



THE ROLE OF TECHNOLOGY IN EARLY CHILDHOOD EDUCATION: BENEFITS AND CONCERNS OF SCREEN TIME FOR YOUNG LEARNERS

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ABSTRACT

Digitisation of India's educational system has increased technology usage in early childhood education. Technology may increase learning, but too much screen time, especially in children, can stunt physical and mental development. Screen time's effects on Indian children's mental and physical health have been thoroughly investigated, mainly in elementary school. This study addresses that knowledge gap by examining the health and development implications of screen usage on Indian pre-schoolers in formal schooling. In 2023, 3,000 preschoolers in urban and semi-urban Delhi, Maharashtra, and Tamil Nadu averaged 5.1 years old and stood at 0.4 standard deviation. Of these kids, 52% were boys. The admissions process included questions on children's well-being, daily screen use, demographics, and family income. The Early Childhood Development Index (ECDI), a standardised measure for assessing students' cognitive, linguistic, social, emotional, and communication skills, was administered midyear. A multivariate logistic regression study found that screen users who used screens for over an hour had lower developmental vulnerabilities across all five areas. Screen usage of 1.5 hours or less per day was better for physical health, emotional maturity, social competence, cognitive development, and communication than 1 hour. These effects persisted after adjusting for parental income, health, and education. Statistics showed no association between family income and screen usage. According to this research, Indian preschoolers who watch more than an hour of TV daily may struggle in many disciplines. Technology is important in the classroom, but too much may harm students' mental, emotional, and physical health. Policymakers, schools, and carers must work together to promote screen safety for young children. We need further research to identify screen use's long-term impacts and set culturally appropriate limitations for young Indian kids.

Keywords: Early Childhood Education, Screen Time, Child Development, Preschool Learners, Educational Technology, Developmental Health, Cognitive Development, India, Digital Learning, Emotional Maturity, Communication Skills, Parental Involvement, Technology Integration, Physical Well-being

INTRODUCTION

One area of contemporary life where technology has had an impact is the educational system. More and more individuals are seeking ways to improve the educational experiences of young children, and one way to do this is by using technology into early childhood education (ECE). This article examines the pros and cons of using technology in schools for young children. Educators, legislators, and other stakeholders can benefit from this study's analysis of the present situation, identification of important aspects, and insights into effective practices regarding technology's role in early childhood education (ECE) [1-4].

Rationale for Technology Integration

Technology should be included into early childhood education for a number of reasons, including the improvement of learning outcomes, the engagement of young learners, and the preparation of young learners for a future driven by technological advancements. It is possible for teachers to accommodate kids who have a broad variety of abilities and approaches to learning by developing lessons that are both interesting and interactive, making use of digital resources and technology that are appropriate for the ages of their pupils. Through the integration of technology into their everyday lives, children are better equipped to flourish in the technologically sophisticated world of today. This is because they are taught to think critically, find solutions to issues, and become adept digital citizens. Technology makes it possible for people to work together, be creative, and be curious. This, in turn, fosters a love of learning and creates a firm foundation for academic accomplishment and learning that continues throughout one's life [5].

Benefits of ECE Technology

Both teachers and kids stand to gain in a number of ways from incorporating technology into preschool programs. Young students' engagement and motivation to learn can be enhanced through a variety of means, including age-appropriate resources, opportunities to practise skills like early literacy, numeracy, and problem-solving, and better communication and collaboration between educators, parents, and carers. The ability to think critically, creatively, and digitally is crucial for success in today's society, and instructors may give their pupils a leg up in these areas by strategically using technology in the classroom [6].

Challenges of Technology

Early childhood educators sometimes find technology integration in the classroom challenging. Among these, we must locate digital content that is suitable for children's ages, ensure that technology is suitable for their developmental stage so that it can support their cognitive and social-emotional growth, guarantee equal access to technology and digital resources for all students, irrespective of their socioeconomic status, and assist educators with pedagogical issues and best practices. To get the most out of technology in preschools while keeping hazards to a minimum, we need to plan smartly, do things on purpose, and reassess often [7].

Balanced Approach to Technology Use

Considering the merits and cons of technology in early childhood education programs helps strike a fair balance. Teachers should use age-appropriate digital tools and activities to support curricular objectives rather than replace them. Teachers should limit children's screen time and utilise technology for relevant, engaging, and learning-oriented objectives. Young people must be taught to think critically, creatively,

and ethically while utilising technology to be responsible digital citizens. By supporting a balanced approach to technology, educators may provide a secure and engaging learning environment for young children [8].

Implications for Practice and Policy

In early childhood education, teachers should supplement rather than replace more conventional forms of instruction using technological tools. Teachers should learn in professional development programs how to design technology-based projects that engage students' imaginations, foster teamwork, and promote critical thinking at age-appropriate levels. In order to ensure that all students, especially those from low-income families, have equal access to educational materials, early childhood education programs should make this a top priority. Some examples of such initiatives include the provision of classroom technology, the renovation of existing school and nursery facilities, and the extension of high-speed Internet connection to disadvantaged areas. To bridge the digital gap, lawmakers should subsidise internet and equipment for low-income families.

Digital content and instructional technology solutions for preschool and kindergarten should be developed and disseminated using quality assurance approaches. Preschool digital learning tools may need to be developed and evaluation criteria may need to be established. In order to set technology standards for ECE, lawmakers should work with educators, researchers, and business moguls. Programs that educate parents on how to limit their children's screen time and act responsibly online should be supported by policymakers. To help parents educate their children at home, we can shed light on the pros and cons of using technology in preschool. Online materials, seminars, and workshops all fall under this category. In order to educate young children safe digital habits, lawmakers should promote collaboration between families, daycares, and schools [9].

OBJECTIVES

1. To investigate how daily screen usage affects many areas of developmental health in Indian preschool-aged children.
2. To examine the connection between early childhood excessive screen use and sociodemographic characteristics.

RESEARCH METHODOLOGY

Participants:

An observational study was conducted in 2023–2024 in Delhi, Maharashtra, and Tamil Nadu using STROBE reporting criteria[10]. The sample includes 3,000 public and private preschoolers. The youngsters averaged 5.1 years old with a standard deviation of 0.4 and were 52% male. Halfway through the school year, preschool teachers gave developmental assessments, and when their children entered school, parents were invited to fill out a demographic and behavioural survey[11].

Measures:

- **Screen Time:** Each day, parents reported how much time their kid spent in front of screens (TV, tablets, mobile phones, computers) during the previous six months. Criteria used to classify responses were as follows: ≤ 1 hour and >1 hour, according to national paediatric recommendations[12].
- **Developmental Health:** A modified Indian Early Childhood Development Index (ECDI) assessed physical health, social competence, emotional maturity, language and cognition, and communication skills.
- **Covariates:** Covariates were derived from the parent questionnaire and included things like amount of sleep, frequency of physical activity, gender, family income, and whether the respondent lived in an urban or rural area[13].

Procedure:

It was a requirement of the registration process that students' screen usage and the behaviours that were related with it be documented[14]. During the month of January 2024, data on development was gathered from teachers via the use of organised observation measures while they were participating in activities in the classroom. The confidentiality of the data was ensured, and parental consent was obtained after being informed.

Statistical Analysis:

Both descriptive statistics and chi-square tests were used in order to investigate the relationship between screen time and income level[15]. In order to examine the connections between screen time and developmental outcomes, logistic regression models with covariate adjustments were used[16]. It was necessary to employ multiple imputation in situations when there was a lack of data. With the assistance of SPSS version 26, the data was examined.

Table 1: Demographics and Health Behaviours of Indian Preschoolers (N = 3000)[17].

Variables	Total Sample N (%)
Explanatory Variables (Parent Report)	
Screen Time	
– > 1 hour	1194 (39.8%)
– ≤ 1 hour	1755 (58.5%)
– Missing	51 (1.7%)
Sex	
– Male	1560 (52.0%)
– Female	1440 (48.0%)
Ethnicity	
– General/Caste Hindu	1590 (53.0%)
– Non-General (SC/ST/OBC/Minorities)	1095 (36.5%)
– Missing	315 (10.5%)
Annual Family Income	

– < ₹6,00,000 (Low to Middle Income)	816 (27.2%)
– ≥ ₹ 6,00,000 (Upper Middle/High Income)	1701 (56.7%)
– Missing	483 (16.1%)
Population Centre	
– Urban	1620 (54.0%)
– Semi-urban / Rural	1380 (46.0%)
Physical Activity Participation	
– Non-participant	534 (17.8%)
– Participant	2406 (80.2%)
– Missing	60 (2.0%)
Sleep Duration	
– < 10 hours	294 (9.8%)
– ≥ 10 hours	2652 (88.4%)
– Missing	54 (1.8%)
Developmental Health Outcomes (Teacher Report)	
Physical Health & Well-being	
– Not Vulnerable	2535 (84.5%)
– Vulnerable	321 (10.7%)
– Missing	144 (4.8%)
Social Competence	
– Not Vulnerable	2475 (82.5%)
– Vulnerable	378 (12.6%)
– Missing	147 (4.9%)
Emotional Maturity	
– Not Vulnerable	2421 (80.7%)
– Vulnerable	429 (14.3%)
– Missing	150 (5.0%)
Language & Cognitive Development	
– Not Vulnerable	2595 (86.5%)
– Vulnerable	246 (8.2%)
– Missing	159 (5.3%)
Communication Skills	
– Not Vulnerable	2559 (85.3%)
– Vulnerable	297 (9.9%)
– Missing	144 (4.8%)

RESULT

Screen Time and Family Income

Research indicates a negative correlation ($\chi^2 = 25.8$, $df = 1$, $p < 0.001$) between a family's financial status and young children's screen time daily. While the recommended daily screen time limit is one hour, children from low-income homes are more likely to exceed it. Over half of low-income children (46.6%) spent more than an hour a day on screens, while over half (53.4%) spent less. Of 1,701 children from households earning > ₹6,00,000, only 1,007 (35.7%) exceeded one hour of screen time daily, while 1,094

(64.3%) adhered to the recommended limit. The financial disparity in screen time is considerable; low-income youngsters are more likely to exceed prescribed limits.

Bivariate Analysis Findings

Over an hour of screen usage each day was associated with an increased risk of developmental vulnerabilities in all five areas[20]. In addition, we noticed several patterns:

- Girls were less likely to be victims than boys.
- Developmental vulnerability was greater for children from low-income homes compared to those from better-income families, and it was much higher for children from non-General social categories (SC/ST/OBC/minority) than for children from General category families[21].
- The risk was higher for kids who didn't engage in organised physical exercise.
- Compared to children who had a full night's sleep (≥ 10 hours), those who slept for less than that were at a higher risk of vulnerability.

Table 2: Preschool-Aged Children in India: Bivariate Correlations Between Explanatory Factors and Vulnerability in Five Areas of Developmental Health[22].

Variables	Physical Health & Well-being OR (95% CI)	Social Competence OR (95% CI)	Emotional Maturity OR (95% CI)	Language & Cognitive Dev. OR (95% CI)	Communication Skills OR (95% CI)
Screen Time					
> 1 hour	1.86*** (1.46 – 2.37)	1.78*** (1.43 – 2.23)	1.62*** (1.31 – 1.99)	1.93*** (1.47 – 2.52)	1.74*** (1.35 – 2.23)
≤ 1 hour (Ref.)	Reference	Reference	Reference	Reference	Reference
Sex					
Male	1.80*** (1.40 – 2.30)	2.85*** (2.24 – 3.63)	3.13*** (2.48 – 3.95)	1.40* (1.07 – 1.83)	1.93*** (1.49 – 2.50)
Female (Ref.)	Reference	Reference	Reference	Reference	Reference
Ethnicity					
General Caste	0.91 (0.70 – 1.18)	0.75* (0.59 – 0.94)	1.11 (0.89 – 1.39)	0.61** (0.45 – 0.82)	0.40*** (0.30 – 0.53)
SC/ST/OBC/Minorities (Ref.)	Reference	Reference	Reference	Reference	Reference

Annual Household Income					
< ₹6,00,000	2.20*** (1.68 – 2.89)	2.06*** (1.61 – 2.64)	1.77*** (1.41 – 2.23)	2.81*** (2.09 – 3.76)	2.26*** (1.66 – 3.08)
≥ ₹ 6,00,000 (Ref.)	Reference	Reference	Reference	Reference	Reference
Population Centre					
Urban	0.84 (0.63 – 1.12)	1.01 (0.76 – 1.35)	0.84 (0.63 – 1.11)	0.81 (0.60 – 1.08)	1.43* (1.07 – 1.90)
Semi-urban / Rural (Ref.)	Reference	Reference	Reference	Reference	Reference
Physical Activity					
Nonparticipant	2.79*** (2.14 – 3.65)	2.14*** (1.66 – 2.75)	1.88*** (1.47 – 2.41)	2.73*** (2.03 – 3.65)	2.65*** (2.01 – 3.50)
Participant (Ref.)	Reference	Reference	Reference	Reference	Reference
Sleep Duration					
< 10 hours	1.68** (1.19 – 2.38)	1.79*** (1.31 – 2.46)	1.88*** (1.39 – 2.53)	2.21*** (1.54 – 3.16)	2.12*** (1.51 – 2.97)
≥ 10 hours (Ref.)	Reference	Reference	Reference	Reference	Reference

Multivariable Regression Results

Indian preschoolers whose daily screen time exceeded an hour were shown to be more prone to developmental vulnerabilities in an adjusted logistic regression study compared to those whose screen time was one hour or less[23]. Sex, family income, caste/ethnic origin, urban or semi-urban domicile, physical activity levels, and sleep duration were among the important confounding variables that remained constant after these correlations were controlled for. Here are the revised results:

- Well-being and physical health: OR = 1.41; 95% CI: 0.99–2.00; p = 0.058
- Social competence: p = 0.004; OR = 1.60; 95% CI: 1.16–2.20
- Emotional maturity: 95% CI: 0.96–1.73; p = 0.097; OR = 1.29
- Cognitive and language development: 95% OR = 1.81 2.74; p = 0.006; CI: 1.19
- Communication abilities: 95% OR = 1.60 2.34–1.10; p = 0.015

Importantly, screen time did not significantly correlate with family income, demonstrating that screen addiction's negative impacts on children's early development were equivalent regardless of socioeconomic level. These findings emphasise the need for age-appropriate screen usage in India, regardless of socioeconomic status[24].

Table 3: Five Developmentally Vulnerable Domains in Indian Preschoolers Affected by Screen Time[25].

Variable	Physical Health & Well-being OR (95% CI)	Social Competence OR (95% CI)	Emotional Maturity OR (95% CI)	Language & Cognitive Development OR (95% CI)	Communication Skills OR (95% CI)
Screen Time					
> 1 hour	1.41 [†] (0.99–2.00) ¹	1.60** (1.16–2.20)	1.29 [†] (0.96–1.73) ²	1.81** (1.19–2.74)	1.60* (1.10–2.34)
≤ 1 hour (Ref.)	Reference	Reference	Reference	Reference	Reference
Sex					
Male	1.73*** (1.34–2.23)	2.83*** (2.21–3.63)	3.13*** (2.47–3.96)	1.36* (1.03–1.79)	1.95*** (1.49–2.55)
Female (Ref.)	Reference	Reference	Reference	Reference	Reference
Ethnicity					
General Category	1.12 (0.84–1.49)	0.88 (0.68–1.13)	1.08 (0.84–1.38)	0.77 (0.56–1.06)	0.49*** (0.36–0.66)
SC/ST/OBC/Minorities	Reference	Reference	Reference	Reference	Reference
Household Income					
< ₹6,00,000	1.55* (1.03–2.31)	1.89** (1.32–2.70)	1.42* (1.02–1.98)	2.42*** (1.56–3.77)	1.98** (1.27–3.10)
≥ ₹ 6,00,000 (Ref.)	Reference	Reference	Reference	Reference	Reference
Population Centre					
Urban	0.92 (0.67–1.27)	1.02 (0.77–1.36)	0.86 (0.66–1.14)	0.83 (0.62–1.11)	1.42* (1.07–1.88)
Rural/Semi-Urban (Ref.)	Reference	Reference	Reference	Reference	Reference
Physical Activity					

Nonparticipant	2.20*** (1.66–2.92)	1.68*** (1.28–2.20)	1.52** (1.17–1.99)	1.99*** (1.46–2.70)	2.12*** (1.57–2.87)
Participant (Ref.)	Reference	Reference	Reference	Reference	Reference
Sleep Duration					
< 10 hours	1.43† (0.99–2.05)	1.51* (1.08–2.12)	1.71** (1.25–2.36)	1.69** (1.15–2.48)	1.63** (1.14–2.33)
≥ 10 hours (Ref.)	Reference	Reference	Reference	Reference	Reference
Screen Time × Income	1.31 (0.78–2.19)	0.87 (0.53–1.40)	1.21 (0.76–1.95)	0.77 (0.43–1.38)	0.72 (0.40–1.28)

Model Refinement and Sensitivity Analysis

Screen time significantly affected physical health and well-being when income interaction factor was eliminated. Emotional maturity was significantly related to Sensitivity analysis and a complete case sub-sample confirmed the durability of these results[26]. Additionally, linear regression models with continuous outcome ratings yielded consistent and statistically significant outcomes.

DISCUSSION

According to the findings of this study conducted in India, children who used screens for longer than the daily recommended limit were more likely to have developmental vulnerabilities. Problems with physical health, social competence, emotional maturity, language and cognitive development, and communication abilities were more common among children whose screen use exceeded one hour daily[27]. There was evidence linking this to the onset of these disorders earlier than expected. These correlations were shown to exist even after adjusting for a variety of characteristics, such as geography (urban vs rural), income, gender, the amount of sleep an individual gets, and physical activity. In addition to the findings of earlier studies, our investigation makes a contribution to the growing body of national and international literature that warns about the risks associated with excessive screen time throughout the formative years of a person's life[28]. Previous studies conducted in India have shown that children's exposure to screen time has a negative impact on their cognitive development, their ability to interact with others, and their ability to maintain emotional control. Through the examination of several facets of developmental health within the framework of India's socioeconomic environment, the current research takes a holistic approach that incorporates the concept of the "whole child[29]."

It was discovered that almost forty percent of the children in our sample were spending on average more than one hour each day in front of a screen. This new phenomenon is a reflection of the fact that mobile phones, tablets, and televisions are becoming more widespread in contemporary Indian households. A significant factor that has contributed to this trend is the widespread use of digital learning tools both during and after the COVID-19 outbreak. The limits between good digital engagement and excessive, unsupervised screen time have become more blurry as a result of our dependency on technology for both pleasure and early education[30]. There was an association between the amount of time that youngsters spent in front of screens that exceeded the advised limits and the degree of financial stability that their

families had. As a result of budgetary restrictions, a significant number of families in India with low incomes are turning to screens as a low-cost alternative to structured play, high-quality nursery and educational possibilities for their children. While there are some educational benefits linked with screen time, there are also developmental difficulties that are related with exposure to screens for lengthy periods of time and without supervision[31]. The results of our study are in contrast to the findings of other researchers from all over the globe who have shown a connection between financial resources and the outcomes of developmental processes. It would seem that individuals from all areas of life are susceptible to the negative consequences that are associated with spending an excessive amount of time in front of screens.

It is possible that children who spend an excessive amount of time in front of screens would lose out on crucial experiences that are beneficial to their health, such as playing outdoors, connecting with actual people, getting adequate sleep, and using their imaginations[32]. In order for them to be prepared for school and for their general growth, these things are essential. The fact that increasing the amount of time spent in front of screens often comes at the price of contact between parents and children is another factor that undermines emotional connection and language acquisition. The findings of this observational research indicate that the use of screens by young children should be controlled by parental supervision, awareness campaigns, and policy-level measures[33]. However, the study cannot establish that there is a cause and effect link between the two. It is also vitally need to do longitudinal research in India in order to evaluate the impact of early digital exposure on developmental outcomes and to locate culturally suitable digital solutions that may augment early learning rather than hinder it.

CONCLUSION

Technology use in preschool and kindergarten is complicated and has both positive and negative aspects, according to one research. While it's true that technology may help students learn, research shows that kids' physical health, emotional development, social skills, linguistic skills, and cognitive abilities are all negatively impacted by long amounts of unsupervised screen usage. According to this poll conducted in India, forty percent of preschoolers exceed the daily recommended screen time. Overexposure is particularly common among men from low-income families. The detrimental developmental impacts are often prevalent and cause for worry, regardless of demographic disparities. Finding a happy balance is essential as technology becomes more embedded in India's educational institutions, especially primary and secondary schools. For well-rounded development, screen-based learning should be supplemented with active play, social engagement, and parental involvement. It is critical that lawmakers, schools, and parents all acknowledge the seriousness of children's screen usage immediately. Help young children learn to use technology by establishing rules, promoting screen-free routines, and highlighting engaging digital material that is age-appropriate.

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