the product is deemed feasible for use.

Figure 2 shows that the interactive e-comic was rated as *Highly Feasible* to be used as a disaster mitigation learning medium in elementary schools, with several improvements suggested based on input from the subject matter experts.

## Assessment Results by Media Experts

The evaluation carried out by media experts aimed to assess the feasibility of the interactive e-comic developed as a disaster mitigation learning medium based on traditional games. The assessment focused on three key components: (1) the quality of the visual presentation of the interactive e-comic as a disaster mitigation learning resource for elementary students, (2) the cover design of the e-comic, and (3) the content design of the e-comic. The outcomes of the media experts' evaluation of the interactive e-comic are summarized in Table 3.

**Table 3.** Product Assessment Results – Media Aspect

| No. | Indicator | Media Expert 1 | Media Expert 2 |
|---|---|---|---|
| 1. | Visual quality of the interactive e-comic as a disaster mitigation educational medium | 3 | 4 |
| 2. | Cover design of the interactive e-comic as a disaster mitigation educational medium | 4 | 4 |
| 3. | Content design of the interactive e-comic as a disaster mitigation educational medium | 4 | 4 |
| | Total Score | 11 | 12 |

Based on Table 3, the validation results from media experts for the interactive e-comic as a disaster mitigation educational medium based on traditional games show a total score of 11 from Media Expert 1 and 12 from Media Expert 2. When converted according to the scoring guidelines, both scores fall into the *"Highly Feasible"* category, indicating that the media meets the criteria for visual quality, cover design, and content design. Nevertheless, several minor improvements in visual elements and layout are still needed to make the media more engaging and user-friendly for students.

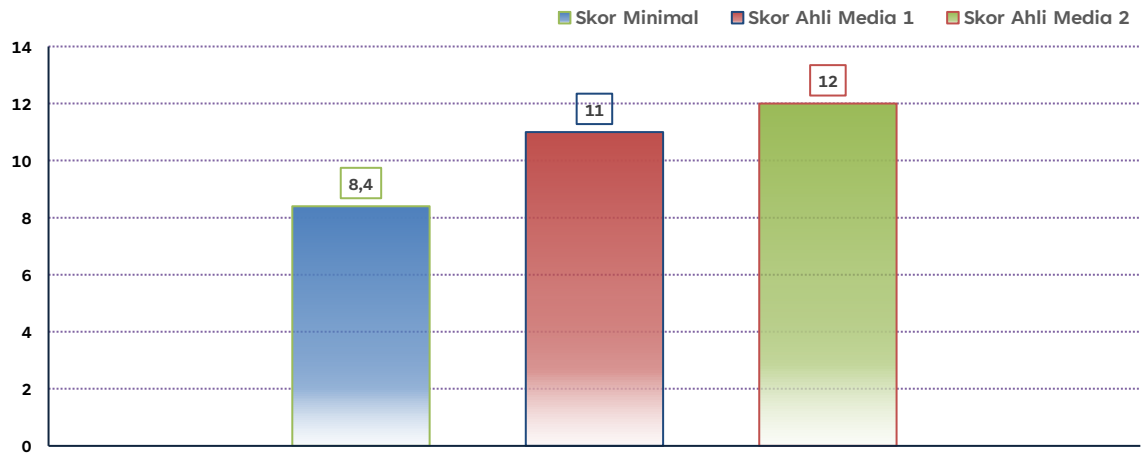



**Figure 3.** Media Expert Validation Results

Thus, the validation results from media experts confirm that the interactive e-comic based on traditional games is *highly feasible* for use in disaster mitigation learning in elementary schools, although minor refinements in color appearance are still needed to make it more comfortable for students to read.

## Main Product Revisions

At this stage, the interactive e-comic was revised to enhance its effectiveness in supporting disaster mitigation learning for fourth-grade students at SDN Kunciran 4 Tangerang. The revision process was guided by feedback and data collected from the preliminary and field trials. The primary aim was to refine the product in preparation for the operational trial. This phase emphasized resolving identified shortcomings, incorporating suggestions and feedback from both teachers and students, and ensuring that the e-comic aligned with learning objectives as well as the needs of learners. The outcomes of the revision are illustrated in Figure 4.

### *Interactive E-Comic Cover*

The design validator suggested that the cover of the interactive e-comic should be made more attractive and representative, for example by clearly displaying the main character, using contrasting and bright colors, and including the title in an easy-to-read font.


(a) Before revision (b) Setelah Revisi

**Figure 4.** E-Comic Cover

### *Characters in the Interactive E-Comic*

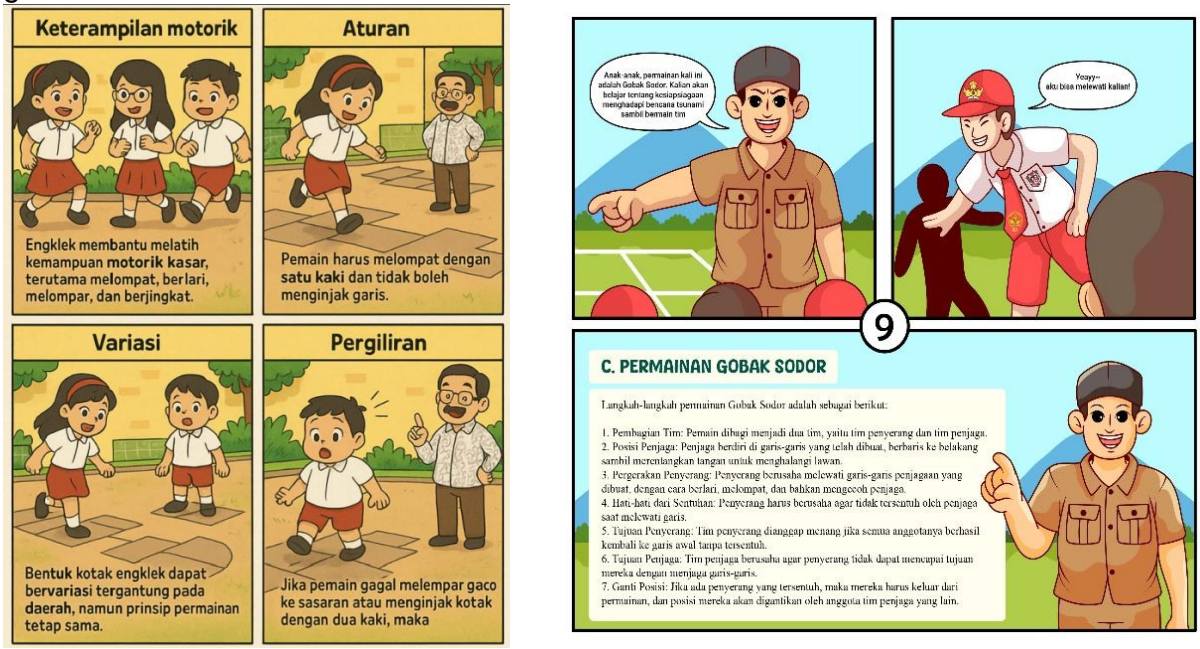
The design validator suggested that the characters in the interactive e-comic did not yet accurately represent elementary school students. This was evident from details such as clothing and hats that lacked the *Tut Wuri Handayani* logo, as well as a character depicted without wearing socks. The validator also commented on the teacher character, who was illustrated with a mustache. This was considered less appropriate, as in the elementary school context, teachers are generally portrayed without mustaches in order to create a more neutral and friendly appearance for students (See Figure 6).


(a) Before Revision (b) After revision

**Figure 5.** Characters in the Interactive E-Comic

### *Content in the E-Comic*

The subject matter validator suggested that the rules and steps of the traditional games should be explained in greater detail and clarity so that students can follow the games without confusion.




(a) Before Revision (b) After Revision

**Figure 6.** E-Comic Contents

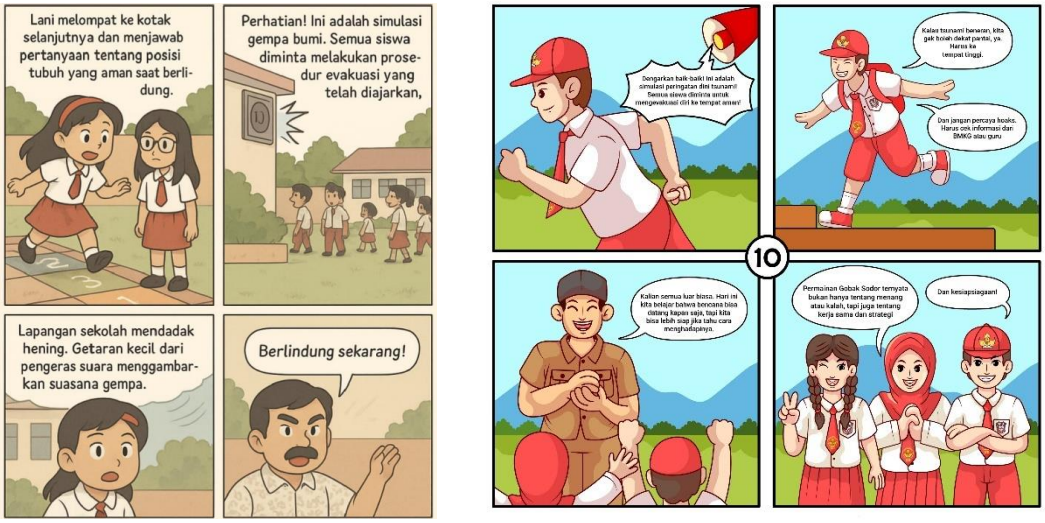
### *Colors in the E-Comic Product*

The design validator suggested that the color selection in the e-comic should ensure good contrast between the background and the text so that the text is easy to read and the visuals are more engaging for students. In addition, the use of colors should be consistent with the story theme and characters to support both comprehension and the overall aesthetics of the media (Figure 7).

### Preliminary Trial

The testing of the interactive e-comic was carried out in three stages: preliminary trial, field trial, and operational trial. The preliminary and field trials were intended to capture teachers' and students' responses to the e-comic as a disaster mitigation

learning medium grounded in traditional games. Data collection employed teacher and student response questionnaires. The teacher questionnaire comprised six indicators translated into 18 items, while the student questionnaire included four indicators with 15 items. The responses were subsequently converted into quantitative scores to determine the feasibility category, as presented in Table 4.




(a) Before Revision (b) After Revision

**Figure 7.** Colors in the E-Comic Product

**Table 4.** Conversion of Total Scores from Teacher and Student Responses

| Quantitative Score Range | Quantitative Score Range | | Quantitative Score Range |
|---|---|---|---|
| | Teacher Response | Student Response | |
| $X_i$ + 1,8 SBi | X > 75,6 | X > 12 | Excellent Feasibility |
| $X_i$ + 0,6 SBi < X ≤ $X_i$ + 1,8 SBi | 61,2 < X ≤ 75,6 | 9 < X ≤ 12 | Good Feasibility |
| $X_i$ – 0,6 SBi < X ≤ $X_i$ + 0,6 SBi | 46,8 < X ≤ 61,2 | 6 < X ≤ 9 | Moderate Feasibility |
| $X_i$ – 1,8 SBi < X ≤ $X_i$ – 0,6 SBi | 32,4 < X ≤ 46,8 | 3 < X ≤ 6 | Low Feasibility |
| X ≤ ($X_i$ – 1,8 SBi) | X ≤ 32,4 | < X ≤ 3 | Very Low Feasibility |

In addition to the preliminary and field trials, the operational trial was conducted to determine the effectiveness of the interactive e-comic in improving students' disaster mitigation knowledge and skills.

The preliminary trial was carried out after the interactive e-comic media was declared feasible by the subject matter and media experts. The purpose of this trial was to obtain feedback on the strengths and weaknesses of the media before it was used in the field trial. The preliminary trial involved one teacher and six fourth-grade students at SDN Kunciran 4 Tangerang. The teacher and students were given the opportunity to observe and use the interactive e-comic media, after which they completed response questionnaires based on their experiences.

### *Teacher Response Data*

The teacher response questionnaire aimed to identify teachers' perceptions of the quality and effectiveness of the media. The results of the teacher response questionnaire in the preliminary trial are presented in Table 5.

Based on Table 5, the total score obtained was 74, which falls into the "feasible" category according to the score conversion. This score is higher than the minimum score of 61.2, with a difference of 12.8 points. This indicates that the teacher considers

the Interactive E-Comic to be feasible for use as a disaster mitigation learning medium in the 4th grade of elementary school.

**Table 5.** Teacher Responses in the Preliminary Trial

| No. | Indicator | Score |
|---|---|---|
| 1. | Relevance of the content in the interactive e-comic | 12 |
| 2. | Accuracy of the material in the interactive e-comic | 9 |
| 3. | Completeness of disaster mitigation material in the media | 10 |
| 4. | Ease of use of the interactive e-comic | 15 |
| 5. | Alignment of the material with learning objectives and character development | 16 |
| 6. | Suitability of the material for students' characteristics | 12 |
| | Total Score | 74 |

### *Student Response Data*

The respondents in the preliminary trial were 6 fourth-grade students from SDN Kunciran 4 Tangerang. During the activity, the students appeared very enthusiastic in using the Interactive E-Comic media. This trial aimed to identify students' responses to the strengths and weaknesses of the media in disaster mitigation learning based on traditional games. The results of the student responses can be seen in Table 6.

**Table 6.** Student Responses in the Field Trial

| No. | Indicator | Score |
|---|---|---|
| 1. | Interest in the appearance and interactivity of the E-Comic | 4,85 |
| 2. | Ease of use of the Interactive E-Comic | 3,05 |
| 3. | Ease of understanding the storyline and disaster mitigation messages | 4,10 |
| 4. | Adequacy of information and content in the E-Comic | 3,15 |
| | Total Score | 15,15 |

Based on Table 6, the total average score from 6 students is 15.15, which falls into the 'highly feasible' category according to the score conversion. This indicates that students found the Interactive E-Comic to be very engaging, easy to use, and effective in delivering disaster mitigation material based on traditional games.

### Operational Trial Result

Following revisions informed by feedback from the preliminary and field trials, the Interactive E-Comic was implemented in the operational trial. As the final phase of the research and development process, this stage involved not only observing but also directly applying the media within the learning process. The purpose of the operational trial was to evaluate the effectiveness of the Interactive E-Comic in enhancing disaster mitigation knowledge among fourth-grade elementary school students.

The operational trial was conducted at SDN Kunciran 4 Tangerang with 30 fourth-grade students as respondents. The lesson began with an apperception activity to recall previously learned material. During the lesson, the Interactive E-Comic was used as a supporting medium that presented stories and interactive disaster mitigation activities. The teacher demonstrated how to use the media, after which each group of students retold the story content and carried out the interactive activities provided in the media. Throughout the learning process, students appeared enthusiastic and actively participated. Data from the operational trial was obtained through students' disaster mitigation knowledge tests, administered twice: a pretest before using the media and a posttest after using the media.

### Disaster Mitigation Knowledge Test Result

The knowledge assessment was administered to evaluate the effectiveness of the Interactive E-Comic in enhancing students' understanding of disaster mitigation. The test included a series of questions designed to measure comprehension of disaster mitigation concepts, safety procedures, and appropriate responses during disaster situations. A summary of the pretest and posttest outcomes is provided in Table 7.

**Table 7.** Summary of Pretest and Posttest Scores on Disaster Mitigation Knowledge

| Class | *Pretest* | *Posttest* | Gain | Category |
|---|---|---|---|---|
| Eksperiment | 48,20 | 82,50 | 0,66 | Moderate |

Referring to Table 7, the students' average score improved from 48.20 in the pretest to 82.50 in the posttest. The resulting gain score of 0.66 was classified within the "moderate" category. These findings suggest that the implementation of the Interactive E-Comic was effective in enhancing disaster mitigation knowledge among fourth-grade elementary school students.

**Figure 8.** Activity *Pretest* dan *Posttest*

### Final Product Revision

The final revision of the product was completed after the operational trial conducted in the field. The revised version of the Interactive E-Comic has been optimized and demonstrated its effectiveness in improving disaster mitigation knowledge among fourth-grade students. The finalized form of the E-Comic media is presented in Figure 9.

### Disemination and Implementation

The research findings indicate that the Interactive E-Comic on disaster mitigation based on traditional games has strong potential to be used as a learning medium in elementary schools. After going through the stages of development, expert validation, preliminary trials, field trials, and operational trials, this medium has been proven to be engaging, easy to use, and effective in improving students' knowledge of disaster mitigation.

Dissemination was carried out by introducing the Interactive E-Comic to teachers and students through trial activities at SDN Kunciran 4 Tangerang. Teachers were provided with a guidebook on how to use the media, while students participated in

learning activities by directly utilizing the E-Comic. The questionnaire results showed that teachers considered the media feasible for use, while students found it highly engaging and useful for understanding disaster mitigation material.

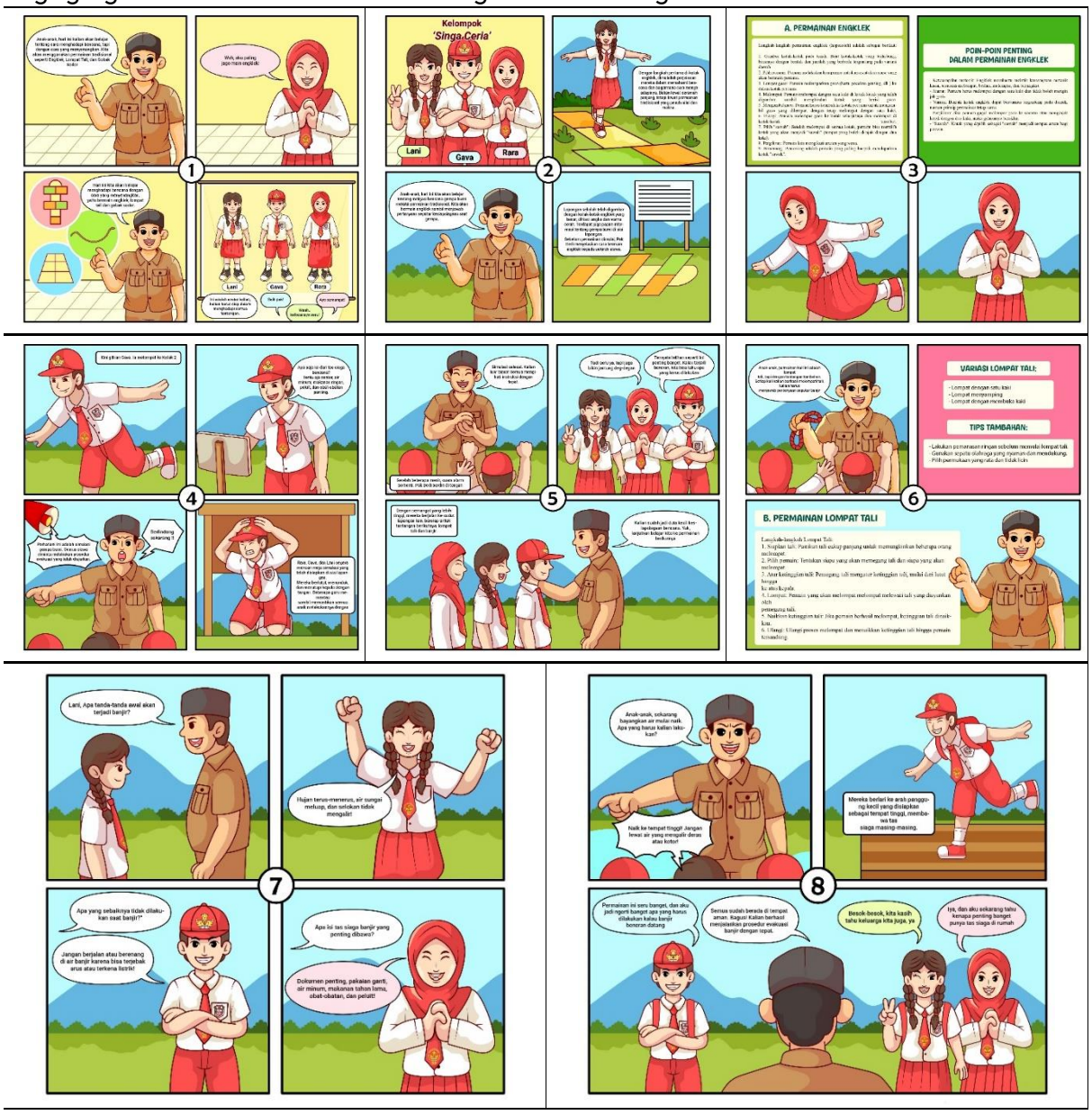



**Figure 9.** Final Product Media E-Comic

The implementation of the E-Comic in learning was conducted using a teacher demonstration method, followed by group activities in which students retold the story content of the E-Comic. Classroom observations indicated a high level of enthusiasm, active participation, and improved understanding of disaster mitigation material. Students' knowledge test results before and after using the E-Comic showed a significant increase in scores, indicating the effectiveness of the media in supporting the achievement of learning objectives.

## Discussion

This study successfully developed an Interactive E-Comic based on traditional games as a disaster mitigation educational medium for elementary school students.

Validation from both material and media experts indicated that the product was highly feasible, with total scores categorized as "very feasible." The material experts highlighted that the content was aligned with basic competencies, accurate, and able to foster students' learning interest, while the media experts emphasized the strengths of the visual aspects, design, and user-friendliness. These findings are consistent with Sabri et al., (2024) and Susanti et al., (2023) who noted that the integration of illustrations and storytelling in learning media enhances student engagement and comprehension.

The preliminary trial, involving one teacher and six students, provided valuable input for improving the media, including adjusting character designs to match student characteristics, simplifying the storyline, and clarifying the rules of traditional games. The field trial with 30 fourth-grade students at SDN Kunciran 4 Tangerang revealed positive responses, with students finding the media attractive, easy to use, and effective in understanding disaster mitigation concepts. The operational trial further demonstrated a significant increase in students' disaster mitigation knowledge scores after using the media, confirming the effectiveness of the Interactive E-Comic as a learning tool. These outcomes reinforce the claims of Akcanca, (2020), Zarvianti & Sahida, (2020) that comics, as learning media, can improve comprehension, memory retention, and critical thinking skills.

Beyond cognitive aspects, the media integrates local cultural values through Bengkulu's traditional games, making learning more contextual and relevant to students' experiences. (Ariffiando & Susanti, 2024). The incorporation of local cultural elements not only enriches the learning material but also fosters emotional engagement and raises student awareness of disaster mitigation. Feedback from teachers and students was implemented through revisions of illustrations, storylines, and step-by-step instructions for the games to make them clearer and easier to understand, thereby increasing the media's effectiveness and appeal. Practically, this Interactive E-Comic offers an innovative alternative learning method tailored to the needs of elementary school students, while theoretically, it reaffirms that combining illustrations, narratives, and local contexts in learning media can enhance the quality of instruction and facilitate the understanding of complex concepts (Akcanca, 2020; Susanti et al., 2023; Zarvianti & Sahida, 2020). In conclusion, this research highlights the vital role of culturally responsive and visually engaging media in fostering meaningful and sustainable learning experiences.

The results of the study indicate that the developed interactive e-comic meets the criteria of feasibility based on expert evaluations as well as user responses. The media was found to be valid in terms of both material and design aspects. The trials conducted also demonstrated that the interactive e-comic helped students understand the material more easily, and its visual presentation was perceived as engaging. Therefore, the interactive e-comic can be considered suitable for implementation as an instructional medium that effectively supports the learning process.

## CONCLUSION

Based on the research findings, it can be concluded that the Interactive E-Comic based on traditional games was successfully developed as a disaster mitigation educational medium for elementary school students and proven to be feasible for use. Validation from material expert 1 showed a score of 15 and material expert 2 a score of 14,

both categorized as “highly feasible,” while validation from media experts yielded total scores of 11 and 12, also within the “highly feasible” category. The initial trial involving one teacher and six students indicated positive responses, with the teacher giving a total score of 74 (“feasible”), while the field trial with 30 students produced an average total score of 15.15 (“highly feasible”). These results indicate that both teachers and students considered the media to be engaging, easy to use, and effective in delivering disaster mitigation material. Furthermore, the operational trial with 30 fourth-grade students of SDN Kunciran 4 Tangerang showed an improvement in disaster mitigation knowledge. The students’ average pretest score of 48.20 increased to 82.50 in the post-test, with an N-gain of 0.66, which falls into the medium to high category. This demonstrates that the use of the Interactive E-Comic was effective in improving students’ knowledge of disaster mitigation.

Based on these findings, it is recommended that teachers implement the Interactive E-Comic based on traditional games regularly in disaster mitigation learning, either as the main medium or as a supplement to thematic textbooks. Media developers are encouraged to continuously update the content and illustrations of the e-comic to be more representative and aligned with students’ characteristics. Further research is recommended to involve more schools or different grade levels to examine the effectiveness of the media in a broader context, as well as to incorporate indicators of critical thinking skills or digital literacy. In this way, the Interactive E-Comic can be optimized as a culturally-based educational tool while instilling disaster mitigation values from an early age.

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