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Development of Pop-Up Book '*Ayo Siaga Bencana*' to Cultivate Disaster Mitigation Awareness in Early Childhood

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Abstract

This study aims to develop the Pop-Up Book media "Ayo Siaga Bencana" (Let's Be Prepared for Disaster) to foster disaster mitigation awareness in early childhood, using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, with a small-scale implementation stage. A mixed-methods approach was applied to children aged 5–6 years (Group B) in PAUD institutions in Kembangan District, with needs analysis conducted through observations, interviews, and teacher–parent questionnaires. The product was validated by material, media, and practitioner experts, yielding feasibility scores of 87.5%, 95%, and 87.5%, all categorized as very feasible. Product trials were conducted in individual, small-group, and large-group stages across three PAUD institutions, followed by a small-scale implementation involving 10 children and one homeroom teacher at PAUD Al-Ikhlas Joglo. The implementation produced a teacher response score of 97.5 and a child response score of 95%, both in the outstanding category. These results indicate that the Pop-Up Book is highly acceptable, engaging, and feasible as a medium for learning disaster mitigation. However, the response data reflect positive acceptance rather than measured learning effectiveness; therefore, future research using comparative assessments (e.g., pre-test and post-test) is needed to evaluate the intervention's impact on children's understanding of disaster management.

Keywords: Pop Up Book, disaster mitigation, early childhood, R&D, ADDIE Model.

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INTRODUCTION

Indonesia is recognized as one of the countries with the highest disaster risk in the world. Situated along the Pacific Ring of Fire and at the convergence of three major tectonic plates, Eurasian, Indo-Australian, and Pacific, the archipelago is highly vulnerable to earthquakes, tsunamis, volcanic eruptions, as well as hydrometeorological disasters such as floods and landslides (BNPB, 2020). These geographical and demographic conditions necessitate early disaster mitigation

awareness so that communities, including children, can respond quickly and appropriately in emergencies.

For young children, disaster risks are even more critical due to their physical, cognitive, and emotional limitations. At this developmental stage, children are unable to recognize warning signs, make quick decisions, or perform self-rescue actions independently. Consequently, they are among the most vulnerable groups during disasters (UNICEF & UNDRR, 2020). Their lack of knowledge often leads to panic and full dependence on adults, underscoring the need for structured disaster education at the preschool level.

However, disaster mitigation education in early childhood institutions remains limited. Learning activities in early childhood education (ECE) settings still rely heavily on verbal explanations or incidental discussions during disaster events, making it difficult for children to grasp abstract concepts such as evacuation or self-protection (Rusanti et al., 2023). Teachers also face challenges due to the absence of developmentally appropriate teaching media. This situation hinders children's preparedness in facing potential disasters.

In this context, the use of innovative learning media is essential. Research indicates that interactive visual media are more effective than conventional teaching methods in helping children understand abstract concepts (Fadillah, 2019; Feni Ayu Mutiara Bru Surbakti et al., 2021). One promising medium is the Pop-Up Book, which presents three-dimensional illustrations that capture children's attention while conveying educational messages in concrete ways (Yuningsih et al., 2022). Beyond entertainment, Pop-Up Books enhance memory retention and stimulate both cognitive and emotional development (Amelia et al., 2022).

These insights are in line with (Yuliana, 2020) A study argues that disaster education must begin at an early age so that children can recognize potential hazards in their surroundings and identify initial self-rescue measures. Similarly, Maharani & Subroto (2019) Highlight that illustrated story media make it easier for teachers to convey disaster mitigation messages in a contextual manner. Therefore, creative tools such as Pop-Up Books represent a relevant alternative for integrating disaster preparedness education into early childhood curricula.

This visual approach also aligns with the learning strategies that emphasize the development of children's critical thinking abilities (Sari et al., 2022; Suryani & Andriyati, 2025). Highlight that visual thinking encourages children not only to observe images but also to interpret meanings, connect information with prior experiences, and make simple decisions. Such pedagogical approaches are highly relevant to disaster mitigation education, as children need to internalize preparedness values rather than merely memorize information (Eka Daryati & Sadiana, 2025).

Within the broader policy framework, disaster education for young children is intended not only to protect them during emergencies but also to foster a generation that is resilient, environmentally conscious, and proactive in preventive actions. Children who are accustomed to learning about safety can develop disaster awareness and even serve as information agents within their families and communities (UNICEF & UNDRR, 2020).

Additionally, Jakarta, as the research site, faces multiple disaster threats. Floods occur recurrently due to heavy rainfall, inadequate drainage systems, and land-use conversion. Residential fires frequently arise in densely populated neighborhoods with unsafe electrical installations. The city also lies within the radius of active faults such as Cimandiri and Baribis, which have the potential to trigger earthquakes (BMKG, 2024). These multiple risk factors further reinforce the importance of disaster education for young children living in urban environments.

Indonesian regulations also support this urgency. Law No. 24 of 2007 on Disaster Management and Law No. 35 of 2014 on Child Protection emphasize that disaster risk reduction is a shared responsibility, including through formal and non-formal education beginning in early childhood. Furthermore, BNPB Regulation No. 4 of 2012 explicitly mandates educational institutions, including ECE, to integrate disaster risk reduction into teaching and school management practices.

Preliminary observations at the institution *Pendidikan Anak Usia Dini* (PAUD) Al-Ikhlas Joglo, Kembangan District, revealed that 88% of children had no understanding of disasters or mitigation measures, whereas 12% could identify only disaster types and were unable to specify appropriate actions. Teachers acknowledged difficulties in teaching the topic due to the lack of relevant educational media. This gap between children's need for interactive disaster-related learning materials and the limited institutional resources underscores the urgency of innovative solutions.

At this point, the presence of Pop-Up Book media becomes significant. The product developed in this study has distinct characteristics compared to similar media because it presents mitigation materials for three types of disastersearthquakes, floods, and residential fires in an integrated manner. Through an interactive 3D visual approach aligned with children's developmental stages, this media not only fosters interest in learning but also helps children understand simple steps to take before, during, and after disasters in a concrete and engaging way (Daryati, 2025; Eka Daryati & Sadiana, 2025).

From a state-of-the-art perspective, previous studies have been dominated by the development of digital media, such as animated videos and Android-based applications (Ramadhani, 2021). While effective, digital media are not always accessible to all early childhood institutions, especially those with limited technological infrastructure. Therefore, the need for practical, affordable, and child-friendly non-digital media remains substantial.

This gap becomes more prominent when considering that existing studies rarely develop non-digital disaster education media that integrate multiple disaster themes with interactive 3D visuals in a format tailored to early childhood characteristics. Thus, the "Ayo Siaga Bencana" Pop-Up Book aims to address this research gap by providing a tangible, developmentally appropriate, and accessible medium for learning disaster mitigation.

Building on this background, the present study focuses on developing the Pop-Up Book "*Ayo Siaga Bencana*" as an innovative medium for early childhood disaster mitigation education. This product is designed not only to introduce common disaster types, such as earthquakes, floods, and fires, but also to teach basic self-rescue steps through interactive visual displays. The purpose of this research is to design, develop, and assess the feasibility of the media, as well as evaluate teachers' and children's responses to its use in learning activities.

METODOLOGI

Type Study

This study employed a *Research and Development* (R&D) approach using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model to develop a pop-up book titled *"Ayo Siaga Bencana"* for early childhood disaster mitigation. The study was limited to small-scale implementation, while a comprehensive evaluation was not conducted due to time and contextual constraints. A mixed-methods approach was used, combining quantitative data from expert validation and teacher/child response questionnaires and qualitative data from observations, interviews, and documentation to provide a holistic understanding of feasibility, attractiveness, and educational usefulness.

Time and Place Study

The research was conducted from June to August 2025 at several Early Childhood Education (ECE) institutions in Kembangan District, West Jakarta. The limited-scale implementation was conducted at PAUD Al-Ikhlas Joglo, involving ten children as the primary trial participants. In addition to the children, teachers served as informants, providing evaluations of the Pop-Up Book's feasibility. The research location was selected based on preliminary observations indicating that most children had little or no understanding of disaster mitigation and that teachers lacked appropriate

instructional materials to explain these concepts. Therefore, the setting was considered representative for testing the acceptance and effectiveness of the *“Ayo Siaga Bencana”* Pop-Up Book.

Target Study

The target population of this study was early childhood learners in group B (ages 5–6) who were developmentally in the preoperational stage and enrolled in early childhood education institutions in Kembangan District, West Jakarta. Purposive sampling was used to select participants. The study involved sequential trials:

1. Individual trial at PAUD Aisyiyah Meruya Selatan, involving 3 children with different cognitive ability characteristics (high, average, and low).
2. Small group trial at PAUD IT, Salman Alfarisi, involving 10 children.
3. Large group trial at PAUD Pelangi Bunda, involving 15 children.
4. Limited-scale implementation at PAUD Al-Ikhlas, involving 10 children and one classroom teacher.

In addition to the children, teachers served as informants, providing evaluations of the Pop-Up Book's feasibility.

Technique Data Collection and Development Instrument

Data were collected using complementary techniques, including observations conducted during all trial stages to document children’s engagement and interaction with the Pop-Up Book, as well as semi-structured interviews with teachers and parents to explore perceptions of disaster education needs and media effectiveness. Additional documentation, such as photographs, videos, field notes, and expert validation forms, was collected to enhance data accuracy. The instruments consisted of expert validation sheets and teacher- and child-response questionnaires using a four-point Likert scale. All scores were summed, averaged, and converted to percentages before being compared with established feasibility criteria. The Pop-Up Book integrates 3D visuals, interactive features, and age-appropriate design, aligned with dual-coding, constructivist, and sensory learning principles, to enhance memory, cognition, and emotional engagement.

The research procedure began with a needs analysis through observations, interviews, and questionnaires distributed to teachers and parents, which informed the design of a Pop-Up Book containing 3D disaster illustrations and simple self-rescue steps. The development phase included drafting the storyboard, selecting materials, producing illustrations, and assembling the book. The final product was validated by experts in material, media, and early childhood education and received

an "excellent" feasibility rating. The Pop-Up Book was then subjected to individual, small-group, and large-group trials, followed by limited-scale implementation at PAUD Al-Ikhlas Joglo. Instruments such as observation sheets, interview guides, validation questionnaires, and response questionnaires were used throughout to assess children's behavior, gather stakeholder perspectives, evaluate content and design quality, and measure teacher and child responses to the media.

Technique Data analysis

Quantitative data from expert validation and teacher–child responses were analyzed descriptively by summing scores for each aspect, calculating means, converting results to percentages, and categorizing them according to predetermined feasibility levels. Meanwhile, qualitative data derived from observations, interviews, and documentation were analyzed thematically to identify patterns related to children's engagement, attention, understanding, and emerging challenges. Together, the descriptive quantitative results and thematic qualitative findings provided a comprehensive understanding of the feasibility, attractiveness, effectiveness, and overall educational usefulness of the "Ayo Siaga Bencana" Pop-Up Book as a disaster mitigation learning medium for early childhood learners.

RESULTS AND DISCUSSION

RESULTS

The product developed in this study was a pop-up book titled "*Ayo Siaga Bencana*" (Let's Be Disaster-Prepared), designed to foster disaster-mitigation awareness among young children. The development followed the ADDIE model, comprising the stages of Analysis, Design, Development, and Implementation, with the Evaluation stage omitted. Three experts conducted validation: a material expert, a media/design expert, and an early childhood education practitioner. These experts assessed the accuracy and relevance of the disaster content, the suitability of the visual and structural design for young learners, and the pedagogical appropriateness of the learning activities. Effectiveness was determined through their evaluation using standardized validation instruments that rated aspects such as content clarity, instructional feasibility, child-friendliness, and potential to support learning outcomes. Based on these assessments, the Pop-Up Book was assigned a "perfect" feasibility rating.

Following validation, the product was tested with children in sequential individual, small-group, and large-group trials and subsequently implemented on a limited scale at PAUD Al-Ikhlas Joglo. These trials aimed to examine children's and teachers' responses to the attractiveness, ease of use, and practicality of media in disaster mitigation learning. The results showed that the media were well received by children and considered helpful by teachers for delivering the material, indicating

that the Pop-Up Book is suitable for use as a disaster-mitigation learning medium in early childhood education.

1. Analysis Phase Results

The needs analysis was carried out through observations, interviews, and questionnaires administered to teachers and parents. Findings revealed that the majority of children were unaware of disasters or mitigation measures. Of the 25 children observed, 88% had no understanding, while 12% could identify disaster types but did not know the appropriate responses. Teachers reported difficulties in integrating disaster-related learning due to the lack of suitable media. This condition indicates a significant gap between the field's fundamental needs and the availability of instructional resources. Accordingly, the development of an innovative, contextual, and enjoyable medium was recommended to introduce disaster mitigation at an early age.

2. Design Phase Results

Based on the needs analysis, the researcher designed a Pop-Up Book containing stories and three-dimensional illustrations of three types of disasters: earthquakes, floods, and fires. The design process began with drafting a storyboard to identify storylines, characters, and scenes illustrating simple self-rescue steps, such as “duck, cover, and hold” during an earthquake and “staying away from fire sources” during a fire. Content selection considered age appropriateness, while language was simplified, and visuals were designed to be engaging. The outcome of this stage was the initial prototype (Draft 1) of the Pop-Up Book, ready for development.

Figures 1 & 2. Draft of Hard Cover and Page 1

Figure 3. Draft of Page 2

3. Development Phase Results

In the development stage, the prototype (Draft 1) was validated by three experts: a material expert, a media expert, and an early childhood education practitioner. The validation results indicated feasibility scores of 87.5% from the material expert, 95% from the media expert, and 87.5% from the practitioner, all categorized as "very feasible." Revisions were made in response to expert feedback, particularly regarding visual elements and text simplification.

Table 1. Validation Scores of Experts on Pop-Up Book

No	Validator	Score (%)	Category
1	Material Expert	87,5%	Very feasible
2	Media Expert	95,0%	Very feasible
3	Practitioner Expert	87,5%	Very feasible

After the expert validation, the Pop-Up Book underwent individual, small-group, and large-group trials. The individual trial with three children at PAUD Aisyiyah Meruya Selatan yielded positive results: children with higher cognitive ability could retell the story, whereas the others participated enthusiastically with guidance. The small-group trial involving ten children at PAUD IT Salman Alfarisi Joglo demonstrated strong attention, active engagement, and the ability to recall simple mitigation steps when prompted. The large-group trial with fifteen children at PAUD Pelangi Bunda Joglo further showed that children were highly enthusiastic, asked questions about the illustrations, and imitated basic safety actions such as protecting their heads or moving away from fire sources. Teachers across all stages reported that the Pop-Up Book supported their explanations of disaster preparedness concepts in a concrete and age-appropriate manner.

The outcomes of these trials confirmed that the Pop-Up Book is engaging, pedagogically suitable, and feasible to use in early childhood classrooms. The final product of this stage was a revised Pop-Up Book, deemed highly feasible and ready for limited-scale implementation.

4. Results of the Implementation Phase

The limited-scale implementation was conducted at PAUD Al-Ikhlas Joglo with ten children from group B, aged 5–6 years. The teacher's response score reached 97.5% in the "outstanding" category, while the children's response score was 95% in the "outstanding" category. These scores indicate that both teachers and children responded very positively to the Pop-Up Book.

Teachers reported that the Pop-Up Book supported the delivery of disaster mitigation materials and made abstract concepts easier to explain during learning activities. Children also demonstrated strong enthusiasm and interest when interacting with the media. During the activity, many children recalled key messages and imitated simple safety steps illustrated in the book; however, these observations were qualitative and not formally quantified.

Table 2. Teacher and Children's Responses to the Pop-Up Book "*Ayo Siaga Bencana*"

No	Respondent	Score	Category
1	Teacher	97.5%	Very Good
2	Children	95.0%	Very Good

Observations during implementation also showed that most children were enthusiastic and attentive during the storytelling activity. More than half were able to retell some of the safety steps presented in the book, and almost all actively engaged with the interactive elements. Teachers affirmed that the media were practical and easy to use in class, although they suggested strengthening the durability of specific interactive components to support repeated long-term use. These findings collectively demonstrate positive user responses, but they do not provide quantitative evidence of improvement in children's understanding of disaster mitigation.

To assess children's understanding before and after implementation, the analysis incorporated qualitative comparisons between the findings of the needs analysis and observations from the implementation stage. During the needs analysis, most children demonstrated no prior knowledge of disasters or mitigation actions. In contrast, observations during the implementation phase indicated that children recalled key messages from the Pop-Up Book and imitated simple safety steps, suggesting improved familiarity and conceptual recognition, even without formal pretest–posttest measures.

Narrative examples also emerged during classroom observations. Several children verbally identified the disasters depicted in the illustrations (e.g., "Ini gempa bumi!" while pointing at the 3D

earthquake scene). In contrast, others demonstrated the recommended actions, such as covering their heads or moving away from objects representing fire sources. One child responded to the earthquake page by saying, "Kalau goyang, kita lindungi kepala," showing that they connected the story visuals with the intended mitigation message. Teachers also reported that children asked relevant questions, such as "*Kalau banjir datang, kita naik ke mana*?", reflecting increased engagement and awareness. These narrative responses strengthened the qualitative evidence supporting the Pop-Up Book's practicality and clarity in introducing disaster mitigation concepts to young learners.

DISCUSSION

The results of this study indicate that the Pop-Up Book "Ayo Siaga Bencana" is a feasible learning medium for disaster mitigation among early childhood learners. Validation by content experts, media experts, and educational practitioners yielded feasibility scores of 87.5%, 95%, and 87.5%, respectively, all classified as "very feasible." Teacher responses reached 97.5%, and children's responses reached 95%, both categorized as "very good," indicating strong user acceptance of the media. These findings demonstrate that the product meets the development objectives, producing media that are theoretically valid, practical, and aligned with PAUD learning characteristics.

The high score from media experts (95%) indicates that the visual and structural design of the Pop-Up Book is well-suited to early childhood learners. This result is consistent with (Piaget, 1962) Explanation that children aged 5–6 are in the preoperational stage, where learning concrete and visual representations supports a more profound understanding. The three-dimensional features of the Pop-Up Book provide concrete visual aids that help children internalize basic disaster mitigation concepts Paivio (1986) Dual coding theory also supports this finding, noting that information is better retained when delivered through combined verbal–visual channels, as reflected in children's high engagement with media.

The teacher response score of 97.5% shows that teachers found the media helpful during learning activities. Teachers reported that the Pop-Up Book made abstract disaster concepts easier to communicate to children. This supports Vygotsky (1978), the concept of the zone of proximal development (ZPD), which explains that children require scaffolding from adults to understand more complex ideas. In this context, the Pop-Up Book functions as a visual scaffold to guide children's comprehension.

The high response from children (95%) indicates that the media is visually appealing and supports learning, Kolb (1984) Experiential learning theory helps explain this, as the Pop-Up Book provides concrete experiences through hands-on interaction. This is consistent with (Pratiwi &

Wibowo, 2020), who found that three-dimensional media enhance children's engagement and attention. Children's active interaction with the book demonstrates how concrete materials can make learning more meaningful.

From the perspective of disaster education, this study aligns with Yuliana (2020), who highlighted the importance of introducing disaster awareness early to enable children to recognize potential hazards, Maharani & Subroto (2019) also confirmed that illustrated media are effective for delivering contextual disaster messages. The use of a pop-up book provides a non-digital alternative that remains interactive. This is particularly relevant because much previous research, such as Ramadhani (2021) Focused on digital media, which may not always be accessible in PAUD institutions. Therefore, this Pop-Up Book provides an accessible and affordable option for early childhood settings.

From a learning theory perspective, the Pop-Up Book demonstrates behaviorist principles through visual stimuli that elicit responses, such as imitating simple mitigation actions. At the same time, it reflects constructivist principles, Bruner (1966), in which children actively construct knowledge through interaction with learning materials. The combination of stories, illustrations, and manipulable features supports a more meaningful learning process.

The main contribution of this study lies in presenting an innovative Pop-Up Book designed specifically for disaster-mitigation learning in early childhood education. Theoretically, this strengthens evidence that concrete visual media can support children's understanding of abstract concepts. Practically, it offers an alternative medium that teachers can easily use without requiring digital technology.

However, several limitations should be acknowledged. The implementation was limited ten 10 children at a single PAUD institution, which restricts the generalizability of the findings. In addition, the evaluation stage of the ADDIE model was not completed, preventing a full assessment of long-term outcomes.

Beyond methodological limitations, there are also practical challenges related to the Pop-Up Book itself. Because it relies on movable three-dimensional components, the media require careful handling, and teachers noted that some components may need reinforcement to ensure durability. In real-world implementation, maintaining the physical condition of the Pop-Up Book during repeated use may be challenging, particularly in active early childhood classrooms. Furthermore, the media

require teachers to allocate time to guided storytelling, which in turn depends on teacher readiness and facilitation skills.

From an academic perspective, the Pop-Up Book has the potential to be integrated into the national PAUD disaster emergency curriculum as a supplementary teaching tool. Its non-digital, interactive format aligns with PAUD learning principles that emphasize concrete experiences, storytelling, and exploratory learning. With further refinement and wider-scale testing, the Pop-Up Book could serve as a practical resource to support structured disaster education activities in PAUD institutions across Indonesia.

CONCLUSION

This study concludes that the development of the "*Ayo Siaga Bencana*" Pop-Up Book through the R&D stages has produced learning media that are both theoretically and empirically suitable for early childhood disaster-mitigation education. The development process, beginning with needs analysis, theoretical alignment with early childhood cognitive development, expert validation, and multi-stage trials, demonstrates that the product adheres to pedagogical principles for introducing abstract concepts through concrete, interactive visuals.

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