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Development of Story Jumper-Based Interactive Illustrated Storybooks to Improve Kindergarten Children's Science Skills

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Abstract: The limited availability of interactive learning media has contributed to the low development of early childhood science skills in kindergarten learning. This study aimed to develop and evaluate an interactive illustrated storybook based on the Story Jumper platform to improve science skills among children aged 5–6 years. The research employed a Research and Development (R&D) approach using the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages. The study involved two expert validators, one media expert and one material expert, while the field testing was conducted with 20 kindergarten children in Group B at TK Negeri Pembina Ranah Batahan, West Pasaman, Indonesia. Data were collected through validation sheets, practicality questionnaires, observation sheets, and pretest–posttest assessments. The findings indicated that the developed media achieved a very valid category, with validation scores of 91.6% from material experts and 88.8% from media experts. The practicality assessment by teachers reached 94.44%, indicating that the media was highly practical and easy to implement in classroom activities. Furthermore, the effectiveness test showed an increase in children's science skills, reflected by an N-Gain score of 0.6656 in the moderate-to-high category. The study demonstrates that the Story Jumper–based illustrated storybook can serve as an innovative and effective digital learning medium to support the development of early childhood science skills through interactive and contextual learning experiences.

Keywords: Digital Storybook; Early Childhood Education; Interactive Learning Media; Science Skills; Story Jumper.

Introduction

Education plays a strategic role in developing human resources and shaping individual competencies needed to face the challenges of the twenty-first century (Branch & Varank, 2009; Rohmiati & Esita, 2024). Early Childhood Education (ECE) represents a foundational stage in the educational process because cognitive, social-emotional, language, and motor development rapidly occur during early childhood (Fadhillah, 2019; Suyanto, 2018). During this sensitive developmental period, children possess high curiosity and strong responsiveness toward environmental stimulation, making early educational intervention essential for optimizing developmental outcomes (Churiyah & Fitri, 2024; Suastra, 2010). Therefore, learning experiences in kindergarten should be designed to encourage exploration, inquiry, creativity, and active engagement through meaningful and contextual activities (Khaerani et al., 2024; Kurniati, 2022).

One important developmental aspect that needs systematic stimulation in early childhood education is science skills development (Rosyidin & Bahri, 2022; Sativa & Buahana, 2024). Science learning in early childhood is not intended to introduce complex scientific theories, but rather to facilitate children in understanding natural phenomena through direct observation, experimentation, and exploration activities (Nabila et al., 2024; Suastra, 2010). Science activities provide opportunities for children to develop critical

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thinking, problem-solving abilities, curiosity, and analytical reasoning from an early (Churiyah & Fitri, 2024; Khaerani et al., 2024). In addition, early science experiences contribute significantly to the development of scientific attitudes, communication skills, and environmental awareness that become important competencies in future learning processes (Ardiyanti, 2022; Oktarina et al., 2025).

The importance of science learning in early childhood has been emphasized in numerous recent studies, particularly regarding the need for innovative and child-centered learning media (Rosyidin & Bahri, 2022; Sativa & Buahana, 2024). Interactive learning media can help children understand abstract concepts through visual, auditory, and experiential representations that are more concrete and meaningful (Branch & Varank, 2009; Churiyah & Fitri, 2024). Digital learning media also provide opportunities for teachers to create more engaging, flexible, and participatory classroom environments aligned with the characteristics of Generation Alpha learners who are highly familiar with technology (Fadhillah, 2019; Nabila et al., 2024). Consequently, integrating technology into early childhood learning is increasingly considered necessary to improve learning quality and student engagement in classroom activities (Kurniati, 2022; Rohmiati & Esita, 2024).

Among various forms of digital learning media, digital storybooks have received considerable attention because they combine narrative elements, visual illustrations, audio features, and interactive activities within a single learning platform (Rosyidin & Bahri, 2022; Sary et al., 2015). Previous studies have demonstrated that digital storybooks can improve children's literacy skills, vocabulary mastery, concentration, and learning motivation through interactive storytelling experiences (Churiyah & Fitri, 2024; Nabila et al., 2024). Moreover, digital storybooks enable children to engage more actively during learning activities because multimedia features can stimulate sensory involvement and sustain children's attention for longer periods (Oktarina et al., 2025; Sativa & Buahana, 2024). Despite these advantages, most previous studies have primarily focused on literacy development and general cognitive stimulation rather than specifically examining the integration of local science content into digital storytelling media for early childhood learners (Khaerani et al., 2024; Rosyidin & Bahri, 2022).

Several recent studies have explored the implementation of digital media in early childhood classrooms; however, substantial limitations remain evident in existing literature (Churiyah & Fitri, 2024; Nabila et al., 2024). Many studies tend to emphasize media attractiveness and usability without comprehensively evaluating effectiveness in improving specific science process skills among kindergarten children (Rosyidin & Bahri, 2022; Sativa & Buahana, 2024). In addition, research integrating local environmental knowledge, particularly Indonesian medicinal plants, into interactive digital storybooks remains very limited (Ardiyanti, 2022; Oktarina et al., 2025). Existing studies also rarely combine interactive storytelling, contextual science learning, and digital multimedia features simultaneously within one integrated educational product specifically designed for children aged 5–6 years (Churiyah & Fitri, 2024; Kurniati, 2022). This condition indicates the existence of a clear research gap regarding the development of contextual digital storybooks that support science skill acquisition in early childhood education settings.

Empirical findings from preliminary observations conducted at TK Negeri Pembina Ranah Batahan further strengthened the urgency of this study. The observations revealed that children's science skills were still relatively low, as only approximately 40% of science learning activities could be implemented effectively using interactive learning media (Oktarina et al., 2025; Sativa & Buahana, 2024). Interviews with teachers indicated that science learning activities were often delivered conventionally through verbal explanation and worksheet-based instruction due to limited access to attractive and practical digital learning resources (Ardiyanti, 2022; Rohmiati & Esita, 2024). Furthermore, learning materials introducing local medicinal plants had not yet been supported by interactive media capable of stimulating children's inquiry processes, observation skills, and active participation during classroom learning (Khaerani et al., 2024; Nabila et al., 2024). If these conditions persist, opportunities for children to develop scientific thinking and environmental awareness from an early age may not be optimally facilitated (Suastra, 2010; Suyanto, 2018).

This study was conducted based on several important considerations. First, there is a practical need for innovative digital learning media capable of supporting meaningful science learning activities in kindergarten settings (Branch & Varank, 2009; Rosyidin & Bahri, 2022). Second, integrating local wisdom content such as medicinal plants into early childhood learning is considered important for strengthening contextual understanding and environmental awareness among children (Nabila et al., 2024; Sativa & Buahana, 2024). Third, the rapid development of educational technology requires teachers to adopt interactive learning approaches that correspond with children's developmental characteristics and digital learning preferences (Churiyah & Fitri, 2024; Rohmiati & Esita, 2024). Therefore, developing an interactive digital storybook based on the Story Jumper platform is expected to provide an effective pedagogical solution for

improving early childhood science skills through enjoyable and inquiry-based learning experiences.

The novelty of this study lies in the integration of contextual science learning concerning local medicinal plants with interactive digital storytelling features through the Story Jumper platform specifically designed for kindergarten children aged 5–6 years. Unlike previous studies that predominantly focused on literacy improvement or general multimedia learning, this study emphasizes the development of science process skills through inquiry-oriented storytelling supported by audio narration, interactive illustrations, and contextual environmental exploration activities (Khaerani et al., 2024; Rosyidin & Bahri, 2022). In addition, this study comprehensively evaluates the validity, practicality, and effectiveness of the developed media using the ADDIE development framework within authentic kindergarten classroom implementation. Therefore, this research contributes both theoretically and practically to the advancement of technology-based science learning media in early childhood education.

Based on the identified problems, theoretical foundations, and existing research gaps, this study aims to develop and evaluate an interactive illustrated storybook based on the Story Jumper platform to improve science skills among kindergarten children. Specifically, this research examines the validity, practicality, and effectiveness of the developed media as an innovative digital learning resource for early childhood science education.

Method

Research Design

This study employed a Research and Development (R&D) approach aimed at developing an interactive illustrated storybook based on the Story Jumper platform to improve early childhood science skills. The R&D approach was selected because the study focused not only on examining educational phenomena but also on systematically designing, validating, implementing, and evaluating an instructional product suitable for kindergarten learning contexts (Branch & Varank, 2009). The development process adopted the ADDIE model, consisting of five sequential stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was chosen due to its systematic, flexible, and iterative characteristics that are widely applied in educational media development research.

Time and Research Location

The research was conducted at TK Negeri Pembina Ranah Batahan, West Pasaman Regency, West Sumatra, Indonesia. The study was carried out from August to December 2025. The research activities included preliminary observation, needs analysis, product design, expert validation, limited and large-scale trials, as well as evaluation of the developed learning media implementation.

Research Subjects

The research subjects consisted of expert validators, teachers, and kindergarten children aged 5–6 years. The validation process involved two validators, namely one media expert and one material expert, selected based on their expertise in early childhood education and instructional media development. The practicality assessment involved one kindergarten teacher who implemented the media during the learning activities. Meanwhile, the effectiveness test involved 20 children from Group B at TK Negeri Pembina Ranah Batahan selected through purposive sampling techniques by considering class readiness, children's developmental characteristics, and research objectives. A small-group trial involving 10 children was initially conducted before the large-scale implementation stage.

Research Procedures

This procedure refers to the steps in the ADDIE model research and development procedure as shown in Figure 1.

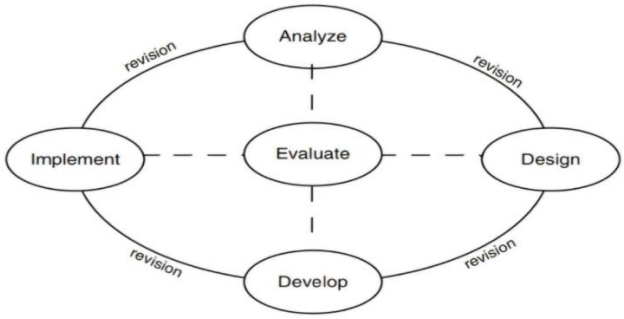

Figure 1. Research Procedure

The development procedures followed the five stages of the ADDIE model as described below:

1. *Analysis Stage*

The analysis stage aimed to identify learning needs, student characteristics, and existing problems related to science learning in kindergarten classrooms. Preliminary observations and teacher interviews revealed that children's science skills were still relatively low due to limited use of interactive learning media and the dominance of conventional teaching methods. In addition, specific digital learning media introducing local medicinal plants had not yet been available in the classroom context.

2. *Design Stage*

At the design stage, the researcher developed the storyboard structure, learning content, visual illustrations, and interactive features of the digital storybook entitled Adventure of Medicinal Plants. The media design integrated audio narration, colorful illustrations, interactive questions, and contextual science activities adjusted to the developmental characteristics of children aged 5–6 years and aligned with the Independent Curriculum learning outcomes.

3. Development Stage

The development stage involved producing the digital storybook using the Story Jumper platform and conducting expert validation. The developed product was evaluated by one material expert and one media expert to assess content appropriateness, media presentation, language suitability, visual appearance, and pedagogical aspects. Suggestions and feedback from validators were used as the basis for revising and improving the product before classroom implementation.

4. Implementation Stage

The implementation stage consisted of limited and large-group trials. The small-group trial involved 10 children to identify initial practicality and usability aspects of the media. Subsequently, the revised product was implemented in a large-group trial involving 20 kindergarten children. During implementation, teachers used the digital storybook in classroom science learning activities related to medicinal plants. Pretest and posttest assessments were administered to examine children's science skill improvement before and after media utilization.

5. Evaluation Stage

The evaluation stage was conducted comprehensively throughout the development process to assess the validity, practicality, and effectiveness of the developed media. Formative evaluation was carried out during each ADDIE stage through expert feedback and trial observations, while summative evaluation focused on the final quality and effectiveness of the instructional product after implementation.

Research Instruments

The research instruments included validation sheets, practicality questionnaires, observation sheets, and pretest–posttest assessments. Validation sheets were used to evaluate the feasibility of the instructional media in terms of content accuracy, language, presentation, and media design. Practicality questionnaires were administered to teachers to assess ease of use, clarity, attractiveness, and implementation efficiency of the media during classroom learning activities. Observation sheets and performance assessments were used to measure children's science skills, including observing, identifying, classifying, and communicating simple scientific findings.

Instrument validity was established through expert judgment involving validators with expertise in early childhood education and instructional media. Instrument reliability was examined through consistency of assessment indicators and clarity of scoring rubrics during the trial process to ensure measurement stability and appropriateness for early childhood classroom contexts.

Data Collection

Techniques Data were collected through observation, interviews, questionnaires, documentation, and learning outcome assessments. Observation and interviews were conducted during the preliminary study to identify classroom problems and learning needs. Validation questionnaires were distributed to experts during the product feasibility assessment stage, while practicality questionnaires were completed by teachers after media implementation. Pretest and posttest assessments were administered before and after learning activities to identify improvements in children's science skills.

Data Analysis

The collected data were analyzed using descriptive quantitative analysis techniques. Validation and practicality scores were converted into percentages using the following formula:

$$P = \frac{f}{N} x\ 100\% \quad (1)$$

Where P represents the percentage score, f represents the obtained score, and N represents the maximum possible score. The interpretation criteria for validity and practicality were adapted from commonly used educational media assessment standards, as presented in Table 1.

Table 1. Interpretation criteria for validity and practicality

Percentage Range	Category
81%–100%	Very Valid / Very Practical
61%–80%	Valid / Practical
41%–60%	Fairly Valid / Fairly Practical
21%–40%	Less Valid / Less Practical
0%–20%	Invalid / Impractical

The effectiveness of the developed media was analyzed using the N-Gain formula to determine the

improvement in children's science skills before and after implementation.

$$N - gain = \frac{Mean\ posttest - mean\ pretest}{Max\ Skor - mean\ pretest} \quad (2)$$

Table 2. N-Gain interpretation criteria

N-Gain Score	Effectiveness Category
> 0.70	High
0.30 – 0.70	Moderate
< 0.30	Low

The effectiveness findings in this study were interpreted descriptively based on mean score comparisons and N-Gain analysis. Therefore, the study does not claim inferential statistical significance because no statistical hypothesis testing procedures were conducted.

Result and Discussion

The Development of the Story Jumper-Based Interactive Illustrated Storybook

The development of the interactive illustrated storybook entitled Adventure of Medicinal Plants was carried out systematically using the ADDIE model, consisting of the analysis, design, development, implementation, and evaluation stages. The product was designed to facilitate science learning activities for kindergarten children through contextual digital storytelling integrated with local environmental knowledge regarding medicinal plants.

Analysis Stage

The analysis stage identified several instructional problems related to science learning implementation in early childhood classrooms. Preliminary observations conducted at TK Negeri Pembina Ranah Batahan indicated that children's science skills had not yet developed optimally, particularly in observing, identifying, classifying, and communicating scientific findings during classroom activities. The learning process was still predominantly teacher-centered and relied heavily on verbal explanation and worksheet activities, resulting in limited opportunities for children to actively construct knowledge through direct exploration and inquiry experiences (Ardiyanti, 2022; Rosyidin & Bahri, 2022).

From a constructivist learning perspective, children learn more effectively when they are actively involved in constructing knowledge through interaction with their environment and meaningful learning experiences. Constructivist theory emphasizes that knowledge acquisition occurs through active exploration, social interaction, and contextual engagement rather than passive information transfer (Branch & Varank, 2009; Suastra, 2010). Therefore, science learning in early childhood education should provide opportunities for children to observe, ask questions, experiment, and interpret phenomena independently through interactive learning environments (Churiyah & Fitri, 2024; Khaerani et al., 2024).

The findings of this preliminary study are consistent with several previous studies reporting that limited use of interactive digital media contributes to low student engagement and suboptimal science learning outcomes in early childhood education contexts. Research conducted by (Arnott, 2017) demonstrated that interactive digital story-based learning environments significantly improved children's cognitive engagement and conceptual understanding during classroom activities. Similarly, (Littleton et al., 2017) emphasized that digital storytelling media facilitate multimodal learning experiences capable of increasing children's motivation, comprehension, and active participation in early learning settings. Other studies also revealed that contextual science learning integrated with multimedia technology positively influences inquiry skills and conceptual understanding among young learners (Marklund, 2022; Papadakis, 2019).

In addition, observations and interviews with teachers revealed that specific digital learning media integrating local environmental content, particularly medicinal plants, were not yet available in the school context. This finding indicates an important pedagogical gap because contextual learning materials associated with children's immediate environment can significantly strengthen meaning-making processes and conceptual retention (Nabila et al., 2024; Sativa & Buahana, 2024). Previous studies have also emphasized that integrating local wisdom and environmental themes into early childhood learning contributes positively to children's ecological awareness and scientific literacy development (Beck & Neil, 2021; Veselinovska et al., 2025).

Design Stage

The design stage focused on preparing the structure and instructional components of the digital storybook. The product was developed through the Story Jumper platform by integrating colorful illustrations, audio narration, interactive questions, and contextual science content regarding medicinal plants commonly found in children's surrounding environments. The story narrative was intentionally designed to stimulate children's curiosity, observation skills, and problem-solving abilities through inquiry-oriented storytelling activities.

The integration of multimedia features within digital storytelling aligns with Mayer's multimedia learning theory, which states that combining visual, auditory, and textual information can improve learners' cognitive processing and conceptual understanding (Az-Zahra et al., 2025; Branch & Varank, 2009; Mayer, 2020). Interactive digital storytelling also supports multimodal learning processes that are particularly suitable for children aged 5–6 years who still rely heavily on concrete representations and sensory experiences during learning activities (Fadhillah, 2019; Peak, 2025).

Several comparative studies have reported similar findings regarding the effectiveness of multimedia-supported storytelling for early childhood learning. Research by (Jaldemark et al., 2021) showed that interactive digital storytelling significantly improved children's communication and inquiry abilities compared to conventional picture-book instruction. (Korat & Falk, 2019) found that digital storybooks enriched with narration and interactive features enhanced children's comprehension and sustained learning attention more effectively than printed storybooks. Other studies further indicated that digital storytelling environments encourage collaborative interaction, exploratory learning behavior, and reflective thinking among young learners (Bus et al., 2015; Karantalis & Koukopoulos, 2022; Suryana, 2025).

Figure 2. storyboard media story jumpe

Development Stage

At the development stage, the interactive storybook prototype was produced and subsequently validated by one material expert and one media expert. The validation process aimed to assess the appropriateness of content, language, instructional presentation, visual appearance, and pedagogical suitability of the developed product.

Table 3. Develop Assesment Instrument

Validity	Percentage (%)	Feasibility Criteria
Media	88,8	very valid
Material	91,6	very valid

The validation results showed that the material aspect achieved a score of 91.6%, while the media aspect obtained a score of 88.8%, both categorized as "very valid." These findings indicate that the developed media fulfilled the required pedagogical and technical standards for early childhood science learning implementation.

The high validation scores suggest that the media successfully integrated science concepts with child-friendly instructional approaches. The use of contextual illustrations, interactive narration, and inquiry prompts enabled the media to function not only as an information delivery tool but also as a scaffold facilitating children's active meaning construction processes. According to constructivist learning theory, scaffolding plays an essential role in supporting children's cognitive development by guiding learners toward higher levels of understanding through structured interaction and exploration (Suastra, 2010; Vygotsky & Cole, 1978).

The present findings are consistent with several previous studies emphasizing that digital storytelling media can effectively support early childhood learning when designed according to children's developmental characteristics. Research conducted by (Robin, 2016) demonstrated that interactive digital storytelling promotes deeper cognitive engagement and supports active learning experiences. Similarly, (Alvi, 2021) reported that multimedia-based storytelling improves children's conceptual understanding and classroom participation because learners become directly involved in meaning-making activities. Recent studies in early childhood education also showed that digital storybooks integrating audio-visual features improve learning accessibility for pre-reading children and increase learning effectiveness in science-related subjects (Montes-Iturrizaga et al., 2023; Rahman et al., 2021).

Implementation Stage

The implementation stage consisted of small-group and large-group trials conducted at TK Negeri Pembina Ranah Batahan.

Table 4. Practicality Test of *Story Jumper* Book Media

No	Total Score	Max Score	Percentage
1	33	36	91,6
Total	33	36	
		Average	91,6%
		Categories	Very Practical

The small-group trial involving 10 children obtained a practicality score of 91.6%, indicating that the media was considered highly practical and easy to implement during classroom learning activities. Teachers reported that the digital storybook was easy to operate and capable of attracting children's attention throughout the learning process.

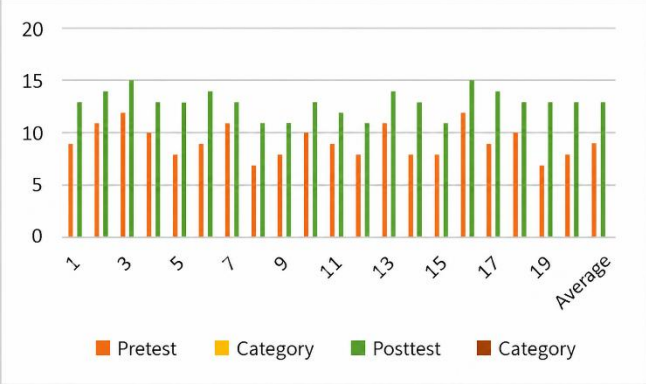

Figure 3. Large Scale Test Pre-test Post-test Comparison

Subsequently, the large-group trial involving 20 children demonstrated an increase in the average science skill score from 9.25 during the pretest to 12.95 during the posttest.

Table 5. N-gain Score

	Descriptive Statistics				
	N	Min	Max	Mean	Std deviation
Ngain_ Score	20	.43	1.00	.6656	.17353
Ngain_ Percent	20	42.86	100.00	66.5595	17.35277
Valid N (listwise)	20				

The N-Gain analysis resulted in a score of 0.6656, categorized as moderate-to-high improvement. These findings indicate that the developed media contributed positively to improving children's science skills, particularly in observing, identifying characteristics of objects, classifying materials, and communicating simple findings.

The improvement in children's science skills can be interpreted through constructivist and inquiry-based learning perspectives. Interactive storytelling activities encouraged children to actively engage in questioning, observing, discussing, and connecting scientific concepts with their daily experiences. Through guided interaction and contextual exploration, children were able to construct understanding more meaningfully than through passive instructional methods.

This finding is supported by previous studies demonstrating that digital storytelling can effectively enhance children's scientific inquiry skills and conceptual understanding. Research by (Hsin et al., 2014) revealed that multimedia-supported inquiry learning environments positively affect children's exploration abilities and problem-solving skills. Similarly, (Kalogiannakis & Papadakis, 2019) found that interactive digital learning tools improve children's participation and understanding of science concepts through experiential and visual learning experiences. Other comparative studies further reported that contextual digital learning media significantly increase motivation, engagement, and higher-order thinking skills among early childhood learners (Beck & Neil, 2021; Compen et al., 2021).

Furthermore, the implementation findings suggest that the Story Jumper platform effectively supports interactive science learning because it combines narrative structure, visual representation, and audio interaction within one integrated learning environment. This multimodal approach aligns with recent educational technology studies emphasizing that early childhood learners benefit substantially from integrated sensory stimulation and interactive instructional environments (Marklund, 2022; Mayer, 2020).

Evaluation Stage

The evaluation stage involved a comprehensive assessment of the validity, practicality, and effectiveness of the developed instructional media. The evaluation results demonstrated that the interactive illustrated storybook fulfilled the criteria of valid, practical, and effective learning media for early childhood science education.

The practicality findings indicated that teachers responded positively to the usability and instructional flexibility of the developed media. The media not only simplified science learning implementation but also created more engaging classroom interactions and increased children's active participation. These findings support previous research indicating that digital storytelling environments can enhance teacher facilitation processes and foster more student-centered classroom learning atmospheres (Jaldemark et al., 2021; Robin, 2016)

In terms of effectiveness, the observed increase in science skill scores and moderate-to-high N-Gain results indicate that the developed media contributed meaningfully to children's learning improvement. However, the findings in this study were interpreted descriptively through mean score comparison and N-Gain analysis rather than inferential statistical testing. Therefore, the study does not claim statistical significance but instead demonstrates practical educational improvement following media implementation.

Overall, the results confirm that integrating contextual science content, digital storytelling, and interactive multimedia features within the Story Jumper platform can provide meaningful learning experiences for kindergarten children. This study contributes to the growing body of literature emphasizing the importance of technology-supported constructivist learning environments in early childhood education. Moreover, the integration of local medicinal plant content represents an important innovation that strengthens contextual science learning and environmental awareness among young learners.

Conclusion

The interactive illustrated storybook based on the Story Jumper platform was successfully developed as a valid, practical, and effective digital learning medium to support early childhood science skills development. The integration of contextual science content, interactive storytelling, and multimedia features was able to encourage children's active participation, inquiry, and exploration during the learning process. This study contributes to strengthening constructivist-based digital learning practices in early childhood education, particularly through the integration of local environmental content into science learning activities. Practically, the developed media can serve as an alternative learning resource for kindergarten teachers to create more meaningful, engaging, and interactive science learning experiences. Future studies are recommended to involve larger samples, apply experimental research designs, and examine the long-term impact of digital storytelling on various aspects of early childhood development.

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Author Contributions
LS: Research concept, media design, data collection, analysis, article writing. YSW: Theory development, methodology, data analysis, article revision. SU: Initial media design, product trial, data collection, analysis. NFZ: Field testing, data processing, media evaluation, writing trial results.

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Conflicts of Interest
The authors declare no conflict of interest.

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