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Pop-Up Books as a Tool for Multisensory Learning: Improving Engagement and Short-term Retention in Early Childhood Education

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Abstract

This study investigates the effectiveness of pop-up books as multisensory learning tools in enhancing engagement and short-term retention among daycare learners in Quezon City, Philippines. Using a quasi-experimental pre-test–post-test design with 60 children aged 3–5 (Experimental = 30; Control = 30), the study measured behavioral, emotional, and cognitive engagement, as well as short-term retention of concepts related to plant care and numeracy. Validated researcher-developed tests (Cronbach's α = 0.82) and an engagement scale (α = 0.86) were used, alongside observational checklists. Results indicated significantly higher gains in the experimental group compared with the control group ($p < 0.001$), demonstrating that tactile and interactive elements in pop-up books promote deeper engagement and improved short-term retention. The findings provide empirical support for integrating low-tech multisensory materials in early childhood education settings.

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INTRODUCTION

Early childhood education (ECE) provides the foundation for lifelong learning, making it essential for young children to experience developmentally appropriate, engaging, and meaningful learning experiences (Rumbidzai & Achebe, 2023). In recent years, multisensory learning has gained recognition as an effective pedagogical approach for supporting cognitive, emotional, and social development among early learners (Aulina et al., 2024; Fan et al., 2024). Multisensory instruction is particularly relevant in childcare centers, where children learn best when visual, auditory, and tactile experiences are integrated (Davies, 2019).

While many studies have examined the impact of traditional picture books and digital media on literacy and comprehension, few have focused on low-tech, tactile, and interactive tools, such as pop-up books. However, in the digital age, interactive apps, augmented reality books, and gamified platforms dominate research, leaving a significant gap in understanding the unique value of physical, multisensory materials. Notably, pop-up books offer rich opportunities for interaction, providing 3D tactile experiences that stimulate exploration and imagination (Marianus et al., 2024). Furthermore, recent literature on interactive media in science and literacy education (Katsampoxaki-Hodgetts et al., 2025; Zourmpakis et al., 2024) highlights the need for comparative research on digital vs. physical multisensory tools, emphasizing that tangible materials may foster deeper engagement due to direct manipulation.

Despite their widespread use, empirical studies on the impact of pop-up books in Philippine daycare settings remain scarce. In response to this gap, this study examines the impact of pop-up books on engagement and short-term retention among young children. By providing empirical evidence, the findings may inform curriculum development, teaching strategies, and policy decisions in early childhood education.

Although multisensory learning has gained increasing attention in early childhood education, existing empirical research has largely concentrated on the use of traditional two-dimensional (2D) books that primarily stimulate visual and auditory senses. While these studies acknowledge the importance of engaging multiple sensory channels, they often overlook the role of tactile and kinesthetic interactions, which are essential components of effective multisensory learning experiences. Pop-up books, which integrate visual, tactile, and interactive elements, therefore represent a form of learning media that remains underexplored, particularly within daycare and early childhood education contexts in the Philippines.

This study aimed to answer the following questions:

1. To what extent do pop-up books enhance engagement among daycare learners aged 3–5?
2. How do pop-up books compare to traditional 2D books in improving children's short-term retention?
3. How does multisensory stimulation contribute to cognitive engagement and short-term memory recall?

By investigating these questions, this research aims to provide a clearer understanding of how pop-up books as a multisensory tool can impact children's learning experiences, specifically in terms of increasing participation, focus, and memory recall. The study's results will also contribute to addressing the gap in the literature regarding the effectiveness of interactive books as educational tools in the Philippine context, offering valuable insights for educators and policymakers seeking to enhance early learning outcomes.

Theoretical Framework

This study is grounded in two prominent theoretical frameworks that reinforce the use of multisensory teaching strategies in early childhood education: Jean Piaget's Theory of Cognitive Development (Pakpahan & Saragih, 2022) and Howard Gardner's Theory of Multiple Intelligences (Aubrey et al., 2024). These theories emphasize the value of interactive, experience-based learning and provide a solid foundation for employing innovative tools such as pop-up books to enhance young learners' engagement and retention.

Jean Piaget's Theory of Cognitive Development emphasizes the importance of active, hands-on learning during a child's formative years. Piaget identified stages of cognitive development, with the sensorimotor (0–2 years) and preoperational (2–7 years) stages being most relevant to early childhood education. During these stages, children are naturally inclined to explore the world around them through their senses and physical actions. Learning, therefore, becomes most effective when children are given opportunities to manipulate objects and engage with materials that stimulate their senses. Pop-up books are ideal for this developmental stage because they provide visual, tactile, and kinesthetic stimuli. As children pull tabs, lift flaps, and observe moving elements, they actively construct meaning through exploration, aligning with Piaget's theory. These interactions foster cognitive growth by helping children form mental representations of the concepts they encounter in the books (Pakpahan & Saragih, 2022).

Complementing Piaget's ideas, Howard Gardner's Theory of Multiple Intelligences supports diverse teaching methods to address unique intellectual strengths. Gardner argues intelligence is not a single, general ability, but a collection of different modalities (Gardner, 1993). These include spatial, bodily-kinesthetic, linguistic, musical, and interpersonal intelligences. Pop-up books tap into several intelligences at once. Visual-spatial intelligence is engaged with colorful, three-dimensional illustrations. Bodily-kinesthetic intelligence is stimulated as children interact with the books. Linguistic intelligence develops as they listen to and discuss stories. This approach accommodates varied learning styles and strengthens memory retention by providing multiple pathways for understanding and recalling information (Aubrey et al., 2024).

Piaget's Theory of Cognitive Development and Gardner's Theory of Multiple Intelligences underpin this study. Children in the preoperational stage learn best through direct manipulation and sensory-rich experiences (Pakpahan & Saragih, 2022). Pop-up books align with these principles by providing tactile, visual, and kinesthetic stimuli, thereby engaging all senses.

Gardner's theory reinforces the value of multisensory tools by activating multiple intelligences, including visual-spatial, bodily-kinesthetic, and

linguistic (Aubrey et al., 2024). These combined frameworks justify the use of pop-up books as powerful tools for promoting active engagement and meaningful learning.

Taken together, Piaget's and Gardner's theories form a comprehensive framework for understanding the educational value of pop-up books. While Piaget emphasizes the need for developmentally appropriate, sensory-rich learning experiences, Gardner stresses the importance of addressing multiple intelligences to ensure meaningful and inclusive instruction. The use of pop-up books in early childhood education embodies both principles, making learning more engaging, interactive, and memorable for young learners. Ultimately, this theoretical grounding supports the premise that multisensory learning tools such as pop-up books can significantly enhance cognitive, emotional, and social development in early learners by appealing to the ways children naturally learn best.

Related Literature and Studies

The use of multisensory learning strategies has gained widespread attention in early childhood education (ECE) due to their effectiveness in improving children's engagement and retention. These strategies, which involve stimulating multiple senses simultaneously, align with the developmental needs of young children and have been shown to enhance learning outcomes. This section reviews the relevant literature surrounding multisensory learning, the role of books in early childhood education, and the potential benefits of pop-up books in promoting active learning and retention.

1. *Multisensory Learning in Early Childhood Education*

The importance of multisensory learning in early childhood education is widely acknowledged by both developmental psychologists and educators. According to research by Khasawneh, young children benefit from learning experiences that engage multiple senses because they are still developing their cognitive, motor, and sensory processing abilities (Khasawneh, 2024). Studies have shown that when children engage in activities that involve sight, sound, touch, and movement, they are better able to internalize new information and form connections between concepts (Bodrova & Leong, 2024). In ECE, multisensory approaches are particularly effective because they not only stimulate different areas of the brain but also allow children to experience learning in a more interactive and meaningful way (Vena et al., 2023).

For instance, research by Yannier et al. (2021) supports the idea that children learn best through active participation and hands-on activities (Yannier et al., 2021). This active engagement, which includes physical interaction with objects, encourages meaningful learning experiences and promotes higher-order thinking. Multisensory learning activities, which incorporate the use of visual aids, tactile materials, and auditory cues, support children's cognitive development by providing multiple pathways for understanding new concepts (Aulina et al., 2024). Therefore, incorporating sensory-rich materials, such as pop-up books, into early childhood education can significantly enhance children's ability to engage with the content and retain information more effectively.

Multisensory learning supports deeper cognitive processing and fosters learner motivation (Bodrova & Leong, 2024; Vena et al., 2023). Emerging

research in gamified and interactive learning environments demonstrates that engagement improves when learners interact with tactile or adaptive elements (Tülübaş et al., 2023; Zourmpakis et al., 2024).

2. *The Role of Books in Early Childhood Education*

Books have long been a cornerstone of early childhood education, fostering the development of language, literacy, and cognitive skills. The traditional 2D picture book, which primarily appeals to visual learners, has been shown to improve children's language comprehension and vocabulary acquisition (Hu, 2022). However, as children develop, their needs for active learning and sensory experiences grow. Research by Chuang and Jamiat (2023) suggests that the integration of interactive books, such as those incorporating elements of touch, movement, and sound, can better capture children's attention and improve their retention of the material (Chuang & Jamiat, 2023).

In the context of early literacy, interactive books offer a significant advantage over traditional 2D books. They allow children to manipulate physical elements of the book, promoting greater engagement and participation in the learning process (Wang et al., 2024). Books that involve interaction, whether through flaps, pop-ups, or textures, provide a richer learning environment that fosters a deeper connection to the material.

Interactive books, including those with pop-ups, are effective in promoting literacy, comprehension, and science learning due to their multisensory features (Anggrasari & Dayu, 2022; Chuang & Jamiat, 2023). However, studies in the Philippine daycare setting remain limited, highlighting the need for research grounded in local cultural and institutional contexts.

3. *Pop-Up Books as a Tool for Multisensory Learning*

Pop-up books, as an innovative form of interactive literature, offer a unique approach to early childhood education by incorporating visual, tactile, and kinesthetic elements into the learning process. These books not only capture children's attention with their dynamic, three-dimensional elements but also encourage them to engage physically with the material. Studies on pop-up books by Anggrasari and Dayu (2022) demonstrate that these books promote an interactive reading experience, fostering a deeper understanding of storylines and concepts (Anggrasari & Dayu, 2022). The physical manipulation of pop-up elements, such as lifting flaps or unfolding pictures, enhances children's fine motor skills while reinforcing the learning content.

Moreover, pop-up books have been shown to improve children's retention and recall of information. A study by Heimann et al (2021) found that children who interacted with 3D books demonstrated higher levels of engagement and memory recall compared to those using traditional 2D books (Heimann et al., 2021). This is because pop-up books stimulate multiple senses at once, making learning more immersive and memorable. Additionally, the tactile interaction with pop-up elements provides children with a hands-on learning experience that is known to support better comprehension and retention (Heimann et al., 2021).

4. *Pop-Up Books in the Philippine Context*

In the context of early childhood education in the Philippines, the use of multisensory tools multisensory tools, such as pop-up books, remains relatively underexplored. Although the Department of Education has introduced various strategies to improve early learning, such as play-based learning and interactive materials, pop-up books have not been extensively studied as an educational tool in local daycare centers or schools. The introduction of multisensory tools such as pop-up books could address some of the challenges faced by early education providers, including engagement issues and language retention among young learners. This study seeks to fill this gap by examining the potential of pop-up books as a tool for promoting active participation, cognitive engagement, and information retention among daycare learners in Quezon City.

5. *Motivation and Engagement*

Motivation and engagement are foundational components of effective learning, particularly in early childhood contexts, where sensory input and interactive experiences shape children's understanding of new concepts. When learners are emotionally invested, behaviorally active, and cognitively focused, their comprehension and retention improve significantly—particularly in approaches that emphasize active participation, such as multisensory or manipulative-based learning. Research in interactive learning environments highlights mechanisms that strengthen engagement. For example, Zourmpakis, Kalogiannakis, and Papadakis (2024) demonstrate that students exhibit stronger motivation when learning environments adapt to their individual needs and performance levels (Zourmpakis et al., 2024). Their work on adaptive gamification demonstrates that personalized challenges, immediate feedback, and regulated cognitive load enhance autonomy and competence, thereby fostering deeper engagement and motivation. Although grounded in digital science instruction, these motivational mechanisms parallel how young children respond to physical manipulatives or pop-up books, where exploration through movement, touch, and visual cues reinforces curiosity and sustained attention (Zourmpakis et al., 2024).

Conversely, engagement can be weakened by overstimulation and distraction. Tülübaş, Karakose, and Papadakis (2023) found that while digital tools can initially boost interest, excessive or unstructured exposure may lead to digital addiction, reduced attention span, and weaker academic performance (Tülübaş et al., 2023). Their findings emphasize that young learners—whose attentional control and executive functioning are still developing—benefit most from structured, tactile, and non-digital learning materials that minimize cognitive fragmentation. Synthesizing these perspectives, the literature suggests that motivation and engagement are optimized when learning environments provide meaningful, sensory-rich interactions while reducing external distractions. Whether through adaptive gamification systems or concrete manipulative activities, children demonstrate stronger behavioral, emotional, and cognitive engagement when learning tasks are developmentally appropriate and aligned with intrinsic motivation. These insights highlight the significance of multisensory instructional tools in

early childhood settings, where engagement plays a vital role in mediating learning outcomes.

6. *Preschool Pedagogy*

Contemporary preschool pedagogy is increasingly defined by inclusive, multimodal, and developmentally responsive approaches that position young children as active meaning-makers. Katsampoxaki-Hodgetts et al. (2025) highlight how integrating artificial intelligence (AI) into preschool settings can enhance multiliteracies-informed curriculum design by supporting diverse communication modes and strengthening children's agency (Katsampoxaki-Hodgetts et al., 2025). Their analysis of AI-enhanced teaching scenarios demonstrates that the Learning by Design (LbD) knowledge processes—Experiencing, Conceptualizing, Analyzing, and Applying—create flexible, culturally sensitive, and socially embedded learning experiences that extend beyond traditional literacy practices. Similarly, Strati (2024) emphasizes that effective preschool pedagogy must harmonize developmental theory with classroom practice through play-based learning, inquiry, differentiated instruction, and cooperative activities (Strati, 2024). Her findings illustrate that teachers rely heavily on playful, exploratory, and intrinsically motivating learning situations to promote holistic development, while also identifying a need for more professional support in implementing inclusive and adaptive teaching methods.

Complementing these perspectives, Hamidova (2025) argues that inclusive pedagogy—characterized by individualized instruction, multisensory activities, and strong family collaboration—is essential for ensuring equitable access to quality early learning, especially for children with disabilities or socio-cultural vulnerabilities (Hamidova, 2025). Her comparative analysis of Uzbekistan and Finland demonstrates how inclusive practices vary across systems but consistently prioritize socio-emotional well-being, child autonomy, and responsive teaching. Across these studies, a shared theme emerges: innovative preschool pedagogy must be multimodal, inclusive, and culturally grounded, whether implemented through AI-enhanced multiliteracies (Katsampoxaki-Hodgetts et al., 2025), inquiry-based play environments (Strati, 2024), or differentiated multisensory approaches (Hamidova, 2025). Collectively, this scholarship affirms that high-quality early childhood education rests on designing learning environments that nurture agency, creativity, and holistic development within flexible and socially responsive pedagogical frameworks.

METHOD

This study employed a quasi-experimental pre-test–post-test research design to examine the effectiveness of pop-up books as a multisensory learning tool in enhancing engagement and short-term retention among early childhood learners. A total of 60 Pre-K1 children, aged 3 to 5 years, from Ibayo Daycare Center in Novaliches, Quezon City, participated in the study. The children were randomly assigned to two groups to ensure comparability prior to the intervention. The experimental group (n = 30) received instruction using pop-up books specifically developed to provide tactile, visual, and interactive

learning experiences. Meanwhile, the control group (n = 30) was taught using traditional 2D storybooks and printed materials typically used in early childhood classrooms.

Both groups underwent the same learning sessions covering the same content, with the primary difference being the instructional materials used. The quasi-experimental approach enabled the researchers to measure changes in engagement and retention before and after the intervention, allowing for clear comparisons between learners exposed to multisensory pop-up books and those using standard instructional resources. This design facilitated a systematic investigation into how multisensory features impact young children's cognitive and behavioral engagement, as well as their ability to retain learned concepts.

Instructional Material

The pop-up book used in the intervention, entitled Ang Hardin ni Mutya, was developed by the researchers and aligned with the official curriculum for Pre-K1 learners. Specifically, it was designed based on Week 6 of the 3rd Quarter under the theme Ako at ang Aking Kapaligiran (Myself and My Environment). The lesson emphasized caring for plants and recognizing the numbers 9 and 10, consistent with the developmental competencies outlined for this grade level. The instructional objectives of the material included enabling children to identify the numbers 9 and 10, learn and demonstrate simple methods for caring for plants, and explore the basic characteristics of plants through exploratory and nature-based activities.

The narrative of Ang Hardin ni Mutya centers on a young girl named Mutya who enjoys planting and eventually cultivates her own vegetable garden, which she lovingly shares with her neighbors. This storyline was intentionally crafted to model pro-environmental behaviors and foster early numeracy skills. The book's tactile, visual, and interactive 3D elements were incorporated to reinforce key concepts through a multisensory learning experience. By allowing children to touch, manipulate, and visually explore the pop-up components, the material aimed to enhance engagement, deepen comprehension, and support meaningful connections between the story and the targeted learning outcomes.

Research Instruments

To systematically assess the impact of the multisensory intervention, quantitative research instruments were employed to measure children's engagement and short-term retention. Researcher-made pre-tests and post-tests were developed to evaluate learners' comprehension of lesson content before and after participation in the pop-up book activities. These assessments covered developmentally appropriate competencies for Pre-K1 learners, including color and object identification, basic numeracy with emphasis on the numbers 9 and 10, and simple concepts related to caring for plants. The test items were validated by three early childhood education (ECE) specialists, and the resulting reliability coefficient, *Cronbach's a*, was 0.82, indicating good internal consistency and confirming the suitability and coherence of the assessment tool.

Engagement was measured using a teacher-assisted Likert-type scale survey designed to capture three quantitative dimensions of engagement: behavioral, emotional, and cognitive. The survey included indicators such as

attentiveness during storytelling, visible emotional responses, level of participation, and sustained interest in the instructional material. Given the young age of the participants, teachers assisted learners in selecting ratings from a five-point scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The engagement scale demonstrated strong internal reliability, yielding Cronbach's $\alpha = 0.86$. Because teachers assisted in rating children's engagement, the study acknowledges the potential for observer bias. Teachers were carefully briefed on the observation and scoring procedures but were not informed of the study's expected outcomes to minimize unintentional influence. This limitation is further addressed in the Discussion section.

These quantitative instruments collectively provided standardized and reliable measures for evaluating differences in engagement and retention between the experimental and control groups, ensuring that the effects of the pop-up book intervention could be assessed with statistical rigor.

Data Collection Procedure

The research was conducted in three distinct phases to systematically evaluate the effectiveness of the pop-up book *"Ang Hardin ni Mutya"* as a multisensory learning tool for early childhood learners. Each phase was designed to capture baseline data, implement the intervention, and measure its impact using both quantitative and qualitative methods.

During the Pre-Implementation Phase, both the experimental and control groups were administered a pre-test and an engagement survey to determine their initial levels of retention and engagement. These baseline measures allowed for a comparative analysis of changes following the intervention. During this phase, teachers handling the experimental group received a briefing on how to incorporate the pop-up book into daily storytelling sessions and classroom activities. The briefing included demonstrations on how to utilize the book's interactive elements to maximize engagement, as well as strategies for connecting story content with hands-on tasks such as plant care and number recognition.

The Implementation Phase spanned two weeks. The experimental group was exposed daily to the pop-up book *"Ang Hardin ni Mutya"* through storytelling sessions that emphasized visual, tactile, and kinesthetic engagement. These sessions were supplemented by related multisensory activities such as role-playing, counting exercises using manipulatives, and a nature walk to explore plant characteristics—directly aligning with the story and learning objectives. Meanwhile, the control group continued learning through conventional 2D books and traditional instructional strategies, which primarily relied on verbal instruction and visual aids without interactive components.

In the Post-Implementation Phase, both groups were administered a post-test and a second engagement survey to measure gains in retention and engagement after the intervention. Additionally, teachers evaluated the children using performance tasks and observational checklists. These tools captured qualitative data on how learners participated during sessions, their responsiveness to activities, and their ability to recall and apply the concepts they had learned. Observations provided insight into the children's behavior, including their attentiveness, verbal responses, and interactions with learning materials.

The collected data were analyzed using a combination of statistical tools. The mean and standard deviation were calculated to describe central tendencies and variability in scores. A paired-sample t-test was used to determine whether there were significant improvements within each group from the pre-test to the post-test. An independent sample t-test was used to compare the performance between the control and experimental groups, identifying whether the observed differences were statistically significant. Descriptive statistics were also used to summarize data from the performance tasks and observational checklists, highlighting trends in engagement and responsiveness that supported the quantitative findings. Through this structured approach, the study effectively assessed the impact of multisensory instruction using pop-up books on the learning experiences of young children.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of Quezon City University. Written informed consent was secured from parents/guardians, and assent was obtained in an age-appropriate manner. Participation was voluntary, and confidentiality was strictly upheld.

RESULT

This section presents the study's results, based on data collected from pre-tests, post-tests, engagement surveys, performance tasks, and observational checklists. The data were analyzed using appropriate statistical tools to determine the effectiveness of the pop-up book "Ang *Hardin ni Mutya"* in enhancing engagement and short-term retention among early childhood learners at Ibayo Daycare Center, Novaliches, Quezon City.

Engagement Levels

The engagement survey assessed behavioral, emotional, and cognitive engagement using a 5-point Likert scale. Pre- and post-intervention mean scores were computed and analyzed for both groups.

Table 1
Engagement Levels

Group	Pre-Engagement Mean (SD)	Post-Engagement Mean (SD)	Mean Difference	t-value (df=29)	p-value
Experimental	3.02 (±0.38)	4.18 (±0.41)	1.16	8.72	$p < 0.001$
Control	3.04 (±0.40)	3.35 (±0.39)	0.31	2.19	$p < 0.05$

The experimental group showed a significant increase in overall engagement (Mean Difference = 1.16, $p < 0.001$), indicating that the pop-up book substantially enhanced behavioral, emotional, and cognitive engagement among learners, whereas the control group demonstrated only modest improvement. Behavioral engagement was reflected in children's active participation during the storytelling sessions, including touching and manipulating the pop-up elements, pointing to objects, and reenacting scenes from the narrative. Emotional engagement also improved, as evidenced by visible excitement, smiles, and enthusiastic responses while interacting with

the book. Additionally, cognitive engagement increased, with children showing sustained attention throughout the sessions and providing more accurate and detailed answers to comprehension questions. This collective pattern of engagement suggests that multisensory, interactive materials can meaningfully elevate young learners' participation and focus during early childhood instruction.

Short-term Retention and Comprehension (Pre-Test and Post-Test Results)

Short-term retention and comprehension were measured using pre- and post-tests, focusing on concepts such as plant care, identifying numbers 9 and 10, and story-related details.

Table 2

Short-term retention and Comprehension (Pre-test and Post-test Results)

Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	Mean Gain	t-value (df=29)	p-value
Experimental	5.12 (±1.07)	8.41 (±0.89)	3.29	11.05	$p < 0.001$
Control	5.03 (±1.11)	6.28 (±1.25)	1.25	4.67	$p < 0.001$

The experimental group's post-test scores improved by 64.25%, while the control group showed only a 24.85% increase. A significant mean gain was observed in the experimental group, supporting the effectiveness of the multisensory pop-up book in improving comprehension and short-term retention.

An independent sample t-test comparing the post-test scores of both groups revealed a statistically significant difference:

Table 3

Independent sample t-test Results

Test	Mean Difference	t-value	p-value
Post-Test Scores (Experimental vs. Control)	2.13	7.02	$p < 0.001$

This indicates that the experimental group significantly outperformed the control group in retaining and comprehending the learning content.

Performance Tasks and Observational Checklists

Performance tasks included story-based activities such as object identification, counting exercises, and reenacting scenes from *"Ang Hardin ni Mutya."* Observational checklists measured attention span, verbal responses, participation, and enthusiasm.

Table 4

Performance Tasks and Observational Checklists

Domain	Experimental (Average %)	Control (Average %)
Task Completion	91%	73%
Verbal Participation	88%	65%

Independent Exploration	86%	60%
Attention and Focus	90%	68%

Teachers observed that children in the experimental group were more engaged during sessions, asked more questions, and often initiated discussions about the story. They also showed greater enthusiasm in exploring the book's pop-up elements and retained more details from the story. In contrast, the control group was attentive but more passive and less participative.

DISCUSSION

The findings of this study provide compelling evidence evidence in support of the effectiveness of pop-up books as multisensory instructional tools in early childhood education. Children in the experimental group demonstrated significantly higher engagement and greater gains in short-term retention compared to those exposed to traditional 2D books, highlighting the value of sensory-rich materials in fostering meaningful learning among young children. These results affirm that when multisensory resources such as pop-up books are developmentally appropriate, culturally relevant, and deliberately integrated into teaching, they enhance children's participation, comprehension, and overall learning experience.

A central outcome of this study was the marked increase in engagement across behavioral, emotional, and cognitive domains among children who interacted with the pop-up book Ang Hardin ni Mutya. This mirrors findings in broader interactive learning research, particularly the work of Zourmpakis, Kalogiannakis, and Papadakis (2024), who demonstrated that learner engagement increases when instructional contexts incorporate adaptive, interactive, and stimulating elements (Zourmpakis et al., 2024). Their study on adaptive gamification demonstrates that features such as personalized challenges, immediate feedback, and regulated cognitive load strengthen motivation by supporting autonomy and competence—mechanisms that parallel how tactile, 3D story elements capture children's attention and support sustained participation. Conversely, research by Tülübaş, Karakose, and Papadakis (2023) underscores the importance of managing overstimulation, noting that unstructured digital media use may negatively affect attention and academic performance (Tülübaş et al., 2023). The current study aligns with this caution, suggesting that structured, hands-on, non-digital multisensory experiences—such as manipulable pop-up elements—are especially advantageous for preschoolers whose executive functioning and self-regulation are still developing.

The conceptual foundations of this study are further supported by classical and contemporary learning theories. Consistent with Piaget's preoperational stage, children aged 2–7 learn best through tactile exploration and concrete representations. The pop-up book allowed learners to touch, manipulate, and visually explore representations of plants, vegetables, and numbers, thereby strengthening their grasp of abstract concepts through embodied learning. This finding aligns with the cognitive benefits of multisensory instruction documented in prior studies (Heimann et al., 2021; Khasawneh, 2024). Complementarily, Gardner's Theory of Multiple Intelligences helps explain why the pop-up book was effective: it activated visual-spatial intelligence through vivid illustrations, bodily-kinesthetic intelligence through physical

manipulation, and interpersonal intelligence through collaborative storytelling—creating multiple pathways for meaning-making.

The significant pre-test to post-test improvement among children in the experimental group (64.25% gain versus 24.85% in the control group) indicates that multisensory stimuli enhance memory encoding and retrieval. Emotional engagement, cultural relevance, and contextual familiarity—all embedded in the story of Ang Hardin ni Mutya—likely contributed to deeper conceptual anchoring. These findings resonate with the work of Katsampoxaki-Hodgetts, Kotsidis, Papadakis, and Anastasiades (2025), who argue for reimagining preschool pedagogy through multimodal, multiliteracies-informed curriculum design (Katsampoxaki-Hodgetts et al., 2025). Their study shows that multimodal learning environments—whether digital or material—expand opportunities for children to construct meaning across diverse representational forms, thereby enhancing cognitive and creative development. This aligns with the work of Maria Argyriou et al. and Søyland (2020), who argue that multimodal learning environments expand opportunities for children to construct meaning across diverse representational forms by integrating various modes and supporting identity formation and cross-cultural understanding (Argyriou & Tapsis, 2025; Søyland, 2020). The pop-up book intervention in the present study serves as a non-digital analogue to these multiliteracies principles, demonstrating how tactile, visually layered materials can enrich sense-making and early literacy in developmentally appropriate ways.

These findings carry important implications for early childhood education. Educators and curriculum designers are encouraged to incorporate multisensory materials into daily instruction, particularly in resource-constrained or non-digital environments where tactile storytelling can effectively foster engagement and foundational skills. The use of culturally relevant narratives, like Ang Hardin ni Mutya, further supports contextualized learning that resonates with children's lived experiences. Policymakers may also consider promoting the development of locally produced multisensory instructional materials to support equitable, culturally grounded pedagogy in Filipino early childhood settings.

However, certain limitations must be noted. Because teachers assisted in rating children's engagement, observer bias cannot be fully ruled out, despite efforts to blind teachers to the expected study outcomes. Additionally, the two-week duration of the intervention limits conclusions to short-term retention; long-term effects on literacy, numeracy, socio-emotional learning, and conceptual understanding remain unknown. Future research could address these gaps through longitudinal designs, comparisons with digital interactive books or augmented reality resources, and investigations into how multisensory storytelling supports broader developmental competencies, such as narrative comprehension, problem-solving, and emotional regulation.

Despite these limitations, the study demonstrates that multisensory instructional materials—specifically pop-up books—offer meaningful cognitive and motivational scaffolds for young learners. The significant engagement gains and substantial improvement in retention underscore the pedagogical value of incorporating interactive, tactile resources into early childhood learning environments. As global research continues to emphasize

multimodal and inclusive approaches to preschool education, the findings of this study contribute to the growing recognition that multisensory, culturally relevant, and developmentally grounded learning tools can play a transformative role in early childhood pedagogy.

CONCLUSION

This study provides empirical evidence that pop-up books function as effective multisensory learning tools for enhancing engagement and short-term retention among daycare learners. Children exposed to tactile, visual, and interactive story elements demonstrated significantly higher behavioral, emotional, and cognitive engagement, as well as stronger short-term memory recall, compared with peers who used traditional 2D books. These findings confirm that developmentally appropriate, sensory-rich instructional materials can meaningfully support early learning processes in non-digital classroom settings.

Beyond its empirical contribution, the study underscores the pedagogical value of integrating culturally relevant, low-tech multisensory resources into early childhood education. The use of the pop-up book *Ang Hardin ni Mutya* illustrates how locally grounded narratives combined with interactive design can foster active participation, conceptual understanding, and motivation among young learners. While the study focused on short-term outcomes, the results highlight the potential of multisensory storytelling to strengthen foundational skills in early childhood curricula. Future research is encouraged to examine long-term learning effects and to compare physical multisensory materials with emerging digital interactive media across diverse educational contexts.

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