LakBayan: An Interactive Digital Storybook for Enhancing the Cognitive Skills of Early Childhood Learners

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ABSTRACT

The integration of EdTech tools in early childhood education involves data-driven resources to provide a meaningful learning experience for children. In line with the Department of Education's policies on ICT integration, this study aims to design, develop, and validate the LakBayan: An Interactive Digital Storybook. The participants of the study included an intact section of 29 Grade 1 pupils and 6 evaluators. Using a descriptive-developmental design with a quasi-experimental approach, the study first described the learners' baseline cognitive skills and the systematic development and evaluation process of LakBayan. Results revealed that post-test scores improved after the intervention. Statistical analysis confirmed a significant difference between the pre-test and post-test scores, evaluating the effectiveness of LakBayan in enhancing the cognitive skills of young learners. The study concludes that LakBayan is a reliable digital resource in ECE, with implications for parent guiding, teacher training, curriculum design, and policy development in the Philippine context.

Keywords: Early childhood education; ICT integration; LakBayan; Interactive digital storybook; Cognitive skills.

INTRODUCTION

The first eight years are known as the most crucial developmental phase of the human brain that leads to lifelong success, according to Busch (2025). This stage is characterized by synaptogenesis; neural connections that are forming rapidly, while connections for all future cognitive, emotional, and behavioral capacities are established. A result of this development is the reinforcement of Executive Functions (EFs), which are essential for the formation of high-level cognitive abilities and skills that are not isolated. These involve functions such as working memory, self-control, and emotional regulation. Multiple behaviors and purposeful actions are fundamental for these EFs. Therefore, modern early childhood education focuses directly on the observable and measurable development of these primary cognitive skills, which are essential for children's meaningful learning.

However, according to Llurag & Kilag (2024), these issues, embedded in socioeconomic divergences and developmental delays, were encountered during the implementation of ECE programs in the Philippines. Many classrooms still rely on traditional teaching methods such as lectures and rote memorization, while learners engage in interactive multi-sensory digital learning. Moreover, there is also an existing significant instructional gap in teaching methods and strategies. The learners' preparedness in technological skills failed due to the instructional disuse (Işıkoğlu & Güzen, 2024).

Studies acknowledge a critical limitation: the lack of personalization and localization in content use, which inhibits the full potential for intrinsic motivation, engagement, and localized application that benefits the EFs from digital storybooks (Tan & Wong, 2023). Additionally, according to Herwegen (2024), available commercial resources in early childhood education are inadequate in strengthening the cognitive skills of digital-native learners, despite the potential of foundational literacy skills and engagement in interactive media.). Lastly,

leaving gaps in high-quality resources and evidence-based frameworks for the Department of Education (DepEd) was caused by the lack of local studies that rigorously developed standards (Cordano, 2025).

In aiming to highlight the resourceful needs for learners to resonate with the immediate social and cultural environment, these findings prioritized content for future intervention. A well-designed Game-Based Learning (GBL) intervention can be developed to support effective scaffolding and interactive learning, which can keep learners engaged within their Zone of Proximal Development (Annuar et al., 2025). To harness the power of multimedia in engaging learners, this was empowered by emerging Digital Storytelling (DST), a highly potent medium in leveraging the intrinsic human connection. DST is deep-rooted in learners' comprehension and overall literacy development (Husein et al., 2024).

Cognitive skills development is effectively stimulated by producing digital storybooks with immersive multi-dimensional environments compared to traditional methods (Labrador, 2025). However, resources must embrace locality and cultural identity for a digital storybook to be effective. The critical elements in effective learning transfer are the use of familiar setting languages and cultural values within the structure, which promote engagement and personal relevance. Requiring conformity to the criteria in functional excellence and pedagogical soundness, the meticulous quality of digital resources needs to be established primarily to ensure educational value (Kucirkova et al., 2023).

Conceptualized as an engaging digital resource with tasks and challenges explicitly tailored to enhancing the foundational cognitive capacities, this study proposed the design, development, and evaluation of LakBayan: An Interactive Digital Storybook for Enhancing the Cognitive Skills of Early Childhood Learners. Furthermore, this study examined how LakBayan, an interactive digital storybook, has been systematically developed, validated, and utilized as an evidence-based learning resource to enhance the cognitive skills of early childhood learners.

Specifically, the systematic development and evaluation of this resource also assessed the baseline cognitive skills of the early childhood learners before the intervention of LakBayan, followed by a rigorous instructional design model, detailed specifications, prototype, content structure, and the final product. It is also evaluated based on the LRMDS Guideline for Non-Print Materials, assessed by a panel of experts. Furthermore, this study investigated the practical modalities of the interactive digital storybook, which can be integrated into the learning process and environment of pupils. Ultimately, based on the findings, the study described the cognitive skills of early childhood learners after the LakBayan intervention and determined if there was a statistically measurable difference in the cognitive skills of early childhood learners before and after exposure to the interactive digital storybook.

Statement of the Problem

The general problem of the study is: How can LakBayan, an interactive digital storybook, be developed and utilized as an interactive learning resource to enhance the cognitive skills of early childhood learners?

Specifically, the study seeks answers to the following questions:

1. How may the cognitive skills of the Early Childhood learners be described before the use of the LakBayan Digital Storybook?

2. How may the interactive digital storybook be designed and developed in terms of:

2.1 design briefs,

2.2 instructional and technical design specification,

2.3 prototype or alpha version,

2.4 functional and technical specification (scripts),

2.5 beta, and

2.6 conformance?

3. How may the developed interactive digital storybook be evaluated in terms of:

3.1 content quality,

3.2 instructional quality,

3.3 technical quality, and

3.4 other findings?

4. How may the interactive digital storybook be integrated into the learning process of the pupils?

5. How may the cognitive skills of the Early Childhood learners be described after the use of the LakBayan Digital Storybook?

6. Is there a significant difference in the cognitive skills of Early Childhood learners before and after the use of the LakBayan Digital Storybook?

RELATED LITERATURE

This discourse connected five core themes: foundations of digital storytelling, integrating digital storytelling for cognitive and holistic growth, instructional design foundations for interactive digital storybooks, intentional design and pedagogical justification for interactive digital learning, and frameworks and standards for evaluating digital storybooks in early childhood education. These themes support holistic and cognitive development, validating and implementing high-quality digital resources for early childhood learners.

Foundations of Digital Storytelling in Early Childhood Education

In early childhood education settings, technology is used to enhance core developmental skills beyond traditional literacy by promoting powerful teaching tools like Digital Storytelling (DST). The aspect of DST sustains young learners' multi-sensory and attention, enabling educators to capture its effectiveness (ASCD Express, 2025). Additionally, to cultivate learners' planning abilities, the process of digital narrative crafting supports higher-order thinking skills, which involve sequencing, platform selection, and organization. Moreover, DST is essential for overall early years development to crucially improve socio-emotional learning skills such as empathy and self-regulation (Edutopia, 2025).

To empower students' structural comprehension and narratives, cognitive scaffolding activities are required for reasoning, planning, and sequencing. Ultimately, a valuable resource like LakBayan meets the ISTE Creative Communicator requirements, helping Philippine early childhood education meet creative standards and national digital literacy. In conclusion, the study's approach has combined multimedia and teaching goals designed for developing an educational technology tool grounded in the foundations of DST in early childhood settings.

Integrating Digital Storytelling for Cognitive and Holistic Growth in Early Childhood Classrooms

The relevance of digital storytelling (DST) in early childhood education has proven to be an effective pedagogical tool for cognitive skills development, serving as a robust mechanism that transcends entertainment for supporting holistic growth. Learners' creative self-expression and comprehension were improved and enabled through DST in 21st-century classrooms (Hernandez, 2023). DST engaged learners to help them build skills beyond academic performance by encouraging empathy (McCusker, 2023).

These valuable findings provided a comprehensive foundation for LakBayan's aim for an educational experience using DST, supporting cognitive growth and a deeper understanding. Ultimately, these resources offered both practical guidance and theoretical support, ensuring that LakBayan is a research-based tool, carefully designed to strengthen cognitive and comprehension skills in young learners.

Instructional Design Foundations for Interactive Digital Storybooks

A pedagogically robust approach like interactive digital storytelling has emerged to foster cognitive, creative, and engagement development in early childhood learners. The Department of Education Bataan (2025) empowered educators to utilize Canva's crucial role as a design tool for interactive and child-friendly materials, and to reinforce development in early childhood education. Additionally, optimal use of digital resources occurs when aligned with learners' cultural context and educational goals (Konerman et al., 2022).

LakBayan adheres to both national and instructional design principles by integrating interactive elements, localized narratives, and cognitive scaffolding to support and develop executive function. Ultimately, LakBayan demonstrates the potential of integrating technology, cognitive enrichment, and cultural relevance in young learners' meaningful learning.

Intentional Design and Pedagogical Justification for Interactive Digital Learning

The use of interactive digital media in shaping fundamental cognitive skills in children is supported by systematic primary literature. The design of digital stories that emphasize children's active manipulation of the digital environment, and not passive consumption of content, builds new cognitive structures. (NAEYC, 2024). In an article by Guernsey & Levine (2024), prioritizing literacy and content over distracting elements is an advocacy and intentional approach for designers to get smarter in designing e-books for children. These provided evidence-based, clear principles for intentional designs and pedagogical justifications.

These empirical findings directly support the evaluation method of LakBayan research. Interactive and objective elements to enhance cognitive results, e-books are much preferred. Additionally, the evidence from educational organizations suggests that evaluating interactive technology techniques should be conducted continuously in ECE classrooms to enable systematic monitoring of competencies in problem-solving and other interesting contexts.

Frameworks and Standards for Evaluating Digital Storybook in Education

The essential technology integration in education ensures that learning materials meet digital quality standards. As stated by the UNESCO Inclusive Policy Lab (2023), to ensure the quality of digital education, global responsibility must uphold inconsistency in standards decreases learning effectiveness. For instance, in the Philippine context, the DepEd LRMDS: Learning Resource Management and Development Section (DepEd PH, 2024) uses an established criterion, a guideline to measure the quality of digital resources.

Overall, the need for all digital platforms to meet quality standards from these perspectives is to ensure effective and equal access to learning experiences. These perspectives align with the LakBayan's development, offering a comprehensive understanding. The development of an effective digital resource aligns with the Philippine set standards, offering policy requirements and theoretical foundations. LakBayan seeks to engage and innovate learning experiences through interactive digital storytelling for young learners.

Related Studies

The growth of digital media in early childhood education examines the developmental, cognitive, and pedagogical implications through prompting empirical studies. These collectively demonstrate the development, validation, and implementation of LakBayan, an interactive digital storybook designed to enhance cognitive skills and executive functions in young children.

Established Impact of Digital Storytelling Impact on Early Learning

Digital storytelling (DST) has been a highly effective teaching strategy in rigorous research for enhancing diverse skills in young learners. According to Al-Akaidi et al. (2025), DST assisted classification, prediction, and observation enhance developmental skills in young children. As reported by Amin et al. (2021), in a study of female primary school students, socio-emotional intelligence was noticeably boosted by DST.

The key recommendations provided the observed positive outcomes across diverse skills, including Social-Emotional Learning (SEL), technological competence, and language proficiency, as a strong foundation for

using DST as the LakBayan intervention. These insights included specialized training and reflective practices for educators, and a comprehensive DST curriculum. Overall, these findings provided the research's justification for digital resource development and the DST impact on cognitive growth, forming a basis for the LakBayan intervention.

Utilizing Interactive Digital Tools to Enhance Learning in Early Childhood Education

The development and learning of young children's cognitive skills were greatly helped by digital storytelling and interactive educational tools. For instance, Manullang et al. (2021) found that while improving language, problem-solving, and memory skills, children remained engaged in DST and educational games. Macalan (2021) also reported that interactive digital storybooks and story animations helped children explore ideas.

These findings reinforced the study on how enjoyable and effective learning is made through pictures, sounds, stories, and interactive activities. This ensured that the storybook is developmentally appropriate, emphasizing early childhood and helping children strengthen comprehension, memory, reasoning, and problem-solving. Together, these studies provided a foundation for LakBayan as a research-based, transformative tool using the power of DST to support children's cognitive growth.

Design-Based Strategies for Interactive Digital Storybooks in Early Learning

The design and development of an interactive digital storybook's effectiveness requires specific appropriate tools and instructional principles to focus on critical learning outcomes, ensuring an educational impact. According to Sari et al. (2022), the Canva application can be utilized to create digital storybooks and other educational media aligned to early childhood learning themes. This focus on engagement shows that resources that enhance preschoolers' online learning engagement are important for effective learning in digital spaces (Yusli & Zainal, 2023).

The development of LakBayan expands upon these studies by aligning it with instructional, cultural, and interactive features. The design framework of the study is supported by document gains in executive functions, language acquisition, and conceptual findings applicable to early childhood education settings. Together, intentionally creating and contextualizing interactive digital storytelling can promote both cultural identity and cognitive development.

Validated Approaches for Strengthening Executive Functions through Digital Interventions

An increase in the use of digital storytelling (DST) in literature has transformed into a crucial, dynamic educational approach and demonstrated its effectiveness in enhancing socio-emotional and cognitive development in diverse educational settings. An empirical study by Tan & Wong (2023) demonstrated that eight weeks of DST intervention at the kindergarten level significantly improved executive functions (EF), such as memory and inhibitive control. Additionally, digital strategy-based cognitive training approaches have brought long-term effectiveness in EF, intelligence quotient (IQ), and academic performance in children (Morán et al., 2025).

Together, these empirical studies provide a solid basis for confirming the design and core objectives of current research. Consistent results on improved EFs and cognitive processing, together with specific methodological recommendations, directly inform the design criteria of the project. Literature strongly suggests that the most effective approach is a strategy-based narrative, delivered by a balanced digital-traditional methodology and rigorously evaluated using design principles that reduce cognitive load during testing.

Evaluation Frameworks and Quality Indicators for Digital Storybooks in Early Education

In the modern era, teachers and researchers have increasingly embraced digital storytelling as an interactive approach for teaching young pupils. In addition, Metwalli & Barakat (2022) found that the use of Digital Storytelling programs helps young children to understand complex geographical concepts by connecting abstract ideas with visually appealing stories. Furthermore, Lin et al. (2024) found that the quality of digital stories developed by pupils can be assessed in terms of their narrative, design, and creativity, which shows how Digital Storytelling promotes pupils' ability to express and organize things.

Collectively, these empirical studies provide LakBayan's solid basis, highlighting the significance of connecting cognitive and real-life experiences, reinforcing the use of DST as an effective educational tool for linking cultural aspects with emotional knowledge. The study aims to establish DST in an innovative educational context by integrating technology and local places.

METHODOLOGY

Methods and Techniques of the Study

This study employed a descriptive-developmental design with a quasi-experimental procedure. A rigorous quantitative methodology is crucial for the objectives of product development, assessment tests, and product evaluation. LakBayan underwent a systematic process creation and validation. It used a descriptive-developmental design and was anchored as a foundational phase using the standardized five-stage ADDIE Model: Analysis, Design, Development, Implementation, and Evaluation. According to Peck (2025), ADDIE was drawn as a basis for course and training development to meet the needs of the evolving digital learning environment. The process of the study subsequently followed the procedures of the ADDIE Model in each stage:

Analysis. In this systematic phase, the researchers established the learners' baseline cognitive skills before and after the intervention and conducted a curriculum review and literature synthesis to justify the need for a digital learning resource and to identify its instructional goals.

Design. This phase focused on the technical and instructional planning of the LakBayan in terms of: design briefs, instructional and technical specifications, prototype or alpha version, beta version, and conformance.

Development. This phase is the creation of LakBayan based on its design specification. It also employed the evaluation of LakBayan using the LRMDS Guidelines for Non-Print Materials. This phase included informed testing, revisions, and finalization of the digital educational tool.

Implementation. In this phase, LakBayan was implemented and integrated into the learning process of learners during sessions and classroom activities. After the intervention, a structured pre-test was administered to measure the significant transformation in their cognitive skills.

Evaluation. This final phase involved rigorous statistical analysis by subjecting the gathered data from both the learners' assessments and the LRMDS results. The final analysis included combined analytical data as evidence of the development of learners' cognitive skills.

Population and Sample of the Study

The study involves three essential groups of respondents: pupils, teachers, and expert validators. The target

population was located at a selected elementary school in Calumpit, Bulacan, Philippines. The direct beneficiaries were the intact section of 29 Grade 1 pupils, that are selected by employing a Purposive Convenience Sampling, which made the choice highly practical for the research due to its availability and accessibility.

Moreover, Purposive Sampling was employed for choosing the expert validators, which consists of 1 elementary master teacher, 1 master teacher who is a research coordinator, and 1 college professor. In addition, 3 Grade 1 teachers served as key evaluators and end-users of the product. Their participation was crucial for validating LakBayan using the LRMDS Guidelines for Non-Print Materials to assess the quality and acceptability to develop an effective educational technology tool.

Research Instrument

These meticulous, structured instruments measured the enhancement of learners' cognitive skills and confirmed the LakBayan intervention acceptability. To measure the cognitive skills of Grade 1 pupils, the primary data gathering tool developed was a validated pre-test and post-test instrument. This 20-item multiple-choice test was essential for the one-group pre-test and post-test quasi-experimental design. A Table of Specifications (TOS) was developed to ensure content validity and alignment with the different learning competencies, systematically

divided into four cognitive domains: Pansin at Pagmamasid (Attention & Observation), Pag-alala (Memory & Recall), Pangangatwiran at Pagkakasunod-sunod (Reasoning & Sequencing), and Paglutas ng Suliranin at Pagpapasya (Problem Solving and Decision Making). Moreover, the LRMDS Guidelines for Non-Print Materials evaluated the quality and educational acceptability of the LakBayan. The tool has a 4-point scale ranging from 1 (Not Satisfactory) to 4 (Very Satisfactory). It was structured into four major factors: Content Quality, Instructional Quality, Technical Quality, and Other Findings. Collectively, these comprehensive data collections created a foundation that was both valid and applicable, allowing evidence-based conclusions regarding LakBayan's development and effectiveness as an educational tool and to gather strategic feedback for its contribution to early childhood settings.

Data Gathering Procedure

The data collection procedure for this study was conducted ethically and systematically, ensuring integrity and participant confidentiality. This followed a sequence of planned steps for a formal and successful process. The first step was to secure permission from the school principal through a Memorandum of Agreement (MOA) and a formal letter of request that outlines the study's objectives and ethical considerations. Using an ethical and informed consent letter for voluntary participation, the researchers sought approval from the parents and guardians of the Grade 1-Magalang, and from the teachers and expert validators for their rigorous evaluation. Once approval was officially granted, the LakBayan Interactive Digital Storybook and the assessment tools underwent instrument validation.

The data collection process began in the 2nd week of January 2026, during which the pre-test was administered to establish the learners' baseline cognitive skills. This month also included the LakBayan development based on its objectives, procedures, and design specifications. The implementation phase, which involved the systematic LakBayan intervention, took place in the 3rd week of January 2026. After the implementation, the product immediately underwent validation, which covered the four major factors: Content Quality, Instructional Quality, Technical Quality, and Other Findings. Following the evaluation phase, the administering of post-tests was conducted to measure if there was a significant transformation in the learners' cognitive skills.

After the methodological data collection period during the 2nd week of February, the results of the pre-test and post-test were carefully reviewed for accuracy by an organized statistical analysis, which determined the significant difference of the learners' cognitive skills before and after the intervention.

RESULTS AND DISCUSSION

The presentation, interpretation, and analysis of the gathered data, as well as the outcomes of the statistical procedures used in the investigation, are covered in this section. It ascertains the contribution of the LakBayan Interactive Digital Storybook on the Cognitive Skills of the Early Childhood Learners. The collected data were tabulated, narratively explained, and then discussed.

Part I. The Cognitive Skills of the Early Childhood Learners Before the Use of the LakBayan Interactive Digital Storybook

Table 1. Summary of the Pre-Test Scores of Early Childhood Learners

Score Range	Verbal Description	PRE-TEST	
		F	%
0-4	Beginning	4	13.79%
5-8	Developing	17	58.62%
9-12	Proficient	8	27.59%
13-16	Highly Proficient	0	0.00%
17-20	Advanced	0	0.00%
	OVERALL	**29**	**100.00%**

F- Frequency % - Percentage

Table 2. illustrates the cognitive skills of early childhood learners before the use of the LakBayan Interactive Storybook. Based on the data, most scores at 58.62% described as “Developing” learners were still in the process of building foundational skills. A smaller group with 27.59% reached "Proficient," while 13.79% were at the "Beginning" level. None of the learners achieved "Highly Proficient" or "Advanced," showing that higher-order cognitive skills were not yet evident in the pre-test results. This concluded that the learners needed assistance to enhance their skills and advance to higher levels of performance. This technique was also used in the study of Nuridayah & Wibowo (2025), who measured students’ digital literacy skills by embedding interactive features and an autonomous learning experience.

Part II. The Design and Development of the LakBayan in terms of LRMDS (Non-Print) Guidelines

Table 2. The Design Briefs Stage

Aspect	Focus	Application
Development	Pedagogy and Domain Knowledge	Objectives are age-appropriate and culturally relevant
Objectives and Outcomes	Clear Instructional Goals	Teaching places in the community while strengthening executive functions
Learning Strategies	Interactive Storytelling and Game-Based Learning	Boosting attention, motivation, and problem solving
Context of Use	Early Childhood Education localized to Filipino Culture and Values	Cultural Identity and Engagement

Table 3. defines LakBayan’s development design blueprint. It aligns the development aspect with the pedagogy and domain soundness to apply cultural relevance and age-appropriateness. The objectives highlight the outcomes of the significant focus on community awareness and strengthening executive functions, which are critical goals for developing young learners. Additionally, learning strategies center on interactive storytelling and game-based learning with improved attention, motivation, and problem-solving skills in early learners. Finally, the context of use centers on the early childhood education in Filipino culture and values, which suggests cultural identity and engagement integration. This phase is aligned with the study of Husein et al. (2024), who highlighted that digital storytelling strongly influences the development of early childhood literacy.

The Design and Development of the LakBayan in terms of Instructional and Technical Specification

Figure 1. The Instructional and Technical Design Specification Stage

Figure 2. Shows the cover page of the LakBayan, designed by one of the researchers. The first phase is the instructional design, which includes identifying the learning objectives of each community place, such as *paaralan, palaruan, istasyon ng pulis, palengke, ospital, botika, istasyon ng bumbero,* and *parke*. These activities are aligned with Bloom's Taxonomy to ensure progression from simple tasks to more complex skills. Each activity is ensured to be learner-centered to encourage participation and community experiences.

For technical design, the researchers utilized the Canva application as a tool to visually design media, interface, and interactive content that are aligned with themes for early childhood. This interactive digital storybook is

presented in the PowerPoint feature by transforming each slide into an interactive and meaningful learning experience. In addition, all elements of the design reinforced the integrity of the resource by safeguarding the intellectual property rights and commitment to originality. The characters maintained a consistent design where all characters still had a uniform visual and 2D effect. This aligns with Sari et al. (2022), who used the same application in enhancing learners' development outcomes.

The Design and Development of the LakBayan in terms of Prototype or Alpha Version

Figure 2. The Prototype or Alpha Version

Figure 3. illustrated that the prototype or alpha version serves as the semi-functional model of the interactive digital storybook. This integrated the core features such as interactivity, story flow, and designed visuals. Though refinements were still recommended to improve learner autonomy, improve pacing, and balance challenge and activity, this phase ensured that the alpha version demonstrated quality standards in instructional effectiveness. By creating simple narratives, prototypes like DST are a promising tool in integrating and engaging children (Saurina et al., 2026). By presenting a draft, this part will allow evaluation to ensure strategies and designs are aligned before moving into developing the resource material.

The Design and Development of the LakBayan in terms of Functional and Technical Specification (Scripts)

Figure 3. The Functional and Technical Specification (Scripts)

Figure 4. exhibits the onscreen events, actions, and system responses developed by the multimedia artist, early childhood expert, and technical writer. The specification meticulously developed the objectives, strategies, and flow to ensure that LakBayan has seamless audio-visual integration, synchronizing narration, visuals, and interactive events. Every button is also linked to specific slides using the hyperlink. This also includes visual cues like arrows, highlights, and icons, carefully guiding learners step by step. The findings of Işıkoglu and Güzel (2024) support the emphasis on developing literacy skills through DST regarding children's improvement in narrative language skills and digital abilities.

The Design and Development of the LakBayan in terms of Beta Version

Figure 4. The Beta Version

Figure 5. represents the completeness of the content of the LakBayan, where all designs, interactivity, and feedback mechanisms are finalized. All audio was deliberately chosen to match the mood and tone of each scene. Chosen audio files are kept simple, age-appropriate, and non-distracting than the overstimulating ones to ensure the overall cognitive skills are enhanced. Instructional scripts were polished based on the alpha feedback. Navigation scripts and links were all tested to ensure reliability, where each interactive element had a defined technical script. This is subject to the overall review, guaranteeing that the resource meets the justification of instructional accessibility, usability, and soundness. A notable pattern aligned with Rahiem (2021) is that culturally relevant digital elements, including images, sounds, and animations, significantly create engaging stories.

The Design and Development of the LakBayan in terms of Conformance

Figure 5. The Conformance Stage

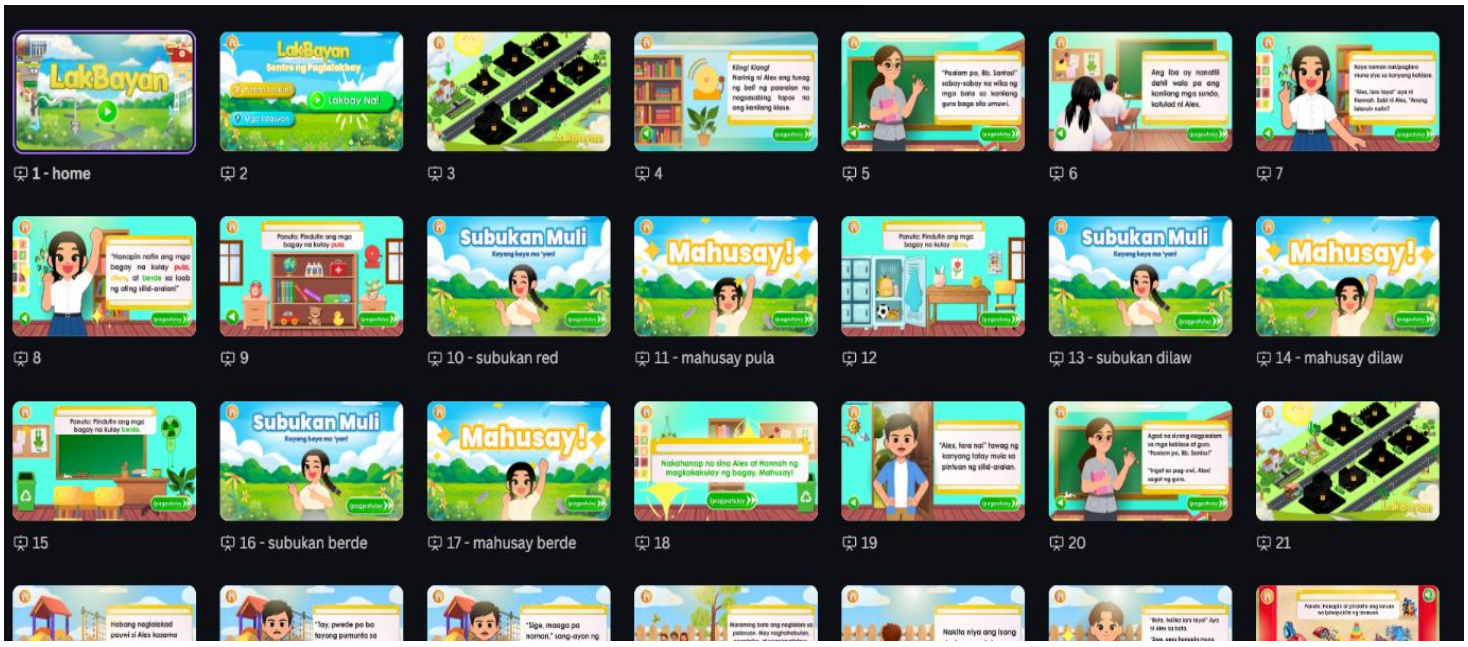

Figure 6. manifests the finalization of the developed interactive digital storybook with completed content, finalized programming, and polished audio. Canva was utilized to ensure consistent design, look, and feel across all pages for visual refinement. For the functional validation, LakBayan activities are reviewed regarding their intended cognitive skills, such as attention, observation, memory, recall, reasoning, sequencing, and problem-solving. The elements and visuals were also confirmed to be appropriate, less distracting, and culturally relevant. Lastly, for standards validation, the interactive digital storybook was checked to see if it is anchored to the DepEd Learning Competencies, ensuring that the product is appropriate for Grade 1 learners and supports areas of development while reinforcing cultural and identity values. In the same study of Nurhidayah & Wibowo (2025) about the utilization of digital storytelling materials, the quality of the designs plays a more important role in children's impactful learning and development to foster 21st-century competencies.

Part III. The Evaluation of the LakBayan in terms of Content Quality

Table 3. Factor A. Content Quality

Factors	Mean	SD	Interpretation
1. Content is consistent with topics/skills found in the DepEd Learning Competencies for the subject and grade/year level it was intended.	4.00	0.00	Very Satisfactory
2. Concepts developed contribute to enrichment, reinforcement, or mastery of the identified learning objectives.	4.00	0.00	Very Satisfactory
3. Content is accurate.	4.00	0.00	Very Satisfactory
4. Content is up-to-date.	4.00	0.00	Very Satisfactory
5. Content is logically developed and organize.	4.00	0.00	Very Satisfactory
6. Content is free from cultural, gender, racial, or ethnic bias.	4.00	0.00	Very Satisfactory
7. Content stimulates and promotes critical thinking.	4.00	0.00	Very Satisfactory
8. Content is relevant to real life situations.	4.00	0.00	Very Satisfactory
9. Language (including vocabulary) is appropriate to the target user level.	4.00	0.00	Very Satisfactory
10. Content promotes positive values that support formative growth.	3.83	0.41	Very Satisfactory
OVERALL	**3.98**	**0.13**	
TOTAL POINTS	**39.83**		**PASSED**

Table 4. shows high ratings consistently in all indicators, receiving a mean score of 4.00 in most factors and a standard deviation of 0.00, which is interpreted as "Very Satisfactory". This indicates unanimous agreement among evaluators about the product's content quality. The 10th factor, which is the "Content promotes positive values that support formative growth", received a lower rating of a mean of 3.83, and a standard deviation of 0.41, still interpreted as "Very Satisfactory". The overall mean of 3.98 with a standard deviation of 0.13, and the total points of 39.83, indicate that LakBayan is reliable, consistently strong, and has passed in this area. While remaining Very Satisfactory, the indicator with slightly lower mean and standard deviation may indicate room for improvement in embedding positive values and lessons. A recent study by Strouse et al. (2023) confirms the importance of content quality in digital storybooks by exploring how multimedia and interactive features can influence young children's learning.

The Evaluation of the LakBayan in terms of Instructional Quality

Table 4. Factor B. Instructional Quality

Factors	Mean	SD	Interpretation
1. Purpose of the material is well defined.	3.83	0.41	Very Satisfactory
2. Material achieves its defined purpose.	4.00	0.00	Very Satisfactory
3. Learning objectives are clearly stated and measurable.	4.00	0.00	Very Satisfactory
4. Level of difficulty is appropriate for the intended target user.	3.83	0.41	Very Satisfactory

5. Graphics / colors / sounds are used for appropriate instructional reasons.	3.83	0.41	Very Satisfactory
6. Material is enjoyable, stimulating, challenging, and engaging.	4.00	0.00	Very Satisfactory
7. Material effectively stimulates creativity of target user.	3.83	0.41	Very Satisfactory
8. Feedback on target user's responses is effectively employed.	4.00	0.00	Very Satisfactory
9. Target user can control the rate and sequence of presentation and review.	3.67	0.52	Very Satisfactory
10. Instruction is integrated with target user's previous experience.	3.83	0.41	Very Satisfactory
OVERALL	**3.88**	**0.22**	
TOTAL POINTS	**39.83**		**PASSED**

Table 5. display high ratings across all indicators, with most mean scores between 3.83 and 4.00, which is interpreted as "Very Satisfactory". Specifically, perfect scores of a mean of 4.00 with 0.00 standard deviation appeared in indicators such as the material, learning objectives, engagement, and feedback on users' responses. A lower rating was observed around the target user's control in the sequence of presentation, with a 3.67 mean and 0.54 standard deviation. This suggests a minor room for improvement in the autonomy of learning. Overall, the product got a mean score of 3.88 with a standard deviation of 0.22. Additionally, the total points got 39.83 and were interpreted as passed, confirming the reliability and quality of LakBayan as an educational technology tool. These findings suggest that LakBayan is effective in terms of instructional quality, defining its purpose, measurable objectives, and stimulating interactive features. A recent study of Papadakis et al. (2021) examined the use of mobile applications and interactive story-based tools and how it effectively improved the learning outcomes of children.

The Evaluation of the LakBayan in terms of Technical Quality

Table 5. Factor C. Technical Quality

Factors	Mean	SD	Interpretation
1. Audio enhances understanding of the concept.	3.83	0.41	Very Satisfactory
2. Speech and narration (correct pacing, intonation, and pronunciation) is clear and can be easily understood.	3.83	0.41	Very Satisfactory
3. There is complete synchronization of audio with the visuals, if any.	4.00	0.00	Very Satisfactory
4. Music and sound effects are appropriate and effective for instructional purposes.	4.00	0.00	Very Satisfactory
5. Screen displays (text) are uncluttered, easy to read, and aesthetically pleasing.	3.83	0.41	Very Satisfactory
6. Visual presentations (non-text) are clear and easy to interpret.	4.00	0.00	Very Satisfactory
7. Visuals sustain interest and do not distract user's attention.	4.00	0.00	Very Satisfactory
8. Visuals provide accurate representation of the concept discussed.	4.00	0.00	Very Satisfactory
9. The user support materials (if any) are effective.	4.00	0.00	Very Satisfactory
10. The design allows the target user to navigate freely through the material.	4.00	0.00	Very Satisfactory
11. The material can easily and independently be used.	4.00	0.00	Very Satisfactory
12. The material will run using minimum system requirements.	3.83	0.41	Very Satisfactory
13. The program is free from technical problems.	3.50	0.55	Very Satisfactory
OVERALL	**3.91**	**0.22**	
TOTAL POINTS	**50.83**		**PASSED**

Table 6. shows a consistent high rating across most indicators, receiving a mean score of 4.00 and a standard deviation of 0.00, interpreted as "Very Satisfactory". The synchronization of audio with visuals, appropriateness of sound effects and music, clarity of visual presentation, and navigation ease. Slightly lower ratings were observed in the indicators such as audio understanding, uncluttered screen displays, and material runs with

minimum system requirements, receiving a mean score of 3.83 with standard deviation of 0.41. The lowest score for this factor was for a program free from technical problems with a 3.50 mean score and 0.55 standard deviation, though all indicators fall under "Very Satisfactory". The overall mean score was 3.91 with a standard deviation of 0.22, and the overall points were 50.83, confirming that LakBayan has passed its technical reliability.

For instance, Papadakis (2022) highlighted that clarity, usability, and technical stability are critical factors influencing the effectiveness of digital storybooks in early childhood education.

The Evaluation of the LakBayan in terms of Other Findings

Table 6. Factor D. Other Findings

Factors	Mean	SD	Interpretation
1. Conceptual errors.	4.00	0	Very Satisfactory
2. Factual errors.	4.00	0	Very Satisfactory
3. Grammatical and / or typographical errors.	4.00	0	Very Satisfactory
4. Other errors (i.e., computational errors, obsolete information, errors in the visuals, etc.).	4.00	0	Very Satisfactory
OVERALL	**4.00**	**0**	
TOTAL POINTS	**16**		**PASSED**

Table 7. exhibits a perfect score across all indicators and each has a mean score of 4.00 with a standard deviation of 0.00, interpreted as "Very Satisfactory". This unanimous evaluation indicates that LakBayan passed this factor and is free from conceptual, factual, grammatical, or technical errors. Overall, the mean score is 4.00 with 0.00 standard deviation, and the total points of 16 confirms that the material has passed regarding the standards of consistency and accuracy. These findings validate LakBayan as an educational technology tool that is highly reliable and free from errors that could result in a reduction of credibility. A research study supports this emphasis on accuracy and error-free design. Kucirkova (2023) highlighted that the reliability and trustworthiness of digital storybooks depend heavily on their freedom from factual and linguistic errors, as these directly influence learner engagement and educational outcomes.

The Summary of the LakBayan Evaluation based on the LRMDS Guidelines for Non-Print Material

Table 7. Overall Evaluation of the Developed LakBayan Interactive Digital Storybook

Factors	Mean	SD	Description
A. Content Quality	3.98	0.13	Very Satisfactory
B. Instructional Quality	3.88	0.22	Very Satisfactory
C. Technical Quality	3.91	0.22	Very Satisfactory
D. Other Findings	4.00	0	Very Satisfactory
OVERALL	**3.94**	**0.11**	**Very Satisfactory**

Table 8. exhibits that the highest mean score was in Factor D. Other Findings with the mean of 4.00 with a standard deviation of 0. This resulted in the storybook fully functioning in all major factors. Meanwhile, Factor A. Content Quality also passed the evaluation with a mean of 3.98 and SD of 0.13. Moreover, Factor B. Instructional Quality received a 3.88 mean with 0.22 SD. Finally, Factor D. Technical Quality showed a mean of 3.91 with 0.22 SD. These results indicated that the interactive digital storybook was constructed with quality and upheld the standards of an effective educational technology resource. In the study of Labrador (2025), digital storybooks with interactive features have a strong technical performance by effectively developing children's cognitive skills more than traditional methods, suggesting that evaluators valued the storybook's interactive design.

Part IV. Enhancing the Cognitive Skills of Early Childhood Learners by Integrating LakBayan into their Learning Process

Table 8. LakBayan Integration in the Learning Process of Early Childhood Learners

Components	Community Places	Application
Attention and Observation	1. Paaralan	Paghahanap ng magkakakulay na bagay
	2. Palaruan	Paghahanap ng laruan
Memory and Recall	3. Istasyon ng Pulis	Tandaan ang detalye ng mensahe
	4. Palengke	Tandaan ang listahan ng mga bibilhin
Reasoning and Sequencing	5. Ospital	Alamin ang dahilan ng mga sakit
	6. Botika	Pagsunod-sunurin ang mga gamot
Problem Solving and Decision Making	7. Istasyon ng Bumbero	Sagutin ang tanong tungkol sa paghahanda sa sunog
	8. Parke	Paglutas ng suliranin sa matematika

Table 9. displays the progression structure of different activities designed to strengthen the cognitive skills of learners through contextualized exploration in our community. The components are sequenced into four domains: attention and observation, memory and recalling, reasoning and sequencing, and problem solving and decision making. The places in the community are also arranged in a structured manner: ang paaralan, palaruan, istasyon ng pulis, palengke, ospital, botika, istasyon ng bumbero, at parke. Each setting was paired with specific fun and engaging activities that are thematically anchored. These activities encouraged meaningful life experiences and confidence among learners. Consistent with the findings of Fibriasari et al. (2021), educational games and digital storybooks sustain children's engagement while improving their executive function, particularly in domains such as, problem-solving, memory, and language skills, thereby reinforcing the learning benefits observed in the integration phase.

Part V. The Cognitive Skills of the Early Childhood Learners After the use of LakBayan Interactive Digital Storybook

Table 9. Summary of the Post-Test Scores of Early Childhood Learners

Score Range	VERBAL DESCRIPTION	POST-TEST	
		F	%
0-4	Beginning	0	0.00%
5-8	Developing	0	0.00%
9-12	Proficient	0	0.00%
13-16	Highly Proficient	1	3.45%
17-20	Advanced	28	96.55%
	OVERALL	**29**	**100.00%**

F- Frequency % - Percentage

Table 10. revealed a remarkable transformation in the learners' cognitive performance after the LakBayan intervention. The data showed that 96.55% of the pupils are at the "Advanced" level, while the remaining 3.45% achieved "Highly Proficient". This suggests that LakBayan successfully moved all pupils to the highest performance levels. These provided empirical evidence of the interactive digital storybook's efficacy in boosting foundational cognitive skills. The recent study of Labrador (2025) supports the success of LakBayan intervention, which found that an interactive digital storybook can effectively enhance cognitive skills more than traditional methods. Using multi-dimensional environments that are immersive tools stimulates mental abilities more actively than passive learning.

The Pre-Test and Post-Test Scores of Early Childhood Learners

Table 10. Summary of Pre-Test and Post-Test Scores

Score Range	Verbal Description	Pre-Test		Post-Test	
		F	%	F	%
0-4	Beginning	4	13.79%	0	0 %
5-8	Developing	17	58.62%	0	0 %
9-12	Proficient	8	27.59%	0	0 %
13-16	Highly Proficient	0	0 %	1	3.45%
17-20	Advanced	0	0 %	28	96.55%
	TOTAL	**29**	**100.00%**	**29**	**100.00%**

F- Frequency % - Percentage

Table 11. presented a remarkable transformation in the cognitive skills of learners following their exposure to the interactive digital storybook. Before the intervention, learners were clustered into lower ranges of performance levels. Specifically, 58.62% were categorized in the "Developing" level, 27.59% as "Proficient", and 13.79% as "Beginning". These suggest that the learners' cognitive skills were largely at the emerging and foundational stages during the pre-test. However, the post-test results reflected a highly transformational shift in their performance level. A significant majority of learners attained the "Advanced" at 96.55%, while the remaining 3.45% achieved "Highly Proficient". This enables the learners' cognitive skills to progress from basic to higher levels of mastery, indicating that the notable redistribution of results occurred after the intervention. Recent empirical studies supported evidence about the effectiveness of Digital Storytelling. Lantz & Schimsky (2024) concluded from their study that project-based learning can develop digital storybooks as an effective learning media tool.

Part VI. The Statistical Analysis of Cognitive Skills Before and After Intervention

Table 11. Summary of Hypothesis Test Results

Variables	t	Sig-value	Decision	Interpretation
Pre-Test and Post-Test	-26.686	0.000	Reject Ho.	There is a significant difference between the pre-test and post-test of early childhood learners after the LakBayan intervention.

Table 12**.** statistically demonstrates a highly significant difference in the cognitive skills of early childhood learners before and after the use of the LakBayan. The paired sample t-test yielded a value of t=-26.686 with a p-value of 0.000, leading to the rejection of the null hypothesis. This shows that the intervention made a huge impact on the improvements in learners' skills. Macalan (2021) discovered that learners can understand complex ideas and enhance their cognitive growth by reinforcing digital resources such as story animations and interactive digital storybooks.

CONCLUSION

The pretest results confirmed that the learners' cognitive skills had a low baseline, with none reaching "Highly Proficient" or "Advanced level". By following the LRMDS Guidelines for Non-Print Materials, the interactive digital storybook met the standards as a pedagogically sound, technically reliable, and culturally relevant resource for learners. Confirming the evaluation phase, the LakBayan passed all criteria, achieving "Very Satisfactory" on each rating. After the integration of LakBayan into classroom learning, the learners exhibited a significant rise in their post-test mean scores. The LakBayan was confirmed as an effective educational technology tool, resulting in a highly significant difference between learners' pre-test and post-test results. Therefore, it can be concluded that LakBayan enhanced cognitive skills, making it a reliable and validated resource for early childhood education.

The results of our study are grounded in establishing learning theories that support the design, development, and evaluation of LakBayan. The theory of Constructivism by Jean Piaget addresses how young learners' cognitive skills can be described before and after the intervention, and they can actively learn through exploration and engagement. Vygotsky's sociocultural theory explains the importance of integrating LakBayan into the learning process of early childhood learners, emphasizing scaffolding. Likewise, Bruner's narrative theory provides the foundation for the LakBayan development, stating that children can have a meaningful learning experience through narrative storytelling. Additionally, Bandura's social cognitive theories support the evaluation phase of LakBayan, proving that multimedia storytelling is instructional and technically validated. Finally, the cognitive theory of multimedia learning by Mayer supported the LakBayan's use of multimedia elements, focusing on both visual and verbal formation. These theories provided LakBayan a comprehensive framework through describing the systematic process of enhancing learners' cognitive skills.

It can be concluded that the pre-test scores revealed low baseline cognitive skills because they lacked intervention materials. The high post-test scores also demonstrated the effects of utilizing an interactive digital storybook that supports formative growth. Learners therefore demonstrated a stronger executive function and reading comprehension. Moreover, the significant difference between the pre-test and post-test scores shows that LakBayan enhanced the cognitive skills of early childhood learners. Ultimately, these results revealed that early learning difficulties need an intervention that unlocks a child's potential through a meaningful learning experience by implementing the LakBayan Interactive Digital Storybook.

RECOMMENDATIONS

The study has contributed to the enhancement of learners' executive functions and learning experiences through educational technology tool like LakBayan. As the study progressed, a few areas surfaced as suggested for future research. The following recommendations can be made:

1. Teachers are highly encouraged to integrate LakBayan into the learning process of children to create more meaningful, interactive, and engaging learning experiences inside the classroom. Parents and guardians should utilize this as a home-based learning tool with their guidance and overall support to their children. Principals and school administrators are also guided to study LakBayan's data-driven framework with the given technology integration, resources, and training program for teachers. This ensures that learners' needs must be prioritized by reinforcing early childhood development not only in schools, but also at home.

2. Policy makers should consider establishing policies that integrate localized and educational interactive digital storybooks like the LakBayan in early childhood curricula. This can also inform ICT-in-education policies, ensuring the educational technology tools are centered to the ECE pedagogy. They can use this data-driven evidence to embed this intervention into national curriculum frameworks.

3. If this study were to be conducted again, it is recommended that future researchers should provide a broader generalizability of the findings by expanding to a larger sample size across diverse schools. Secondly, conducting a longitudinal study by extending the LakBayan exposure can examine the sustainability of its impact. Lastly, they should also incorporate qualitative data to uncover the non-numerical results and the hidden stories behind the performance change.

4. While LakBayan has established its effectiveness in the learning process of learners, there are still questions that need further study. One major area was testing the learners' cognitive gain sustainability, whether the executive functions and comprehension persist over time and still improve without continuous exposure.

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