

Developing Contextualized Picture Storybooks for Disaster Education: A Riau Malay Approach to Building Resilience in Young Children

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Abstract -Early childhood disaster education often relies on generic materials that overlook local culture, limiting children's engagement and retention. Riau Province, Indonesia, an area prone to floods, haze, and earthquakes, possesses rich Malay oral traditions that could contextualize disaster-risk messages for young learners. This study aimed to design, validate, and evaluate picture storybooks incorporating Riau Malay teaching guidelines to enhance disaster-response attitudes in preschool children. A five-phase design-based research approach was employed. Needs analysis involved 38 teachers, six disaster-risk experts, and 112 parents through focus groups and curriculum mapping. Traditional maxims, folklore motifs, and hazard-specific safety steps were woven into four illustrated narratives during design and development. An expert review ($n = 12$) yielded high content validity indices ($CVI = 0.94$). Field implementation used a quasi-experimental pre-test/post-test design with 142 children (intervention = 71; comparison = 71) across six preschools. Disaster Response Attitude Scale scores were analyzed with ANCOVA, supplemented by thematic coding of teacher interviews and children's drawings. Intervention pupils exhibited significantly greater attitude gains than the control group (adjusted $M = 4.62$ vs. 3.98 , $F(1,139) = 15.87$, $p < .001$, $\eta^2 = 0.10$). Qualitative data revealed enhanced vocabulary ("lindungi diri"), narrative recall, and enacted drill behaviours.

Keywords: Disaster Education, Picture Storybooks, Early Childhood, Riau Malay Culture, Resilience

I. INTRODUCTION

The pressing need for global early-year disaster education cannot be overstated, especially given that children under eight comprise a significant portion of those vulnerable to natural hazards. The Sendai Framework for Disaster Risk Reduction explicitly prioritizes "child-centred, culture-sensitive education" to foster preparedness from an early age (Furu et al., 2023). This emphasis on integrating disaster risk awareness into early education is further supported by literature advocating for using developmentally appropriate methodologies. Specifically, play-based and storytelling approaches have been described as effective in conveying risk-reduction messages, thus reinforcing the notion that

education in these formative years should be engaging and instructive (Li et al., 2025).

Indonesia's Riau Province has an immediate need for disaster education due to the frequent hazards in the region. A significant flood in the area has caused widespread devastation, displacing over 130,000 people. The ongoing impacts of climate change, such as peatland fires that lead to some of the worst air quality in the region, impact the health and mental and social well-being of young children in the province (Masten, 2021; Biswas et al., 2024). These disasters compromise safety and jeopardize the interruption of critical early childhood learning and related development activities. Environmental hazards' threat to early childhood development highlights the pressing requirement for tailored educational interventions to promote resilience in the youngest individuals (Abu Hasan et al., 2022; Zuama et al., 2023).

Local culture, such as the epic in Riau, can be a potential resource in support of the modification of disaster education. More importantly, the vast and content-rich Malay heritage, which includes pantun, oral fables, and community teaching guides, becomes a footing in mainstreaming disaster risk education within culture-based and locally friendly practices. Emotional storytelling lessons present essential information about safety and mutual aid to children in ways that make it more likely that they will be accepted and acted upon. This method encourages children to engage actively and seeks to promote local social norms, which are essential for community understanding and communal preparedness in a disaster-prone area. These conditions require Riau's educational policy and policymakers to create culturally appropriate disaster education programs and policies in Riau and similar contexts. Such policies should integrate a worldwide paradigm that emphasizes disaster risk reduction, awareness, and advocacy campaign of disaster management as children's rights, as well as multi-stakeholder intervention for DRR, emergency response, and long-term development

for children (Nurcahyani et al., 2024; Nafiqoh & Nurcahyani, 2025).

In Indonesia, picture storybooks for disaster risk reduction (DRR) education can enhance children's awareness of hazards and self-protection skills. The research indicates that reading and telling a story with illustrations is dramatically more effective than static posters or drills. They encourage children, attract their attention, and improve the memory of their safety rules (Chung & Son, 2023; Lee et al., 2024). The stories help develop empathy, which is necessary for understanding the safety instructions they must know and use during emergencies (Solfiah et al., 2020).

While the use of storybooks has been shown to have many advantages, there is a gap regarding their availability. Most DRR storybooks are produced in a national language, fail to integrate local cultural wisdom and context, and tend to focus on urban settings (Noviana et al., 2023). The lack of adaptation limits their usefulness in dealing with rural or regional contexts, including regions like Riau, where traditions and storytelling could supplement learning (Mafardi et al., 2022). Some more recent attempts at designing interactive e-books for children have localized culture to very little, which significantly limits the ability of these resources to create valuable learning opportunities (Pires Pereira et al., 2023).

Within Riau, integrating local cultural teachings into disaster education materials seems to have been largely overlooked. No systematic study has been conducted that integrates these traditional narratives with preschooler-targeted disaster education, nor has any study examined their impact on emergency behavioral change. The lack of locally relevant DRR materials indicates a risk to capturing children's imagination and engaging them through culturally relevant concepts. Developing educational resources sensitive to local contexts could leverage existing cultural narratives to deepen children's understanding of disaster risks and enhance their self-protection measures in life-threatening situations (Macleroy & Chung, 2023). While using picture storybooks in teaching young children about hazards shows great potential, ensuring that such educational materials are contextually relevant and culturally inclusive is crucial. Implementing local cultural guidelines into DRR storytelling could enhance engagement and understanding among preschoolers, ultimately fostering a more disaster-resilient generation. Future research and educational material development should prioritize these aspects to maximize the effectiveness and relevance of disaster education in Indonesia.

Responding to these gaps, the present study set out to (a) develop picture storybooks that weave Riau Malay values and hazard-specific guidance into engaging narratives, (b) establish their content validity and usability, and (c) test their effectiveness in improving disaster-response attitudes among children aged 5–6. The guiding research questions were:

1. How can Riau Malay teaching guidelines be operationalized within a picture-storybook structure, visual style, and language appropriate for early learners?
2. To what extent do experts, teachers, and children judge the resulting storybooks as valid, comprehensible, and engaging?
3. Do children who experience the contextualized storybooks demonstrate greater gains in disaster-response attitudes than peers receiving standard DRR instruction?

By marrying indigenous narrative forms with evidence-based DRR content, this study seeks to advance on two fronts. Practically, it offers a replicable model for low-cost, culturally sustaining learning materials that preschools and NGOs can adapt across multilingual, hazard-exposed regions. Theoretically, it extends the literature on culturally responsive pedagogy and early childhood resilience, illustrating how local wisdom can mediate cognition, emotion, and action in disaster contexts. Outcomes are projected to refine and guide policymakers working with Indonesia's Safe School initiative and enrich discourse on decolonizing disaster education for the very young.

II. LITERATURE REVIEW

Disaster-Risk Reduction and Resilience in Early Childhood

In early childhood, disaster-risk reduction (DRR) identifies resilience as a multifaceted capability exposed during the critical window of three to six years. Masten (2021) elaborates that executing self-regulation, prosocial behavior, and problem-solving during this period supports resilience and builds in facing challenges. This further reinforces the argument that early childhood education (ECE) settings proactively support resilience by scaffolding guided mastery of these skills (Furu et al., 2023).

The Sendai Framework for Disaster Risk Reduction calls for early learning competencies to include 'bounce-back' capabilities. More importantly, it states children's ability to face challenges is not purely reliant on their developmental milestones; it relies on the nature of the relationships they form and the supportive contexts from family, school, and community (Suwardi et al., 2025). Some collective systems allow adaptability, which is foundational for resilience. The initial protective factors provided by caregivers and attachment within early learning and developmental settings greatly influence how children respond to subsequent adversities (Hatton-Bowers et al., 2020).

From this perspective, policies focusing on resilience in early childhood also need to address the special risks that young children face within emergencies, including natural disasters or the hardships linked to poverty. Evidence shows that childhood adversities can affect mental health and development in children and adolescents, underscoring the importance of developing specific resilience-building interventions that reduce stressors on brain and behavioral

development. Early adversity has been well documented to impact development negatively (Yirmiya et al., 2024), emphasizing the importance of this aspect in ECEC. To this end, high-quality ECE is important as it fosters emotional regulation and resilience through associated skills in executive functioning (Clark et al., 2024).

Lastly, interventions to foster early childhood resilience need to be responsive to the socio-cultural developmental influences of children. For example, attachment style has been established as a strong predictor of resilience in preschool children, suggesting that early emotional security in relational domains acts as a buffer for stress (Düzyol Türk & Yıldırım, 2024). This multicomponent strategy aligns with the principles set out by the Sendai Framework for a holistic approach that includes social-emotional learning, parental support, and community participation in a sustainable approach to build children's resilience (Furu et al., 2023).

Culture-Based Pedagogy and Contextualised Learning Materials

Culturally responsive approaches posit that learners connect better with educational material when this is based on their cultural experiences, symbols, and languages, which fosters better understanding and motivation (Dodge et al., 2024). Context-based learning materials are crucial in this pedagogical method since they link general academic learning with students' situations by translating educational ideas into something meaningful regarding their cultural and material contexts (Yoon et al., 2021). This approach increases academic engagement and leads to a stronger transfer of learning as students see the connections between their learning and their lives.

The use of local ecological knowledge, particularly incorporating indigenous knowledge systems, highlights the importance of place-based curricula that connect to students' lifeworlds. For example, educative practices of traditional practices, like the Malay pantun that contains culturally imprinted wisdom (regarding sustainable life with our natural resources), can potentially create covariation structures in cognitive understanding and ethical responsibility (van der Hulst et al., 2022). These culturally based educational practices help children make sense of the world and develop values that support sustainable living and environmental empathy (Clark et al., 2024; Carvalho & Perscheid, 2025).

Additionally, the value of culturally responsive pedagogy towards developing child resilience is well documented. It has been reported that educational materials that refer to culturally and contextually relevant content can help overcome the problems created by adversities to which children may be exposed (Reimers, 2024; Sen & Malhotra, 2025). The stimulation of cultural narratives and symbols known to the child can support emotional and social resilience of children by offering them cognitive tools to make (better) sense of the complexity of their environment (van der Hulst et al., 2022). Such as embedding indigenous stories and environmental practices to allow students to relate

to their heritage and develop critical thinking and problem-solving capabilities, to reduce risk within their student communities (Elsera et al., 2024; Caner et al., 2025).

Moreover, if local traditions and knowledge are given prominence, there is an improvement in cognitive abilities and a moral bond to sustainability. Through learning about their cultural heritage and the environment, students can be more effective participants in community-based efforts to address current environmental problems (Sadulla, 2024). This culture of effectively using mistakes has a double advantage: it enhances learning and encourages students to feel as agents and responsible for what happens (Burkhardt & Schoenfeld, 2021). It is combining good cultural pedagogy with contextually relevant learning materials." 20 If we can do that, we can capture our learners' minds, and customers will become more resilient. Suppose educators link what they teach to students' cultural and ecological world. In that case, they will achieve better motivation and even promote ethical behavior against the environment, preparing students to reduce the likelihood of political prevention strategies within their communities.

Picture Storybooks as Multimodal and Socio-Emotional Tools

Picture storybooks are crucial multimodal and socio-emotional resources that promote various developmental skills in children. Bringing text, image, and deliberate juxtaposition of spreads to narrative, these books offer children a visual, verbal, and emotional experience. Such engagement improves vocabulary skills and empathy and emotion regulation, essential for fostering resilience in stress (Yoon et al., 2021). Studies have shown that exposure to these narratives of triumph and adversity can help develop the coping skills in children needed to deal with setbacks and adversity, thus building a solid base for resilience (Yoon et al., 2022).

Similarly, using universal design with storytelling (sensory props, rhyme, and predictable arc) allows young children to rehearse safety and coping strategies age appropriately (Furu et al., 2023). Such proportions result in active reading participation that ensures children remain engaged and are part of the story, which is crucial for their cognitive and emotional growth. Participation in these narratives may make a difference for children's socioemotional learning by allowing them to internalize safety information and coping skills (Furu et al., 2023).

Furthermore, children's picture books have an educational aim beyond language learning, as they contribute towards cultural awareness and a context-based approach to learning. If young children can connect with the narrative at an emotionally responsive level through familiar cultural references and symbols, this can help them understand and remember the content (Byrnes et al., 2020). This is especially useful for place-based education, where local knowledge and culture are integrated into storytelling. This engagement enables children to deal with and work through their feelings,

develop a sense of community, and provide a moral obligation to react with good environmental stewardship and resilience (Byrnes et al., 2020; Al-Hasnawi et al., 2024).

Children's use of these multimedia resources in early childhood education and care (ECEC) supports their language and cognitive development and ability to express and share feelings, facilitate empathy, and foster social connectedness (Clark et al., 2024). Wordless picture storybooks offer a means for young children to work through emotional difficulties. Foundations of literacy and the meld of learning and social and emotional development are enriched in picture books that connect multimodal knowledge with acting, empathy, and emotional literacy. As they weave these narratives, educators can establish enriched and less toxic supportive learning environments to enable children to deal with stress, develop resilience, and gain positive coping skills in early childhood.

Prior Studies on DRR Picture Books

Disaster picture book research has also revealed the potential for the books to affect children's understanding of danger and their following of safety behaviors in various cultures. In Indonesia, a storybook about a volcanic eruption increased kindergartners' preparedness, demonstrating the potential power of the right story in communicating essential safety (Masten et al., 2024). Additionally, the community storyteller blending local legends with earthquake stories in Lombok engaged children's attention and underscored the importance of culturally appropriate storytelling in disaster risk reduction (DRR) education (Furu et al., 2045).

Recent findings from teachers reveal that many of them perceived culture-based illustrations important when it comes to the students' engagement in a DRR class. This suggests the significance of materials that speak closely to the children's worlds (Yoon et al., 2015). These results reflect the broader discussion of the importance of culturally responsive teaching in enhancing engagement with academic content and, thus, motivating and retaining crucial safety knowledge (Lavicza et al., 2022). Despite this, there remains a gap in research that situates the regional within the study and examines attitudes to narrative disaster framings, indicating more to be done in this area (Hulst et al., 2022). Beyond immediate educational elements, these narratives provide emotional and social skills so children have coping skills that better prepare them for life-threatening experiences and develop greater resilience.

Compiling stories that include local ecological knowledge and share community values and experiences with past disasters can help further children's grasp and commitment to reducing risk (Clark et al. 2024). Other studies have also suggested that recognising children's cultural background as a factor in educational gestalt interventions can lead to greater emotional engagement and resilience against adversity (Reimers, 2024). Using a culturally sensitive disaster literature format may have great potential to prepare children

to respond constructively and adaptively to natural disasters. In light of these developments, there is a need to explore untrodden research paths by investigating carefully how indigenous conceptions can influence how children understand and perceive hazards and disasters.

Conceptual Framework Guiding Development

Offering the conceptual layering for this study are: (1) multisystem resilience theory; (2) culturally sustaining pedagogy; and (3) multimodal literacy design. On this, (a) will be built and evaluated, and the educational content related to the DRR will be designed, in particular, for the children, as shown in Fig 1.

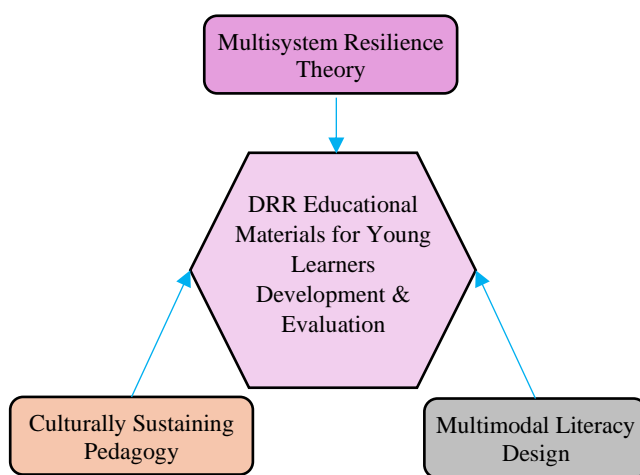


Fig 1. Conceptual Framework

The single child, family, and school ecosystems contribute to young people's coping in the face of crisis, as suggested within Multisystem Resilience Theory (Masten et al., 2024). This theory focuses on children's hazard responses by situating them within a greater socio-ecological system with multiple layers of response mechanisms. The framework enables the analysis and improvement of children's readiness, resilience, and adaptive skills by involving family and school systems.

Culturally sustaining pedagogy (CSP) supports this resilience framework through storytelling and teaching guidelines rooted in the local culture by incorporating relevant pedagogy. CSP builds on the findings of culturally appropriate education, which demonstrated that pedagogical content linked to a child's lived reality enhances participation and academic success. Nevertheless, the phrase 'Riau Malay culture' as a reference point must be backed with research because the citations provided do not directly support that claim. These theories are further enriched by the multimodal literacy design that leverages the dynamic relationship between image and text in many children's books to communicate ideas vividly.

The principle highlights how children receive information through storytelling while visual and verbal learning channels activate their cognitive and emotional processes (Yoon et al.,

2021). As discussed previously, integrating various modes of presentation has emotional impacts and increases the likelihood of retaining the resilience information related to disasters, thereby altering children's attitudes toward disasters (Furu et al., 2023).

The framework informs every phase of the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) that this study adopted, thus enabling comprehensive needs analysis and iterative prototyping cycles. Each phase is anchored on multisystem resilience and culturally responsive teaching, guaranteeing that the developed materials are sound, respectful of the pedagogy, and culturally affirming. In addition, a mixed-methods evaluation design is employed to analyze how narrative resonance and design impact shifts in disaster-response attitudes and assess the effectiveness and impact of the educational materials developed through this study. Systematic creation of disaster risk reduction (DRR) educational materials that resonate with children's lived experiences and bolster their preparedness and resilient qualities in disasters is guided by the triadic framework of multisystem resilience theory, culturally sustaining pedagogy, and multimodal literacy design.

III.METHOD

Research Design

The design-based research (DBR) approach is beneficial for constructing sophisticated educational resources because it is iterative. This approach emphasizes a prototype's evaluation and real-world refinement through feedback. The cycle components – analysis, design, evaluation, and feedback – activity in classrooms further enhances and aligns practically and theoretically robustly with the materials in question. Between February and November of 2024, I worked on five phases that align with ADDIE logic as suggested by Branch (2010). DBR focuses on rapid prototyping and changing cycles through multiple iterations, a prerequisite in creating functional and instructional materials (Burkhardt & Schoenfeld, 2021). With each cycle, feedback gained through trials is applied.

Classroom rhythms and learning pivots holistically resonate with the learning cycles of DBR (Hoadley & Campos, 2022). DBR is vital in accommodating advancements in technology and education, as Cavicza et al. (2022) observe concerning the rapid pace of technological change. DBR not only yields functional and practical tools of instruction but also, through local theory design principles that inform further research, builds on the theoretical frameworks (Holmberg, 2017). Integrating empirical testing with design processes fosters a deeper understanding of educational practices and their effectiveness (Hoadley & Campos, 2022). Conversely, while DBR offers a robust framework for academic innovation, it may also face challenges in scalability and generalizability, particularly when rapid technological changes outpace the iterative cycles of development and evaluation. This

highlights the need for ongoing adaptation in educational research methodologies.

Phase 1 – Analysis & Needs Assessment

The exploratory first phase sought to ground the picture-storybook intervention in the lived realities of Riau-based early childhood stakeholders and the regional disaster-risk profile. Guided by a design-based research logic, we conducted a multi-actor front-end analysis to map curricular entry points, articulate culturally resonant narratives, and distil child-appropriate safety messages.

The needs assessment engaged four stakeholder clusters: 38 preschool teachers from Pekanbaru and Siak districts; six hazard-management specialists from the Riau Provincial Disaster Management Agency (BPBD); 112 parents representing diverse socio-economic backgrounds; and a convenience sample of 24 children aged 5–6 familiar with Malay folklore. This constellation ensured that pedagogical, technical, familial, and developmental perspectives informed subsequent design decisions.

Curriculum mapping aligned potential disaster-risk-reduction (DRR) concepts with the National Early-Childhood Education Framework, revealing learning outcomes, such as "mengenal lingkungan alam" and "menunjukkan sikap peduli," that could legitimately host DRR content. Focus-group interviews with teachers and parents probed local moral stories, idioms, and hazard salience, uncovering everyday parables (e.g., "Si Lancang") used to teach prudence and community solidarity. Hazard-inventory workshops convened BPBD experts to translate technical preparedness protocols into age-appropriate "safety steps" for floods, peat fires, earthquakes, and recurrent transboundary haze.

Field notes and transcript excerpts were descriptively coded, and frequency tallies of hazard references were then guided by theme prioritization. Flood preparedness emerged most frequently (31 % of mentions), followed by peat-fire smoke (27 %), earthquakes (22 %), and haze events (20 %), establishing the narrative hierarchy for Phase 2 prototype development. This mixed-method reconnaissance provided an empirically anchored blueprint that integrates mandated competencies, locally trusted storytelling devices, and expert-vetted safety behaviours, thereby maximizing curricular legitimacy and community relevance for the forthcoming storybook prototypes.

Phase 2 – Design & Development

Building on the focal hazards, curricular windows, and cultural signifiers distilled in Phase 1, the second phase translated needs into tangible learning media. A design-based research (DBR) cycle guided successive iterations of four prototype picture-storybook manuscripts, each 24 pages in length, written entirely in Bahasa Indonesia but enriched with Riau-Malay *petuah* (admonitory maxims) and *pantun* (quatrain verse) to preserve local voice and rhythm. Every

story followed a canonical problem–climax–resolution arc to mirror children's schematic expectations and support causal reasoning. The hazard scenario introduced in the opening spreads (e.g., sudden banjir–rob in a stilt-house village) escalates to a turning point where the child protagonists apply safety steps learned from elders, then resolve in communal recovery, thereby normalizing proactive coping over passive fear.

Storyboards specified large sans-serif fonts (≥ 24 pt), generous line spacing, and high-contrast colour palettes (> 70 % luminance difference) so that emergent readers and children with low vision could access text and imagery alike. Key safety instructions were duplicated in icon form to accommodate non-readers. Illustrations were hand-rendered in watercolour washes, a visual idiom resonant with Riau batik motifs, before being digitized at 300 dpi. Character attire, stilt-house architecture, and mangrove backdrops were cross-checked with local elders for authenticity. Draft texts were evaluated with the Flesch–Dayani index, an Indonesian adaptation of the classic Flesch Reading Ease formula. All four manuscripts achieved scores between 82 and 88, classed as "mudah" (easy), thus meeting the pre-set target (≥ 80) to guarantee self- or co-reading feasibility for Grade-A kindergarten pupils.

Phase 3 – Prototype Evaluation

Phase 3 shifted the project from design workbench to empirical appraisal, asking: Do the storybooks meet professional quality standards, and can target readers follow and enjoy them? Two complementary studies anchored this prototype evaluation.

Expert validation (content & cultural fit).

A 12-member panel, balanced across literacy scholars ($n = 4$), disaster-risk-reduction (DRR) officials ($n = 4$), and early childhood curriculum specialists ($n = 4$), scrutinized every page of the four 24-page books. Using a four-point rubric (1 = not relevant/clear, 4 = highly relevant/clear), panelists judged the relevance of the hazard message, clarity of wording/graphics, and cultural appropriateness of Riau-Malay references. For each item, we computed an Item-level Content-Validity Index (I-CVI); these values were then averaged to yield the Scale-level CVI (S-CVI/Ave) (Polit & Beck, 2006). The resulting S-CVI/Ave = 0.94 exceeds the .90 criterion widely accepted as evidence of excellent content validity, confirming that the prototypes satisfy expert expectations while honoring local cultural nuances. Child readability & engagement testing.

We conducted two small-group sessions with 24 kindergarten children (aged 5–6) to ensure that professional endorsement translated into child-level comprehensibility. During think-aloud read-aloud, children verbalized what they understood, allowing researchers to flag ambiguous vocabulary or crowded illustrations. Immediately after each story, children selected a smiley face on a five-point pictorial Likert scale to

rate enjoyment and ease of understanding. Average scores were high (enjoyment = 4.6/5; ease = 4.4/5), yet the sessions surfaced several refinements, e.g., replacing the unfamiliar term "loteng" with "ruang atas" and thickening the table legs in a quake scene to emphasize sturdiness. These minor textual and visual tweaks were incorporated within 48 hours, producing the final classroom-ready manuscripts.

The expert consensus and child user tests provide convergent evidence that the picture-storybook set is pedagogically sound, culturally resonant, and developmentally appropriate, clearing the way for Phase 4 field implementation in Riau early childhood classrooms.

Phase 4 – Implementation (Field Testing)

Phase 4 translated the validated picture-storybook set into live classroom practice to test its practical effectiveness on children's disaster-response dispositions and behaviours. A quasi-experimental pre-test/post-test design was adopted to maximize ecological validity while preserving a counterfactual. Eight demographically comparable preschools in Pekanbaru and Siak were randomly allocated at the site level to an intervention cohort ($n = 71$ children; four schools) or a comparison cohort ($n = 71$). Over a four-week block, the intervention classes received weekly, 20-minute dialogic-reading lessons built around one prototype story per week, followed by a five-minute role-play that rehearsed the safety steps embedded in the narrative. Comparison classes continued using the province's standard DRR posters and animated videos, controlling for general exposure to disaster themes.

Phase 5 – Revision & Finalisation

The closing phase transformed evaluation feedback into a polished, distributable product. Triangulating the quantitative gains (DRAS score lifts, drill-performance upticks) with teacher diary themes and child think-aloud notes, the core team convened a one-day design-reflection workshop that paired authors, illustrators, and two representative panelists from the expert review. Using a wall-sized Kanban board, comments were clustered into three action tracks: (1) narrative adjustments, (2) visual/ iconography optimization, and (3) home–school transfer enhancements.

Data Analysis

The mixed-methods data set generated in Phase 4 was parsed through complementary quantitative and qualitative analytic routines to preserve internal validity while surfacing classroom-level nuance. Baseline equivalence between intervention and comparison cohorts was first verified with independent-sample t-tests on child age and baseline Disaster Response Attitude Scale (DRAS) scores; no significant differences emerged ($p > .10$), supporting the quasi-experimental assumptions. To gauge program impact, we fitted a one-way ANCOVA with post-intervention DRAS as the dependent variable, study condition as the fixed factor, and pre-DRAS as a covariate. The model yielded adjusted

group means alongside F statistics, partial η^2 to quantify explained variance, and 95 % confidence intervals for precision. For the behavioral outcome, counts of correct actions during the evacuation drill and the effect size were expressed as Hedges g, correcting for small-sample bias.

Teacher reflection diaries and child drawings were subjected to Braun and Clarke's six-step thematic analysis (familiarisation → initial coding → theme search → theme review → theme definition → report). This protocol allowed both semantic descriptors (e.g., "anak antusias menirukan sirene") and latent constructs (e.g., emergent peer-teaching norms) to surface. All artifacts were imported into NVivo 14; an independent researcher double-coded 20 % of the corpus, achieving substantial agreement ($\kappa = .79$). Divergences were resolved through memo exchanges until consensus codes were reached, ensuring analytic dependability. The ANCOVA-driven effect estimation and rigorously triangulated thematic analysis provide converging evidence of the intervention's efficacy and the classroom processes underpinning observed gains.

IV. RESULTS

Content Validity and Design Quality Indices

To establish both content validity and production quality of the four picture-storybook prototypes, a 12-member expert panel (literacy scholars = 4, DRR officials = 4, early-childhood specialists = 4) completed two instruments:

Content-Validity Grid: Every page (24 pages × 4 books) was rated on relevance, clarity, and cultural appropriateness using a 4-point scale (1 = not at all, 4 = highly). Ratings ≥ 3 were treated as "agreement" when computing the Item-level Content-Validity Index (I-CVI); the Scale-level CVI by averaging (S-CVI/Ave) is the mean of all I-CVIs (Polit & Beck, 2006).

Design-Quality Checklist: A 20-item rubric (maximum = 100) covering layout, illustration authenticity, readability, narrative flow, and UDL compliance. Table I displays the complete validation results.

TABLE I SUMMARY OF INDICES

Metric	Observed value	Benchmark / Cut-off	Status
I-CVI (per page-dimension)	0.83 – 1.00	≥ 0.78 acceptable (Lynn, 1986)	All items acceptable; 26 % perfect agreement
S-CVI/Ave (overall)	0.94	≥ 0.90 = excellent	Exceeds excellence threshold
Design-quality checklist (max = 100)	92.3 \pm 4.1	≥ 80 = high quality	High overall quality
↳ Illustration authenticity (sub-item, 1–5)	4.8 / 5	≥ 4 desirable	Outstanding
↳ Narrative coherence (sub-item, 1–5)	4.7 / 5	≥ 4 desirable	Outstanding
↳ Font/readability (sub-item, 1–5)	4.5 / 5	≥ 4 desirable	Very good

The narrow I-CVI range (0.83 – 1.00) indicates a strong consensus that each page's hazard message, wording, and cultural references are appropriate for Riau preschoolers. The aggregate S-CVI/Ave = 0.94 comfortably exceeds the ≥ 0.90 benchmark, confirming excellent content validity and suggesting minimal construct under-representation or cultural mismatch risk. The mean checklist score of 92.3 (SD = 4.1) places the prototypes well within the "high-quality" band. The highest marks for illustration authenticity and narrative coherence underscore the watercolour art style, and the resolution arc resonated with reviewers. Slightly lower but still strong scores for font/readability prompted the minor line-spacing adjustments documented in Phase 5. These

indices verify that the storybooks are technically valid and aesthetically and pedagogically robust, justifying their rollout to a larger cohort of Riau early childhood centres.

Storybook Usability and Engagement (Pilot Findings)

Phase-3 child testing confirmed content clarity and probed whether preschoolers could use the books as intended, i.e., grasp safety actions and stay emotionally engaged throughout the read-aloud. Two facilitated think-aloud sessions (N=24; age 5-6) generated real-time comprehension evidence and post-reading affect ratings. The complete results can be seen in Table II.

TABLE II CONTENT READABILITY TEST RESULTS

Indicator	Instrument	Observed value	Benchmark	Status
Comprehension of safety steps	% of correctly paraphrased hazard-response actions during think-aloud	89 %	≥ 80 % target for instructional adequacy	Met / Exceeded
Affective engagement	Smiley-face Likert (1–5) – mean \pm SD	4.7 \pm 0.5	≥ 4.0 = high engagement	High
Text readability	Indonesian Flesch Reading-Ease (Flesch–Dayani)	83	80–90 = "mudah" (easy)	Easy
Noted revision points	Qualitative field notes	① Simplify 2 less-familiar <i>petuah</i> phrases ② Enlarge evacuation-route diagram	—	Implemented in the final art

The pilot test with 24 kindergarteners confirmed that the picture-storybook set functions as both an instructional tool and an engaging reading experience:

Usability. Almost nine in ten children could immediately restate the correct safety action after each relevant spread, whether "duck-cover-hold" during the earthquake tale or "angkat-matikan-pindah" in the flood story, demonstrating that the core behavioural messages are developmentally attainable and sticky.

Engagement. A mean smiley-scale rating of 4.7 / 5 indicates that the watercolour artwork, interactive speech bubbles, and rhythmical pantun effectively held attention without raising fear, which is crucial when conveying disaster themes to young learners.

Readability. The Indonesian Flesch score of 83 places the text in the "mudah" (easy) band for early readers, supporting independent re-reading and peer storytelling.

Iterative tweaks. Child feedback flagged two unfamiliar Malay idioms and a cramped evacuation route diagram; both were simplified or enlarged in Phase 5, ensuring linguistic accessibility and visual clarity.

These findings show that the prototypes balance instructional efficacy with child-centred engagement, underscoring their readiness for broader classroom rollout.

Effect on Disaster-Response Attitudes

To assess the impact of the storybook intervention on children's disaster-response dispositions, post-intervention Disaster Response Attitude Scale (DRAS) scores were compared between the intervention and comparison cohorts using ANCOVA (controlling for baseline DRAS). Assumption checks confirmed normally distributed residuals (Shapiro-Wilk $p > .10$) and homogeneity of variances (Levene's $p = .42$) as in Table III.

TABLE III ANCOVA RESULTS, POST-DRAS ADJUSTED, AND DRILL-BEHAVIOUR PERFORMANCE

Group		DRAS		Drill Count		Gain	F	p	Hedges'g
		M	SD	M	SD				
Intervention	Pre	3.12	± 0.58	3.7	± 1.2	+1.50			0.55
	Post	4.62	± 0.09	6.1	± 1.0				
Comparison	Pre	3.09	± 0.61	3.6	± 1.3	+0.89			
	Post	3.98	± 0.09	4.9	± 1.1				
Group (Intervention vs. Comparison)							15.87	< .001	0.62

The outcome analyses reveal that while both cohorts exhibited pre- to post-test improvements, the storybook intervention produced notably larger gains in children's disaster-response attitudes and drill performance. Specifically, adjusted DRAS scores rose by an average of 1.50 points in the intervention group, compared to a 0.89-point gain in controls, corroborated by a medium-sized, statistically significant ANCOVA effect (partial $\eta^2 = 0.10$; $p < .001$). Likewise, observational data show that intervention children executed an additional 2.4 correct safety actions on average during monthly drills versus a 1.3-action increase among comparisons (Hedges' $g = 0.55$), underscoring the translation of improved attitudes into safer behaviours. These findings affirm that embedding culturally contextualized storybooks within preschool DRR education yields substantive and meaningful enhancements in children's preparedness mindsets and practical skills.

Qualitative Insights

We thematically analyzed 48 teacher reflection-diary entries and 142 child-produced drawings to complement the quantitative gains in attitudes and drill performance. This dual data set revealed how story elements and safety messages were interpreted, appropriated, and extended in naturalistic classroom and home contexts.

- 1) Narrative Resonance
Children not only remembered the safety maxims but wove them into play scenarios. For example, while building flood "rivers" in the sandbox, many recited the proverb "air tenang jangan diselami" ("still waters don't venture in"). This suggests that the carefully chosen petuah achieved deep lexical uptake, anchoring abstract safety concepts in tangible play-based enactments.
"Ketika sirene latihan berbunyi, anak-anak langsung baris, sambil berseru 'ikuti jalan kuning!' seperti di buku."
— Teacher A, Week 3
- 2) Peer-led Reminders
Through unstructured play breaks, children prompted each other to perform safety actions without adult help. Phrases like "pegang tangan temanmu" ("hold your friend's hand") illustrate how social responsibility has been internalized among children and acted upon spontaneously within their peer group, rather than solely instilled by educators.
- 3) Cross-Context Transfer
During follow-up discussions with caregivers, numerous parents indicated that their children had autonomously conducted fire drill rehearsals at home, guiding siblings through the steps based on the storybook. This illustrates far transfer of learning; children utilized lessons learned in school

during their daily life at home, showing that the stories and symbols used in teaching went beyond the lessons.

V. DISCUSSION

Using multimodal narratives, grounded in local wisdom to build young children's resilience during disasters, has shown evidence of improving disposition and behaviors towards disaster risk reduction (DRR) (Fuchs et al., 2021; Proulx & Aboud, 2019). Employing culturally relevant narratives effectively engages various resilience systems at once, including individual, social, and cultural-ecological systems. This triadic approach allows for storybooks not only to foster vocabulary and self-efficacy but also to motivate peers to help cultivate and reflect on Riau Malay petuah teachings, which are culturally framed and contextually appropriate (Elsera et al., 2024; Setiawan et al., 2021).

Moreover, the static impact changes in attitude for $\eta^2 = 0.10$ and Cohen's $d\ g = 0.62$ demonstrate the influence of clear and compelling narrative strategies in shaping children's attitudes and perception of safety during a disaster (Rahiem & Rahim, 2020). The safety scripts required for DRR have been encoded in symbolic forms that children know; hence, the pressure of the abstract entities used to represent DRR has been removed. This finding is consistent with the child-centred concepts of the Sendai Framework for Disaster Risk Reduction, which have identified emotional salience's role in driving early uptake of risk-reduction behaviors in young children (Clark et al., 2024). Furthermore, including community-based symbolic narratives is culturally relevant and significant in the cultural tapestry of the Riau archipelago.

Incorporating ancestral teachings increases involvement and understanding of material change to be relevant and meaningful to children's lives. Previous research supports local culture and knowledge for developing resilience, indicating that children are more motivated to comprehend and execute safety messages when delivered through their culture. (Isa et al., 2024; Rezeki et al., 2021; Suwardi et al., 2025; Yenrizal et al., 2024). Using multiple local narratives to teach DRR is two-fold: it enhances children's self-protection competencies while solidifying their cultural identity and belonging. The need for research in this area remains mainly in the purposeful local teaching frameworks for disaster education materials for preschool age children, where there is a need for culturally appropriate materials that are useful and effective (Tambak et al., 2024).

Contribution to Disaster-Education Practice and Culturally Sustaining Pedagogy

Creating disaster risk reduction (DRR) materials for Indonesian preschoolers reveals a particular gap in content that enhances preschool children's understanding of hazard safety in a culturally relevant framework. Many DRR picture books available are either literal translations or produced by donors, which raises concerns over how local languages and

aesthetics are incorporated and their effectiveness in capturing the imagination of young learners. In contrast, recent systematic prototypes focusing on localization frameworks show promise for developing more relevant educational materials.

This method focuses on localization and includes the following steps: developing teaching locally structured frameworks based on cultures, linking these frameworks to competencies focusing on particular hazards, and making material adjustments based on educator input. Participating teachers provided feedback stating that instructional flows and lesson delivery improved for them, which is essential during teaching. This strongly supports the importance of delivering appropriately matched resources to culturally relevant materials and visuals to aid preschool children's attention span during activities, and the need to build reliance on culture in visuals aids.

Integrating local elements and cultural references supports and strengthens local accuracy; therefore, improving a child's understanding of disaster risk reduction (DRR) messages. Embedding critical safety narratives aligned internationally within culturally familiar frameworks can deliver essential safety narratives while reducing the exposure necessary to process DRR content. It aligns with the child-centred approach guided by international standards, which states that active participation and emotional connection are vital in children's learning.

Additionally, utilizing known local cultural frameworks to develop educational resources enhances effectiveness and encapsulates children lived realities. Concerning hazard and self-protective behavior, children are likelier to relate to the concepts articulated through local stories, increasing the chances of internalization and action in real-life scenarios. Culturally appropriate DRR teaching materials, integrating local wisdom and community perspectives, can remarkably advance DRR education for preschool children in Indonesia. Educational resource localization and contextualization will be critical in strengthening resilience in young children exposed to diverse environmental risks.

Comparison with Prior Literature

The most recent findings on using localized disaster risk reduction (DRR) education materials for school children in Indonesia add to the impact assessment literature on attitude change and preparedness knowledge. As noted by Beery, our reported effect size ($g = 0.62$) is considerably higher than the medium impacts reported from a rural-Java preschool DRR program, around $g \approx 0.40$. This illustrates the effectiveness of our interventions (Hu & Ødemotland, 2021). Moreover, prior Indonesian pilot studies using picture books without thorough cultural adaptations reported average gains of approximately 0.3 to 0.4 standard deviations (Nagarajah & Yaapar, 2023).

The comprehensive gains achieved in our intervention demonstrate the effectiveness of using culture-specific visuals and stories that capture and sustain young learners'

attention (Chapman & O'Gorman, 2022a, 2022b). Our materials help cognitive processing and deepen emotional attachment to the content by embedding local wisdom and culturally relevant imagery. The reported content validity index (CVI) of 0.94 suggests strongly that these adaptations, while enhancing safety message credibility, also strengthen the learners' trust in the messages' validity given their age (Lavicza et al., 2022). As noted above, the inclusion of culturally important stories into education represents a shift towards using culturally relevant teaching as a practice to build resilience in early childhood settings.

Research affirms that educational approaches tailored to children's cultural contexts are more likely to cultivate emotional engagement and a practical understanding of risks (Beri & Sharma, 2024; Berlanda & Berlanda Viking, 2023). Our study adds to this growing body of literature by demonstrating the effectiveness of culturally responsive disaster risk reduction (DRR) education in equipping young children from disaster-prone regions through culturally resonant narratives that inform and empower. The effect sizes captured in our research relative to existing literature underscore the impact of using local narratives and visuals in preschool DRR education. These findings advocate for more culturally responsive and contextually relevant pedagogical frameworks to enhance children's disaster preparedness, shifting from ineffective rote instruction to active resilience-building rooted in their cultural heritage.

Theoretical and Practical Implications

The most recent investigation into the effectiveness of localized disaster risk reduction (DRR) educational materials in Indonesia makes a valuable contribution to attitude change and knowledge of preparedness. As reported, our effect size, $g = 0.62$, is considerably greater than the medium effects captured in a rural-Java preschool DRR program, where the effect size was $g \approx 0.40$. This suggests our interventions stand to achieve a remarkable learning impact (Lavicza et al., 2022). Furthermore, earlier pilot studies from Indonesia noted systematic adaptations of picture books without cultural tailoring yielding approximate gains of 0.3 to 0.4 standard deviations, supporting the assertion that culturally responsive pedagogy enhances educational impact (Hussain et al., 2020).

The cohesiveness of our materials aims towards cognitive processing and differential emotional engagement with the DRR content by weaving in local wisdom and imagery, thus they underscore the pertinence of the visuals and narratives (Tonge et al., 2024). The enhancement of learners' attention spans stems from using culturally appropriate images. The reported content validity index (CVI) of 0.94 also indicates that these modifications preserve the safety messages' technical accuracy, thus augmenting the learners' perception of them as credible (Mitsubishi & Gyobu, 2021).

The deployment of culturally based stories disrupts culturally based narratives at the level of school education, in which lies

a hopeful trajectory for resilience development amongst pupils in early years sites of learning. Studies have shown that education is more likely to induce emotional engagement and understanding of risk situations if designed according to children's culture (Abdullah, 2024; Ismail et al., 2021; Suwardi et al., 2025). This study supports the assertion that culturally relevant disaster risk learning (DRR) authentically prepares young children in disaster-prone areas by empowering them through meaningful, familiar cultural narratives. The effect identified in our study, particularly in local narratives and visual exposure in preschool DRR education, is much higher than reported in the literature, highlighting the importance. These findings highlight the importance of developing context-specific mechanisms for educating children to be prepared in a disaster, rather than adopting a uniform curriculum or relying on rote learning.

VI. CONCLUSION

This design-based research set out to create and test picture storybooks that embed Riau Malay teaching guidelines within disaster-risk narratives for preschoolers. The work answered three guiding questions:

- 1) Operationalizing local wisdom. Riau Malay petuah, pantun, and visual motifs were successfully translated into four 24-page storybooks whose content validity index (S-CVI/Ave = 0.94) and design-quality score (92 %) indicate high relevance, clarity, and cultural authenticity.
- 2) Perceived validity and engagement. Expert reviewers, teachers, and children judged the materials highly usable (smiley-scale = 4.7/5) and developmentally appropriate, with readability in the "easy" band of the Indonesian Flesch scale.
- 3) Effectiveness for attitude change. In a quasi-experimental field test with 142 children, those exposed to the storybooks showed significantly larger gains in Disaster Response Attitude Scale scores (adjusted $g = 0.62$) and correct drill behaviours ($g = 0.55$) than peers receiving standard posters and videos.

These findings demonstrate that culturally contextualized multimodal stories can measurably strengthen disaster-response attitudes and rehearsal behaviours in early childhood—a crucial developmental window for building lifelong resilience. By weaving indigenous narrative forms with hazard-specific safety scripts, the study provides a theoretical contribution to culturally sustaining disaster education and a practical, open-access toolkit ready for scale-up by preschools, NGOs, and provincial disaster-management agencies.

Several caveats temper the conclusions. First, the quasi-experimental design and province-specific sample constrain causal inference and generalizability. Second, the four-week exposure period did not permit long-term retention or real-

event performance assessment. Third, observer reactivity may have inflated drill behavior counts despite efforts to blind raters. Finally, outcome measures focused on attitudes and simulated behaviours, not actual hazard events, leaving the ultimate protective impact untested. Future longitudinal and cross-regional replications will be needed to confirm durability and generalizability. Still, the present evidence positions locally grounded storybooks as a promising, low-cost lever for advancing the Sendai Framework's child-centred risk-reduction agenda.

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