

Empowering Early Childhood Resilience: Development of Illustrated Storybooks for Disaster Mitigation with Local Wisdom

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Abstract: **Empowering Early Childhood Resilience: Development of Illustrated Storybooks for Disaster Mitigation with Local Wisdom.** **Objective:** This study aimed to develop and evaluate the effectiveness of an illustrated storybook based on *Tunjuk Ajar Melayu Riau* as an innovative learning medium to enhance disaster preparedness in early childhood. **Methods:** The research adopted the Borg & Gall Research and Development (R&D) model. Study participants included 60 children aged 5-6 years across three PAUD sites in the Riau region, Indonesia. The intervention was conducted over two weeks with a total of six sessions. Effectiveness was assessed using the Disaster Preparedness Scale for Early Childhood (DPSEC) (12 items, $\alpha=0.87$) through pre-test and post-test. Quantitative data were analyzed using the Paired-Sample T-test, Normalized Gain (N-Gain), and Cohen's d Effect Size, complemented by qualitative thematic analysis of interviews. **Findings:** The book offers novelty by combining local cultural values with interactive features, such as a maze game, specifically designed to foster critical thinking and environmental awareness, addressing the current limitation of passive disaster education media in Indonesia. The effectiveness test results showed a highly significant increase in disaster preparedness scores, soaring from a pre-test mean of 55% to a post-test mean of 90% ($t(59)=14.82$, $p<0.001$). The impact was classified as high, with an average N-Gain of 0.71 and a strong Effect Size ($d=1.92$). Qualitatively, the Cultural Resonance of the Malay characters significantly boosted engagement, while the Maze Game mechanistically stimulated planning and critical thinking. Teachers rated the product as highly practical with an average score of 88%, confirming its feasibility and curricular alignment. **Conclusion:** The illustrated storybook based on *Tunjuk Ajar Melayu Riau* is an effective, feasible, and practical learning model for enhancing early childhood disaster preparedness. Its success is driven by the synergy between the maze's cognitive scaffolding and the contextual reinforcement of local wisdom, offering a vital model for culturally-based disaster mitigation education in Indonesia. However, generalization is currently limited to the Riau context.

Keywords: cultural identity; disaster mitigation; early childhood education; *tunjuk ajar melayu*.

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■ INTRODUCTION

The golden age of early childhood, from 0 to 6 years, is an important period for physical, cognitive, and social-emotional development.

During this time, children learn through a playful, non-coercive approach. This approach allows children to build understanding through concrete experiences relevant to their needs (Chandrawati

et al., 2024; O'Reilly et al., 2022; Yoshikawa et al., 2013). In supporting the optimization of this development, educators' roles are very important, including providing appropriate teaching materials. One form of effective teaching material is picture storybooks, which combine stories with engaging visuals (Britto et al., 2017; Munar et al., 2022). Picture storybooks can help children understand concepts and build critical, creative, and collaborative thinking skills.

The use of picture storybooks as learning media has the advantage of conveying educational messages through a combination of text and images. This book not only enhances children's imagination but also supports experiential learning (Aryani et al., 2023; Cicchino, 2013; Hamid et al., 2021; Hussein et al., 2019; Kartika et al., 2023). However, in the context of early childhood education in Indonesia, the availability of teaching materials that are relevant to the local environment is often a challenge. For example, teaching materials that reflect Malay local wisdom values are still limited to language and literature, and do not address important issues such as disaster mitigation. In fact, given Indonesia's disaster-prone geography, disaster mitigation education from an early age is essential.

Indonesia ranks among the world's most disaster-prone countries, experiencing more than 3,000 disaster events annually according to BNPB (2023). However, disaster mitigation education for early childhood remains extremely limited. National data from Kemendikbudristek (2022) indicates that less than 15% of PAUD institutions implement structured disaster preparedness programs. Existing learning materials are dominated by posters, which tend to be passive, non-interactive, and abstract for early learners. This gap poses serious risks because early childhood (0–6 years) is a critical developmental period characterized by rapid cognitive, emotional, and sensory growth. During this period, children require hands-on, visual, and

culturally relevant materials to build foundational safety awareness.

The posters often lack detailed explanations, resulting in limited understanding among children (Mauludiyah et al., 2023; Nurhayati et al., 2023). More interactive, context-based media, such as picture storybooks grounded in local wisdom, can help improve children's understanding of disaster mitigation. For example, through picture storybooks that teach the concept of "Disaster Preparedness Bags," children can learn practical steps for dealing with emergencies.

Studies by Agustina et al. (2018), Chandrawati et al. (2024), Mercer et al. (2016), and Ternik et al. (2017) demonstrate that picture storybooks can support comprehension of hazard concepts and emergency actions. However, most existing storybooks target elementary-aged learners and rarely integrate local wisdom. Meanwhile, research on local-wisdom-based learning (Christoplos et al., 2001) suggests that embedding cultural identity helps children connect moral, environmental, and social meanings within stories. Despite this progress, no available literature reports early childhood disaster-mitigation storybooks grounded in *Tunjuk Ajar Melayu* Riau, a cultural framework emphasizing harmony with nature, attentiveness to environmental signals, and collective responsibility.

Previous research indicates the potential of picture storybooks to facilitate learning about disaster mitigation (Kurt & Dindar, 2025; Regondola & Astorga, 2025). This study aims to develop a culturally grounded, interactive picture storybook to strengthen early childhood disaster preparedness. The novelty of this product lies in: (1) direct integration of *Tunjuk Ajar Melayu* Riau values into storyline, visuals, and behavioral messages; (2) incorporation of maze games specifically designed to reinforce critical thinking about evacuation decisions; (3)

adaptation for children aged 5–6 using visual scaffolding aligned with the *Merdeka Curriculum*'s PAUD Learning Outcomes (CP) on Critical, Creative, and Collaborative Thinking; and (4) empirically validated R&D procedures with detailed implementation, reliability reporting, and effectiveness testing. This study contributes both a pedagogical model and a culturally attuned disaster education resource for early childhood settings in Riau and similar regions.

This picture storybook is integrated into disaster mitigation education as part of a larger series. But also with interactive game elements like the maze. The goal of this game is to encourage children's critical thinking. The reason for this is that generating the mind (thinking) while reinforcing the educational content asserts (Mauludiyah et al., 2023; Nurhayati et al., 2023). Maze games are widely documented as a cognitive stimulus for problem-solving and critical thinking (O'Reilly et al., 2022). A maze requires children to analyze pathways, predict consequences, and make decisions—core components of early critical thinking. However, no disaster-education storybooks for PAUD presently incorporate maze elements as a learning mechanism to reinforce decision-making during emergencies. It is part of the learning outcomes guidelines for the foundation phase (GA) of the *Merdeka Curriculum*, which focuses on critical, creative, and collaborative thinking skills. So, this book will be a medium not only for education but also for moulding children's character into that of confident, characterful lifelong learners.

The primary added value of this illustrated storybook lies in its profound integration of the Malay cultural context, specifically *Tunjuk Ajar Melayu* Riau values, with disaster mitigation education. The foundational philosophy of *Tunjuk Ajar Melayu* (TAM) concerning the human-nature relationship centers on maintaining a delicate balance between humans and nature (Noviana et al., 2023; Tan et al., 2018). This

indigenous worldview teaches that nature is a revered source of life that must be respected, rather than merely exploited. A specific value, such as environmental sensitivity ('mendengar alam' or 'listening to nature'), directly translates into preparedness behavior by training children to be highly perceptive of environmental changes, viewing impending hazards not as a surprise but as a natural consequence of imbalance. Furthermore, the cultural value of communal solidarity ('gotong royong' or collective endeavor) provides a profound basis for social preparedness and collective evacuation, teaching children the importance of mutual care and assisting others rather than just self-preservation (Tan et al., 2018). By embedding this philosophy, the storybook transforms disaster mitigation from a set of external rules into a culturally integrated value, thereby significantly enhancing affective engagement and promoting the development of critical, creative, and environmentally aware individuals. Therefore, TAM ensures that preparedness becomes an integral part of the children's core cultural identity, fostering resilience through heritage.

While other local wisdom-based media may focus on language or literary aspects, this product explicitly links local wisdom to the critical issue of disaster preparedness. The book introduces Malay traditions and wisdom, including a reminder to maintain a balance between humans and nature. As such, the book serves a dual function: it is not only an instructional material but also a tool for reinforcing local cultural identity. Beyond its cultural function, the book offers a novel and effective learning model for holistic character development in children. Specifically targeted at early childhood, the book uses engaging stories, appealing visualizations, and interactive elements such as a maze game to facilitate a concrete understanding of disaster preparedness concepts. The maze game is specifically designed to stimulate the development

of critical, creative, and collaborative thinking skills, which align with the learning outcome guidance in the *Merdeka Curriculum*. This focus on a playful, non-coercive approach is highly relevant to young children's characteristics.

Overall, this research aims to develop a comprehensive design, product, and assessment for teaching materials that can significantly contribute to the local wisdom-based education concept in Indonesia. By combining practical disaster mitigation knowledge (such as the concept of a Disaster Preparedness Bag) with rich local values, the book is expected to be an educational innovation. Its added value lies in its ability to nurture children who are not only disaster-resilient but also environmentally aware and characterful, thereby supporting the local wisdom-based approach to disaster mitigation education in Indonesia.

Based on the urgency of the problem in disaster mitigation education and the need for developing contextual and interactive media, this study is focused on answering the following research questions:

1. How is the development and validation process of the illustrated storybook based on *Tunjuk Ajar Melayu Riau* carried out?
2. How is the practicality level of the illustrated storybook based on *Tunjuk Ajar Melayu Riau* evaluated by PAUD teachers?
3. Is the illustrated storybook based on *Tunjuk Ajar Melayu Riau* significantly effective in enhancing disaster preparedness attitudes among early childhood children?

■ METHOD

Participants

Participants in this study were selected using purposive sampling. The research population consisted of early childhood children (5–6 years old) and teachers working at PAUD (Early Childhood Education) schools in the Riau region,

Indonesia. The schools were deliberately chosen for their relevance to the local cultural context of *Tunjuk Ajar Melayu Riau*, which served as the primary focus of the media, and for their willingness to fully participate in the intervention study. The research sample for the effectiveness test comprised 60 children aged 5–6 years, spread across three PAUD sites in the Riau region. This number was deemed adequate for conducting comparative statistical analysis and effectiveness testing.

Research Design and Procedures

The research method used was Research and Development (R&D) with the Borg & Gall development model. This model was selected because it has systematic steps from the initial needs analysis to product dissemination, including Data Collection (Observation, Interview, or Literature Study). The data were used to design the teaching media in the form of a storybook related to *Tunjuk Ajar Melayu Riau*. The development process comprises nine key steps, including expert validation, a limited field test, revision, and evaluation. Each stage is implemented systematically so that the product produced aligns with the needs and characteristics of early childhood. This research primarily focuses on developing effective materials to help children change their attitudes and perspectives towards disasters and disaster response. This study employed Research and Development (R&D) following Borg & Gall's modified model, consisting of: (1) needs analysis; (2) product design; (3) expert validation; (4) limited trial; (5) revision; (6) main field test; (7) final revision; and (8) dissemination. Each phase was executed in full detail to ensure replicability.

This process started with a needs assessment based on direct observation. After that, the first draft of the instructional materials was developed based on the needs analysis results and the literature. The initial product was

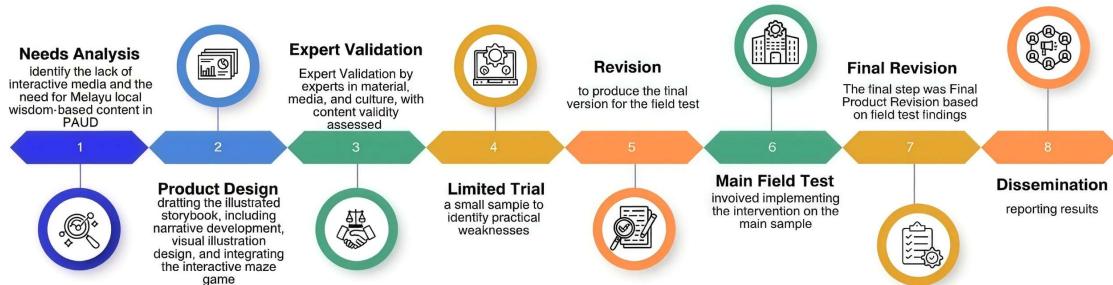


Figure 1. Schematic of development research procedure

then validated by material, design, and local wisdom experts to ensure content feasibility. Validation used quantitative descriptive analysis techniques with Aiken's V formula to measure content validity. The validated product was tested on a limited basis in one class to evaluate its initial effectiveness. Data from this trial were used to revise the product before it was tested on a wider scale. This procedure aims to produce quality and applicable teaching materials.

Data Collection

Data collection techniques involved observation, interviews, and documentation. For the teaching practice, the implementation of picture storybook materials in reading teaching and learning activities was observed. Teaching material needs were gathered through teacher and child-centered interviews. Documentation required: gathering photos, field notes, and related records. In addition, quantitative data were collected through pre- and post-tests to measure changes in disaster response attitudes. The combination of these techniques ensured comprehensive data collection for further analysis. Research data were divided into primary data, collected directly from the study subjects, and secondary data, derived from the relevant literature.

The product trial process consisted of three systematic phases: a limited trial, a main field test, and a final assessment to ensure the product's readiness for broad implementation. During the

limited trial phase, the study employed a one-group pretest-posttest design involving a single class to assess the effectiveness of the teaching materials by comparing pre- and post-intervention conditions. In the second phase, the product was tested across three schools to ensure the accuracy and consistency of the research results. Throughout this implementation process, several instruments, including questionnaires, observation sheets, and interviews, were used to evaluate the product's feasibility and practicality in depth. Data validity and reliability were strictly maintained during this evaluation to ensure the final product was thoroughly tested and ready for widespread use.

The intervention procedure began with a mandatory one-hour teacher preparation session to ensure consistency across all research sites. The main intervention spanned two weeks and consisted of six structured sessions, each allotted 30 minutes to maintain children's focus on learning disaster mitigation. In Stage 1, activities focused on introducing the concept through teacher-led story reading and discussions guided by picture cues related to local wisdom. Moving into Stage 2, children were actively engaged through interactive elements such as a maze game and role-playing basic evacuation scenarios to build practical skills. Finally, Stage 3 focused on reinforcing understanding by identifying essential emergency tools and practicing safe routes to ensure comprehensive mastery of safety behaviors.

Instruments

The research instruments were designed to measure the content, language, and graphics of the teaching and learning materials. Experts evaluated the tools based on criteria such as alignment with learning objectives, readability, and design aesthetics. Analysis of the pre-test and post-test quantitative data was conducted to see how effective the given teaching materials were. Using a 5-point Likert scale, the assessment criteria evaluated children's attitudes toward the development of disaster response systems. Data were analyzed using qualitative descriptive methods to support quantitative results. The instrument's validity was measured using Aiken's V formula, with a minimum validity index of 0.8. The validation results became the basis for product revision before being used in a wider trial.

This study also assessed the practicality of teaching materials through teachers' and children's responses during the field trial. Practicality questionnaires were designed to assess users' experience of the implementation of teaching materials. Direct observation was conducted to record the level of implementation of teaching materials in real learning contexts. The data was analyzed to measure the effectiveness of the application of teaching materials, with a minimum success criterion of 75%. If the results were inadequate, revisions will be made based on feedback from teachers and observers. The evaluation also includes the level of children's understanding of the content of the teaching materials through discussions and interactive games. This process ensures the teaching materials can be effectively applied in various learning situations.

This study utilized three primary instruments to comprehensively collect both quantitative and qualitative data to evaluate the effectiveness and practicality of the developed media. The first instrument is the Disaster Preparedness Scale for

Early Childhood (DPSEC), consisting of 12 items to measure children's disaster preparedness attitudes through indicators of recognizing danger signs, identifying emergency equipment, and understanding evacuation behavior; this instrument has been proven to have high content validity (Aiken's V e" 0.80) and strong internal reliability (Cronbach's Alpha = 0.87). Additionally, the practicality of the storybook was assessed using a Teacher Practicality Questionnaire containing 10 items related to usability and curriculum integration, which demonstrated very high instrument consistency (Cronbach's Alpha = 0.90). Finally, qualitative data were gathered through a semi-structured interview guide to gain deeper insights into teachers' perceptions and children's engagement levels during the intervention, ensuring that the research findings were not based solely on numerical scores but were also supported by in-depth observations of the learning process in the field.

Data Analysis

The results of data analysis were used to assess the feasibility, practicality, and effectiveness of picture storybook teaching materials. Qualitative data helped to understand the design and content aspects, while quantitative data provided an overview of changes in children's attitudes. The evaluation process involved data triangulation to increase the validity of the research results. After going through this stage, the product is ready to be disseminated as a local wisdom-based teaching material to improve disaster response attitudes in early childhood. Therefore, this research is expected to make a significant contribution to disaster mitigation education in Indonesia.

The data analysis techniques in this study employed a mixed-methods approach to provide a comprehensive overview of the effectiveness of the developed media. Quantitative data from the DPSEC pre-test and post-test scores were

analyzed using a Paired-Sample T-test to examine the significance of changes in preparedness attitudes before and after the intervention, and the Normalized Gain (N-Gain) was calculated to assess the intervention's effectiveness on children's learning outcomes. Furthermore, Cohen's d Effect Size was applied to provide empirical evidence regarding the magnitude of the storybook intervention's impact on student behavior change. To complement these numerical findings, qualitative data from interviews were analyzed using Thematic Analysis with the Braun & Clarke approach to identify in-depth patterns of the media's working mechanisms, which were then substantiated with direct quotes from participants to ensure the contextual validity of the findings.

To provide a more informative and in-depth comparison, the raw research scores were converted into five descriptive categories ranging from Very Low (0–20), Low (21–40), Medium (41–60), and High (61–80), to Very High (81–100%). This categorization aims to clearly illustrate the dramatic shift in children's competency levels before and after the intervention. By grouping the data on this scale, the effectiveness of the illustrated storybook in

improving disaster preparedness can be measured not only by numerical growth but also by the qualitative transformation in children's understanding as they progress from lower categories to very high mastery.

■ RESULT AND DISCUSSION

Development of Illustrated Storybooks for Disaster Mitigation with Local Wisdom

The development of learning media in the form of an illustrated storybook based on *Tunjuk Ajar Melayu Riau* produced a final product titled "SEAN: Disaster Response Attitude for Early Childhood," which is specifically designed for children aged 5–6 years. The main features of this media include the integration of visual narratives with local wisdom, as well as interactive elements in the form of a maze game that functions as an evacuation simulation. Visually, the product features characters wearing Riau Malay traditional clothing (*Teluk Belanga*) to enhance children's emotional connection with the content. The book's content structure covers three main types of disasters fire, earthquake, and flood, each of which is outlined in pre-, during-, and post-disaster phases to provide a comprehensive understanding of mitigation.



Figure 2. Illustration of the picture storybook integrating *Tunjuk Ajar Melayu* Local Wisdom.



Figure 3. Table of contents



Figure 4. Participants' Hands-on Activity During Intervention and Data Collection.

The eligibility of this media was determined by expert validation. Based on expert validation results, this media achieved a very high validity score, with an average Aiken's V index of 0.85. Specifically, the material validator, media design validator, and local wisdom expert provided consistent scores of 0.85, which empirically categorize this product as 'Highly Feasible' or highly valid. This high validation score indicates that the illustrated storybook has met technical quality standards, linguistic readability, and the accuracy of mitigation concepts appropriate for early childhood developmental stages.

This high validation score indicates that the illustrated storybook has met technical quality standards, linguistic readability, and the accuracy of mitigation concepts appropriate for the developmental stages of early childhood. The high material validity is driven by a systematically structured concept presentation, in which abstract mitigation knowledge is visualized as concrete steps easy for children to understand. The novelty of this media lies in its holistic integration of three main pillars: local cultural values (*Tunjuk Ajar Melayu*), interactivity (maze game), and cognitive scaffolding, which are rarely found simultaneously in other disaster mitigation learning media. Through the concept of "listening to nature" (*mendengar alam*), adapted from local wisdom, children are invited to recognize environmental danger signs through an intuitive approach familiar to their lives.

The visual design and narrative in this book were intentionally arranged to minimize children's cognitive load, aligning with multimedia learning principles (Darling-Hammond et al., 2020; Gay, 2018; Mayer, 2005) that emphasize integrating text and images to facilitate knowledge transfer. Furthermore, the use of relevant stories and characters who embody local cultural identities supports students' affective engagement, which, according to the literature, is key to success in local wisdom-based learning and to strengthening information retention in early childhood. Thus, the

media design is not only academically valid but also effective as an instrument for character development and critical thinking skills, stimulating planning and decision-making within the interactive games.

Practicality and Student Responses

The practicality of the "SEAN" media was evaluated to ensure that this storybook is not only valid in terms of content but also functional and easy to use within a dynamic early childhood classroom setting. Based on the assessment results, the media obtained an average practicality score of 88%, indicating that the storybook is "Highly Practical" for implementation. Teachers stated that the narrative navigation structure, supported by visual picture cues, significantly eased their guidance in transitioning from one disaster concept to another without requiring excessive verbal explanation. From the students' perspective, interactive elements such as the maze game proved highly helpful for understanding evacuation sequences independently, as reflected in their high enthusiasm and ability to complete simulations with minimal teacher assistance.

The findings of this study show that the "SEAN" media has a high Perceived Ease of Use due to its intuitive visual design, thereby reducing the instructional burden on teachers. Furthermore, teachers' Perceived Usefulness of this media is strong because it can simplify complex mitigation materials into narratives that are familiar and relatable to children.

The use of *Tunjuk Ajar* Riau Malay elements, particularly the visual representation of characters in traditional Malay attire, was a significant draw. The visual representation of characters wearing Riau Malay traditional clothing generated strong identification from the children. This was evident from the expressions of enthusiasm and spontaneous comments, such as the one made by Student A (age 5): "Wah, ada baju Teluk Belanga! Ceritanya Melayu, bu! Saya mau baca lagi, suka liat gambarnya."

(Wow, it has a Teluk Belanga shirt! It is a Malay story, Teacher! I want to read it again, I like seeing the pictures). This authentic expression, supported by the observation of teacher A: “*Anak-anak langsung tertarik ketika melihat tokoh memakai pakaian Melayu*,” (The children were immediately interested when they saw the characters wearing Malay clothes). This cultural connection transformed the book from a generic educational tool into a relatable and meaningful narrative. The familiarity and pride associated with local culture created a welcoming and highly engaging learning environment, which is crucial for information retention in early childhood.

The second theme confirms the theoretical link between the book’s interactive element and cognitive skill development. The maze game incorporated into the story actively stimulated children’s critical thinking and problem-solving skills. This interaction resulted in a tangible understanding of the evacuation concept. When asked after completing the maze, Student B (age 6) explained his actions using simple language that demonstrated conceptual understanding: “Jalannya harus ke pintu. Kalau ada api, tidak boleh lewat situ. Cari jalan yang kosong, baru lari ke lapangan.” (The path must go to the door. If there is fire, I cannot go that way. Find the empty path, then run to the field). This comment reinforces teacher B’s direct observation of this mechanism: “Saat memainkan maze, anak terlihat berpikir sebelum memilih jalur” (While playing the maze, the child appeared to think before choosing a path). The maze functioned as a safe, low-stakes scenario requiring planning, hypothesizing, and evaluating consequences (trial and error) all foundational components of critical thinking. This finding strongly supports the claim that the book is effective not just for knowledge transfer but also for cognitive skill development.

Compared with previous studies on technology and media acceptance in schools,

these findings reinforce the theory that both teachers and students are more likely to accept media that is contextually relevant (e.g., local culture). Previous literature has argued that picture storybooks for children can be an effective learning medium (Darling-Hammond et al., 2020; Gay, 2018; Mayer, 2005). While research generally focuses on digital devices that are often constrained by technological literacy, this study provides a new insight: interactive print media designed with clear navigation principles can provide an equivalent level of ease of use, and can even be more effective for early childhood groups. This proves that the “ease” factor is not always synonymous with digitalization, but rather depends on the extent to which the media design is able to communicate visually and functionally with its users.

Using relatable stories helps children grasp the abstract concepts of disaster preparedness in the context of disaster mitigation. This matters because the characteristics of early childhood allow children to understand material more easily when presented visually/verbal (Mann & Monteith, 2005; Mayer, 2005). Another great value in the book’s content is the Malay *Tunjuk Ajar* that is used. Through its values (such as “Listening to Nature, Studying Self”), Malay culture recognizes the essence of living nature, instilling environmental awareness from an early age. Examples from literature outside North America indicate that lessons grounded in local culture can also deepen children’s understanding of important concepts and contribute to the preservation of traditional values (Gay, 2018).

Furthermore, the book’s beautiful, simple design makes it easier for teachers to fit this teaching material into the existing curriculum. This finding is consistent with research by P. J. Ching (2018), Y.-H. Ching et al. (2018) and Regondola & Astorga (2025) demonstrate that visual-based learning media more strongly motivate students to learn actively. The benefit of this picture

storybook is its contextual approach, which is relatable to the needs of children in Indonesia. Nonetheless, further study is essential to understand the lasting effect this teaching material has on children's preparedness for disasters. Future research may investigate the creation of similar teaching materials for diverse forms of disaster or in electronic format to increase accessibility. This is consistent with research (Fang, 2018; Noviana et al., 2023; Öztürk-Kahriman, 2010; Sun et al., 2025), which demonstrates that the impact of both digital and physical storybooks is positive for children's perceptions of socio-environmental and safety issues.

Effectiveness of Early Childhood Resilience

The effectiveness of the "SEAN" illustrated storybook intervention in enhancing children's disaster resilience and preparedness was evaluated using the Disaster Preparedness Scale for Early Childhood (DPSEC). Based on quantitative data from 60 participants, the statistical analysis indicates a significant improvement. The analysis reveals that the children's average preparedness scores increased drastically from 55% (SD=6.45) during the pre-test phase to 90% (SD=4.12) in the post-test phase. A hypothesis test using a Paired-Sample T-test yielded a value of $t(59) = 14.82$ with a significance of $p < 0.001$, confirming that this change did not occur by chance. Explicitly, there is a significant difference between the pre-intervention and post-intervention conditions, with an Effect Size (Cohen's d) of 1.92, which falls into the "very large effect" category. Furthermore, a Normalized Gain (N-Gain) value of 0.71 indicates that the media's effectiveness is in the high category for improving children's overall mitigation competencies.

This significant improvement in learning outcomes can be attributed to the interactive simulation features in the media, which allow

students to visualize abstract concepts in concrete terms. The delivery of material does not stop at text narratives but is reinforced by an evacuation maze game that serves as a "cognitive rehearsal." Pedagogically, this activity transforms children from passive listeners into active decision-makers who must plan safe routes amidst simulated danger. Additionally, the use of picture cues, combined with the "*Tunjuk Ajar Melayu*" local wisdom, serves as cognitive scaffolding, bridging technical disaster knowledge with cultural schemas already familiar to the children. This makes it easier for children to absorb information about identifying emergency equipment and natural danger signs because they feel an emotional connection to the characters and the cultural setting presented (Plass et al., 2015).

These findings align with studies by Howells (2018), Laukkonen et al. (2018), and the OECD (2019), which indicate that interactive visual media are highly effective in improving children's safety perceptions. However, this study provides new insights (novelty) showing that media effectiveness depends not only on visual sophistication but also on "cultural contextualization." While previous research, such as Rahiem (2020), emphasized conventional storybooks, this study shows that integrating local wisdom values (*Tunjuk Ajar* values) with elements of gamification enhances memory retention. The affective engagement of children through local cultural identity has proven to be a catalyst that accelerates the transformation of passive understanding into proactive behavioral readiness.

One key element in stimulating children's critical thinking is the use of interactive games, such as mazes (Kurt & Dindar, 2025; Masten & Narayan, 2012; Sarafova, 2023; Ternik et al., 2017). These games also guide children in applying the concepts of action and consequence, which are vital in emergency scenarios (Plass et al., 2015). This element aligns with the learning

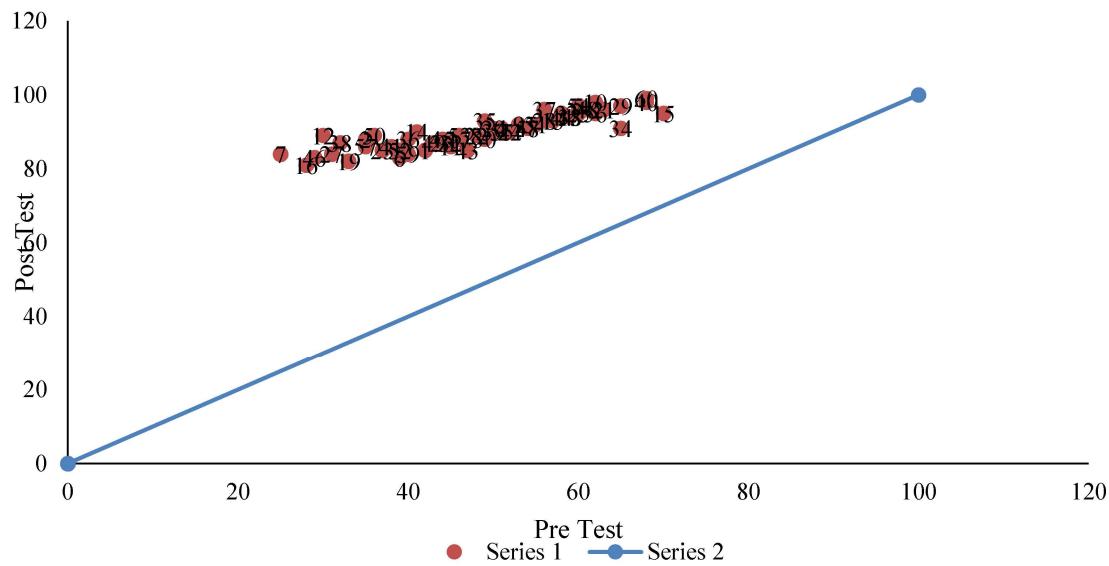


Figure 5. Analysis of pre-test and post-test score data distribution

outcome guidance in the *Merdeka* Curriculum, which highlights opportunities for critical, creative, and collaborative thinking (Howells, 2018; Laukkonen et al., 2018; OECD, 2019). The quantitative findings are strongly supported by robust practical validation: the teacher practicality score reached 88%, indicating that the storybook is highly usable, engaging, and easily integrated with the learning outcomes of the *Merdeka* Curriculum for Early Childhood Education (CP-

PAUD). The high teacher acceptance confirms that the model is feasible and functional in the field. Nevertheless, it is crucial to note that the generalization of effectiveness claims is limited to the study's specific context: 60 children across three PAUD sites in Riau. To claim broader national effectiveness, further trials across diverse cultural regions and various types of disaster hazards would be required to test the product's reliability and external validity.

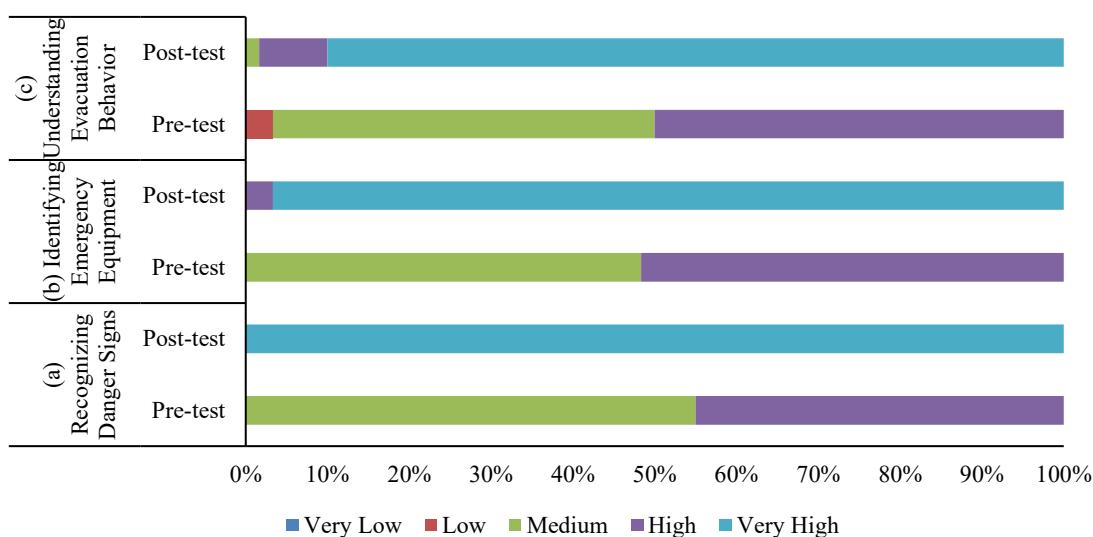


Figure 6. Analysis of pre-test and post-test scores per indicator

Figure 6, illustrating the analysis of pre-test and post-test scores per indicator, demonstrates a consistent and significant increase across all measured dimensions of disaster preparedness. This finding explicitly confirms that the storybook intervention was effective in enhancing specific knowledge and behavioral skills. Specifically, substantial improvements were observed in Recognizing Danger Signs, Identifying Emergency Equipment, and Understanding Evacuation Behavior. The uniform positive trend across all indicators suggests that the storybook's multifaceted approach, combining visual narratives with interactive elements, successfully addressed the diverse cognitive and behavioral requirements for comprehensive disaster preparedness in early childhood. This validates the design strategy to integrate actionable skills, such as planning (Evacuation Behavior), with critical knowledge (Recognizing Danger Signs and Equipment Identification).

Consistent exposure to the content and interactive activities (such as role-playing and the maze) successfully translated theoretical knowledge into actionable behavior. Teacher C provided clear evidence of this outcome: “*Sekarang mereka tahu apa yang harus dibawa dan ke mana harus pergi,*” (Now they know what they must bring and where they must go). This theme demonstrates that the storybook achieved its ultimate goal: moving children beyond a passive understanding toward the development of concrete, easily recallable, and potentially life-saving behavioral responses in an emergency.

However, the first challenge to consider is the trial's limitation, which was conducted in only a handful of schools in one region. The findings of this study alone cannot provide us with a broader picture, particularly across cultures and geographic regions. Moreover, although this book is effective in early childhood, its sustainability requires support from various parties, such as teacher training, to maximize its use. There is also

a need for political will to support education policies that enable widespread implementation. As proposed by Darling-Hammond et al. (2020), to successfully implement educational innovations, systems support, and adequate training for the education workforce are required.

These findings carry profound policy implications and broad practical relevance for curriculum policymakers at both national and regional levels. The significant increase in children's disaster preparedness scores (N-Gain 0.71), supported by the high teacher practicality score (88%), suggests that this local wisdom-based illustrated storybook model is feasible for standardization and highly recommended. For regional policymakers in Riau, the findings validate the use of *Tunjuk Ajar Melayu Riau* as an effective curriculum framework for developing disaster-responsive character, aligning with the *Merdeka Curriculum*'s emphasis on local context. Nationally, the model is highly replicable and adaptable across other regions in Indonesia that also possess strong local wisdom. The core of this model's replication lies in its design framework, which combines visual-narrative learning, cognitive interactivity (the maze game), and cultural contextualization. Thus, this model offers a flexible conceptual framework for strengthening national resilience by leveraging the richness of Indonesia's local wisdom, substituting *Tunjuk Ajar Melayu* with relevant local cultural values (e.g., *Tri Hita Karana* in Bali or maritime values in Aceh) tailored to specific regional hazards.

■ CONCLUSION

The results of this research indicate that picture storybooks based on *Tunjuk Ajar Melayu Riau* are effective in enhancing disaster response behavior in early childhood. The book is designed to blend visual information, story, and local cultural values into children's living reality. The findings indicate that the picture-story-based

approach is more effective for children to understand the concept of Disaster Preparedness because it delivers information in an engaging, interactive manner. Through expert validation, limited trials, and field tests, this learning material is considered feasible, practical, and effective. Its use received a positive response from teachers, and the children were very keen and active in the learning process.

Not only does the book affirm understanding of disaster preparedness, but it also builds local cultural identity based on Tunjuk Ajar Melayu values, such as harmony with nature, environmental awareness, and others. The findings apply specifically to the 60 children in Riau and should not be generalized nationally without further studies. This research demonstrates how cultural integration and maze-based cognitive stimulation can strengthen safety education while reinforcing local identity. Continued development and scaling may enhance Indonesia's disaster-preparedness efforts for early learners.

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