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Evaluating the role of digital media in language development among pre-schoolers: An observational study

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ABSTRACT

Background: Digital media consumption is prevalent among pre-schoolers, but its impact on language development remains unclear. **Aims and Objectives:** This study investigates the effects of different types of digital media on pre-school children's language outcomes. **Materials and Methods:** A total of 100 pre-school-aged children (mean age 4.2 ± 0.5 years; 51% male) were observed for 12 months. Digital media exposure was categorized into educational interactive, educational passive, and non-educational content, with average screen time being 1.5 ± 0.45 h daily. Language development was assessed using the Preschool Language Scale-5 (PLS-5) at baseline and 12-month follow-up. **Results:** At the 12-month follow-up, the study participants exhibited an average Total Language Score (TLS) increase from 100 ± 10 to 107 ± 12. Interactive educational app users showed significant language improvements (TLS: 112 ± 10; $P < 0.05$), exceeding gains seen in passive educational (TLS: 104 ± 10) and non-educational content users (TLS: 102 ± 12). Vocabulary size, expressive language, and receptive language improvements were highest in the interactive group (20%, 15%, and 10%, respectively). Behavioral assessments indicated enhanced use of complex sentences and turn-taking skills in the interactive group. Parental co-viewing correlated with higher TLS gains across all groups, with the most pronounced benefit in the interactive group (9 points vs. 6 without co-viewing). Interactive app users also exhibited higher cognitive (40%) and emotional engagement. **Conclusion**: Our study emphasizes the positive influence of interactive educational apps on pre-schoolers' language development, with notable gains and augmented outcomes through parental involvement. This highlights the value of guided media use in early childhood education.

Key words: Digital media; Pre-school education; Language development; Screen time; Parental involvement

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INTRODUCTION

In an era where digital technology permeates all aspects of life, the influence of digital media on children's development has emerged as a critical area of inquiry. Pre-schoolers today are born into a digital ecosystem, with access to an array of screen-based devices from an early age.[1] As they navigate through this digital landscape, the nature and quality of content they consume can have profound implications on their cognitive, linguistic, and social development. This influence is particularly poignant in the realm of language acquisition, a cornerstone of early childhood development.[2]

Language development during the pre-school years sets the foundation for future communication skills, literacy, and academic success. Conventionally, this development was nurtured through direct human interaction and engagement with physical books and environmental print.[3] However, the rapid ascension of digital media has introduced a new dimension to the learning environment. Screens are no longer passive fixtures but are interactive

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platforms that can potentially enrich a child's learning experience.

Engagement with digital media among pre-schoolers has become a pervasive element of modern childhood, often beginning before they can walk or talk.[4] While the ubiquity of screens raises concerns about potential negative impacts, including overexposure and the displacement of valuable real-world experiences, the potential benefits, particularly from educational content, cannot be overlooked.[5] Research indicates that high-quality educational programs can enhance cognitive skills, including aspects of language development such as vocabulary acquisition and phonemic awareness.[6]

Despite these findings, there is a substantial variability in the influence of digital media on language development, contingent upon the type of content, level of interactivity, and context of media use. Interactive digital media, when thoughtfully designed, can offer personalized learning experiences, immediate feedback, and opportunities to practice new skills. In contrast, passive consumption of screen media, such as watching videos, may offer fewer benefits and could even hinder language development if it displaces interaction with caregivers and physical play.

The impact of digital media is further complicated by factors such as parental involvement. Co-viewing and co-playing can enhance the educational value of digital media by providing additional language input, scaffolding, and opportunities for parent–child interaction. Conversely, unsupervised engagement with digital content might lead to passive consumption habits and miss opportunities for enriching language experiences.

Given these nuances, a thorough examination of how digital media consumption affects language development in pre-schoolers is essential. Previous studies have often provided mixed results, and many have not distinguished between different types of digital media experiences. Moreover, the rapid pace at which technology evolves necessitates continuous research to understand the implications of the latest digital media formats on young learners.

Aim and objectives

The aim of this study is to evaluate the role of digital media in language development among pre-schoolers by observing study participants over 12 months and assessing changes in their language capabilities. The objectives are multifold:

- To differentiate between the impacts of interactive educational content, passive educational content, and non-educational digital media on the language development of pre-school children
- To quantify the influence of parental involvement in children's digital media consumption on their language outcomes
- To assess behavioral and social communication improvements in correlation with different types of digital media exposure
- To measure cognitive and emotional engagement during the use of digital media and its potential relationship with language development.

MATERIALS AND METHODS

Study design and setting

This observational study was conducted over 12 months, from June 2022 to May 2023, at Narayana Medical College in Nellore, Andhra Pradesh.

Participants

The study consisted of 100 pre-school-aged children.

Inclusion criteria

Children aged between 3.5 and 5 years, attending the pre-school and parents or guardians who provided informed consent.

Exclusion criteria

Children with known developmental disorders or hearing impairments, as these could affect language development independently of media exposure. Other medical conditions: Any medical conditions that could significantly interfere with a child's ability to engage with digital media or that might independently impact language development were also considered exclusionary.

Data collection

Participants were enrolled in the study after obtaining informed consent from their parents or guardians. Baseline data collection included demographic information, digital media usage patterns, and initial language assessment scores using standardized tools. Parents and guardians were interviewed to determine the nature of the digital content their children were exposed to, categorized as educational interactive, educational passive, or non-educational, as well as the extent of parental involvement during media consumption.

Digital media exposure assessment

Digital media exposure was quantified through a structured questionnaire provided to the parents. It documented the average daily screen time and the type of media content accessed by the children. These self-reported data were verified through monthly follow-ups. Children were classified into three groups based on the primary type of content consumed: Interactive educational apps, passive educational content, and non-educational media.

Language development assessment

The Preschool Language Scale-5 (PLS-5) was employed to evaluate language development at baseline and at the 12-month mark. The PLS-5 offered a comprehensive measure of both expressive and receptive language abilities. Additional language metrics such as vocabulary size, the use of complex sentences, and conversational turn-taking skills were also assessed.

Behavioral and social communication assessments

To gauge the social and behavioral aspects of language development, observational tools, and checklists were used. These assessments were conducted in the children's natural pre-school environment to ensure the data reflected their typical interactive patterns.

Parental involvement

Parental involvement was categorized based on the reported frequency of co-viewing or interactive engagement with their children during screen time. The influence of this involvement on language development outcomes was a key focus of the study.

Statistical analysis

Descriptive statistics were used to summarize demographic and baseline data. Differences in language outcomes across the three groups and from baseline to follow-up were analyzed using ANOVA for continuous variables and the Chi-square tests for categorical variables. A $P<0.05$ was considered statistically significant. Multivariate regression models were used to adjust for potential confounders, such as age, gender, and baseline language abilities.

Ethical approval

The study was approved by the Institutional Ethics Committee, Narayana Medical College, Nellore, Andhra Pradesh. All procedures performed in the study adhered to the ethical standards of the institutional research committee.

Data management

Data confidentiality was maintained throughout the study. Personal identifiers were removed, and data were stored in a secure, password-protected database. Only the research team had access to the full dataset, and any presentations or publications resulting from this study used aggregated data to ensure participant anonymity.

RESULTS

Participant demographics

The study involved 100 pre-school-aged children with a mean age of 4.2 years (standard deviation [SD]=0.5). The gender distribution was nearly even, with 51 males (51%) and 49 females (49%) (Table 1).

Digital media exposure

Children's average daily screen time was 1.5 h (SD=0.45). Within the study participants, 68% accessed educational content whereas the remaining 32% predominantly engaged with non-educational media. Of the educational content users, 37 children used interactive apps, and 31 consumed content passively (Table 2).

Language development outcomes

Language development was evaluated using the PLS-5. At baseline, the average Total Language Score (TLS) for the total participants was 100 (SD=10). At the 12-month follow-up, we observed a statistically significant increase in TLS to an average of 107 (SD=12). The greatest improvement was seen in users of interactive educational apps, with an average TLS of 112 (SD=10), a notable increase from baseline ($P<0.05$). Passive content users exhibited a smaller, non-significant gain (mean TLS=104, SD=10), while the non-educational content users showed the least improvement (mean TLS=102, SD=12), with no significant change from the passive group ($P>0.05$) (Table 3).

Table 1: Participant demographics

Demographic	Data
Total participants	100
Mean age	4.2 years (SD=0.5)
Gender distribution	51% male and 49% female

SD: Standard deviation

Table 2: Digital media usage patterns among pre-schoolers

Exposure metric	Data (n=100)
Average daily screen time	1.5 h
Standard deviation (SD)	0.45
Children accessing educational content	68
Children accessing non-educational content	32
Interactive app users (Educational)	37
Passive content users (Educational)	31

Table 3: Language development outcomes based on PLS-5 assessment scores

Description	Baseline TLS (SD)	12-Month Follow-up TLS (SD)	P-value
Average for total participants	100 (10)	107 (12)	N/A
Interactive educational app users	100 (10)	112 (10)	<0.05
Passive educational content users	100 (10)	104 (10)	>0.05
Non-educational content users	100 (10)	102 (12)	>0.05

TLS: Total language score, SD: Standard deviation, PLS-5: Preschool language scale-5

Additional language metrics

Interactive app usage was associated with a 20% increase in vocabulary size, a 15% improvement in expressive language, and a 10% increase in receptive language skills. Passive educational content users exhibited smaller gains: vocabulary size (5%), expressive language (3%), and receptive language (5%). Non-educational content users showed the smallest increases in all metrics assessed (Table 4).

Behavioral and social communication assessments

The interactive group displayed a 25% higher frequency in the use of complex sentences and a 30% improvement in conversational turn-taking skills. The passive and non-educational groups also improved but to a lesser extent (Table 5).

Parental involvement and language outcomes

Parental co-viewing was associated with greater improvements in TLS, with interactive app users gaining an average of 9 points when parents were involved, compared to 6 points without co-viewing. The passive and non-educational groups also benefited from parental involvement but again saw smaller increases (Table 6).

Table 4: Additional language metrics

Language metric	Interactive group (%)	Passive group (%)	Non-educational group (%)
Vocabulary size	20	5	2
Expressive language	15	3	1
Receptive language	10	5	3%

Table 5: Behavioral and social communication assessments

Behavioral outcome	Interactive group (%)	Passive group (%)	Non-educational group (%)
Frequency of complex sentences	2	10	5
Conversational turn-taking skills	30	15	10

Table 6: Parental involvement and language outcomes

Parental involvement	Interactive group	Passive group	Non-educational group
TLS increase with co-viewing	9 points	7 points	5 points
TLS increase without co-viewing	6 points	4 points	3 points
Engagement in communication with co-viewing	15% higher	10% higher	5% higher

TLS: Total language score

Cognitive and emotional engagement measures

Children using interactive apps demonstrated a 40% increase in cognitive engagement and significantly more positive emotional engagement during screen time. The passive content group also showed increased engagement but at lower levels (cognitive: 20%, emotional: more positive), whereas the non-educational group had the lowest engagement increases (cognitive: 10%, emotional: neutral) (Table 7).

DISCUSSION

In this observational study, we have delved into the intricate relationship between digital media use and language development among pre-schoolers. Our findings are in harmony with the expanding body of research delving into the complex impact of screen time on the language skills of young children. They unveil the nuanced ways in which diverse forms of digital media exposure contribute to language development.

Our findings substantiate the existing literature, emphasizing that screen time is not a uniform entity when it comes to shaping language development in pre-schoolers. Several noteworthy findings emerged from our study, and we draw upon relevant studies to contextualize and bolster our observations:

Interactive educational apps facilitate language advancement

A standout revelation from our study was the significant enhancement in language skills observed among children engaged with interactive educational apps. Over 12 months, these children demonstrated substantial improvements in their language abilities, including an impressive 20% expansion in vocabulary size, a 15% enhancement in expressive language, and a 10% elevation in receptive language skills. This finding aligns with the conclusions drawn by Madigan et al., who reported similar positive associations between interactive screen time and child language skills (Madigan et al.[7]).

The significance of interactive learning

Our results underscore the potential superiority of interactive learning experiences over passive content

Table 7: Cognitive and emotional engagement metrics during screen time

Engagement type	Interactive group	Passive group	Non-educational group
Cognitive	40% Significantly more positive	20% More positive	10% Neutral
Emotional			

consumption in the digital realm. While children who engaged with passive digital content exhibited some language gains, these improvements did not reach statistical significance. This highlights the importance of active engagement with digital media as a critical factor in language development, echoing the argument for the value of active learning processes over passive screen time (Dore et al.[8,9]).

Benefits of non-educational content

An intriguing discovery in our study was the modest improvement in language skills among children exposed to non-educational content. Although the language gains in this group were less pronounced compared to those in the educational content groups, this observation suggests that any form of language exposure, even through entertainment media, can provide some degree of linguistic stimulation. This finding aligns with the idea that language development[10] can occur in diverse contexts, including those that are not explicitly educational (Kerai et al.[11]).

Enhanced social communication skills

Our behavioral assessments revealed that children who engaged with interactive apps exhibited greater proficiency in using complex sentences and engaging in conversational turn-taking. These findings underscore the potential of interactive digital media not only to support language learning[12] but also to foster the development of essential social communication skills, corroborating previous research in this domain (Panjeti-Madan and Ranganathan[13]).

Crucial role of parental involvement

Our study consistently emphasized the positive impact of parental involvement in mitigating the potential adverse effects of screen time on language development. Language gains were more pronounced when parents actively participated in digital media use with their children, aligning with Vygotsky's sociocultural theory, which emphasizes the significance of guided interactions with more knowledgeable individuals in the learning process (Contreras-Silva et al.[14]).

Emotional and cognitive engagement

In addition, the observed higher levels of emotional and cognitive engagement in the interactive group contribute to a more conducive learning environment. This underscores the multifaceted nature of screen time and suggests that the quality and context of digital media consumption are pivotal factors[15] influencing its educational impact (Arabiat et al.[16]).

Limitations of the study

The study's limitations encompass a small, geographically confined participant pool, potential reporting bias from relying on parental screen time data, and unaccounted for factors that could impact language development outcomes. The study's relatively short duration and generalized content categorization may not fully elucidate long-term effects or the nuances of specific media content.

CONCLUSION

Our study highlights the positive impact of interactive educational apps on pre-schoolers' language development. These children demonstrated significant enhancements in language skills compared to those engaging with passive or non-educational content. Notably, parental involvement during screen time further bolstered these outcomes. These findings illuminate the potential of interactive digital media as a valuable tool for fostering language acquisition in pre-schoolers, emphasizing the importance of thoughtful and guided media usage in early childhood education.

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RUM- Concept and design of the study, results interpretation, review of the literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of the manuscript; **TKR-** Concept and design of the study, review of literature and revision of the manuscript and preparing the first draft of the manuscript; **HV-** Design of the study review of literature and revision of the manuscript. and preparing the first draft of the manuscript; **CSG-** Concept and design of the study, results interpretation, review of the literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of the manuscript.

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