

Designing AI-Driven Storytelling to Enhance Language Skills in Early Childhood Education: A Research Framework

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Abstract

This study explores the integration of a custom AI storytelling application, *StorySpark*, into early childhood education to support language development in children aged 4–6. Using a quasi-experimental approach, the study compares an experimental group using the app with a control group. *StorySpark* encourages vocabulary enrichment, creative expression, and interactive engagement through dialogue-based storytelling. Preliminary findings from the initial implementation phase indicate high levels of participation and linguistic interaction, suggesting strong potential for fostering narrative skills. Although statistical analysis is pending, the study offers promising insights into the pedagogical use of AI in inclusive, developmentally appropriate language learning environments.

Keywords: artificial intelligence, early childhood education, preschool language development, storytelling, narrative skills, educational technology

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Introduction

Language development in preschool-aged children plays a crucial role both cognitively and socially. At this stage, children begin to comprehend and organize their environment through language, using it not only as a means of communication but also as a tool to express their thoughts, emotions, and intentions. Oral language forms the foundation for later literacy, critical thinking, and broader interaction with the world.

Recent research supports the view that early language experiences significantly influence children's academic trajectories and socioemotional development. For instance, Liu et al. (2024) emphasize that rich verbal interactions in early childhood are predictive of reading comprehension and self-regulation in later years. Moreover, Bleses et al. (2016) have shown that expressive vocabulary at the age of three can reliably predict academic achievement a decade later. Language is not only a vehicle of expression but also a cognitive tool that enables children to reflect, plan, and reason about their experiences (Rowe, 2020; Silva & Cain, 2015).

Therefore, supporting oral language in the preschool years is essential not just for linguistic purposes, but for empowering children's ability to connect with others, navigate social environments, and construct meaningful understandings of the world around them.

In recent years, the advancement of digital technologies and Artificial Intelligence (AI) has introduced new tools for early childhood education. AI-powered applications are being developed with the aim of enhancing children's learning through personalized, interactive experiences (Holmes et al., 2019; Zhang et al., 2024). These tools, particularly those focused on storytelling, provide dynamic environments where children can co-create narratives with the support of visual and verbal prompts.

This study explores the potential impact of such AI-based storytelling tools on preschool children's narrative abilities. Specifically, it investigates how the use of an AI application influences linguistic features such as lexical richness and story coherence, as well as the degree of children's emotional engagement and active participation in story construction (Hirsh-Pasek et al., 2015; Liu et al., 2024). In doing so, it contributes to the growing body of research on the educational application of AI in early childhood and highlights the importance of fostering meaningful linguistic interactions through developmentally appropriate technologies.

Theoretical Background

The Importance of Stimuli in Language Development

Language development plays a fundamental role in a child's overall growth during the early years of life. Language serves as a tool for thinking, communication, and understanding the surrounding world. The more advanced a child's verbal expression is, the more confident they become, enhancing their ability to participate in social interactions.

Cognitive stimuli that a child receives also contribute to the development of broader skills, such as social and emotional abilities. Vygotsky (1978) emphasized the role of social interaction in language development, highlighting that the cultural context and interaction with more knowledgeable individuals significantly shape learning. His concept of the Zone of

Proximal Development explains how children can develop language and cognitive skills with the support of more capable peers or adults.

As children are exposed to linguistic stimuli such as words and sentences, they internalize and organize them mentally. Continuous exposure strengthens the connections between these linguistic elements (Bruner, 1983). Environments that encourage conversation, storytelling, and play create ideal conditions for the rapid development of language skills (Lever & Sénéchal, 2011).

Narrative Discourse as a Tool for Language Development

Narrative discourse is closely linked to language development. Through storytelling, children become familiar with the structure of language and develop skills such as rich vocabulary, understanding abstract concepts, grammar, and syntax. Exposure to fictional stories allows them to experiment with language (Pesco & Gagné, 2015).

Research shows that children who engage in storytelling and dialogue with adults improve both their comprehension and their ability to construct new information (Snow, 1983). Such interactions expose them to more structured speech, offering valuable opportunities for linguistic growth.

The Role of Technology and Artificial Intelligence in Language Development

The rise of digital technology has transformed how children are exposed to and practice language. When properly integrated into educational environments, technological tools can support language development (Liu et al., 2024). Through meaningful activities, young children develop early literacy skills. Digital books designed for young readers often include images, sounds, interactive elements, and activities related to letters. These multimedia features enhance children's comprehension and expression (Jack & Higgins, 2019). Additionally, software applications that promote storytelling give children opportunities to experiment with language and strengthen their narrative abilities (Hirsh-Pasek et al., 2015).

Nevertheless, the integration of technology in education has sparked debate about its potential impact on critical thinking and the possibility of delaying language development (Youvan, 2024). Easy access to information may lead to superficial learning and a lack of evaluative thinking. Children are often captivated by visual stimuli, spending extensive time in front of screens. This extended screen time can reduce their opportunities to engage in conversation with adults and peers, limiting exposure to verbal stimuli and negatively affecting vocabulary development.

The use of Artificial Intelligence (AI) in education remains a relatively new field (Parliament, 2021). Current research on the effects of AI in learning is still limited (Daskalaki et al., 2024; Lo, 2023), and many educators face challenges incorporating such tools into their teaching practice (Göçen & Aydemir, 2020).

AI has the potential to revolutionize education by replicating human cognitive functions such as learning, decision-making, problem-solving, and creativity (Parliament, 2021). It incorporates technologies like Machine Learning, Deep Learning, and Natural Language Processing. For example, machine learning systems analyze students' academic data and generate personalized educational content based on their strengths and weaknesses. Deep

learning enables the creation of advanced tools, such as automated assessment systems that provide feedback on assignments (Zhang et al., 2024). Natural Language Processing supports the development of intelligent assistants and chatbots that can respond to students' questions in real time and explain concepts.

Digital tools that allow children to create and illustrate their own stories are increasingly available. Notable examples include Animated Drawings and Storynest.ai. With the guidance of AI, children are trained to construct stories with a beginning, middle, and end, including unexpected events, character traits, and narrative conventions typical of different formats (book, short story, film script, etc.). Being able to narrate and simultaneously visualize the creation of a story motivates and inspires children to engage with storytelling. In a classroom setting, such activities also foster collaborative learning.

Method

Participants

The final sample consisted of 50 preschool children (23 girls, 46.9%), aged between 4 and 6 years ($M = 5.1$, $SD = 0.6$). All participants were enrolled in a private kindergarten in southern Athens. Based on classroom records, over 80% of the children had previously participated in story-related activities through traditional methods. Informed consent was obtained from all parents, and all children completed the full intervention period without attrition. Prior to the intervention, informed consent was obtained from parents, children, and educators, ensuring ethical compliance and voluntary participation.

The intervention took place during scheduled, teacher-led classroom activities, with small group sessions comprising approximately 16 children each. Notably, the children had prior exposure to story creation using traditional methods, such as oral storytelling, picture-based narration, and teacher-facilitated retellings.

Following the completion of the AI-assisted storytelling sessions, the children were given a printed questionnaire. The purpose of the questionnaire was to gather insights into their experience with the application, focusing on dimensions such as enjoyment, engagement, and their willingness to use the tool again. This feedback was valuable for evaluating the child-centered appeal and educational potential of the application.

Intervention Phases

The intervention spanned a period of six weeks and was structured into two distinct phases, each with its own pedagogical focus and implementation goals.

Weeks 1–2: Introductory Activities

The first phase was dedicated to familiarizing children with the digital environment and the core features of the *StorySpark* application. Activities during this period were designed to be playful, exploratory, and supportive of gradual adaptation to the AI interface. Children engaged in:

- Navigating the application through trial-and-error exploration,
- Listening to sample stories generated by the app,

- Participating in guided discussions based on images, story openings, and character prompts.

This phase emphasizes building confidence, curiosity, and a basic understanding of narrative elements (beginning, middle, end) in preparation for more active story creation. It also allowed educators to scaffold the children's interaction with the application while observing their natural reactions and verbal responses.

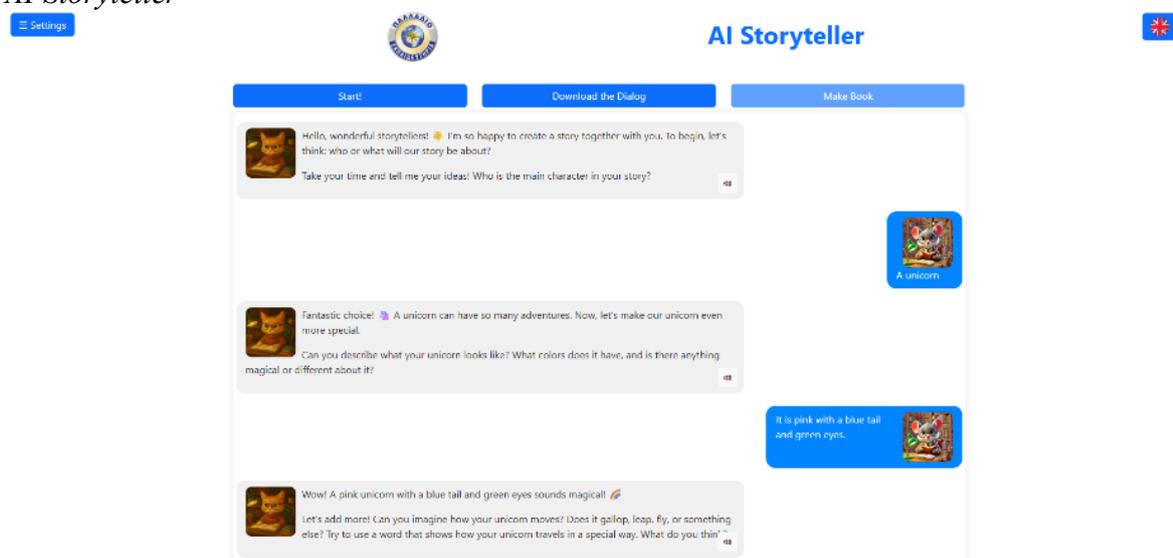
Weeks 3–6: Guided Story Creation

The second phase focused on structured story production using the AI application. Children participated in two sessions per week, each lasting approximately 45 minutes. During these sessions:

- Children co-constructed stories by interacting with the app, selecting visual elements, proposing plot developments, and choosing characters.
- The app offered prompts and visual suggestions while encouraging children to express ideas through spoken language.
- Educators facilitated the process when necessary, providing support without intervening in the children's narrative choices.

This phase aimed to foster narrative development, lexical enrichment, and increased participation. Each session concluded with oral sharing of the story and group reflection, contributing to collaborative learning and metalinguistic awareness.

Figure 1
AI Storyteller



Data Collection Method

To evaluate both the narrative performance and engagement levels of the participants, a combination of qualitative and quantitative data collection tools was employed. Two main instruments were used:

Structured Observation Sheet

A custom-designed observation sheet was created by the researcher to record children's narrative behavior during each session. The tool included predefined criteria organized into three thematic axes:

- Linguistic Indicators (e.g., variety of verbs, plot coherence, use of connectives),
- Emotional Response to Visual Stimuli (e.g., excitement, facial expression, spontaneous verbalization),
- Participation and Initiative (e.g., willingness to contribute ideas, involvement in decision-making).

Each criterion was rated using a standardized 3-point scale (0–2), allowing for systematic documentation of each child's performance and progression across sessions. Observations were conducted immediately after each session to ensure accuracy and minimize recall bias.

Children's Post-intervention Questionnaire

At the end of the intervention, children completed a short, age-appropriate printed questionnaire designed to capture their subjective impressions of the application. The questionnaire consisted of five items, each rated on a four-point Likert scale (Very Much – Not at All), addressing areas such as:

- Enjoyment of story creation
- Visual appeal of the illustrations
- Willingness to use the app again
- Level of fun during interaction
- Group storytelling experience

This tool aimed to assess the emotional engagement and perceived value of the activity from the children's perspective.

Table 1

Research Instruments

Tool	Purpose	Components	Format
Structured Observation Sheet	To systematically assess children's narrative performance, emotional response, and participation during each session.	- Linguistic indicators (e.g., verb variety, coherence, connectives) - Emotional response to images - Participation and initiative (rated on a 3-point scale)	Researcher-designed structured form, filled after each session.
Children's Post-Intervention Questionnaire	To capture children's subjective impressions of the app and their emotional engagement with the storytelling experience.	- 5 questions with 4-point Likert scale (Very Much – Not at All) - Topics: enjoyment, visuals, reuse intention, group experience	Printed questionnaire, completed by children at the end of the intervention.

Data Analysis

Quantitative Analysis

To assess the linguistic and narrative development of the participants throughout the intervention, a descriptive statistical analysis was conducted using mean scores for each thematic indicator across all sessions.

The results revealed notable variation among the indicators. The highest mean scores were observed in:

- Lexical Richness (M = 1.58),
- Plot Coherence (M = 1.00),
- Initiative (M = 0.75), and
- Verb Variety (M = 0.75).

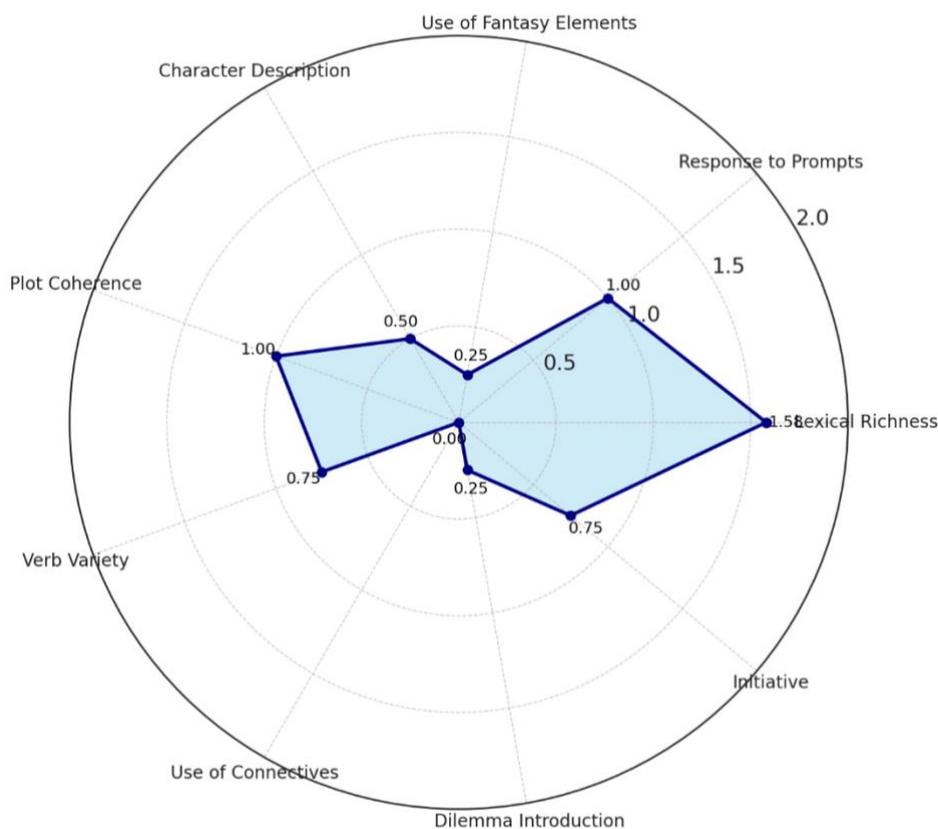
These findings suggest that the majority of children demonstrated an increasing ability to use diverse vocabulary and to construct coherent storylines while showing initiative in storytelling.

Conversely, lower averages were recorded for:

- Use of Fantasy Elements (M = 0.25),
- Dilemma Introduction (M = 0.25), and especially,
- Use of Connectives (M = 0.00).

This indicates that while basic narrative elements were supported through the intervention, more complex linguistic features such as cohesive devices and imaginative expansions were less frequently present.

These results provide a baseline understanding of the children's overall linguistic performance and will be further interpreted through comparative and time-series analyses in the following sections.

Figure 2*Average Scores per Thematic Indicator (Labeled Radar Chart)*

Comparative Findings

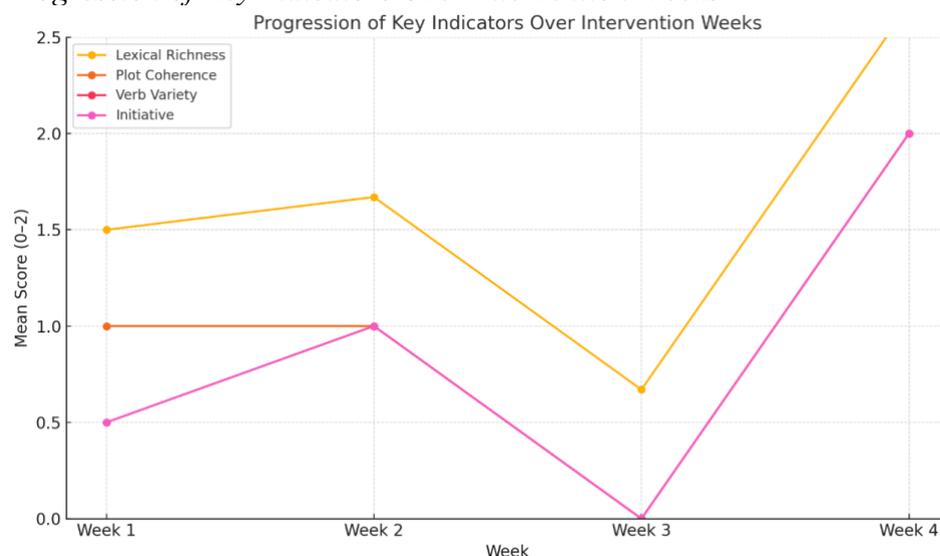
To explore the progression of linguistic performance across the intervention period, mean scores for selected thematic indicators were calculated per week. The indicators analyzed were: Lexical Richness, Plot Coherence, Verb Variety, and Initiative.

The results demonstrate a clear upward trend from Week 1 to Week 4:

- Lexical Richness increased from 1.50 in Week 1 to 2.67 in Week 4.
- Plot Coherence remained stable during the first two weeks ($M = 1.0$) and rose sharply to 2.0 by Week 4.
- Verb Variety and Initiative followed a similar trajectory, reaching their peak in the final week ($M = 2.0$).

These findings suggest that children gradually improved their narrative structure and linguistic creativity as they became more familiar with the application. The initial dip in Week 3 may reflect a natural fluctuation or group-specific factors, but the final outcomes indicate that sustained engagement with the AI storytelling tool can foster meaningful linguistic development.

Figure 3
Progression of Key Indicators Over Intervention Weeks



Correlation Analysis

To examine how specific narrative dimensions interact, a Pearson correlation analysis was conducted among the thematic indicators recorded during the intervention. This analysis helps identify patterns of co-occurrence and shared development across linguistic behaviors.

The results revealed several strong and positive correlations:

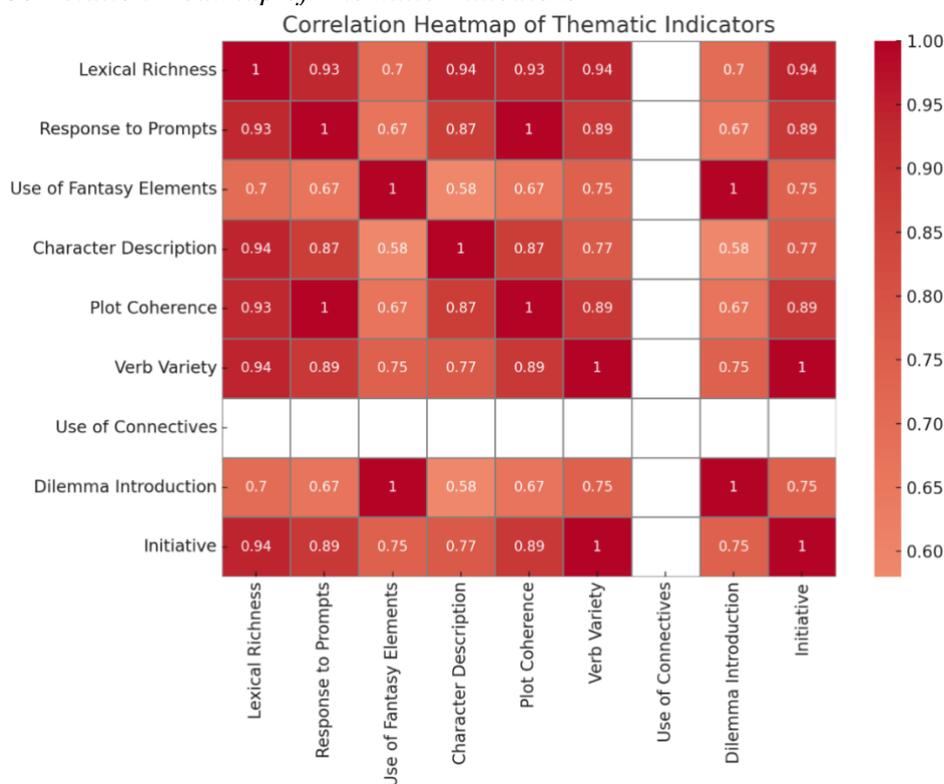
- Lexical Richness showed a very high correlation with:
 - Character Description ($r = 0.94$),
 - Verb Variety ($r = 0.94$),
 - Initiative ($r = 0.94$), and
 - Plot Coherence ($r = 0.93$).
- Response to Prompts was also strongly associated with:
 - Plot Coherence ($r = 1.00$),
 - Initiative ($r = 0.89$),
 - Character Description ($r = 0.87$).

These findings suggest that children who used richer vocabulary also tended to build stronger plots, describe characters more effectively, and take more initiative during storytelling. The high correlation between plot coherence and response to prompts implies that sustained interaction with the application contributed to structured story development.

Interestingly, Use of Fantasy Elements had a moderate-to-strong correlation with several variables (e.g., *Lexical Richness*: $r = 0.70$), indicating that imaginative content may enhance vocabulary use, though it appeared less frequently overall.

On the other hand, **Use of Connectives** could not be meaningfully analyzed due to the uniformly low values (mostly zeros), resulting in insufficient variance for correlation computation.

Figure 4
Correlation Heatmap of Thematic Indicators



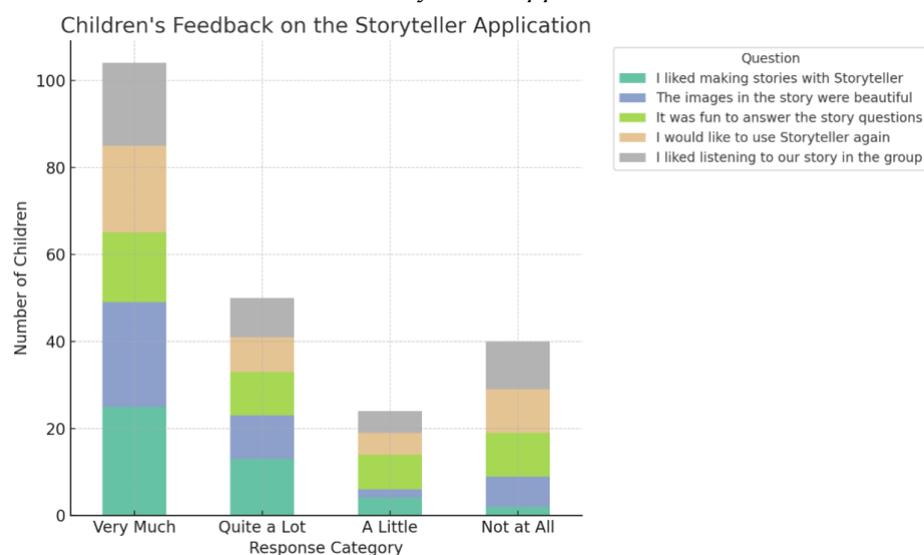
Children’s Perceptions of the AI Storytelling Experience

The children's feedback revealed overall positive experiences with the AI storytelling application:

- 50% (25 children) responded “Very much” when asked if they enjoyed creating stories.
- 48% found the story visuals very appealing, while only 14% responded negatively.
- Responses were more mixed regarding the interactivity of answering questions, with 32% “Very much,” but also 10 children selecting “Not at all.”
- Over 50% expressed a desire to use the application again in the future.
- Group storytelling was positively received by most, though 11 children were neutral or negative.

This data suggests high emotional engagement and enjoyment, with areas (like question answering) that may benefit from refinement.

Figure 5
Children's Feedback on the Storyteller Application



Discussion

The findings of this study suggest that the integration of an AI-powered storytelling application can positively influence the development of narrative and linguistic skills in preschool-aged children. Throughout the six-week intervention, participants exhibited improvements in key areas such as lexical richness, plot coherence, and storytelling initiative. These improvements were particularly evident in the final sessions, indicating that repeated interaction with the application reinforced the children's ability to construct coherent and expressive stories.

The data further revealed strong correlations between lexical variety and other narrative dimensions, such as character description and initiative, suggesting that vocabulary development plays a foundational role in overall narrative competence. Notably, although the use of fantasy elements and connectives remained relatively low, this may reflect the children's developmental stage or the limited timeframe of intervention.

Children's subjective feedback was largely positive. The majority expressed enjoyment in using the application, appreciation for its visual components, and a desire to reuse it. This emotional engagement likely contributed to their willingness to participate and experiment with language during storytelling sessions.

These results support the notion that AI-based tools, when designed with pedagogical intent, can provide meaningful opportunities for language practice, particularly when combined with teacher facilitation and peer interaction. The *StorySpark* application appears to offer a promising model for early childhood education, blending creative expression with structured linguistic development.

Limitations of the Study

Despite the encouraging findings, several limitations must be acknowledged:

- **Short Intervention Period:** The intervention lasted only six weeks, which may not be sufficient for capturing long-term language development, particularly in more complex narrative structures (e.g., use of connectives or abstract vocabulary).
- **Limited Control Group Comparison:** Although a quasi-experimental approach was used, a detailed comparative analysis between traditional and AI-based storytelling methods was not fully developed in this phase.
- **No Pre-/Post-Test Standardization:** The study relied on structured observation and children's self-reported experience rather than standardized pre- and post-intervention tests, limiting the ability to quantify progress with high precision.
- **Technology Familiarity Bias:** Children who were more familiar with tablets or digital tools may have interacted more easily with the app, influencing both engagement and performance outcomes.

Future research should extend the intervention period, involve more diverse participant groups, and incorporate pre/post standardized language assessments. Additionally, integrating teacher interviews and parental feedback would provide a more holistic understanding of the tool's impact.

Conclusion

This study explored the potential of an AI-powered storytelling application to support the narrative and linguistic development of preschool-aged children. The results indicate that the integration of digital tools such as *StorySpark* can foster key language competencies, particularly lexical richness, story structure, and narrative initiative—within a short-term, classroom-based intervention.

Children engaged actively with the application, demonstrating growing confidence in generating story content, responding to prompts, and expressing original ideas. Positive feedback from the participants highlighted not only the educational value of the tool, but also its capacity to generate emotional engagement and enjoyment—critical factors in early childhood learning.

While certain narrative features such as the use of connectives and fantasy elements remained underdeveloped, these may require extended exposure or additional scaffolding strategies. Nevertheless, the overall trend suggests that AI-supported narrative environments can offer children opportunities to experiment with language in meaningful and motivating ways.

Importantly, the success of such tools depends not only on their technical design but also on the pedagogical context in which they are used. Educators play a key role in guiding, observing, and reinforcing the linguistic opportunities that emerge during AI-supported storytelling.

In conclusion, *StorySpark* appears to be a promising digital resource for enhancing early language education. Future research should expand on these findings with longer interventions, diverse settings, and standardized outcome measures to further validate the effectiveness and scalability of AI in early childhood language development.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

This manuscript was prepared with the assistance of generative AI tools (ChatGPT) for language editing and initial drafting under the direction and critical revision of the authors. All content has been reviewed and verified by the authors.

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