

Interactive Illustrated Book with AR Technology as a Supportive Tool to Help Overcome Anxiety in Early Childhood

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Abstract

This study examines the role of interactive illustrated books as supportive educational media for early childhood learners aged 3–6 years, viewed from a visual communication and emotional learning perspective. The research explores how visual storytelling and interactive features, such as pop-up elements, mini activities, and limited augmented reality (AR) integration, can support children's ability to recognize and manage early experiences of anxiety. A qualitative research approach was employed, involving interviews with child psychologists and early childhood education practitioners, questionnaires distributed to parents, and a literature review. User testing was conducted through individual and group trials to evaluate children's responses to the designed media. The findings indicate positive responses from children, parents, and teachers in terms of engagement, usability, and emotional expression related to overcoming anxiety in early childhood. The study concludes that interactive illustrated books function not merely as entertainment, but as mediating tools that bridge emotional communication between children and adults. Furthermore, the findings suggest that augmented reality can serve as a complementary feature that enhances engagement without replacing the tactile and relational strengths of physical books in early childhood emotional learning contexts.

Keywords: early childhood, anxiety, interactive book, illustrated book

Buku Ilustrasi Interaktif dengan Teknologi AR sebagai Alat Pendukung untuk Membantu Mengatasi Kecemasan pada Anak Usia Dini

Abstrak

Penelitian ini mengkaji peran buku bergambar interaktif sebagai media pendidikan pendukung bagi anak usia dini (3–6 tahun), dilihat dari perspektif komunikasi visual dan pembelajaran emosional. Penelitian ini mengeksplorasi bagaimana narasi visual dan fitur interaktif, seperti elemen pop-up, aktivitas mini, dan integrasi augmented reality (AR) yang terbatas, dapat mendukung kemampuan anak dalam mengenali dan mengelola pengalaman awal kecemasan. Pendekatan penelitian kualitatif digunakan, melibatkan wawancara dengan psikolog anak dan praktisi pendidikan anak usia dini, kuesioner yang dibagikan kepada orang tua, serta tinjauan literatur. Uji coba pengguna dilakukan melalui uji coba individu dan kelompok untuk mengevaluasi respons anak-anak terhadap media yang dirancang. Temuan menunjukkan respons positif dari anak-anak, orang tua, dan guru dalam hal keterlibatan, kemudahan penggunaan, ekspresi emosional terkait dengan bagaimana anak usia dini dapat mengatasi kecemasannya. Studi ini menyimpulkan bahwa buku ilustrasi interaktif tidak hanya berfungsi sebagai hiburan, tetapi juga sebagai alat perantara yang menjembatani komunikasi emosional antara anak-anak dan orang dewasa. Selain itu, temuan menunjukkan bahwa realitas tertambah dapat berfungsi sebagai fitur

Received: 4 November 2025

Revised: 11 December 2025

Accepted: 19 December 2025

pelengkap yang meningkatkan keterlibatan tanpa menggantikan kekuatan taktil dan relasional buku fisik dalam konteks pembelajaran emosional pada masa kanak-kanak.

Kata kunci: *anak usia dini, kecemasan, buku interaktif, buku ilustrasi*

INTRODUCTION

Early childhood (ages 3-6) is a stage of rapid emotional development, where children begin to learn how to recognize and express various emotions, including anxiety. The expression of anxiety in young children can take the form of crying, screaming, silence, hiding, or other behaviours that are often misunderstood by adults. Unfortunately, many adults still perceive crying or fussiness as a sign of being naughty or spoiled, which leads them to respond with scolding or anger. Instead, when anxiety is not handled properly, it can negatively affect a child's social skills, mental health, and overall quality of life (Sanchez et al., 2018, p.153).

On the other hand, parents or caregivers often feel confused or unsure about how to explain emotions to their children or how to help them manage those feelings. Therefore, a supportive medium is needed to address this challenge. According to Limyati (Kofan et al., 2024), a child psychologist, the freedom for children to play and engage in daily activities is essential to support their growth, development, and socialization. She also emphasized that involving children in various types of media can encourage them to be more active and help boost their self-confidence.

One effective medium is a storybook. This is supported by the study “Dampak Pengembangan Buku Cerita Bergambar Untuk Anak Usia Dini” by Dellya Halim and Ashiong Parhehean Munthe (2019). The research found that picture storybooks can be an effective medium for conveying the value of *serve et amate* (serve and love), a core value in the vision and mission of a Catholic school in Central Jakarta. The study involved a trial with two kindergarten classes, B2 and B3, each consisting of 22 children. One class received material explanations without using storybooks, while the other used picture storybooks. The results showed that children who read the storybooks performed better in the post-test and understood the material more clearly. In contrast, children who did not use storybooks appeared more confused and showed less optimal results.

Although storybooks can now be read digitally through gadgets, physical books offer unique advantages. A study by Altamura, Vargas, and Salmerón (2023) found that comprehension is six times better when reading physical books compared to digital formats. The researchers explained that physically turning pages helps create a kind of mental "index" that allows readers to visually map information to specific pages (Rothkops, as cited in Artushin, 2024). Physical books also help build emotional connections with story characters, as children can become

more immersed in the storyline. In addition, printed books are gentler on the eyes and reduce excessive screen exposure, which may negatively affect children's eye health.

In today's digital era, technological literacy has become essential and should not be avoided, but introduced to children in an age-appropriate manner. One effective approach is through physical storybooks integrated with technology, such as augmented reality (AR). This combination can help make the story more engaging and interactive, while also guiding children to use digital devices responsibly. As a result, children can develop a positive and balanced relationship with technology that supports their growth and learning.

Several previous studies have explored the use of augmented reality (AR) in children's books as a medium for emotional expression, particularly for children with Autism Spectrum Disorders (ASD). Tolle, Del Moral, and López (2024) demonstrated that AR-adapted books could support emotional expression in children with ASD by providing visual and interactive stimuli. Similarly, Alkadhi et al. (2020) emphasized the importance of co-designing AR storybooks tailored to the specific emotional and cognitive needs of children with ASD. Miningrum, Tolle, and Bachtiar (2021) also developed an AR-adapted book (AREmotion) focused on helping children with ASD recognize and express emotions through digital interaction.

However, these studies primarily focus on children with special needs and emphasize digital interaction as the core medium. There is still limited research that examines the integration of augmented reality within physical illustrated storybooks designed for typically developing early childhood (ages 3–6), particularly as a supportive tool to help manage everyday anxiety, rather than as a therapeutic or diagnostic intervention. Moreover, the role of parents or caregivers as emotional mediators during shared reading activities is rarely discussed as a central design consideration.

With these advantages, physical storybooks can serve as not only educational tools but also safe and effective ways to help children manage anxiety. The familiar storylines can offer a sense of comfort and security, presenting everyday situations children can relate to, along with practical solutions they can understand and apply. Moreover, storybooks play a valuable role in supporting children's emotional development.

Beyond the media itself, the role of parents is also crucial in providing emotional support. Young children tend to be imitative by nature, they absorb and mimic what they see, hear, and feel from their surroundings. This occurs because, at this developmental stage, they are still learning to distinguish between right and wrong, good and bad, as well as appropriate and inappropriate behavior (Aini et al., 2024), p. 21. Parents, as the closest figures in a child's life, often serve as the

primary role models. Therefore, parents' habits, attitudes, responses, and behaviors play a significant role in shaping a child's character.

Therefore, this study aims to address this research gap by designing an interactive illustrated physical storybook enhanced with augmented reality (AR) technology as a supportive medium for helping early childhood (ages 3–6) recognize and manage feelings of anxiety. Unlike previous studies that focus on digital-based AR media or children with specific developmental disorders, this research positions AR as a complementary layer to a book-centered, tactile, and narrative reading experience, mediated by parents, teachers, or caregivers.

The novelty of this research lies in the integration of visual communication design principles, tactile interaction, and age-appropriate AR features within a physical book format, tested in an Indonesian early childhood context. By emphasizing shared reading and parental involvement, this study contributes to the development of emotionally supportive learning media that bridge communication between children and adults, while maintaining a balanced and responsible use of technology for young children.

METHOD

This study employed a descriptive qualitative research method. According to Sugiyono (2016), qualitative research focuses on understanding phenomena in their natural settings, with the researcher acting as the primary instrument. This approach was chosen to explore the design needs, emotional characteristics, and media preferences related to early childhood anxiety, rather than to produce statistical generalizations.

Data collection was conducted through interviews, questionnaires, and literature review as a form of methodological triangulation. Semi-structured interviews were conducted with two child psychologists and one early childhood education practitioner to gain insights into children's emotional development, common anxiety triggers in early childhood, and suitable approaches for emotional learning media. Each interview lasted approximately 45–60 minutes and was conducted either face-to-face or online. The interview questions focused on emotional behaviors in children aged 3–6, parental roles in emotional regulation, and recommendations for age-appropriate media design.

Questionnaires were distributed to 20 parents of children aged 3–6 years to identify common forms of anxiety experienced by their children, parental responses to anxiety, and their expectations regarding educational and interactive media. The questionnaire consisted of both closed-ended and open-ended questions and was administered over a period of one week. The results were used to support and complement the interview findings by identifying recurring patterns and parental needs.

A literature review was conducted by examining academic journals, books, and previous design studies related to early childhood development, anxiety, illustrated books, interactive media, and visual communication design for children. This review provided theoretical grounding and comparative references for the design process. The collected data were analyzed using the 5W1H approach (What, Why, Who, Where, When, and How) to translate research findings into concrete design decisions, including narrative structure, visual style, interactive features, and the integration of augmented reality (AR) within a physical book format. To ensure data validity and trustworthiness, source triangulation was applied by comparing findings from interviews, questionnaires, and literature studies. In addition, user testing involving individual and group trials with children was conducted to validate whether the designed media aligned with the identified needs and effectively supported children's emotional understanding

RESULT

Interactive Illustration Book

Questionnaire findings indicate that parents are generally aware of the types and causes of anxiety experienced by their children, particularly fears related to darkness, separation, and unfamiliar situations. However, many parents reported difficulties in verbally explaining emotions and coping strategies to children aged 3 to 6. This highlights a gap between parental awareness and the availability of age-appropriate emotional learning media.

Insights from interviews with child psychologists and early childhood education practitioners further emphasize that young children tend to understand emotions more effectively through visual narratives and concrete representations rather than abstract verbal explanations. The experts highlighted that storytelling combined with visual cues can help children externalize their fears and feel emotionally validated, especially when the reading process involves adult mediation.

Based on these findings, an interactive illustrated storybook was selected as the primary design medium. The interactive format allows children to actively engage with the story, while illustrations support emotional recognition and comprehension. This approach also facilitates shared reading between children and caregivers, aligning with the identified need for emotional guidance and parent-child interaction during anxiety-related situations.



Figure 1. Cover “KEGELAPAN”
Source: Devina Sisilia Sutandy Documentation, 2025



Figure 2. Cover “KEGELAPAN”
Source: Devina Sisilia Sutandy Documentation, 2025



Figure 3. “KEGELAPAN” 2.
Source: Devina Sisilia Sutandy Documentation, 2025.



Figure 4. Cover “PERGI KE DOKTER”.
Source: Devina Sisilia Sutandy Documentation, 2025.



Figure 5. “PERGI KE DOKTER” 1.
Source: Devina Sisilia Sutandy Documentation, 2025.



Figure 6. “PERGI KE DOKTER” 2.
Source: Devina Sisilia Sutandy Documentation, 2025.



Figure 7. Cover “HARI PERTAMA SEKOLAH”.
Source: Devina Sisilia Sutandy Documentation, 2025.



Figure 8. “HARI PERTAMA SEKOLAH” 1.
Source: Devina Sisilia Sutandy Documentation, 2025.



Figure 9. “HARI PERTAMA SEKOLAH” 2.
Source: Devina Sisilia Sutandy Documentation, 2025.

5W1H Analysis: Understanding Early Childhood Anxiety as the Basis for Interactive Book Design

The 5W1H analysis was applied to synthesize findings from questionnaires, interviews, and literature review into a coherent framework that guided the design of the interactive illustrated book. This approach allowed the research data to be translated into concrete design considerations that are relevant to early childhood emotional development.

What: Anxiety in Early Childhood

Early childhood anxiety is defined as a psychological condition characterized by excessive worry that may disrupt a child's emotional balance and daily functioning (Oktamarina et al., 2022). Questionnaire findings indicate that parents commonly observe anxiety-related behaviors such as fear of darkness, reluctance to sleep alone, crying when separated from caregivers, and avoidance of unfamiliar situations. These behaviors align with interview findings from child psychologists, who emphasized that anxiety in young children is often expressed behaviorally rather than verbally. Children at this developmental stage tend to lack the vocabulary to articulate complex emotional states, making visual and narrative-based media particularly relevant for emotional learning.

Why: Causes of Anxiety in Young Children

The causes of anxiety in early childhood are multifaceted, involving biological, environmental, and developmental factors. Literature findings suggest that children aged 10 months to 2 years commonly experience separation anxiety, while children aged 4 to 6 years may develop fears triggered by imagination, such as fear of darkness or imaginary creatures (Radcliff, 2023). Questionnaire responses revealed that parents often associate their children's anxiety with new experiences, such as attending school for the first time or visiting unfamiliar places. Interviews with psychologists further highlight that anxiety may intensify when children lack consistent emotional reassurance or when adults respond to fear with dismissal or reprimand. These findings underscore the importance of supportive media that normalize fear as a valid emotion and provide coping strategies in a non-threatening manner.

Who: Key Figures in Supporting Emotional Regulation

The analysis identifies parents, teachers, and caregivers as the primary figures responsible for supporting children in managing anxiety. Questionnaire data indicate that parents are generally aware of their role in emotional guidance but often feel uncertain about effective communication strategies. Interviews with early childhood education practitioners emphasize that adult mediation during storytelling plays a crucial role in helping children interpret emotional content. At the early childhood stage, children learn through imitation and interaction with their closest environment (Aini et al., 2024). Therefore, the interactive illustrated book

is designed not only for children but also as a shared medium that facilitates dialogue and emotional bonding between children and adults.

When: Emergence and Timing of Anxiety

Research findings indicate that anxiety can emerge as early as infancy, around six months of age, and may persist or evolve if emotional regulation skills are not introduced early (Bakken, 2023). Questionnaire responses support this view, as parents reported recurring anxiety-related behaviors during transitional moments such as bedtime or school preparation. These findings highlight the importance of introducing emotional learning media during calm and receptive moments, such as bedtime or leisure time, when children are more open to reflection and guidance. This insight informed the decision to design the book for flexible use rather than as a rigid instructional tool.

Where: Contexts of Anxiety Expression

Children express anxiety in various environments, including at home, school, and public spaces. Questionnaire findings show that home-based anxiety often relates to separation and bedtime routines, while school-related anxiety is associated with social interaction and unfamiliar settings. Psychologists interviewed in this study emphasized that emotional learning is most effective when it mirrors children's real-life experiences. Consequently, the book's narrative settings were designed to reflect familiar contexts, such as bedrooms, playgrounds, and classrooms, enabling children to recognize their own experiences within the story and feel emotionally represented.

How: Strategies for Supporting Anxiety Management

The analysis suggests that illustrated storybooks are an effective medium for helping children recognize and manage anxiety. Visual storytelling allows emotional concepts to be conveyed concretely and accessibly, while interactive elements encourage active engagement rather than passive consumption. Interview findings indicate that expressive storytelling, supported by visual cues, tone of voice, and physical interaction with the book, enhances children's emotional comprehension. Based on these insights, key design strategies include the use of clear and dominant illustrations, soft color palettes informed by color psychology, short and simple texts, rounded typography, and age-appropriate page counts. Interactive features, such as pop-up elements and augmented reality (AR), were integrated to maintain attention and foster curiosity while ensuring that adult guidance remains central to the experience.

Through the 5W1H analysis, research findings were systematically translated into design decisions that directly respond to the emotional characteristics and needs of early childhood. This analytical framework ensures that the interactive illustrated book is grounded in empirical data rather than subjective

design preferences, thereby reinforcing its relevance as a supportive medium for managing anxiety in young children.

Previous Design

Previous design studies have demonstrated the effectiveness of illustrated and interactive books as media for addressing emotional issues across different age groups. Handoko (2021), for instance, explored anxiety caused by overthinking among adolescents and young adults aged 15–25 through the design of an illustrated book and reflective journal. The study concluded that visual storytelling combined with self-reflective activities was effective in helping users recognize and reduce overthinking at an early stage. However, the study focused on a cognitively mature audience capable of abstract self-reflection, limiting its applicability to early childhood contexts.

Similarly, Kofan (2024) developed an interactive activity book aimed at building self-confidence among children aged 4–6 years. Through user testing, the study found that repeated interaction with the book encouraged children to become more confident, courageous, and expressive, particularly in social and classroom settings. The activities embedded in the book also supported cultural learning by introducing Indonesian values and practices. While the study successfully demonstrated the role of interactivity in supporting socio-emotional development, it primarily addressed confidence-building rather than anxiety management, and it did not integrate digital or technological elements.

Building on these previous design studies, the present research extends the exploration of interactive books by focusing specifically on anxiety management in early childhood through narrative-based emotional learning. Unlike prior works, this study combines traditional illustrated storytelling with interactive features and augmented reality (AR) technology within a physical book format. This approach not only aims to help children recognize and cope with anxiety but also emphasizes guided interaction between children and adults. By situating the design within everyday emotional experiences and incorporating age-appropriate technological integration, this study positions itself as a continuation and expansion of earlier interactive book designs.

Purpose and Strategy of Book Media-User Testing

User testing was conducted to evaluate whether the interactive illustrated book effectively supported children's emotional understanding and aligned with the needs identified through interviews and questionnaires. Two stages of testing were implemented: an individual trial and a group trial. This approach allowed the researcher to observe both personal interaction dynamics and collective engagement in a learning environment.

The first stage involved an individual test with one parent and a three-year-old child. During the session, the child demonstrated a strong interest in the book's interactive components, including sticker-based achievement indicators, pop-up elements, and guided storytelling. The child remained attentive throughout the reading session and was able to verbally express feelings related to the story with support from the parent. The augmented reality (AR) feature further increased curiosity and engagement, indicating that technology integration can enhance emotional learning when accompanied by adult guidance. Feedback from the parent highlighted the clarity of the illustrations and the appeal of the interactive features. Suggestions for improvement focused on material usability, such as replacing velcro elements with magnets, and expanding story themes to include other common childhood anxiety triggers, such as visiting the dentist or playing independently in public spaces.

The second stage consisted of a group test conducted with a Kelompok Bermain Besar (KGB) or playgroup class involving twelve children aged five to six years in Sidoarjo. The session was facilitated by the researcher as the storyteller and supported by a classroom teacher. A qualitative pre-test and post-test were conducted through closed-ended questions to assess children's understanding of anxiety-related situations. Prior to the reading session, most children reported being accustomed to sleeping alone or in the dark, while a smaller number expressed fear. The children also demonstrated awareness that seeking comfort from parents was a common coping strategy, with physical affection such as hugging being the most frequently mentioned response.

Following the storytelling and interactive activities, the post-test results indicated an increased sense of confidence and emotional readiness among the children. The children were able to recall story content, identify emotional situations, and respond to questions with greater assurance. Observational data showed high participation levels, particularly during the interactive and AR segments, which were identified as the most engaging aspects of the book. The accompanying teacher provided positive feedback regarding the book's user-friendliness, relatable narrative themes, and visual clarity. The mini-activities embedded within the book were also found to support focus and sustained attention during the session.

Overall, the user testing results suggest that the interactive illustrated book effectively translates research-based design strategies into a practical emotional learning tool. The findings validate the integration of interactive features and AR technology within a physical book format, provided that adult mediation remains central to the reading experience.

DISCUSSION

This study demonstrates that while parents generally recognize anxiety-related behaviors in early childhood, they often experience difficulty in translating this awareness into effective emotional guidance without appropriate mediating tools. The findings confirm that emotional understanding in early childhood requires not only cognitive explanation but also concrete, visual, and narrative-based experiences. This supports developmental perspectives that emphasize the importance of symbolic representation and storytelling in helping young children process abstract emotional concepts (Bakken, 2023).

The results of the user testing indicate that interactive illustrated storybooks can function as an effective emotional communication medium between children and adults. The integration of tactile elements, as pop-ups, stickers, and mini activities, encouraged children to remain engaged and actively participate in the reading process. These findings align with multisensory learning theories, which suggest that children aged three to six learn more effectively when sensory interaction is combined with guided social interaction. Shared reading activities in this study enabled parents and teachers to scaffold children's emotional expression, reinforcing the role of adult mediation in early emotional regulation.

Compared to previous studies that examined the use of augmented reality in emotional learning contexts, this research presents a distinct approach. Earlier studies largely focused on digital applications or targeted specific developmental conditions, such as Autism Spectrum Disorders, where technology functioned as the primary learning medium (Alkadhi et al., 2020; Miningrum et al., 2021; Tolle et al., 2024). In contrast, this study positions AR as a supportive and complementary feature embedded within a physical illustrated book. The findings suggest that AR can enhance attention and curiosity without displacing tactile interaction or narrative continuity. This hybrid approach offers an alternative framework for integrating emerging technologies into early childhood learning while maintaining developmentally appropriate practices.

However, the findings also reveal several limitations that warrant critical reflection. Technical challenges related to QR code scanning, loading time, and material durability affected the smoothness of interaction during testing sessions. Additionally, the qualitative nature of the study and the limited number of participants restrict the generalizability of the findings. The absence of long-term observation also limits the ability to assess sustained emotional development outcomes beyond immediate engagement and comprehension.

Despite these limitations, this study contributes academically by expanding the discourse on interactive media design for emotional learning in early childhood. It offers a design-based research perspective that integrates visual communication design, emotional literacy, and responsible technology use. The findings highlight

the importance of positioning technology as a facilitator rather than a replacement for human interaction in emotional education. Future research may build upon this study by incorporating longitudinal designs, comparative studies with non-interactive books, or quantitative measures of emotional development to further validate the effectiveness of hybrid interactive learning media.

CONCLUSION

This study concludes that interactive illustrated storybooks can serve as an effective supportive medium for helping young children recognize and manage feelings of anxiety when combined with adult mediation. The findings indicate that tactile interaction, narrative storytelling, and limited augmented reality integration contribute positively to children's emotional engagement and understanding. Rather than functioning as the primary learning tool, AR operates effectively as a complementary feature that enhances attention while preserving the developmental benefits of physical books and shared reading experiences.

Academically, this research contributes to the field of visual communication design and early childhood education by proposing a hybrid media framework that integrates emotional literacy, multisensory learning, and responsible technology use. However, the study is limited by its qualitative scope, short-term testing, and technical constraints related to AR implementation. Future research is recommended to employ longitudinal methods, larger participant groups, and comparative experimental designs to further examine the long-term impact of interactive illustrated media on early emotional development and anxiety regulation.

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