



**The effect of increased screen time on early childhood development and its
association to increased dysfunction in educational systems: A scoping review**

Submitted by Silvia Maarschalk

Student Number: 201501238

**Thesis submitted in fulfilment of the requirements for the degree of
Masters of Social Science (Counselling Psychology)**

**In the
DISCIPLINE OF COUNSELLING PSYCHOLOGY
School of Sciences, College of Humanities, University of KwaZulu-Natal,
Pietermaritzburg, South Africa.**

November 2025

**Supervised by
Dr Adele Munsami**

Declaration

I, Ms Silvia Maarschalk, declare that

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
3. This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
4. This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:
 - a. Their words have been rewritten, but the general information attributed to them has been referenced
 - b. Where their exact words have been used, then their writing has been placed in italics and inside quotation marks and referenced.
5. This thesis does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source is detailed in the thesis and in the References sections.

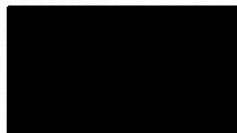
Name: Silvia Maarschalk (201501238)

Supervisor name: Dr Adele Munsami

Date: 12 November 2025

Date: 12 November 2025

Signature:



Signature:



AI Declaration

Use of Generative AI Tools:

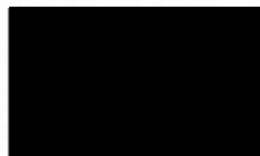
I acknowledge that generative AI tools were used during the preparation of this thesis in the following ways:

- a) Language editing and proofreading: I used Grammarly (2025) and Claude 3.5 to assist with grammar, style refinement, and clarity improvements.

In all cases, AI-generated suggestions were critically reviewed, edited, and evaluated to ensure accuracy, appropriateness, and originality. Where applicable, references were added for any ideas or text influenced by external sources.

I affirm that the intellectual content and scholarly contributions of this thesis remain my own, and all AI usage complied with the ethical and academic standards of the University of KwaZulu-Natal.

Signature:

A black rectangular box redacting the signature.

Date: 12 November 2025

ABSTRACT

Although non-compliance with screen time guidelines is widespread globally, developmental outcomes are not uniformly adverse. Instead, they depend on content quality, use context, and child-specific factors. This thesis explores these contingencies through a systematic evidence synthesis and their implications for South African early childhood policy and practice.

A scoping review of peer-reviewed articles was conducted, and the results were analysed using a thematic synthesis. Eight databases were searched between March and May 2025, including Google Scholar, PubMed, EBSCO, JSTOR, Wiley Online Library, ScienceDirect, SAGE Journals, and SpringerLink. In total, 3778 records were retrieved, of which 94 studies met the inclusion criteria and were included in the final synthesis. Findings highlight a 'context paradox': all infants and 57.5% of preschoolers exceeded screen time guidelines, yet outcomes were shaped more by content and co-viewing than by duration alone. Passive, entertainment-driven screen use was associated with adverse effects, while moderate (30–60 minutes daily) educational content with active co-viewing provided protective benefits. Social-emotional development emerged as the most sensitive domain, with executive function mediating 54% of screen time's total effect on behavioural difficulties. The first three years were identified as a critical period of vulnerability. However, protective factors (moderate duration, educational content, and active co-viewing) can buffer against harm, making adverse outcomes contingent rather than inevitable. Though South African research remains limited, culturally grounded co-viewing practices offer practical insights for resource-constrained settings. To translate global evidence into local action, early childhood policies must reflect the realities of South African families and be informed by locally grounded research. This thesis supports screen optimisation rather than elimination and outlines key protective factors for screen viewing in early childhood. Integrating these into

national curricula, supported by longitudinal research, may bridge the evidence-to-practice gap and support healthier, context-sensitive screen use in early childhood.

TABLE OF CONTENTS

ABSTRACT	iv
TABLE OF CONTENTS	vi
ABBREVIATIONS	xiv
LIST OF TABLES	xv
LIST OF FIGURES	xvi
ACKNOWLEDGEMENTS	xvii
CHAPTER ONE	1
INTRODUCTION	1
1.1 Introduction	1
1.2 Background to the research problem.....	1
1.3 Rationale for the study	4
1.4 Aims and objectives of the study	5
1.4.1 Aim.....	5
1.4.2 Objectives.....	5
1.5 Research questions.....	6
1.6 Definition of key terms operationalised in this study	7
1.7 Outline of the dissertation	9
1.8 Conclusion	10
CHAPTER TWO	11
LITERATURE REVIEW.....	11

2.1 Introduction	11
2.2 Early childhood development: The critical foundation.....	12
2.3 The digital age: Transforming childhood.....	12
2.4 Defining and measuring screen time.....	13
2.4.1 Defining screen time	13
2.4.2 Device-specific considerations.....	13
2.4.3 Content quality and viewing context	14
2.4.4 Measurement and validation challenges	14
2.5 Screen time guidelines and global compliance crisis.....	15
2.6 Critical periods and age-specific vulnerabilities	16
2.6.1 Age-specific vulnerabilities	16
2.6.2 Neuroimaging evidence	17
2.6.3 Timing effects	17
2.6.4 Displacement mechanisms	17
2.7 Developmental domain vulnerabilities	18
2.7.1 Social-emotional development and displacement mechanisms	18
2.7.2 Cognitive development and executive function impairments	19
2.7.3 Language and communication development.....	19
2.7.4 Physical development and health	20
2.7.5 Domain integration and protective factors	21
2.8 School readiness and educational implications.....	21

2.9 South African context and research gaps	23
2.9.1 Limited local evidence base and emerging research.....	23
2.9.2 Under-representation of low-resource contexts	24
2.9.3 Digital equity and infrastructure disparities.....	24
2.9.4 Multilingual and cultural context gaps.....	25
2.9.5 Policy implementation challenges.....	25
2.9.6 Environmental and safety moderators.....	26
2.9.7 Research design and methodological needs	26
2.10 Theoretical framework: developmental systems perspective	26
2.10.1 Developmental systems and ecological foundations.....	27
2.10.2 Cognitive-developmental perspectives	28
2.10.3 Relational and affective frameworks	29
2.10.4 Media-specific engagement frameworks	29
2.10.5 Integration: A systemic approach.....	30
2.11 Summary and research justification	31
CHAPTER THREE.....	33
METHODOLOGY.....	33
3.1 Introduction.....	33
3.2 Methodological approach.....	33
3.2.1 Scoping review framework	33
3.3 Scoping review procedures	34

3.3.1 Step 1: Identifying the research question	34
3.3.2 Step 2: Identifying relevant studies	35
3.3.3 Step 3: Inclusion and exclusion criteria	36
3.3.4 Step 3: Study selection process	38
3.3.5 Step 4: Data charting	40
3.3.6 Step 5: Collating, summarising, and reporting the results	42
3.4 Rigour and validity	43
3.5 Ethical considerations	44
3.6 Conclusion	45
CHAPTER FOUR	46
RESULTS	46
4.1 Introduction	46
4.2 Descriptive overview of included studies	46
4.2.1 Population representation: who was studied?	47
4.2.2 Screen time measurement: how was exposure assessed?	48
4.2.3 Screen time: How was it defined, measured, and reported?	48
4.2.4 Screen time exposure and compliance with international guidelines	49
4.3 Developmental domains	50
4.4 Research Question 1: Exceeding screen time recommendations and developmental vulnerability	50
4.4.1 Exposure patterns and vulnerability thresholds	50

4.4.2 Thematic findings: Vulnerability patterns emerging across developmental domains	51
4.5 Research Question 2: Screen exposure and learning challenges in educational settings	53
4.5.1 Theme 6 Foundational capacities undermined by excessive screen time ...	53
4.5.2 Theme 7 Direct Assessment of School Readiness and Academic Outcomes	54
4.6 Research Question 3 and 4: South African Research Gaps and Contextual Recommendations for Educational Settings	55
CHAPTER 5	57
DISCUSSION	57
5.1 Introduction	57
5.2 Developmental vulnerability across domains	58
5.2.1 The scale of non-compliance: A global crisis	58
5.2.2 Dose-response relationships and critical period vulnerability: Non-linear risk acceleration	59
5.2.3 Screen-linked self-regulation and behavioural vulnerabilities.....	61
5.2.4 Cognitive, language, and developmental pathways of screen exposure	63
5.2.5 Motor development and physical health disruption.....	65
5.2.6 Content type, co-viewing context, and quality as moderators of vulnerability	67
5.3 Screen exposure and learning challenges in educational settings.....	68

5.3.1 Executive function as the primary mediating mechanism	68
5.3.2 Direct school readiness deficits.....	70
5.3.3 Content type as a critical moderator of school readiness	70
5.3.4 Bidirectional relationships between screen time and self-regulation.....	71
5.3.5 Implications for South African classrooms.....	72
5.4 South African context, evidence gaps, and protective factors	75
5.4.1 The critical evidence gap: Absence of South African research	75
5.4.2 Low-SES populations as contextual proxies: Mirroring South African realities.....	76
5.4.3 Protective factors from low-SES research: Evidence-based pathways for South Africa.....	78
5.4.4 Tailored recommendations for South African educational settings.....	80
5.4.5 Policy integration: Filling the gap between evidence and practice.....	83
5.4.6 Building local evidence: Priorities for South African research	85
5.4.7 Toward screen optimisation rather than elimination.....	85
5.5 Theoretical Integration: Why context and content matter.....	87
5.5.1 Developmental systems theory: Beyond simple dose-response	87
5.5.2 Vygotsky's zone of proximal development and active co-viewing as scaffolded learning.....	87
5.5.3 Displacement Theory: Understanding why language, motor, and sleep outcomes suffer	88

5.5.4 Uses and Gratifications Theory and Digital Equity: Explaining why restriction alone cannot work in South African contexts	89
5.6 Methodological Limitations	90
5.6.1 Search strategy and conceptual scope limitations	91
5.6.2 Critical evidence gap: South African research exclusion	92
5.6.3 Data access and grey literature limitations.....	92
5.6.4 Quality assessment and interpretive constraints	93
5.6.5 Contextual and temporal biases	93
5.6.6 Scoping review methodology as an iterative process	94
5.6.7 Summary of limitations as direction for future research.....	94
5.7 Conclusion and future directions	95
5.7.1 Discussion synthesis of key takeaways.....	95
5.7.2 South African policy gap and integration imperative	95
5.7.3 Toward screen optimisation: Protective factors and individual differences	96
5.7.4 Closing: From evidence to contextually responsive practice.....	96
CHAPTER SIX	98
CONCLUSION	98
6.1 Reprise of aim and scope	98
6.2 Synthesis of key findings: Answering the research questions	98
Research question 1: The context paradox.....	98
Research question 2: Executive function as a mediating pathway	98

Research question 3: The South African evidence gap and policy imperative....	99
Research question 4: Screen optimisation as a feasible pathway	99
6.3 Implications and Future Directions.....	100
6.4 Closing Perspective.....	100
References	101
Appendices.....	136
Appendix A	136
Chapter 3 Methodology Tables.....	136
Appendix B	148
Exemption of Ethics Review Letter	148
Appendix C	149
Chapter 4 Results Tables.....	149
Appendix D	169
Turnitin Similarity Report.....	169

ABBREVIATIONS

APP:	American Academy of Paediatrics
ADHD:	Attention-Deficit/Hyperactivity Disorder
CPS:	Canadian Paediatric Society
DST:	Developmental Systems Theory
ECD:	Early childhood development
HSSREC:	University of KwaZulu-Natal Human and Social Sciences Research Ethics Committee
JME:	Joint Media Engagement
PCC:	Population Concept Context
PRISMA-ScR:	Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews
SES:	Socio-Economic Status
WHO:	World Health Organisation
ZPD:	Zone of Proximal Development

LIST OF TABLES

Table A1 *Primary PCC-aligned search terms*

Table A2 *Secondary search terms using PCC elements*

Table A3 *Search Strategies and Yields for Electronic Databases (Dates Accessed: March - May 2025)*

Table 4 *Criteria for Inclusion and Exclusion of Studies*

Table A5 *Full-text articles excluded and reasons for exclusion*

Table 6 *Charting of Data Using a Narrative Review Approach*

Table C7 *Combined Summary Table of Study Characteristics by Age Group*

Table C8 *Summary of Screen Time Reporting Formats Used Across Included Studies (N = 94)*

Table C9 *Breakdown of Screen Content Typologies Reported Across Included Studies*

Table C10 *Vulnerability Patterns Emerging Across Developmental Domains*

Table C11 *Summary of Evidence Linking Screen Time to Impairment of Foundational Capacities for School Readiness*

Table C12 *Summary of Evidence on Screen Time, School Readiness, and Academic Outcomes*

Table C13 *Screen Exposure Risks in Low-SES Contexts: Mechanisms of Vulnerability Relevant to South African Early Childhood Environments (Themes 8–12)*

Table C14 *Protective Factors and Intervention Points in Low-SES Populations (Theme 13) Evidence-Based Pathways to Attenuate Developmental Risk*

LIST OF FIGURES

Figure 1 PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews)

ACKNOWLEDGEMENTS

I want to express my sincere gratitude to all those who have supported me throughout the course of this research and the completion of my master's thesis.

Firstly, I would like to extend my heartfelt thanks to Sihle Mamutse, whose unwavering support throughout this process has been invaluable. Her assistance with academic research provided essential practical support, enabling me to persevere. I am especially grateful for her consistent encouragement and the generous contribution of her time and expertise.

A special note of appreciation goes to my supervisor, Dr Adele Munsami, for her patience, guidance, and steadfast support. Her encouragement throughout this research journey has been deeply appreciated.

I would also like to sincerely thank my Counselling Master's internship supervisor, Shelley Barnsley, for her ongoing encouragement and support. Her belief in my ability to complete this work, even during the most challenging moments, played a meaningful role in helping me reach this milestone.

Moreover, most especially to my family, thank you for your steady support. To my parents, your belief in me and your continuous encouragement made this journey possible. To my children, thank you for your patience and understanding as I pursued and completed this important milestone.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Over 95% of households globally now own mobile devices, with many young children accessing screens before their first birthday (Mallawaarachchi, Anglim, Hooley, & Horwood, 2022). This widespread use of digital technology is rapidly reshaping how children play, communicate, and learn, prompting growing concerns about developmental impacts among educators, caregivers, and policymakers (Mallawaarachchi et al., 2022; Rathnasiri, Rathnayaka, Yasara, & Mettananda, 2022).

Over the past two decades, the rapid integration of digital technology into everyday life has dramatically altered how young children interact with their environments (Radesky & Christakis, 2016). Devices such as smartphones, tablets, and televisions are increasingly common in homes and early childhood settings (Draper et al., 2020). As a result, children are increasingly exposed to screen-based media during key developmental windows (Lin et al., 2020; Rocha et al., 2023; Zhang et al., 2022).

1.2 Background to the research problem

The rapid transformation of early childhood media environments is now considered a global developmental crisis (Rideout, Foehr, & Roberts, 2010). Neurobiological evidence shows that excessive screen exposure during sensitive periods can alter brain architecture and developmental pathways (Lin et al., 2020; Rocha et al., 2023; Mallawaarachchi et al., 2022). Screen time among young children has nearly doubled over the past two decades (Radesky & Christakis, 2016), and the COVID-19 pandemic accelerated the integration of digital technologies into early learning (Joseph et al., 2022).

Recent data show widespread non-compliance with global screen time guidelines (Brauchli et al., 2024). In Sri Lanka, 96% of preschoolers use electronic devices, and 60% exceed the WHO's ≤ 1 -hour daily recommendation for ages 2–5 (Rathnasiri et al., 2022). In South Africa, 68% of children aged 0–5 exceed these limits, averaging 1.6 hours daily (Prioreschi & Norris, 2022; Simuja et al., 2024). Despite WHO and national guidelines recommending zero screen time for children under two, over half of South African children begin using screens before two, with up to 65% exposed before 18 months in urban areas (Tomaz et al., 2020; Prioreschi & Norris, 2022). These trends mirror international patterns across diverse socioeconomic settings (Radesky & Christakis, 2016).

Non-compliance is especially concerning during early childhood, a period of heightened neuroplasticity when brain architecture is susceptible to environmental stimuli (Knudsen, 2004; Canadian Paediatric Society [CPS], 2017; Hutton et al., 2022). These violations suggest existing guidelines may be inadequate in addressing the complex realities families face, while pointing to population-level developmental risks that require systematic investigation (Brauchli et al., 2024).

The first three years are a critical neurodevelopmental window during which environmental exposure significantly influences brain development (Knudsen, 2004; CPS, 2017; Hutton et al., 2022). Screen exposure before age two is consistently associated with deficits in emotional regulation, attention, and executive function (Rathnasiri et al., 2022; Mallawaarachchi et al., 2022). Excessive use during this stage is linked to cascading developmental vulnerabilities (Brauchli et al., 2024). Dose-response associations are evident: preschoolers with over one hour of weekday screen time have 1.8 times higher odds of ADHD symptoms (Zhou et al., 2023), and each additional hour of daily screen exposure at age three and a half is associated with a measurable decline in verbal IQ by age five and a

half (Yang et al., 2024). Early use of smartphones and tablets also correlates with reduced prosocial behaviour and increased peer difficulties (Mallawaarachchi et al., 2022).

These psychosocial risks are further compounded by displacement mechanisms that replace essential parent-child interactions and unstructured play. Both are vital for healthy development. Displacement disrupts co-regulated learning and embodied exploration, with screen use exceeding two hours daily linked to cognitive, social, and behavioural impairments (Brauchli et al., 2024; Rocha et al., 2023; Tekin & Alpgan, 2023)

The impact of excessive screen use extends into educational settings. Studies show it disrupts foundational competencies needed for school readiness (Vanderloo et al., 2022; Tekin & Alpgan, 2023). Research links early digital exposure to diminished academic performance, attention issues, and classroom behaviour concerns (Pagani et al., 2013; Harmon, 2022; Yang et al., 2024; Przybylski et al., 2020). Although these are well-documented globally, they require local investigation. South Africa's educational landscape is shaped by overcrowded classrooms, limited resources, and significant linguistic diversity (Simuja et al., 2024). These factors may influence how screen exposure affects young children.

Excessive screen use in early childhood is associated with executive function deficits, inattention, and poor self-regulation. These skills are essential for classroom learning (Zhou et al., 2023; Yang et al., 2024; Danet et al., 2022). In South Africa, these issues are exacerbated by overcrowding, understaffing, and limited resources, further disrupting classroom dynamics and learning outcomes (Tomlinson et al., 2019). Despite some recent progress, South African research on early screen exposure remains fragmented. This lack of comprehensive evidence creates uncertainty about the relevance and applicability of international findings to local contexts.

This study adopts a systems-based perspective to explore how screen exposure affects early development in under-resourced environments. It is grounded in Developmental Systems Theory (DST) (Feldman et al., 2023), supported by media and cognitive-developmental frameworks that reflect the complexity of early childhood development.

1.3 Rationale for the study

Early childhood is a critical period of brain development, marked by heightened neuroplasticity and rapid acquisition of core skills in language, cognition, motor coordination, and emotional regulation (Knudsen, 2004; CPS, 2017; Hutton et al., 2022). Environmental inputs during these sensitive windows shape neural architecture by reinforcing synaptic connections and directing developmental trajectories (Knudsen, 2004; Hutton et al., 2022).

Increasing evidence links excessive screen exposure during this period to disruptions in attention, executive function, and social cognition (Rathnasiri et al., 2022; Mallawaarachchi et al., 2022). As global screen time among young children rises, concerns about its long-term developmental effects have intensified (Chen & Adler, 2020; Brauchli et al., 2024).

The American Academy of Paediatrics (AAP) and the World Health Organisation (WHO) recommend no screen time for children under 2 years old. For children aged 2 to 5, they advise a maximum of one hour per day (American Academy of Paediatrics [AAP], 2016; World Health Organisation [WHO], 2019). However, few follow these guidelines. About 97% of children aged 0 to 4 have used mobile devices. Some researchers refer to this as a global compliance crisis (Radesky & Christakis, 2016).

In South Africa, 68% of children aged zero to five exceed WHO guidelines, averaging 1.6 hours of screen use daily (Prioreschi & Norris, 2022; Simuja et al., 2024). Urban children show consistently higher screen exposure than rural peers, highlighting socio-geographic

disparities (Prioreshi & Norris, 2022). While international literature has expanded, it remains skewed toward high-income Western contexts, limiting its applicability across diverse settings.

This study responds to the limited and fragmented nature of local research by synthesising global evidence on screen time and its developmental and educational implications, while identifying context-specific gaps relevant to South African children. By situating international findings within local sociocultural and infrastructural realities, the study aims to inform culturally responsive research, policies, and interventions for early childhood development in South Africa.

1.4 Aims and objectives of the study

1.4.1 Aim

The overarching aim of this study is to critically assess the impact of increased screen time on early childhood development and classroom functioning as described in existing literature. It focuses on synthesising international research findings while integrating available South African evidence to address gaps specific to the South African context. By offering evidence-based insights, the study seeks to assist South African professionals and caregivers in enhancing early childhood development and improving functionality and learning in early years educational settings.

1.4.2 Objectives

The study objectives are as follows:

1. To comprehensively review, map and analyse existing literature on how exceeding daily screen time recommendations is associated with developmental vulnerability across cognitive, social-emotional, language, and physical domains during early childhood.

2. To review and examine how increased screen exposure relates to learning challenges in educational settings, with particular attention to school readiness and classroom functioning implications.
3. To identify what gaps exist in South African research on screen time and early childhood development, and determine how professionals can be better informed about evidence-based practices.
4. To synthesise key recommendations from existing literature that can inform South African educational contexts, accounting for unique cultural, linguistic, and socioeconomic considerations.

1.5 Research questions

This study is guided by the following four research questions, which align with the comprehensive theoretical framework established in the literature review:

1. How is exceeding daily screen time recommendations associated with developmental vulnerability across key developmental domains in early childhood?
2. How is increased screen exposure associated with learning challenges in educational settings?
3. What gaps exist in South African research on screen time and early childhood development, and how can professionals be better informed?
4. What are the key recommendations for South African educational settings derived from existing literature on screen time and developmental outcomes?

1.6 Definition of key terms operationalised in this study

Screen time:

Screen time refers to the time a child spends using digital devices with screens, such as televisions, tablets, smartphones, and computers. This can be for educational or recreational purposes (World Health Organisation [WHO], 2019).

Early childhood:

Early childhood refers to the developmental period from birth to age 8, marked by rapid growth in cognitive, emotional, motor, and social domains (Knudsen, 2004; Canadian Paediatric Society [CPS], 2017; Hutton et al., 2022).

Neurodevelopment:

Neurodevelopment is the process by which the brain and nervous system grow and mature, particularly during the first 5 years, when environmental inputs can significantly shape long-term cognitive, emotional, and behavioural outcomes (Hutton et al., 2022).

Developmental outcomes:

Developmental outcomes encompass measurable aspects of a child's functioning, including language acquisition, attention, executive functioning, self-regulation, and socio-emotional skills, which may be influenced by early screen exposure (Mallawaarachchi et al., 2022; Yang et al., 2024).

Digital displacement:

Digital displacement refers to the process by which screen use replaces essential developmental activities such as parent-child interaction, physical play, and co-regulated learning, potentially undermining optimal development (Brauchli et al., 2024; Tekin & Alpgan, 2023).

Co-viewing:

Co-viewing is the practice of adults and/or caregivers watching screen content with a child while actively engaging through explanation, dialogue, or shared reflection. This can scaffold learning and mitigate developmental risks (Takeuchi & Stevens, 2011; Yang et al., 2024).

Educational content:

Educational content refers to screen media intentionally designed to support learning, often characterised by age-appropriate language, repetition, socio-emotional themes, and opportunities for interaction (Barr & Linebarger, 2017; Draper et al., 2020).

Executive function:

Executive function is a set of cognitive skills that includes working memory, inhibitory control, and cognitive flexibility. These skills support goal-directed behaviour, emotional regulation, and learning readiness (Diamond, 2013; Rocha et al., 2023).

Socio-economic status:

Socio-economic status (SES) reflects a family's social and economic position, typically measured by income, education, and occupation. SES influences both screen use patterns and access to protective factors in early development (Canaslan-Akyar & Sungur, 2022; Draper et al., 2020).

Screen optimisation:

Screen optimisation is a developmental strategy that prioritises quality, context, and balance of screen use. It focuses on educational content, active co-viewing, and time limits rather than blanket restriction or elimination (Karani et al., 2022; Simuja et al., 2024).

Digital equity:

Digital equity refers to fair and meaningful access to digital technology, ensuring that all

children can benefit from educational content and developmentally supportive screen use (Robinson et al., 2015).

1.7 Outline of the dissertation

This dissertation is divided into six chapters, as described in the following sub-sections.

Chapter one: Introduction

This chapter introduces the research problem, rationale, and aims of the study. It outlines the background to the issue of increased screen time in early childhood and its developmental implications, presents the study objectives and research questions, and explains the significance of the research within both global and South African contexts.

Chapter two: Literature Review

This chapter critically reviews existing global and South African literature on early childhood screen exposure. It explores the neurodevelopmental, cognitive, psychosocial, and educational outcomes associated with screen use, and highlights research gaps, especially in low- and middle-income contexts such as South Africa.

Chapter three: Methodology

This chapter outlines the scoping review methodology used in the study. It details the research design, databases searched, inclusion and exclusion criteria, data extraction process, and thematic synthesis approach, ensuring transparency and replicability.

Chapter four: Results

Chapter Four presents the findings of the scoping review in relation to the four research questions. Results are organised by key themes emerging from the included literature, highlighting patterns of screen time exposure, developmental outcomes, and contextual variations across socioeconomic settings.

Chapter five: Discussion of Findings

This chapter interprets the findings presented in Chapter Four, structured around the four research questions. It integrates the results with the study's objectives and theoretical frameworks, compares them with existing literature, and explores their implications for early childhood development in South Africa. The discussion also considers the relevance and applicability of international evidence within local contexts.

Chapter six: Conclusions and recommendations

The final chapter summarises the main findings and provides evidence-based recommendations for policy, early childhood practice, and future research. It emphasises the need for culturally responsive and contextually appropriate interventions to address early screen exposure in South Africa.

1.8 Conclusion

This chapter introduced the study by presenting the background, rationale, aims, and objectives guiding the research. It outlined the growing global and local concerns surrounding increased screen time in early childhood, particularly during sensitive neurodevelopmental periods. The chapter highlighted key evidence linking early and excessive screen exposure to developmental and educational vulnerabilities, with particular concern for the South African context, where research remains fragmented. The research questions and objectives were articulated to guide a scoping review that synthesises international and local literature, aiming to inform contextually relevant interventions and policies. The next chapter critically examines the empirical literature on screen time and its developmental consequences in early childhood.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The early years of childhood represent a critical developmental window marked by heightened neuroplasticity and rapid growth across cognitive, social-emotional, language, and physical domains (Knudsen, 2004; CPS, 2017; Hutton et al., 2022). Over the past two decades, screen time exposure among young children has nearly doubled globally (Chen & Adler, 2020; Madigan & Racine, 2020). International research documents associations between excessive screen exposure and compromised developmental outcomes. These include emotional dysregulation, language delays, and reduced executive functioning (Gastaud et al., 2023; Radesky et al., 2015; Zhang et al., 2022).

However, much of the evidence on early childhood screen exposure comes from high-income countries, limiting its relevance for low- and middle-income contexts. In South Africa, where structural inequities intersect with rising digital access, research remains fragmented across developmental domains. Children average 1.6 hours of daily screen time, with 68% exceeding WHO recommendations (Prioreschi & Norris, 2022; Tomaz et al., 2020). These risks are compounded by poverty, linguistic diversity, and limited caregiver capacity, yet South African-specific data remain scarce (Seiler, 2024).

This chapter synthesises the existing literature on the effects of screen time during early childhood. The review examines four key areas: developmental vulnerabilities across domains, learning implications in educational settings, South African research gaps, and contextual recommendations. The chapter proceeds from foundational developmental concepts to domain-specific vulnerabilities, then to the South African research landscape and theoretical frameworks.

2.2 Early childhood development: The critical foundation

Early childhood, spanning from birth to eight years, is a critical phase marked by exceptional neuroplasticity that lays the foundations for cognitive, emotional, and social capabilities (Nelson & Sheridan, 2011; Hutton et al., 2022). Development operates across four interconnected domains. These are cognitive development (encompassing memory, attention, and executive function), social-emotional development (involving emotional regulation and relationship formation), language and communication development (including receptive and expressive skills), and physical development (involving motor skill acquisition) (Roslan et al., 2022; UNICEF, 2023).

Critically, these domains demonstrate dynamic interdependence. Emotional security facilitates cognitive exploration, and language development enhances social competence (Roslan et al., 2022; Shonkoff & Phillips, 2000). Disruptions in any single domain, whether through environmental deprivation or excessive screen exposure, can compromise holistic development. This is particularly true in low- and middle-income countries where structural constraints amplify developmental risks (Roslan et al., 2022).

2.3 The digital age: Transforming childhood

The fourth industrial revolution has fundamentally transformed childhood experiences through increased digital integration (Karani et al., 2022). Screen time has nearly doubled over the past two decades, with digital devices progressively integrated into family routines (Chen & Adler, 2020; Gastaud et al., 2023). The current generation has been characterised as "digital natives", children born into screen-saturated environments (Radesky & Christakis, 2016).

The COVID-19 pandemic accelerated this integration, normalising digital media as both an educational necessity and a default caregiving tool (Erol, Şimşek, & Işıkoğlu, 2025).

While this transformation creates opportunities for educational access and digital literacy development, it also raises concerns about children's screen use during critical developmental periods. Digital literacy is defined as the ability to effectively use, understand, and critically evaluate digital technologies and information. These evolving patterns necessitate a systematic understanding of the effects of screen exposure during critical developmental windows. This understanding begins with clear definitions and measurement approaches.

2.4 Defining and measuring screen time

Understanding screen time's developmental impacts requires precise definitions and measurement approaches. These approaches must capture the complexity of contemporary digital engagement. This section examines how screen time is conceptualised, classified, and measured. Critical distinctions in these areas influence developmental outcomes.

2.4.1 Defining screen time

Screen time refers to time spent engaging with screen-based devices, including television, tablets, smartphones, and computers, across multiple contexts (home, school, social environments) and encompassing both educational and entertainment applications (Chen & Adler, 2020; Gastaud et al., 2023). In South African contexts, children average three hours daily screen exposure. This exceeds international guidelines by 50% and does not include classroom exposure (Draper et al., 2019).

2.4.2 Device-specific considerations

The type of device children use significantly influences developmental impact. Among preschoolers, television (87%) and smartphones (63%) are the most commonly used devices (Rathnasiri et al., 2022). However, the effects vary considerably. Television use is linked to weaker home literacy practices, whereas computer use tends to show more positive associations (Rathnasiri et al., 2022; Chen et al., 2020).

2.4.3 Content quality and viewing context

The developmental impact of screen time is shaped not only by duration, but also by content type and viewing context, with co-engagement and educational quality acting as key moderators (Joseph et al., 2022; Tekin & Alpgan, 2023). Educational media, such as age-appropriate programming and interactive learning applications, can support vocabulary growth, cultural understanding, and school readiness. These benefits are particularly evident when caregivers co-view with children (Radesky et al., 2015; Tomopoulos et al., 2007).

Longitudinal research demonstrates that viewing educational programs like Sesame Street between ages two and three predicts stronger vocabulary and academic outcomes, especially in low-income settings (Wright et al., 2001). In contrast, entertainment content that is fast-paced, violent, or developmentally inappropriate is linked to attention difficulties, language delays, and behavioural problems (Wright et al., 2001; Zhang et al., 2022).

Even media labelled "educational" offer limited developmental benefit without caregiver mediation. Such media may displace key activities, including shared reading and direct teaching, particularly in under-resourced homes (Tekin & Alpgan, 2023; Tomopoulos et al., 2007). Co-viewing and active caregiver engagement are therefore essential to transform screen time into meaningful learning experiences (Sweetser, Johnson, Ozdowska, & Wyeth, 2012; Radesky et al., 2015; Tomopoulos et al., 2007)

2.4.4 Measurement and validation challenges

Accurately measuring young children's screen exposure remains methodologically challenging. Most studies rely on parent-reported questionnaires. These approaches are practical but vulnerable to recall bias and inconsistent focus on duration, content, or context (Gath, 2023; Kim, 2021; Schwarzer et al., 2022).

More comprehensive tools, such as SCREEN-Q, offer greater insight into exposure patterns (Barr et al., 2020). However, objective methods such as device tracking or time-use diaries, though more precise, face feasibility limitations. Rapid technological change continues to outpace tool validation. Many instruments lack sensitivity to developmental relevance or cultural variation. Standardised, multidimensional measures are therefore needed to address these gaps (Barr et al., 2020; Roslin et al., 2022; Gath et al., 2023).

2.5 Screen time guidelines and global compliance crisis

Global health organisations have established evidence-based guidelines. However, implementation reveals a disconnect between recommendations and practice. The WHO recommends zero screen exposure for children under 12 months and a maximum of 1 hour daily for children aged 2 to 4 years (WHO, 2019). The AAP aligns closely, advising no screen time for children under 18 months and one hour daily for children aged 2 to 5 years with caregiver co-viewing (AAP, 2016).

International consensus on these recommendations spans Australia, Canada, and the United Kingdom (Tremblay et al., 2017; Royal College of Paediatrics and Child Health, 2019). South Africa has adopted these into the national 24-Hour Movement Guidelines. These recommend zero exposure for children under two years and no more than one hour for children ages two to five (Draper et al., 2019).

Despite this international consensus, compliance remains low. 97% of children aged zero to four years have used mobile devices, averaging three hours of daily screen time. This is three times the WHO recommendation (Brauchli et al., 2024; Radesky & Christakis, 2016). In South Africa, 68% of children exceed WHO guidelines, averaging 1.6 hours daily. Urban children are exposed for 1.71 hours compared to 0.45 hours in rural areas (Prioreschi & Norris, 2022; Draper et al., 2019).

Implementation challenges in South Africa are multifaceted. While 70% of families believe television supports literacy development, only 35% co-view with their children. Smartphone penetration reaches 98%, yet 60% of caregivers cite safety concerns that confine children indoors (Prioreschi & Norris, 2022; Karani et al., 2022). Language development vulnerabilities also emerge from exposure patterns. Only 45% of screen time is spent on educational content, while background television is present in 80% of low-socioeconomic-status households, often used as a childminding tool (Karani et al., 2022).

2.6 Critical periods and age-specific vulnerabilities

Early childhood represents a critical period of heightened neuroplasticity, during which the brain is exceptionally responsive to environmental input (Knudsen, 2004; CPS, 2017; Hutton et al., 2022; Nelson & Sheridan, 2011). Neuroplasticity is the brain's capacity to form and reorganise synaptic connections. This capacity operates most robustly during the first years of life, especially in language acquisition, emotional regulation, and executive function (UNICEF, 2023; Zhang et al., 2022).

2.6.1 Age-specific vulnerabilities

Children aged zero to three are especially vulnerable due to peak neuroplasticity (Hutton et al., 2022). Introducing screens between 12 and 18 months is linked to a 20% higher risk of language delays. Virtual input fails to provide the scaffolding offered through interaction within the zone of proximal development (Knudsen, 2004).

The first 18 months represent a particularly sensitive period. Screen use before this point is associated with later problematic usage in approximately 40% of children in high-income countries (CPS, 2017). During this window, the brain's heightened plasticity means that rapid, multisensory digital input may accelerate synaptic pruning or alter cortical folding.

These changes shift development away from typical developmental trajectories (Hutton et al., 2022).

2.6.2 Neuroimaging evidence

Neuroimaging studies now provide strong evidence of structural brain changes associated with screen exposure. Hutton and colleagues (2022) found that preschoolers aged three to five who averaged 1.8 hours of daily screen time showed reduced structural development in brain regions responsible for executive function and language (Hutton et al., 2022). These alterations reflect disrupted neuroplasticity. Passive viewing is associated with more adverse effects than educational content (Hutton et al., 2022; CPS, 2017).

2.6.3 Timing effects

When screen exposure occurs is just as important as how long it lasts. Sensitive periods unfold in a developmental sequence. Lower-level processing systems develop before higher-level circuits (Knudsen, 2004). If early foundational systems are disrupted, the development of more complex skills may be compromised. This creates cascading effects throughout development.

Children exposed to screens before 18 months follow markedly different developmental paths than those first exposed after age 2, even when overall screen time is equivalent (Hutton et al., 2022).

2.6.4 Displacement mechanisms

Displacement effects intensify vulnerability during critical periods. Displacement occurs when screen time crowds out vital developmental experiences. Research shows that displacement explains approximately 40% of adverse developmental outcomes. This suggests that indirect effects are just as important as direct effects of screen exposure (CPS, 2017). Once neural pathways become organised around screen-based stimuli, future neuroplasticity

operates within those constraints. This makes later intervention increasingly difficult (Hutton et al., 2022).

2.7 Developmental domain vulnerabilities

Understanding how screen exposure affects specific developmental domains requires examination of complex, interconnected pathways. These pathways show how digital media influences cognitive, social-emotional, language, and physical development. This section explores domain-specific vulnerabilities while recognising the dynamic interactions between these areas, as emphasised by Developmental Systems Theory (Feldman, Elias, Blum, Jiménez, & Stancin, 2023).

2.7.1 Social-emotional development and displacement mechanisms

Social-emotional development involves key skills including emotion recognition, regulation, secure attachment, and prosocial behaviour. These capacities begin forming in the earliest caregiver-child relationships (Roslan et al., 2022). Screen exposure can interfere with this process, particularly when unstructured use displaces vital face-to-face interactions that support emotional regulation (Tomopoulos et al., 2007; Tekin & Alpgan, 2023; Radesky et al., 2015).

Evidence demonstrates dose-response relationships. Children who spend an average of 2.37 hours on screens daily show higher levels of anxiety and withdrawal (Geng et al., 2023). Executive functioning deficits explain 15% of the variance in emotional challenges (Geng et al., 2023). Age plays a moderating role. While children under three show weaker links between screen use and internalising behaviours, the associations become stronger in those aged three and older (Geng et al., 2023).

Content type significantly influences outcomes. Violent media is linked to poor self-regulation, while educational programming appears to support it. Children who use

smartphones tend to have the lowest self-regulation scores (Canaslan-Akyar & Sungur, 2022).

2.7.2 Cognitive development and executive function impairments

Cognitive development, including attention, memory, and executive functions, is foundational for school readiness. These capacities are particularly sensitive to environmental input during early childhood (Harmon et al., 2024). Longitudinal studies link excessive screen exposure during critical windows to impaired executive functioning (Brauchli et al., 2024).

Increased screen use at age 3.5 years predicts lower verbal intelligence quotient by age 5.5 years (Yang et al., 2024). Thai research shows executive deficits mediate 61% of the association between screen time and behavioural problems (Likhitweerawong et al., 2024).

Bidirectional patterns also emerge. Children with weaker executive control are more likely to receive devices for emotional regulation. This reinforces both exposure and cognitive vulnerabilities (Danet et al., 2022). Early television use at 29 months predicts reduced classroom engagement by kindergarten, with persistent attention difficulties (Pagani et al., 2013). Chinese research confirms that preschoolers who exceed screen time guidelines face a significantly higher risk of attention-deficit/hyperactivity disorder, undermining learning capacity (Gautier et al., 2023).

Content type matters, though educational applications may offer some protective benefit when used appropriately (Harmon et al., 2024).

2.7.3 Language and communication development

Language development depends on rich, reciprocal interactions, particularly in the first three years. Passive or non-interactive media use undermines these opportunities (Tekin & Alpgan, 2023; Radesky et al., 2015). Longitudinal studies show dose-response patterns.

Korean and Swedish cohorts link greater daily screen use before age two to lower vocabulary scores by age five (Kim & Chung, 2021; Sundqvist et al., 2024). Exceeding recommended limits, especially when exposure begins before 18 months, increases the odds of language delays by 15-20% (Kim & Chung, 2021).

Displacement plays a key role. Screen time, especially television, correlates negatively with shared reading (Tekin & Alpgan, 2023), and reduced reading mediates the relationship between screen use and language deficits (Gath et al., 2023). Each additional hour of exposure is linked to fewer reading and teaching interactions, regardless of socioeconomic status (Tomopoulos et al., 2007).

However, content quality matters significantly. Recent research shows that educational programming is associated with improved self-regulation and vocabulary outcomes, especially when co-viewed (Canaslan-Akyar & Sungur, 2022; Gath et al., 2023). Still, in many homes, educational content makes up less than half of exposure (Rathnasiri et al., 2022). In multilingual contexts like South Africa, aligned content may support language development, but mismatched linguistic input can hinder vocabulary acquisition and transfer (Roslin et al., 2022).

2.7.4 Physical development and health

Physical development in early childhood includes motor coordination, sensory integration, sleep regulation, and general health. Each of these areas underpins learning capacity. However, screen exposure is associated with multiple adverse outcomes, such as poor sleep quality, reduced physical activity, and disrupted self-regulation (Oncesi & Kes, 2023; Kerai, Chagani, & Naseer, 2022; Pagani, Fitzpatrick, Barnett, & Dubow, 2010).

Weight gain and sedentary behaviour represent well-established risks. Canadian longitudinal studies show that higher early television viewing predicts increased body weight

and reduced physical activity by later childhood (Pagani et al., 2010). Motor skill development demonstrates particular vulnerability. Egyptian research reveals moderate negative correlations between touchscreen usage and visual-motor integration (Mahmoud et al., 2021).

Sleep disruption is a critical mediating factor (Oncesi et al., 2023). Preschoolers with more than two hours of daily exposure show significantly elevated sleep disturbance scores. Blue light emissions delay melatonin production (Oncesi et al., 2023). Screen-induced sleep disruptions account for 22% of the variance in the relationship between exposure and self-regulation deficits (Oncesi et al., 2023).

Screen exposure displaces active play. Canadian longitudinal evidence shows early television exposure predicts a 13 per cent decrease in weekend physical activity by middle childhood (Pagani et al., 2010).

2.7.5 Domain integration and protective factors

Socioeconomic disparities are consistent across developmental domains. Lower maternal education correlates with greater media use and elevated behavioural symptoms (Geng et al., 2023). Protective factors, including co-viewing and caregiver mediation, buffer against adverse effects when consistently implemented. However, co-viewing is significantly more frequent in high self-regulation families than in low-socioeconomic-status households, where it occurs in only 40% of families (Canaslan-Akyar & Sungur, 2022).

2.8 School readiness and educational implications

School readiness encompasses the multidimensional skills required for successful formal learning. These include cognitive abilities, social-emotional regulation, and executive functioning. All of these capacities are compromised by excessive screen exposure. Longitudinal evidence indicates that teachers rated children who spent more time watching

television early as having greater attention difficulties and reduced task persistence in the classroom (Pagani et al., 2013). These deficits manifest as compromised task orientation, productivity, autonomy, cooperation, and rule-following (Pagani et al., 2013).

Low-income preschoolers demonstrate particularly pronounced vulnerabilities. Increased mobile exposure significantly predicts poorer overall school readiness skills (Harmon et al., 2024).

Screen exposure creates domain-specific educational challenges. Canadian prospective data demonstrate that preschool screen use significantly predicts language and cognitive vulnerabilities by kindergarten (Vanderloo et al., 2022). Turkish research reveals moderate negative correlations between mobile device exposure and teacher-rated achievement in numeracy, literacy, and attention. Children who exceed 2 hours per day show achievement shortfalls of 20-25% (Tekin & Alpgan, 2023). Receptive vocabulary shows an 11% unit decrease with early television exposure. Mathematical cognition shows a 7% decrease in number knowledge assessments (Pagani et al., 2013).

Educational implications extend beyond individual performance to classroom management. Children with elevated screen exposure histories demonstrate significantly greater attention problems. These attention problems create instructional challenges affecting broader classroom dynamics (Harmon et al., 2024; Lin et al., 2020). 17% of children demonstrate school-readiness vulnerabilities below the tenth percentile in at least one developmental domain. Screen exposure contributes significantly to these vulnerabilities (Vanderloo et al., 2022).

South African educational contexts face particular challenges. Classroom sizes exceeding 40 students with limited resources mean children entering school with screen-related attention deficits, language delays, or social-emotional difficulties may struggle to

receive necessary support. The multilingual nature of South African education, where children learn in non-home languages, adds complexity when combined with screen-related language delays. Children who experienced displacement of caregiver interactions through excessive screen exposure may face compounded challenges navigating formal environments. These environments require strong foundational language and social-emotional skills.

2.9 South African context and research gaps

While international research on screen time has grown substantially, South African studies on early childhood remain limited. This raises important questions about how well global findings apply locally. Most evidence comes from high-income countries, where parenting practices, infrastructure, and cultural norms differ significantly from those in low- and middle-income contexts such as South Africa (Gastaud et al., 2023; Radesky et al., 2015).

2.9.1 Limited local evidence base and emerging research

South African research remains fragmented. Karani and colleagues (2022) found that 75% of children under two years exceeded WHO guidelines. Clear dose-response relationships show increased screen exposure correlates with expressive language delays (Karani et al., 2022). Prioreshi and Norris (2022) documented that children aged 0 to 5 years average 1.6 hours of daily screen exposure. 68% exceed WHO limits through predominantly television and smartphone use (Prioreshi & Norris, 2022).

Intermediate-phase children exceed recommended limits by 75%, with 62% engaging in solitary viewing, a pattern that correlates with relational deficits (Seiler, 2024). Urban-rural disparities are stark. Urban high-income preschoolers average 1.71 hours per day, with 81% exceeding the guidelines. Rural children average 0.45 hours (Draper et al., 2019).

2.9.2 Under-representation of low-resource contexts

Global literature on screen time and early childhood development predominantly reflects findings from affluent, Western populations, with limited representation from low- and middle-income countries. This creates substantial gaps in understanding how intersecting risk factors such as poverty, under-resourced schools, community violence, and constrained alternatives to screen use shape developmental outcomes in South African contexts. These realities may alter exposure patterns and developmental impacts in ways not captured by international guidelines (Prioreschi & Norris, 2022; Simuja et al., 2024; Tomlinson et al., 2019).

Soweto research highlights how these intersections operate. 98% smartphone access coexists with 60% of families experiencing safety fears that confine children indoors. These conditions create bidirectional vulnerabilities, in which screens become default caregiving tools (Prioreschi & Norris, 2022). 40 to 50% of children under five experience stunting, while only 20 to 30% access quality digital literacy. This creates developmental complexity absent from international literature (Simuja et al., 2024).

2.9.3 Digital equity and infrastructure disparities

Digital equity encompasses access, use quality, and developmental outcomes. This concept is particularly relevant in South Africa. 98% smartphone penetration coexists with profound disparities in meaningful use. While 95% of households own devices, with initiation at 6-12 months, utilisation patterns vary dramatically by socioeconomic status (Prioreschi & Norris, 2022). Urban-rural divides are stark. Urban children log 1.71 hours daily compared to rural children's 0.45 hours. Urban areas have 1.88 times the odds of non-compliance with guidelines (Draper et al., 2019).

2.9.4 Multilingual and cultural context gaps

South African research highlights multilingual and cultural dynamics often overlooked in global literature. Screen content in dominant languages like English can either support or hinder development, depending on its alignment with children's home languages. This alignment creates code-switching demands that may complicate development (Karani et al., 2022).

In Soweto, higher-socioeconomic-status households favour educational applications (40%) over unsupervised scrolling (35%). However, content remains predominantly English, despite a 25% baseline language delay in multilingual homes (Prioreshi & Norris, 2022). Communal co-viewing rooted in Ubuntu values offers protective effects. Culturally attuned engagement reduces relational deficits by 20-30% compared to solitary use (Seiler, 2024).

2.9.5 Policy implementation challenges

South Africa's 24-Hour Movement Guidelines represent a significant policy advancement. These recommendations advise no screen time for children under 2, and no more than 1 hour daily for those aged 2 to 5. The guidelines were adapted from global frameworks and translated across 11 official languages (Draper et al., 2019). However, compliance remains low. While 70% of families understand television as a literacy tool, only 35% co-view in ways that could support development (Karani et al., 2022). In Soweto, 55% of caregivers report setting limits. However, 70% still view screens as educational. This reveals a disconnect between policy and practice (Prioreshi & Norris, 2022). Broader implementation is also hampered by corruption, funding constraints, and safety concerns that undermine equity efforts (Simuja et al., 2024).

2.9.6 Environmental and safety moderators

South African research highlights how safety concerns uniquely shape screen use, beyond what global guidelines account for. In Soweto, perceived neighbourhood danger is linked to a 25% increase in screen time. Families often feel it is safer for children to stay indoors rather than engage in outdoor play. Screens fill the void as a safer alternative (Prioreschi & Norris, 2022).

Although 92% of families in densely populated townships (6,500 per square kilometre) report access to safe play spaces, utilisation drops to 65% in high-crime areas. This indicates that environmental risks directly influence media use patterns (Prioreschi & Norris, 2022).

2.9.7 Research design and methodological needs

Existing South African studies highlight important methodological considerations while revealing limitations. Cross-sectional designs predominate, limiting causality assessment and risking reverse causation (Seiler, 2024). The Soweto study ensured strong validity by using accelerometers and adapting tools for multiple languages. This demonstrates feasible approaches for culturally responsive measurement (Prioreschi & Norris, 2022). Future research requires ethnographic approaches with objective measurement tools. These tools must capture the full spectrum of South African childhood experiences (Simuja et al., 2024).

2.10 Theoretical framework: developmental systems perspective

Early childhood development emerges from complex, reciprocal interactions between the child and the environment. Understanding these influences requires theoretical frameworks that accommodate multifaceted complexity. Developmental Systems Theory (DST) provides this foundational framework.

2.10.1 Developmental systems and ecological foundations

DST positions development not as linear but as emerging from continuous, bidirectional interactions among biological, psychological, and environmental systems (Lickliter & Honeycutt, 2003). Development unfolds through ongoing interactions between biology, experience, and environment. This means that it is not from a fixed genetic blueprint. This process, known as probabilistic epigenesis, highlights how early experiences shape outcomes over time, as Lickliter and Honeycutt (2003) explain in their account of Gottlieb's theory (Gottlieb, 1997; Lickliter & Honeycutt, 2003). This framework reveals bidirectional influences that challenge reductionist approaches. Genes provide resources for plasticity, yet developmental histories actively modulate expression patterns, demonstrating gene-environment interplay transcending simple dichotomies (Lickliter & Honeycutt, 2003).

Bronfenbrenner's Ecological Systems Theory builds on DST by describing how children develop within nested, interacting systems, from the immediate microsystem (family, school) to broader macrosystems (culture, policy) (Feldman et al., 2023). This model highlights that development is not shaped by isolated risk factors but by patterns of interaction across ecological layers. When applied to screen exposure, this suggests that the media's developmental impact must be understood within a broader ecology. This includes caregiver-child interaction, socioeconomic conditions, cultural practices, and content quality.

Applied to screen exposure, developmental systems, and ecological theories suggest that digital technology's influence cannot be understood through screen-time metrics or isolated developmental domains alone. Instead, screen exposure must be viewed within a broader developmental ecology, encompassing family interactions, socioeconomic conditions, caregiver mediation, content quality, and individual characteristics (Feldman et al., 2023; Lickliter & Honeycutt, 2003). For example, when caregiver-child interaction is

displaced, a key social process is lost. This can interfere with the development of emotion regulation, a core psychological capacity. Poor emotion regulation may, in turn, impair executive functioning, a crucial cognitive domain. Together, these cascading effects can undermine school readiness (Diamond, 2013).

2.10.2 Cognitive-developmental perspectives

Piaget's (1952) Sensorimotor Theory highlights that passive screen viewing contributes minimally to language acquisition during early childhood. Contemporary research supports this, showing that children learn only 0–10% of words from screens compared to live interaction (Hassinger-Das et al., 2020).

Vygotsky's Zone of Proximal Development (ZPD) framework explains how co-viewing can transform potentially harmful passive exposure into developmentally supportive interaction (Vygotsky, 1978). According to ZPD theory, children's learning is maximised when adults scaffold experiences just beyond the child's independent capacity. This transformation occurs through dialogic scaffolding, where caregivers contextualise content, explain narratives, and support meaning-making (Vygotsky, 1978).

Tomasello's Cultural Cognition Framework emphasises that human learning uniquely depends on understanding others' communicative intentions through joint attention and shared meaning-making (Tomasello, 2003). Screens lack this reciprocal intentionality: a child watching a video cannot engage in the bidirectional communication necessary for cultural learning. In contrast, co-viewing with caregivers who explain, respond to, and adjust the content restores this shared intentional frame, supporting cultural learning and language development (Tomasello, 2003).

2.10.3 Relational and affective frameworks

Attachment theory emphasises the importance of responsive, synchronous caregiver–child interactions in building secure attachment and emotional regulation (Bowlby, 1969, as cited in Hazan & Shaver, 1992; Ainsworth et al., 2015; Mikulincer et al., 2003). Applied to screen exposure, this theory suggests that passive, screen-mediated experiences may disrupt the face-to-face, contingent exchanges through which infants develop emotional security and self-regulation. These dyadic interactions are especially critical during infancy, when attachment systems are most sensitive. However, co-viewing that includes emotional scaffolding and responsiveness may help preserve the relational quality essential to secure attachment (Takeuchi & Stevens, 2011). This framework complements Vygotsky's (1978) emphasis on supported, interactive learning by highlighting the relational and affective context in which development occurs.

2.10.4 Media-specific engagement frameworks

Joint Media Engagement (JME) extends social learning theory by examining how shared media experiences between caregivers and children transform potentially passive exposure into active learning opportunities (Takeuchi & Stevens, 2011). JME posits that the quality of interpersonal engagement during screen use, such as verbal scaffolding, emotional responsiveness, and contextual explanation, significantly moderates developmental outcomes (Takeuchi & Stevens, 2011). Active co-viewing, characterised by dialogic interaction and meaning-making, differs fundamentally from passive co-viewing, where the caregiver is physically present but not engaged (Hassinger-Das et al., 2020). This framework is particularly relevant for understanding why identical screen durations produce vastly different developmental trajectories depending on responsive caregiver engagement.

Uses and Gratifications Theory positions users as active agents who select media to meet social, emotional, and cognitive needs (Katz et al., 1973; Ruggiero, 2000). In low-resource South African settings, this helps explain how families use digital devices to manage safety concerns, boredom, and limited alternatives, particularly in contexts shaped by poverty and unemployment (Chigona & Chigona, 2010).

The Media Practice Model posits that media engagement arises from ongoing, reciprocal interactions between individual preferences and environmental factors (Steele & Brown, 1995). This model is particularly relevant in multilingual South African households, where the predominance of English-language content may not align with children's home languages or support culturally embedded communication styles.

Displacement Theory posits that time spent on one activity displaces time for others, with developmental outcomes depending on what is displaced (Neuman, 1988). Contemporary research shows that screen time can reduce opportunities for caregiver interaction, physical play, and exploratory learning (Tekin & Alpgan, 2023; Przybylski et al., 2020). As such, screen time can displace enriching developmental activities (Hassinger-Das et al., 2020; Linebarger & Walker, 2005).

Digital inequality frameworks examine disparities in access, digital skills, and outcomes, which are especially relevant in South Africa, where 98% smartphone penetration coexists with significant gaps in meaningful use (Robinson et al., 2015).

2.10.5 Integration: A systemic approach

These integrated theoretical perspectives demonstrate that screen exposure effects extend beyond simple dose-response models. Understanding these effects requires examining complex, bidirectional interactions between child development, family practices, community resources, and cultural contexts. This systemic approach is essential for understanding early

childhood development in diverse South African settings, where ecological contexts, caregiver needs, and cultural practices fundamentally shape how digital technologies influence development.

2.11 Summary and research justification

This literature review has established a strong foundation for understanding how screen exposure impacts early childhood development. Effects span cognitive, social-emotional, language, and physical domains. While global evidence highlights consistent dose-response relationships, the South African context remains profoundly under-represented. This is concerning given the country's unique developmental landscape, including high stunting rates, multilingual learning environments, and wide digital equity disparities.

Despite rising screen exposure, 68% of children exceed WHO guidelines, and 97% use mobile devices by age four. Nevertheless, there is limited local research exploring how these behaviours intersect with developmental outcomes, educational readiness, and caregiver practices. International guidelines often fail to reflect lived realities in South Africa. Safety concerns, linguistic diversity, and communal caregiving patterns shape screen use in distinct ways. This mismatch between global evidence and local context creates both a practical and a research gap.

A systematic synthesis of the literature is urgently needed. Such a synthesis must map what is known, identify where evidence is lacking, and inform contextually relevant recommendations. Recommendations are needed for policy, professional practice, and caregiver support. A scoping review is well-suited to this task. It accommodates a wide range of study designs, theoretical approaches, and outcome measures. This is especially important

in a field marked by methodological diversity and limited representation from low- and middle-income settings.

By situating international research within the realities of South African early childhood contexts, this study aims to contribute foundational evidence. This evidence can guide future investigations, strengthen implementation efforts, and support more culturally responsive approaches to digital media use in early childhood.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology used in this scoping review and provides a clear explanation of the procedures applied. The approach is based on the framework developed by Arksey and O'Malley (2005), which promotes methodological rigour and transparency. The chapter concludes with a discussion of ethical considerations relevant to the chosen methodology. This review follows established scoping review protocols that prioritise the systematic and transparent application of methods at each stage (Pham et al., 2014). This structured process supports the replicability of similar studies in different contexts.

3.2 Methodological approach

This scoping review was guided by the six-stage framework developed by Arksey and O'Malley (2005), which offers a structured method for mapping the existing literature on a defined topic while promoting methodological rigour and transparency. The framework comprises six iterative stages: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, (5) collating, summarising, and reporting results, and (6) consultation exercise. This review focused on peer-reviewed journal articles exploring the relationship between screen time and early childhood development (Arksey & O'Malley, 2005; Pham et al., 2014). The specific steps and procedures followed in applying this framework are detailed in Section 3.3.

3.2.1 *Scoping review framework*

Scoping reviews differ from systematic reviews and meta-analyses in that they map the breadth and characteristics of the existing literature rather than evaluate intervention

effectiveness. They are particularly suited for exploratory research questions, as they systematically identify and organise study types, populations, methodological approaches, and evidence gaps within a defined topic area (Arksey & O'Malley, 2005; Munn et al., 2018). A key advantage of scoping reviews is their ability to clarify how key concepts are defined and applied across the literature, revealing both consistencies and inconsistencies in the operationalisation of core variables (Munn et al., 2018).

This approach is well-suited to the present study. It aims to explore how screen time is defined and measured in early childhood settings, identify patterns in developmental outcomes, and highlight gaps in South African classroom-based research. This scoping review maps the scope and key features of existing literature on screen time and early childhood development. It helps clarify what is currently known, highlights inconsistencies in definitions and measurements, identifies gaps in the evidence, and offers recommendations relevant to South African education settings (Arksey & O'Malley, 2005; Munn et al., 2018).

3.3 Scoping review procedures

The following section details the implementation of each stage of Arksey and O'Malley's (2005) six-stage framework. The iterative and transparent application of these procedures supports the methodological rigour and replicability of this scoping review.

3.3.1 Step 1: Identifying the research question

Formulating a straightforward, well-defined research question is an essential initial step in conducting a scoping review, as it guides the entire review process and informs the development of search strategies. This scoping review's research questions are as follows:

- i. How is exceeding daily screen time recommendations during early childhood development associated with developmental vulnerability, either social, emotional, linguistic, cognitive, or physical, in young children?

- ii. How is increased exposure to screen time associated with the increasing learning challenges observed in early childhood educational settings?
- iii. What gaps and limitations exist in current South African research on increased screen time usage and its associations with classroom dysfunction, and how can caregivers and educational professionals be better informed?
- iv. What are the key recommendations derived from existing literature on heightened screen time usage and classroom dysfunction that can be tailored to address specific challenges faced by South African educational settings?

3.3.2 Step 2: Identifying relevant studies

A comprehensive and systematic search was conducted to identify primary studies addressing the research questions. Following Arksey and O'Malley's (2005) recommendations, studies were sourced from eight electronic databases: Google Scholar, PubMed, EBSCO, JSTOR, Wiley Online Library, ScienceDirect, SAGE Journals, and SpringerLink. The search was restricted to English-language, full-text, peer-reviewed articles published between 2000 and 2024 to ensure current and contemporary relevance to the research questions.

The search strategy was developed using Boolean operators combining keywords across Population–Concept–Context (PCC) elements. Primary search terms included: (*"Early Childhood" OR "Young Children"*) AND (*"Screen Time"*) AND (*"Social Development" OR "Emotional Development" OR "Physical Development" OR "Cognitive Development" OR "Language Development"*) AND (*"Educational Settings"*). A comprehensive list of primary and expanded search terms, including synonyms and related terminology, is presented in Appendix A (Tables 1 and 2). The search strategy was implemented between March and May 2025, with search yields for each database summarised in Appendix A (Table 3).

3.3.3 Step 3: Inclusion and exclusion criteria

Clear and specific inclusion and exclusion criteria were established prior to the search to guide study selection and ensure methodological consistency. These criteria address study design, population, concept, context, language, time period, and source type. A comprehensive breakdown of all inclusion and exclusion criteria is presented in Table 4 below.

Table 4

Criteria for Inclusion and Exclusion of Studies

Criteria	Inclusion Criteria	Exclusion Criteria
Study Design	Quantitative and Qualitative	Narrative reviews, Literature reviews
Population	Children aged 0–12 years (early childhood and young children)	Studies focusing on adolescents, only intermediate-aged children, adults, or general populations, not specific to early childhood
Concept	Screen time exposure, media/device use (including television, tablets, smartphones), and its effects on development	Studies not involving screen time or digital media exposure. Studies not assessing developmental vulnerabilities.
Context	Studies conducted in or related to early childhood education, preschool,	Studies focused on screen time in the home without any

	kindergarten, or childcare settings; studies examining screen time in the home environment where outcomes are relevant to developmental or school readiness domains (e.g., school behaviour, executive function, emotional regulation).	connection to the child's developmental, behavioural, or educational outcomes (e.g., parental screen use practices, device access only), as well as studies involving secondary or tertiary education populations.
Language	English	Non-English
Time Period	2000-2024	Outside of 2000-2024
Source	Full-text publications and sources; peer-reviewed	Abstracts only, no full text available; not peer-reviewed

An important clarification regarding the inclusion criteria: Literature reviews and narrative reviews were excluded from the final pool of studies for data charting and analysis, as they did not present original empirical findings. However, such secondary sources were retained in the literature review chapter to provide theoretical context and background. Additionally, studies reporting exclusively positive associations between screen time and child development, without reference to developmental vulnerability or dysfunction, were excluded during full-text review to maintain focus on the review's central aim: investigating risk factors and developmental challenges associated with exceeding recommended screen time limits.

3.3.4 Step 3: Study selection process

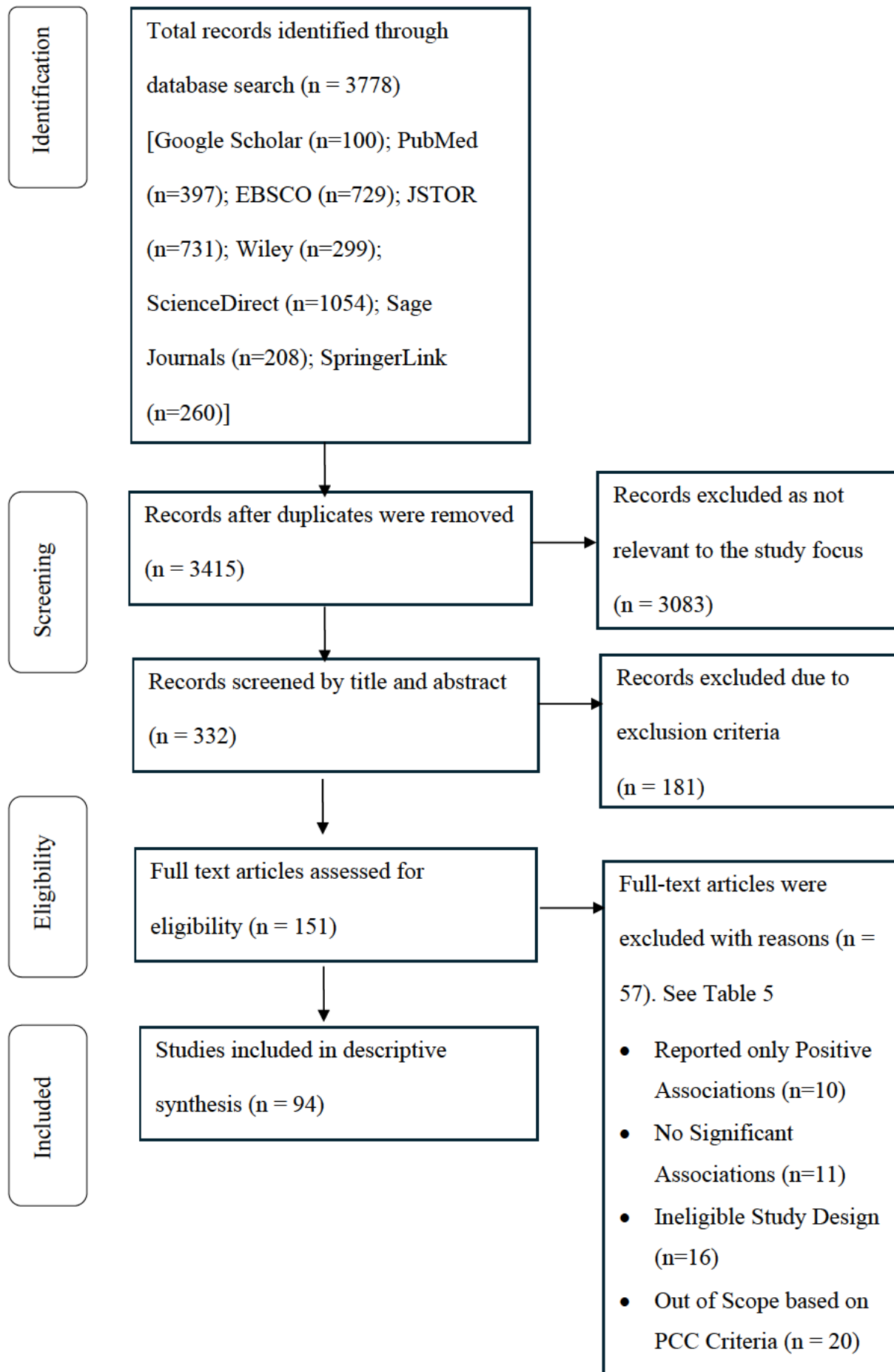
The study selection process followed a systematic, multi-phase screening approach to ensure rigorous and consistent application of inclusion and exclusion criteria. All retrieved records were exported into a reference management system, where duplicate entries were identified and removed. The remaining records underwent a three-phase screening process: (1) title screening, (2) abstract screening, and (3) full-text review.

To enhance rigour and minimise potential bias, a second reviewer (qualified at the master's level in Research Psychology) was appointed to screen all articles at each phase independently. Both reviewers conducted the screening independently, and the results were compared. Consensus was achieved on 100% of included studies following discussion. This dual-review process ensured greater reliability and consistency in the application of criteria, in line with best-practice recommendations (Levac, Colquhoun, & O'Brien, 2010).

The PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) flow diagram (Figure 1) provides a visual summary of the screening and selection process. Initial electronic database searches identified 3,778 studies. Following removal of 363 duplicates, 3,415 articles underwent title screening, resulting in exclusion of 3,083 studies that did not meet inclusion criteria. The remaining 332 articles proceeded to abstract screening, after which 181 were excluded due to irrelevance, scope mismatch, or lack of developmental outcomes. Subsequently, 151 full-text articles were assessed for eligibility. Of these, 57 articles were excluded based on various criteria (see Appendix A, Table 5 for detailed exclusion categories), resulting in a final pool of 94 articles included for data charting and analysis.

Figure 1

PRISMA-ScR Flow Diagram for Study Selection



During full-text screening, articles were excluded for the following reasons: reporting only positive developmental outcomes without reference to dysfunction; presenting no statistically significant findings; lacking primary empirical data (e.g., literature reviews, study protocols); falling outside the scope defined by the PCC framework; or failing to meet peer review and population requirements.

3.3.5 Step 4: Data charting

The fourth step of Arksey and O'Malley's (2005) framework involves systematically extracting and organising key information from each included study. Data charting was conducted using a structured, iterative approach, enabling both descriptive and analytical data to be captured in relation to the study's research objectives. The data charting strategy was informed by the narrative review approach proposed by Pawson (2002), adapted to suit the focus of this review.

Key information extracted from each included study included: study title, authors, year of publication, and journal; country of study and socioeconomic context (if reported); study design and sample size; detailed study population characteristics; screen time measurement methods and standardized exposure (expressed in hours per day); type of screen modality (e.g., television, tablet, smartphone); developmental domain assessed (cognitive, emotional, social, language, or physical); specific outcome measures applied; and key findings. This structured approach to data charting enabled comprehensive synthesis of a diverse body of literature, supported comparative analysis across studies, and facilitated identification of patterns, thematic trends, and knowledge gaps. A summary of the charting framework is presented in Table 6 below.

Table 6*Charting of data using a narrative review approach (Pawson, 2022)*

Charting categories
Study Title, Authors, Year of Publication, Journal
Country of study, SES context if reported
Study design, sample size
Study population details
Screen time measurement, Screen type and time (standardised hours per day)
Developmental domain assessed
Developmental outcome measures
Key findings

To contextualise screen time exposure consistently across studies, studies were categorised according to age-specific guidelines. Three age groups were applied: infants and toddlers (0–2 years), preschool-aged children (2–6 years), and school-aged children (6–12 years). For children under 2 years, both the AAP and WHO recommend no screen exposure, except for video chatting (Council on Communications and Media, 2016; WHO, 2012). For preschoolers (2–5 years), the recommendation is limited to one hour per day of high-quality programming, preferably co-viewed with a caregiver. For children aged 6–12 years, while neither the AAP nor the WHO specifies an upper limit, both emphasise moderation and balance. This review adopted a two-hour daily threshold for the 6–12 age group, aligning with the Canadian 24-Hour Movement Guidelines (Tremblay et al., 2016) and the Australian Government Department of Health (2019). This threshold has also been applied in South African studies (Draper et al., 2019). These benchmarks enabled systematic comparison

across the 94 included studies and supported consistent classification of screen time exposure as either within or exceeding recommended guidelines.

3.3.6 Step 5: Collating, summarising, and reporting the results

The fifth stage of Arksey and O'Malley's (2005) framework involved synthesising data through thematic and descriptive analysis to interpret findings within the context of the research questions. This process included summarising key results across studies, identifying and interpreting patterns, and recognising gaps in the literature.

Thematic analysis, a qualitative method of identifying and analysing patterns or themes within data, was employed to organise and interpret findings (Braun & Clarke, 2012). This method supports a deeper understanding of how various elements relate to overarching research questions and enables alignment of emerging themes with existing literature (Alhojailan, 2012). The six-step model developed by Braun and Clarke (2012) was applied which includes the following steps:

- Step 1: Familiarisation with the data, involving repeated reading of the selected literature
- Step 2: Generation of initial codes, identifying recurring patterns
- Step 3: Searching for themes, grouping related codes
- Step 4: Reviewing themes to ensure accuracy and relevance
- Step 5: Defining and naming themes to capture the essence of the data
- Step 6: Producing the report, presenting themes within the broader research framework

Thematic analysis enabled the identification of consistent patterns across studies, particularly regarding screen time and early childhood development. These themes were compared with findings from the literature review to assess alignment and gaps. In addition

to thematic findings, a descriptive summary of study characteristics was provided, as recommended by Arksey and O'Malley (2005). This included details such as the number of studies analysed, study designs, publication years, target populations, and geographical distribution. Levac et al. (2010) outline key steps for implementing this fifth stage, which include: (1) analysing the data; (2) presenting the results; and (3) explaining how findings connect to the broader topic of the review. This approach ensured results were both analytically robust and relevant to study aims.

3.4 Rigour and validity

Several strategies were employed to address concerns regarding methodological rigour in scoping reviews (Levac, Colquhoun, & O'Brien, 2010):

a) Clear and explicit inclusion and exclusion criteria were established prior to the search, ensuring consistent application throughout the selection process (see Table 5, Section 3.3.3).

b) The search strategy was developed using the PCC (Population–Concept–Context) framework and rigorously applied across eight electronic databases. Database-specific technical limitations were accommodated where necessary, following best-practice guidance for relevance-ranked databases (Haddaway et al., 2015).

c) Dual independent review of all articles at each phase of screening (title, abstract, and full-text) by two qualified reviewers, with consensus-based resolution of any discrepancies, ensured greater reliability and consistency in the application of selection criteria.

d) Structured data charting using a predetermined framework supported systematic and consistent extraction of information across all 94 included studies.

e) Transparent documentation of all decisions, exclusion reasons, and methodological choices created an audit trail supporting replicability.

Regarding validity, content validity was maintained through consistent application of extraction criteria and thematic analysis across all included studies (Levac et al., 2010). Inter-rater reliability was not formally measured; however, dependability was reinforced through the systematic application of inclusion criteria, clear documentation of all decisions, and the maintenance of an audit trail throughout the review process. Although scoping reviews are inherently exploratory, this study followed a structured, transparent methodology, as proposed by Arksey and O'Malley (2005), to ensure consistency in study selection and data extraction across all stages.

Concerning generalizability, this review was designed to map the scope, nature, and direction of existing evidence on screen time and early childhood development. The findings are therefore transferable to comparable research contexts, particularly in early childhood education, developmental health, and policy development.

3.5 Ethical considerations

This study relied exclusively on publicly available secondary data from peer-reviewed journal articles. As no human participants were involved, the study received an exemption from ethical approval by the University of KwaZulu-Natal Human and Social Sciences Research Ethics Committee (HSSREC) (Approval number: 00027305). A copy of the approval letter is included in Appendix B.

The use of a scoping review methodology was selected in part for its transparency and replicability. All data were accessed through legal and ethical means, ensuring full compliance with institutional research integrity policies and broader academic standards (Arksey & O'Malley, 2005).

3.6 Conclusion

This chapter outlined the systematic, rigorous methodological approach used in this scoping review. Guided by Arksey and O'Malley's (2005) six-stage framework, the review followed a structured process that included: (1) formulation of clear research questions, (2) comprehensive systematic search across eight electronic databases, (3) rigorous application of inclusion and exclusion criteria with dual independent review, (4) systematic data charting using a predetermined framework, (5) thematic and descriptive synthesis to identify patterns and gaps, and (6) transparent reporting of all procedures and findings. Explicit inclusion and exclusion criteria were established and rigorously applied throughout, and ethical procedures were followed. The structured approach to data charting, combined with both descriptive and thematic synthesis, supported systematic identification of patterns, thematic trends, knowledge gaps, and key insights within the existing body of literature on screen time and early childhood development. These findings provide a solid foundation for the presentation and discussion of results in the following chapter.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the findings of the scoping review. As outlined in Chapter 3, the review followed the Arksey and O'Malley (2005) scoping methodology and Braun and Clarke's (2012) thematic analysis framework. A total of 94 studies were included, spanning cognitive, socio-emotional, language, and physical developmental domains.

Findings are organised into two main sections: a descriptive summary of study characteristics and screen time patterns (Sections 4.2), followed by a thematic synthesis of developmental impacts. The thematic synthesis is structured to align directly with the study's research questions. Section 4.3 addresses Research Question 1, examining how exceeding daily screen time recommendations is associated with developmental vulnerabilities. Section 4.4 presents findings related to Research Question 2, synthesising evidence on screen exposure and its impact on learning and classroom functioning. Section 4.5 addresses Research Questions 3 and 4, focusing on the representation of South African research, identifying contextual gaps, and outlining recommendations relevant to early childhood educational settings.

Interpretation of these findings, including their theoretical, contextual, and policy implications, is provided in Chapter 5.

4.2 Descriptive overview of included studies

Eight databases, including Google Scholar, PubMed, EBSCO, JSTOR, Wiley Online Library, ScienceDirect, SAGE Journals, and SpringerLink, were searched between March and May 2025, yielding 3,778 records. After screening and eligibility assessment, 94 peer-reviewed studies met the inclusion criteria for this scoping review. All studies were published

between 2000 and 2024, with publication volume increasing markedly after 2010. The median publication year was 2021, and the peak occurred in 2024 ($n = 18$), reflecting the growing relevance of screen time research in early childhood.

Most studies focused on preschool-aged children (2–6 years), with additional representation of infants (0–2 years) and school-aged children (6–12 years), though age categories often overlapped. The majority of studies (84.0%) examined typically developing children, while a smaller proportion (16.0%) included clinical or context-specific populations. Only 14 studies (14.9%) were conducted explicitly in school-based settings.

Sample sizes ranged from 27 to 52,625 participants (median = 382, IQR: 156–1,205), reflecting variability in statistical power and generalisability.

Regarding screen time measurement, most studies (89.4%) used structured parent-report questionnaires, with few employing diaries (7.4%) or child self-reports (2.1%). Of these, only 18.1% used validated instruments. Nearly 80% used custom tools, highlighting inconsistency in measurement practices.

Television was the most frequently assessed screen type ($n = 60$), followed by smartphones ($n = 47$) and tablets ($n = 45$). Only 37.2% of studies specified screen content, and fewer still distinguished educational vs. entertainment media or examined background exposure. Quantified daily screen time estimates were reported in 80.9% of studies; the remainder provided only categorical data.

4.2.1 Population representation: who was studied?

Across the included studies, preschool-aged children were the most frequently studied population (90.4%), often as the primary target group. Infants and school-aged children were less commonly included, typically as secondary groups. Because several studies spanned multiple age categories, totals exceed 94.

Only a minority of studies (14.9%) took place in school or classroom contexts; most research was conducted in home or clinical settings. Additionally, while most studies included typically developing children, a subset (16.0%) focused on those with clinical diagnoses or adverse developmental contexts.

A detailed breakdown of age group representation and settings is presented in Appendix C (Table C7).

4.2.2 Screen time measurement: how was exposure assessed?

Among the 94 included studies, 84 (89.4%) assessed screen time using structured parent-report questionnaires. Seven studies (7.4%) utilised parental recall diaries, while two studies (2.1%) relied on child self-report. No studies used teacher-reported screen time measures, including those conducted in educational settings.

Regarding measurement validation, only 17 studies (18.1%) reported using formally validated screening tools. The most frequently used validated instrument was the SCREEN-Q Questionnaire (n = 4), followed by the Children's Electronic Media Use Questionnaire (n = 3). In contrast, the majority of studies (n = 67; 79.8%) employed custom-developed instruments, underscoring substantial variability in how screen time is operationalised and measured across the literature.

4.2.3 Screen time: How was it defined, measured, and reported?

Across the 94 included studies, screen time exposure was measured using various definitions and composite formats. No studies used teacher-reported screen exposure, including those conducted in school-based settings (n = 14).

There was no standardised definition of screen time across the dataset. Most studies (n = 84; 89.4%) used structured parent-report tools, though terminology varied. Television was the most frequently examined modality (n = 60), followed by smartphones (n = 47) and

tablets (n = 45). Twenty-four studies used broad or aggregated terms such as screen-based media or any screen use, without differentiating between device types. At the same time, many adopted composite definitions that combined multiple screen types into a single metric.

Regarding screen time quantification, 76 studies (80.9%) reported use as a quantified daily estimate (e.g., hours or minutes per day). A smaller subset (n = 21; 22.3%) disaggregated values by weekday and weekend exposure. Eighteen studies (19.1%) did not provide quantifiable estimates; instead, they noted screen presence without reporting duration. When daily screen time was not directly stated, estimates were standardised to hours per day. For weekly totals or disaggregated weekday/weekend data, average daily values were calculated. Studies reporting screen time as categorical thresholds (e.g., <1 hour/day) were approximated using midpoint estimates to support synthesis.

Regarding screen content, only 35 studies (37.2%) specified the nature, purpose, or context of media exposure. Content classification varied: 10 studies differentiated educational from entertainment content, while 11 studies reported co-viewing with caregivers or background TV exposure. Additional themes included violent, fantastical, or adult-directed content (n = 6), interactive versus passive use (n = 4), and contextual factors such as timing, location, or parental intent (n = 4). Most studies (n = 59; 62.8%) did not report on content type, limiting analysis of how specific media characteristics relate to developmental outcomes. Measurement formats and screen content classifications are summarised in Tables C8 and C9 (Appendix C).

4.2.4 Screen time exposure and compliance with international guidelines

This section presents the core compliance data across age groups based on the WHO and AAP screen time guidelines. Of the 94 included studies, 74 (78.7%) provided quantifiable estimates of daily screen time exposure across three developmental age groups:

infants (0–2 years; n = 3), preschool-aged children (2–6 years; n = 60), and school-aged children (6–12 years; n = 11). Several studies included multiple age groups; therefore, exposure data were disaggregated accordingly.

Preschool-aged children showed the highest mean daily screen time at 3.75 hours (Median = 1.70), followed by infants at 1.80 hours (Median = 1.10) and school-aged children at 1.75 hours (Median = 1.70). Table 14 summarises average screen time by age group.

Screen time compliance was assessed based on WHO and AAP guidelines: 0 hours/day for infants, ≤ 1 hour/day for preschool-aged children, and ≤ 2 hours/day for school-aged children. Across all age groups, most studies reported daily screen use exceeding recommended limits. No infant studies met the 0-hour guideline, and only 16.4% of preschool studies met the ≤ 1 -hour/day threshold. In contrast, 46.2% of school-aged studies complied with the ≤ 2 -hour/day recommendation, although mixed reporting was standard.

4.3 Developmental domains

Of the 94 studies, 48 (51.1%) examined a single developmental domain, while 46 (48.9%) assessed multiple domains. Social-emotional development emerged as the most frequently evaluated domain (n = 56; 59.6%), followed closely by cognitive development (n = 52; 55.3%). Language development appeared in 26 studies (27.7%), while physical development received minimal attention (n = 17; 18.1%).

4.4 Research Question 1: Exceeding screen time recommendations and developmental vulnerability

4.4.1 Exposure patterns and vulnerability thresholds

As established in Section 4.2.5, preschool-aged children substantially exceed international screen time recommendations, with a mean daily screen time of 3.75 hours and

low overall compliance with the ≤ 1 -hour/day guideline. This section examines the specific developmental vulnerabilities associated with such excess exposure.

4.4.2 Thematic findings: Vulnerability patterns emerging across developmental domains

Building on the exposure patterns established in Section 4.4.1, this section presents five interrelated vulnerability patterns that characterise screen-related developmental risk. These themes are synthesised from domain-specific analyses across cognitive, social-emotional, language, and physical domains, revealing consistent dose-response relationships and critical threshold effects.

Theme 1: Dose-response relationships in early exposure: Non-linear risk acceleration.

A dose-response relationship was evident across developmental domains, with threshold effects emerging at varying critical points: 1 hour/day for physical development, 1–2 hours/day for language and social-emotional outcomes, and 2 hours/day for cognitive vulnerabilities. Beyond these domain-specific thresholds, developmental risks accelerated non-linearly, with greater daily screen exposure associated with progressively poorer outcomes in cognitive, social-emotional, language, and physical domains, particularly when exposure began before age 2.

Theme 2: Screen-linked self-regulation and behavioural vulnerabilities

High screen exposure was consistently associated with reduced self-regulation, including increased irritability, impulsivity, mood instability, hyperactivity, and inattention. Clear dose–response patterns were evident, with greater screen time linked to more pronounced behavioural difficulties. These vulnerabilities frequently predicted downstream academic challenges, including reduced school readiness, executive functioning, and academic performance.

Theme 3: Cognitive, language, and developmental pathways of screen exposure

Language delays emerged at thresholds of >1–2 hours/day in infancy and early childhood, manifesting as reduced vocabulary and reduced expressive and receptive communication. Concurrently, executive function deficits (particularly attention, processing speed, and working memory) were consistently associated with screen time exceeding 2 hours/day. Two primary pathways mediated these outcomes: (1) impaired executive function accounted for >54% of behavioural sequelae, and (2) screen use displaced parent-child interaction and home literacy practices essential for language development.

Theme 4: Motor development and physical health disruption

Screen exposure as low as 1 hour/day was linked to motor development delays and reduced motor readiness by school entry, and higher screen time (>2 hours/day) disrupted sleep architecture and quality, mediated academic underperformance. Early television exposure was associated with cascading metabolic consequences (elevated BMI, reduced physical activity) evident by later childhood, suggesting displacement of developmentally necessary physical activity and routine-dependent neurological maturation.

Theme 5: Content type, co-viewing context, and quality as moderators of vulnerability

Both content type and viewing context substantially moderated developmental impact. Educational programming was associated with improved vocabulary, numeracy, and school readiness, while non-educational and violent content predicted lower academic performance and increased aggression. Critically, children viewing alone significantly exceeded recommended limits, and background television disrupted parent-child interaction and language development. Active, engaged co-viewing with caregiver scaffolding mitigated developmental risk, whereas passive co-viewing offered limited protection and was linked to

dysregulation and academic underperformance. Detailed evidence supporting each of these five vulnerability patterns is presented in Appendix C (Table C10).

4.5 Research Question 2: Screen exposure and learning challenges in educational settings

Research Question 2 examines how screen exposure affects learning in educational contexts. Multiple foundational capacities, such as attention regulation, executive functioning, self-regulation, and inhibitory control, are essential for school readiness and classroom success. Across the 94 reviewed studies, excessive screen time consistently compromised each of these capacities, with direct implications for educational performance and classroom functioning.

Two primary mechanisms were identified: (1) direct impairment of core cognitive and behavioural skills essential for learning, and (2) the displacement of enriching developmental activities such as play, caregiver interaction, and shared reading. Notably, screen-related learning challenges were not universal but were substantially moderated by content type, context of use, and caregiver engagement.

4.5.1 Theme 6 Foundational capacities undermined by excessive screen time

Building on the dose–response vulnerability patterns identified in Section 4.3.2 (RQ1), this section examines how excessive screen exposure impairs foundational capacities that directly influence classroom functioning. These include attention regulation, executive functioning, inhibitory control, and behavioural self-regulation. Together, they form the cognitive and behavioural infrastructure essential for learning, academic adjustment, and peer engagement in early educational environments.

Theme 6 examines how these four foundational capacities mediate school readiness. Theme 7 (Section 4.4.2) builds on this by presenting evidence of how these impairments

manifest in observable academic and classroom outcomes. Each capacity showed consistent impairment with increased screen exposure. This section presents evidence organised by capacity, supported by indicative findings from the literature. A summary of this evidence is presented in Appendix C (Table C11).

4.5.2 Theme 7 Direct Assessment of School Readiness and Academic Outcomes

Nine studies explicitly assessed school readiness. School readiness was operationalised as measured capacity across language, numeracy, motor, social-emotional, and cognitive domains essential for classroom entry. This revealed consistent dose-response relationships between screen exposure and reduced readiness. These studies provide direct evidence that the foundational capacity impairments identified in Theme 6 translate into measurable educational deficits observable at school entry. A summary of this evidence is provided in Appendix C (Table C12).

Across nine studies directly assessing school readiness, excessive screen exposure consistently undermined the four foundational capacities essential to it (attention regulation, executive functioning, inhibitory control, and self-regulation). Results indicate that these impairments translate directly into measurable academic deficits, particularly in literacy and numeracy domains. Critical threshold effects emerged at approximately 1–2 hours per day for foundational capacities (attention, executive function, self-regulation), with more pronounced school-readiness deficits observed at ≥ 3 hours of daily screen exposure. Impacts intensified particularly at school transition points (ages 4–6), when classroom demands exceed the regulatory capacity of screen-exposed children. Notably, content type emerged as a significant moderator: educational programming supported protective developmental trajectories, while entertainment-focused content was associated with greater educational harm. Most significantly, bidirectional feedback loops between screen time and self-

regulation suggest that early screen-related regulatory difficulties create cumulative disadvantage trajectories, wherein initial regulatory deficits drive both continued excessive media use and reduced engagement with developmentally enriching activities (shared reading, structured play) necessary for academic skill acquisition. These findings show that screen-related learning difficulties are not just about harmful content. Instead, they reflect a broader disruption to the core skills children need to learn well. This means interventions should focus on both reducing screen time and building key abilities such as self-regulation and executive function.

Having established the developmental and educational impacts of excessive screen time in the international evidence base (RQ1 & RQ2), this section turns to the critical question of research representation and contextual relevance: Are these findings applicable to South African early childhood environments, and what specific evidence guides South African policy and practice?

4.6 Research Question 3 and 4: South African Research Gaps and Contextual Recommendations for Educational Settings

This section addresses Research Question 3 (quantifying South African research gaps) and Research Question 4 (identifying contextually relevant recommendations). Of the 94 studies that met the inclusion criteria, none (0%) were conducted in South Africa, and only one (1.1%) originated from any African country. This highlights a critical geographic and contextual gap in the global evidence base, particularly regarding how screen exposure operates in low-resource, high-inequality early educational settings.

To address this gap, 13 studies (13.8%) focused on low socioeconomic status (SES) populations were analysed as contextual proxies, selected for their structural similarities to South African early childhood environments. These included limited access to quality early

childhood programmes, high caregiver work burden, unsupervised screen use, and persistent educational inequities.

The analysis of these 13 studies identified seven themes, grouped into developmental risk (Themes 8–12) and protective factors (Theme 13). While the risk patterns mirror those in the broader dataset (Sections 4.4–4.5), their manifestation in low-SES settings demonstrates how structural disadvantage amplifies vulnerability through increased screen exposure, reduced content quality, limited supervision, and the displacement of enriching developmental activities.

These findings address Research Question 3 by illustrating the specific contextual risks missing from South African research, and Research Question 4 by identifying protective mechanisms that inform the recommendations in Chapter 5. Full evidence from the low-SES studies is presented in Appendix C (Table C13).

Despite the substantial and compounded risks identified in Themes 8-12, six protective mechanisms emerged from low-SES studies that substantially attenuate vulnerability and create intervention pathways. These protective factors are organised by intervention level (family-level, content/resource, institutional, and child-level), clarifying where South African policy and practice can most effectively interrupt risk trajectories. Critically, these protective factors operate within resource-constrained contexts, demonstrating feasibility for implementation in low-resource South African early childhood settings. A summary of these protective factors and intervention points is provided in Appendix C (Table C14).

CHAPTER 5

DISCUSSION

5.1 Introduction

This scoping review investigated the effects of increased screen time on early childhood development and classroom functioning, drawing on 94 studies published between 2000 and 2024 (Arksey & O'Malley, 2005; Braun & Clarke, 2006). The review was guided by four research questions: associations between excessive screen time and developmental vulnerability; links between excessive screen time and learning challenges; evidence gaps in the South African context; and feasible, evidence-based recommendations for educational settings.

The analysis revealed a concerning pattern. Findings indicate widespread non-compliance with international screen time guidelines across all age groups (Brauchli et al., 2024). Children in early childhood are widely exceeding recommended screen time limits, beginning in infancy and continuing through the preschool years (WHO, 2019; Reid Chassiakos et al., 2016). Beyond this quantitative non-compliance, the evidence reveals a more complex picture. Developmental vulnerability is not solely determined by duration but also by content quality and context of use (Joseph et al., 2022; Tekin & Alpgan, 2023). Educational content and co-viewing with caregivers emerged as protective factors (Sweetser, Johnson, Ozdowska, & Wyeth, 2012). These findings align with social learning theory and joint media engagement research, which highlight the importance of responsive, interactive engagement during screen use. Such interactions support comprehension through shared discussion and scaffolded meaning-making (Bandura & Walters, 1977; Takeuchi & Stevens, 2011; Tekin & Alpgan, 2023)

This chapter discusses the findings across four key thematic areas. First, it explores developmental vulnerabilities associated with excessive exposure across social-emotional, cognitive, linguistic, and physical domains. Second, it examines the implications for school readiness and classroom functioning. Third, it highlights gaps in South African research and contextual challenges affecting screen use and policy alignment. Finally, it presents evidence-based protective strategies and intervention opportunities relevant to South African educational settings.

5.2 Developmental vulnerability across domains

5.2.1 The scale of non-compliance: A global crisis

This scoping review reveals a widespread and concerning pattern of non-adherence to internationally recognised screen time guidelines in early childhood (WHO, 2019; Reid Chassiakos et al., 2016). Infants (0 to 2 years) showed universal non-compliance, with all studies reporting some screen exposure despite the WHO recommendations of zero daily use. Among preschool-aged children (2 to 6 years), only 16.4% met the ≤ 1 -hour-per-day recommendation, while 57.5% exceeded it. Average daily screen time was 1.8 hours for infants and 3.75 hours for preschoolers, both well above recommended limits.

These findings directly address Research Question 1. Exceeding screen time recommendations appears to be a global trend rather than an isolated occurrence. The high rates of non-compliance, particularly among infants and preschoolers, provide a clear foundation for examining how early and excessive exposure may contribute to developmental vulnerabilities. The following sections explore these domain-specific impacts.

5.2.2 Dose-response relationships and critical period vulnerability: Non-linear risk acceleration

Across all developmental domains, a clear dose-response relationship emerged, with greater daily screen exposure consistently associated with progressively poorer outcomes. While these thresholds represent synthesised patterns across the reviewed literature, variation exists in how individual studies operationalised these boundaries. This reflects both methodological heterogeneity and potential contextual differences in developmental sensitivity. Critical thresholds appeared at varying points by developmental domain: 1 hour/day for physical development, 1 - 2 hours/day for language and social-emotional outcomes, and 2 hours/day for cognitive vulnerabilities, beyond which developmental risks intensified significantly (Tamana et al., 2019; Waller et al., 2023; Uzundag et al., 2022; Schwarz et al., 2024; Chen et al., 2021).

Children exposed to screen time exceeding 2 hours per day, particularly before age 2, showed consistent impairment across cognitive, social-emotional, language, and physical domains (Tamana et al., 2019; Liang et al., 2024; Pagani et al., 2013). Even exposure as low as 1 hour per day was linked to increased vulnerability across multiple developmental domains, including weaker physical and motor readiness by school entry (Kerai et al., 2022; Pagani et al., 2013). Notably, higher screen time beginning in infancy (around 12 months) was significantly associated with poorer developmental functioning at 24 months across language, motor, and socio-emotional domains (Slobodin et al., 2024).

These dose-response patterns, synthesised from the reviewed evidence, suggest that the timing and duration of exposure interact dynamically to shape developmental trajectories. While individual studies did not uniformly test neurobiological mechanisms, the pattern of findings aligns with theoretical understanding. The reviewed literature demonstrates a

developmental sequence pattern, suggesting that lower-level processing systems develop before higher-level circuits (Knudsen, 2004; CPS, 2017; Hutton et al., 2022). If early foundational systems are disrupted through excessive screen exposure during these critical windows, the development of more complex skills may be compromised. This creates a cascading effect throughout development (Knudsen, 2004; Casey et al., 2005; Christakis, 2019).

The first three years appear to be a particularly vulnerable window for the effects of screen exposure across all developmental domains (Knudsen, 2004; CPS, 2017; Hutton et al., 2022). These critical period effects emerge particularly in Results subsections 1.1 (Cognitive Vulnerability, $n = 12$ studies) and 1.2 (Language Delays, $n = 10$ studies), which demonstrate that infants (0–2 years) show universal non-compliance with guidelines and exhibit evidence of harm across domains (see Results Section 4.4.2). Literature reviewed by Chen et al. (2021) indicates that screen exposure before 12 months may be linked to a sharp increase in the risk of autism-like behaviours, possibly reflecting disruption of foundational developmental processes.

Longitudinal findings reinforce the salience of timing. Higher television viewing at age 2 was associated with significantly poorer kindergarten readiness outcomes at age 5 (Pagani et al., 2013), while children with less exposure at age 2 demonstrated better self-regulation at age 4 (Cliff et al., 2018). These effects appear to compound over time. Greater screen exposure in infancy, particularly around 12 months, was significantly associated with poorer developmental functioning at 24 months across multiple domains (Slobodin et al., 2024). Screen exposure exceeding 2 hours per day at 24 months was associated with lower language outcomes at 36 months and continued developmental vulnerability through age 7 (Kim & Chung, 2021).

While the empirical evidence documented in Section 4.4.2 (Theme 1) establishes consistent timing effects and threshold patterns, these mechanisms may reflect fundamental principles of neuroplasticity and sensitive periods in early brain development. During the first three years of life, rapid synaptogenesis and pruning occur in the prefrontal cortex, sensory cortices, and associative brain regions. These systems are susceptible to environmental inputs (Knudsen, 2004; Hutton et al., 2022). Excessive or poorly moderated screen interaction can alter developmental trajectories by overstimulating reward circuits, reducing opportunities for reciprocal social interaction, and limiting real-world sensory and motor experiences critical for neural integration (Christakis, 2019; Hutton et al., 2022). From a developmental systems perspective, as described by Feldman et al. (2023), environmental interference during periods of heightened plasticity may lead to long-term changes in brain connectivity and function, with downstream effects on learning, attention, and emotional regulation.

Evidence shows that infants are almost universally exposed to screens, despite guidelines. This non-compliance, along with signs of lasting developmental harm, suggests that the current WHO recommendation of zero screen time for children under age 2 may be both appropriate and essential for safeguarding development (WHO, 2019).

5.2.3 Screen-linked self-regulation and behavioural vulnerabilities

Social-emotional development appears to be the domain most consistently affected by early screen exposure. It plays a foundational role in shaping classroom behaviour, peer relationships, and school readiness. Social-emotional development was examined in 59.6% of the studies, making it the most frequently investigated domain. Strong associations were consistently found between screen exposure and social-emotional vulnerability (Canaslan-Akyar & Sungur, 2022; Cliff et al., 2018; Kerai et al., 2022; Madigan et al., 2020).

Excessive screen use was linked to emotional and behavioural dysregulation, including irritability, impulsivity, mood instability, hyperactivity, and inattention (Yang et al., 2024; Zhou et al., 2023). These symptoms may serve as early markers of compromised self-regulation, an essential capacity for adaptive functioning in educational settings (Denham et al., 2012; Galetzka, 2017). The evidence suggests clear dose-response relationships, with children exposed to 2-3 hours per day showing significantly negative impacts on cooperation and self-control (Shou & Nanakida, 2022), while those exceeding 2 hours daily were significantly more likely to exhibit clinically significant emotional symptoms, hyperactivity, and conduct problems (Rakickiene et al., 2021). Gender-specific vulnerabilities further illuminate how screen exposure interacts with developmental and social factors. Boys demonstrated greater susceptibility to externalising behaviours such as aggression and hyperactivity, while girls showed heightened sensitivity to internalising symptoms, including anxiety and emotional withdrawal (Hinkley et al., 2018; Liang et al., 2024; Neville et al., 2021). Such gendered patterns could reflect differential socialisation processes and emotional expression norms, where boys' behavioural dysregulation becomes externally visible, whereas girls' responses manifest as withdrawal or anxiety.

The apparent vulnerability of social-emotional development may stem from screen time's potential to disrupt critical parent-child interactions and displace essential social learning experiences. Children watching alone had 8.56 times higher odds of exceeding screen time recommendations compared with co-viewing situations (Dy et al., 2023). This highlights how unshared media exposure undermines the responsive, contingent communication that fosters emotion regulation and empathy. From an attachment theory perspective, consistent and emotionally attuned interactions between caregiver and child form the basis for self-regulation, empathy, and social competence (Hazan & Shaver, 1992;

Ainsworth et al., 2015). When screen exposure displaces caregiver-child reciprocity, it may impair the child's ability to internalise emotional regulation strategies and secure attachment models. In parallel, social learning theory posits that children acquire behavioural norms and emotional responses by observing and imitating social models (Bandura & Walters, 1977). High exposure to fast-paced or aggressive media content may reinforce impulsive or dysregulated responses, while limiting opportunities for prosocial modelling (Bandura & Walters, 1977; Takeuchi & Stevens, 2011).

5.2.4 Cognitive, language, and developmental pathways of screen exposure

While social-emotional outcomes were the most frequently studied and showed consistent associations with screen-related dysregulation, there is also consistent evidence linking excessive screen exposure to cognitive and language delays.

Excessive screen exposure appears to disrupt attention control and executive processes central to higher-order thinking (Likhitweerawong et al., 2024; Yang et al., 2024; Zhou et al., 2023). Of the 94 studies reviewed, 26 (27.7%) examined language development directly, while a further subset (n = 15; 15.9%) investigated executive function and cognitive processing. These studies highlight how screen time may displace critical social interactions necessary for language acquisition and simultaneously disrupt attentional mechanisms fundamental to learning (Sundqvist et al., 2024; Marriage et al., 2021; Rayce et al., 2024). The evidence reveals apparent dose-response vocabulary deficits, where higher screen exposure consistently predicted lower expressive and receptive vocabulary scores even from infancy (Sundqvist et al., 2024; Rayce et al., 2024; Dy et al., 2023; Çelen Yoldaş & Özmert, 2021; Kim & Chung, 2021). These findings suggest that risks to language outcomes may increase sharply once daily screen use exceeds 1-2 hours. This indicates that even moderate exposure may disrupt key developmental processes. Vocabulary impairments follow

threshold effects, with progressive deterioration as each additional hour of screen use reduces opportunities for communication and problem-solving (Rayce et al., 2024; Dy et al., 2023; Pagani et al., 2013; Rocha et al., 2021).

For cognitive development specifically, excessive screen exposure was consistently associated with difficulties in attention regulation and broader executive dysfunction (Tamana et al., 2019; Waller et al., 2023; Sinvani et al., 2023). Preschoolers exposed to more than 2 hours of screen time per day showed significantly higher rates of clinically significant inattention problems (Tamana et al., 2019). In addition, direct associations were observed between children's screen media use and increased ADHD symptoms (Waller et al., 2023). Passive television viewing significantly correlated with elevated executive dysfunction, indicating that frequent exposure to low-engagement content may hinder the development of self-management and cognitive control processes necessary for later learning (Sinvani et al., 2023).

Notably, while neuroimaging evidence remains limited in the broader literature, emerging studies provide mechanistic insights into these cognitive disruptions. Neurocognitive changes observed in neuroimaging studies may be particularly significant, as they suggest lasting biological impacts linked to screen exposure. Higher screen exposure has been associated with reduced cortical thickness and disrupted development in higher-order associative brain regions (Hutton et al., 2022). Further, children with higher touchscreen usage demonstrated significantly lower Full-Scale IQ scores, with processing speed and working memory being the most affected domains (Lin et al., 2020). These neurobiological findings reinforce behavioural evidence by showing that excessive digital engagement may alter the key mechanisms supporting executive functioning (Diamond, 2013; Paulus et al., 2019).

As Theme 3.3 reveals, these linguistic deficits may arise not merely from content quality but also from the displacement of parent-child interactions and home literacy activities (Chen et al., 2020; Gath et al., 2023; Likhitweerawong et al., 2024; Martins et al., 2020; McArthur et al., 2022; Poulain et al., 2019; Rai et al., 2023; Rocha et al., 2021; Schwarzer et al., 2022; Sundqvist et al., 2024; Tomopoulos et al., 2007). These serve as the primary engine of language growth. Studies revealed that screen exposure significantly lowered reading frequency and shared teaching opportunities, with children exposed to more than 2 hours per day engaging in 1.6 fewer days of reading per week (Tomopoulos et al., 2007). High screen users demonstrated less co-viewing and reduced parent-child interaction quality (Çelen Yoldaş & Özmert, 2021), while greater screen use was negatively associated with literacy-promoting activities. This was particularly true in low-SES households where television and tablet use reduced shared reading opportunities (Kotrla Topić et al., 2020; Chen et al., 2020). Such findings suggest a displacement mechanism in which digital engagement may substitute for, rather than supplement, linguistically enriching activities within the home (Neuman, 1988; Linebarger & Walker, 2005; Przybylski et al., 2020; Tekin & Alpgan, 2023).

5.2.5 Motor development and physical health disruption

Although physical development received comparatively less research attention in the included studies (only 17 of 94, 18.1%), the available evidence suggests meaningful associations among screen exposure, motor development, sleep quality, and long-term health trajectories. Across the studies included, consistent patterns emerged suggesting that increased screen exposure may be associated with compromised fundamental motor and physical health indicators. Children with suspected motor delays reported significantly higher screen use than typically developing peers (Chaibal & Chaiyakul, 2022). Whilst higher

television viewing at age two predicted weaker motor readiness at kindergarten entry (Pagani et al., 2013). Fine motor and visual-motor integration appeared particularly sensitive to high touchscreen use, which was negatively associated with visual-motor integration and physical quality of life (Mahmoud et al., 2021).

Sleep disruption also appeared to be a pervasive physiological correlate of screen exposure. Children exposed to more than two hours per day experienced significantly poorer sleep quality, bedtime resistance, and more frequent night waking (Chandranaik et al., 2024; Waller et al., 2021). Device-specific effects show that portable screens, which are often used in proximity before bedtime, cause greater sleep loss than stationary devices. This was true for boys, who lost an average of 11 minutes of sleep per hour of device use, and for girls, who lost an average of 6 minutes of sleep per hour of device use (Lan et al., 2020). Such sleep disturbances are particularly concerning given their established links to attention, emotional regulation, and learning consolidation. These create indirect pathways through which screen-related sleep loss may amplify developmental vulnerability (Mindell & Leichman, 2017; Hale & Guan, 2015).

The long-term health implications of sustained sedentary behaviour are equally notable. Each additional hour of television at 29 months predicted higher BMI, lower physical activity, and greater consumption of sugary snacks and soft drinks by Grade 4 (Pagani et al., 2010), while children with bedroom televisions at age four had higher BMIs and poorer dietary patterns by adolescence (Pagani et al., 2019). Elevated screen time was found to displace sensorimotor interaction and contribute to central disruptions in cognitive and behavioural functioning, particularly within executive domains (Martins et al., 2020). As documented across Theme 4 subthemes (motor delays, sleep disruption, and long-term metabolic outcomes), these interconnected effects may create bidirectional cycles. Screen-

induced inactivity and poor motor development reinforce sedentary routines and greater screen dependence, while sleep disruption contributes to emotional dysregulation and diminished school readiness (Chandranaik et al., 2024; Pagani et al., 2010; Pagani et al., 2019).

5.2.6 Content type, co-viewing context, and quality as moderators of vulnerability

Although screen time guidelines often focus on duration, this review's evidence shows that what children watch and how they engage with media may have a greater impact on development than the number of hours spent on screens (Bandura & Walters, 1977; Takeuchi & Stevens, 2011). This nuanced understanding may challenge simplistic "screen time is bad" narratives and suggest pathways for developmentally appropriate media use.

The distinction between educational versus entertainment content appeared to be a powerful moderator across multiple domains. Educational programming was consistently linked to stronger vocabulary and school-readiness outcomes (Wright et al., 2001). This was in stark contrast to entertainment or general-audience programming, which was associated with adverse outcomes for academic achievement and language development (Wright et al., 2001). Importantly, educational apps were linked to better executive functioning but showed domain-specific rather than broad developmental benefits (Harmon & Arnold, 2024), indicating that content quality may create targeted rather than universal protective effects.

Co-viewing appeared to be a potent protective factor. As noted earlier, children watching alone had 8.56 times higher odds of excessive screen time compared to co-viewing situations (Dy et al., 2023), while the lack of maternal participation in screen activities led to significantly more behavioural problems at age six and higher dysregulation and lower academic performance at age 8 (Cerniglia et al., 2021). However, the quality versus quantity of co-viewing appeared to be crucial, as passive parental presence offered little protection

compared to active, engaged mediation, with screen use reducing parent-child closeness and passive co-viewing showing no protective effects (Yang et al., 2024; Gath et al., 2023).

Background television appeared particularly harmful, regardless of co-viewing, and was consistently associated with disrupted parent-child interactions and lower vocabulary and cognitive scores during meals (Martinot et al., 2021; Yang et al., 2024).

These contextual factors create a complex matrix in which moderate educational content paired with active co-viewing proved beneficial for cooperation in both preschool and primary settings (Shou & Nanakida, 2022). However, identical durations with entertainment content and solo viewing predicted developmental harm. This pattern aligns closely with social learning theory and joint media engagement research. This research emphasises that the developmental impact of media depends not only on what is watched but also on the quality of the interpersonal scaffolding that accompanies it (Bandura & Walters, 1977; Takeuchi & Stevens, 2011; Tekin & Alpgan, 2023). Active co-viewing may allow caregivers to contextualise, explain, and emotionally frame media content, reinforcing comprehension and moral reasoning through shared discussion. In contrast, passive co-viewing fails to provide scaffolding, limiting modelling and guided learning opportunities. These are key mechanisms highlighted in both attachment and social learning frameworks (Vygotsky, 1978; Tomasello, 2003).

5.3 Screen exposure and learning challenges in educational settings

5.3.1 Executive function as the primary mediating mechanism

The evidence from this scoping review reveals that excessive screen exposure undermines four foundational capacities essential for school readiness: executive functioning, attention regulation, inhibitory control, and self-regulation (Tamana et al., 2019; Waller et al., 2023; Likhitweerawong et al., 2024). Of these, executive function emerges as the central

mediating mechanism, accounting for over 54% of the total effect of screen time on behavioural difficulties in classroom contexts (Likhitweerawong et al., 2024). This finding suggests that executive function may be a critical pathway through which early screen exposure translates into observable learning difficulties in educational settings.

Executive function is essentially working memory, inhibitory control, and cognitive flexibility (Feldman et al., 2023). These cognitive aspects are foundational to children's ability to follow teacher instructions, sustain attention during lessons, regulate emotions during peer conflicts, and engage in cooperative learning (Diamond, 2013). When excessive screen exposure disrupts these capacities during critical developmental periods, children enter school with weakened self-management and attentional resources. This directly compromises their capacity for academic engagement (Best & Miller, 2010; Denham et al., 2012).

The evidence demonstrates clear dose-response relationships. Excessive screen time, defined as 1 to 2 hours per day, was consistently associated with poorer attention regulation, including increased inattention, hyperactivity, executive dysfunction, and reduced classroom focus (Tamana et al., 2019; Cliff et al., 2018; Waller et al., 2023).

More specifically, impulse control deficits emerged at thresholds as low as 2–3 hours per day in preschoolers, with greater impairment at 3–4 hours per day in children entering formal schooling (Canaslan-Akyar & Sungur, 2022; Cerniglia et al., 2021). Passive viewing and mobile media use showed robust associations with executive dysfunction. This suggests that low-engagement content may be especially disruptive to self-management and cognitive control processes (Sinvani et al., 2023; Uzundag et al., 2022). Screen exposure before age 2 emerged as particularly damaging to executive development. Children first exposed during infancy show significantly weaker delay of gratification and lower school-readiness scores at kindergarten entry (Harmon & Arnold, 2024; Uzundag et al., 2022).

5.3.2 Direct school readiness deficits

Nine studies in the scoping review explicitly assessed school-readiness outcomes, providing direct evidence of how screen exposure shapes early educational success. The findings reveal consistent dose-response effects. Children exposed to more than three hours of daily screen time demonstrate significantly lower school-readiness scores across multiple developmental and academic indicators (Tekin & Alpgan, 2023). The longitudinal evidence demonstrates dose-response patterns. Increased screen exposure in infancy predicted deficits in vocabulary, number knowledge, motor skills, and classroom engagement by kindergarten entry (Pagani et al., 2013; Tekin & Alpgan, 2023). This pattern suggests cumulative disadvantage, wherein early exposure effects compound over time.

The impact on core academic skills was particularly striking. Television time was negatively associated with reading readiness, while mobile device time was negatively associated with number readiness. This indicates that different screen modalities may disrupt different academic competencies (Tekin & Alpgan, 2023). Higher screen use was significantly associated with a greater risk of school readiness vulnerability, with increased exposure linked to lower language and cognitive readiness scores (Vanderloo et al., 2022). These findings align with cascading developmental pathways where executive function deficits evolve into broader academic vulnerabilities. As follows, executive function deficits serve as a measurable pathway through which screen time disrupts academic skill acquisition (Harmon & Arnold, 2024).

5.3.3 Content type as a critical moderator of school readiness

A critical finding emerging from the Research Question Two analysis is that content type substantially moderates developmental and academic outcomes. This suggests that the quality and purpose of media exposure may be more influential in determining school

readiness than duration alone (Wright et al., 2001; Harmon & Arnold, 2024). Educational programming was consistently associated with improved vocabulary, reading, math, and executive functioning skills. This stands in stark contrast to entertainment-focused or non-educational content, which has been linked to reduced vocabulary, weaker executive control, and lower overall school readiness (Wright et al., 2001; Harmon & Arnold, 2024).

Educational apps specifically were linked to better executive functioning. However, the evidence suggests domain-specific rather than broad developmental benefits, indicating that content quality may create targeted rather than universal protective effects (Harmon & Arnold, 2024).

These findings have significant implications for early childhood contexts in South Africa. While the international evidence demonstrates the protective effects of educational content, local implementation requires culturally contextualised and linguistically appropriate programming.

Takalani Sesame is a South African adaptation of Sesame Street. It promotes language, numeracy, and social-emotional learning in local languages and cultural contexts. This kind of educational programming shows how content can be tailored to support school readiness in a locally meaningful way (Sesame Workshop South Africa, 2020). However, access to such quality content remains uneven, particularly in low-resource and rural households (Seiler, 2024).

5.3.4 Bidirectional relationships between screen time and self-regulation

One of the most important patterns to emerge from the school readiness findings was the two-way relationship among screen time, self-regulation, and academic readiness. This points to a cycle in which early strengths or difficulties may reinforce long-term educational outcomes (Parrish et al., 2022). Greater television exposure was associated with lower

effortful control, which in turn influenced later screen use, creating a feedback loop. This feedback loop is where weakened self-regulation predicts increased media dependence, which, in turn, further undermines regulatory capacity (Parrish et al., 2022). Conversely, children with higher effortful control demonstrated significantly better academic readiness, social competence, and fewer behavioural problems. This suggests that stronger internal regulation helps limit excessive screen exposure and its associated risks (Parrish et al., 2022).

These bidirectional effects indicate that early intervention during critical developmental windows may interrupt maladaptive cycles before they compound. Displacement mechanisms compound these bidirectional effects. Screen exposure displaces enriching activities such as shared reading and structured play, which are themselves protective factors supporting stronger school readiness (Cliff et al., 2018; Geng et al., 2023; Martins et al., 2020; Tekin & Alpgan, 2023).

These findings have direct implications for early intervention. Limiting screen time alone may be insufficient. Interventions should also prioritise strengthening executive function and self-regulation through structured play, which the evidence identifies as a protective factor for school readiness (Cliff et al., 2018; Geng et al., 2023; Martins et al., 2020).

5.3.5 Implications for South African classrooms

The school readiness evidence provides the most direct response to Research Question Two, establishing clear pathways through which excessive screen exposure translates into the learning challenges observed in early childhood educational settings. However, the implications for South African contexts are particularly significant given distinctive classroom challenges and the documented evidence gaps (Spaull & Kotze, 2015; Karani et al., 2022).

In South African early learning environments, we often see overcrowding, high learner-to-teacher ratios, and variability in early childhood preparation (Department of Basic Education, 2015). It is in these settings that the executive function and self-regulation deficits associated with early screen exposure may manifest more acutely (Spaull & Kotze, 2015; Karani et al., 2022). Teachers working with large groups of children face significant challenges. Challenges include managing attention and behavioural regulation, which may be misinterpreted as screen-related dysregulation, defiance, or a learning disorder rather than a developmental lag in executive function (Denham et al., 2012).

Recognising this distinction is crucial when designing responsive classroom management and instructional approaches. The absence of South African research on school readiness and screen exposure means that teachers lack locally specific guidance on recognising and managing screen-related classroom difficulties (Karani et al., 2022). However, emerging South African research documented in the broader literature, including studies by Seiler (2024) on social-emotional impacts and Draper et al. (2019) on guideline non-compliance. These provide initial insights that could inform teacher preparation and classroom practice if integrated into professional development frameworks.

Teacher training and professional development should explicitly address the developmental effects of screen use (Best & Miller, 2010). Training modules could prioritise explicit instruction in executive function development, including self-regulation through structured routines, emotion coaching, and guided play. These practices are identified as supportive in early intervention research (Best & Miller, 2010; Denham et al., 2012). Specific activities such as working memory games and movement breaks may operationalise these principles in classroom contexts. Moreover, equipping teachers with an understanding of the developmental pathways linking screen exposure and behaviour could improve early

identification. Furthermore, it could reduce punitive responses toward children who exhibit difficulties with attention or regulation (Diamond, 2013).

The evidence reviewed for Research Question Two suggests potential policy implications. Integrating screen awareness and executive function development into South Africa's Early Childhood Development (ECD) curricula and teacher education standards could address identified gaps between international evidence and local practice (Department of Basic Education, 2015). Existing frameworks, such as the National Curriculum Framework for Children Birth to Four and the National Integrated ECD Policy, could be strengthened by including explicit guidelines on media use, interactive learning alternatives, and parent-teacher collaboration in managing home media environments (Department of Basic Education, 2015; Department of Social Development, 2015). Integrating these principles into ECD practitioner training, the Curriculum and Assessment Policy Statement, and school-readiness assessments would ensure systemic alignment between neuroscience evidence and educational practice.

The displacement of developmentally enriching activities identified across studies suggests that South African early childhood programs must prioritise structured play, shared reading, and motor skill development as protective factors against screen-related educational disadvantage (Tekin & Alpgan, 2023; Martins et al., 2020). However, this recommendation must acknowledge the reality that many South African families may rely on screens due to economic constraints and limited alternative childcare options (Prioreshi et al., 2022; Seiler, 2024). This highlights the importance of community-based, low-cost interventions such as play-based learning hubs, mobile libraries, and caregiver education programmes.

Implementation will require investment in teacher training and curricular revision, with a

phased approach starting in high-need districts being a pragmatic strategy given existing resource constraints.

5.4 South African context, evidence gaps, and protective factors

5.4.1 The critical evidence gap: Absence of South African research

The most striking finding of this scoping review is the complete absence of South African research from the 94 included studies, despite spanning 24 years and examining early childhood screen exposure globally. As documented in the literature review, South African research does exist. This includes studies by Karani et al. (2022) on language development in multilingual households. Prioreschi and Norris (2022) on screen exposure patterns in Soweto, Seiler (2024) on social-emotional impacts, and Draper et al. (2019) on guideline non-compliance. However, these did not meet the specific methodological criteria required for inclusion in this review.

This absence is not merely a methodological issue but reflects broader patterns of under-representation in global early childhood research. While 1 study (1.1%) originated from the African continent and 13 studies (13.8%) focused on low-SES populations that share structural similarities with South African contexts, the evidence base remains predominantly drawn from high-income, English-speaking countries.

This disparity creates a real problem. Policy recommendations for South African contexts must be made with caution. The current international evidence base may not reflect the unique interactions between screen exposure, poverty, multilingualism, and other local developmental factors. From a developmental systems perspective, this absence also points to a possible misalignment between the ecological realities of early childhood in South Africa and the assumptions that underpin much of the global literature.

5.4.2 Low-SES populations as contextual proxies: Mirroring South African realities

Given the absence of South African studies, the 13 low-SES international studies (13.8% of the dataset) serve as imperfect but meaningful contextual proxies. These populations share structural similarities with many South African early childhood contexts. Similarities include limited parental availability, constrained access to educational resources, overcrowded living conditions, and restricted outdoor play opportunities.

Risk factors identified in these low-SES studies offer critical insights. However, to meaningfully guide South African policy, these risks must be understood alongside the protective mechanisms that emerged in parallel. The sections that follow present both risks and protections in thematic alignment, clarifying how targeted supports may buffer against context-specific vulnerabilities.

Elevated screen time in low-SES settings

Low-SES children demonstrated dramatically elevated screen exposure. Over 90% of children aged 0-60 months met the WHO/AAP guidelines. This rose from 41.7% in infants to 85.2% in preschoolers. Most critically, screens were often used as a behavioural regulation tool in resource-limited households. However, this practice was associated with significant developmental risks, with children exposed to 2-3 hours per day showing reduced cooperation and self-control (Shou & Nanakida, 2022). These patterns likely mirror South African realities, where economic constraints, limited childcare options, and safety-driven indoor confinement may create similar patterns of screen dependence.

Displacement of Enriching Activities

Low-SES studies consistently documented that passive screen use displaced enriching, co-regulatory activities essential for development (Cerniglia et al., 2021; Martins et al., 2020). Higher screen exposure was significantly associated with poorer executive

functioning and fundamental motor skills. This suggests that screen use crowds out active play and other experiences essential for attention, coordination, and problem-solving (Martins et al., 2020). In South African contexts, where safety concerns and limited access to outdoor spaces often confine children indoors, this displacement mechanism may be particularly pronounced.

Content quality and educational access limitations

The evidence from low-SES studies reveals a critical disparity. While screen exposure was excessive, most screen time was spent on passive video viewing rather than educational apps, and entertainment content was negatively associated with language and academic development. Whilst educational content showed protective effects (Harmon & Arnold, 2024; Wright et al., 2001). This pattern likely reflects South Africa's digital equity gap. Local evidence from South African households indicates that high-quality educational content remains unevenly distributed, particularly in low-resource and rural communities (Karani et al., 2022).

Socioeconomic amplification of screen effects

The evidence demonstrates that socioeconomic variables significantly amplify the developmental impacts of screen exposure (Canaslan-Akyar & Sungur, 2022). Children from lower-income and less-educated households showed greater reductions in social interaction, self-control, and independence, with racial disparities further compounding risk. For South African contexts, this finding is particularly salient. The international evidence demonstrates that lower-SES households, disproportionately affecting Black families and less-educated parents, show amplified screen effects. In South Africa, where documented poverty, educational inequality, and systemic racial disparities intersect, these mechanisms likely compound developmental vulnerabilities.

Together, these themes demonstrate the need to design screen-related interventions that reflect South Africa's specific socioeconomic challenges. As the next section shows, low-SES studies also identified several protective factors that can buffer risk. Understanding how these protective mechanisms operate within high-risk contexts is key to informing responsive, feasible strategies in the South African early learning sector.

5.4.3 Protective factors from low-SES research: Evidence-based pathways for South Africa

Despite concerning patterns documented in low-SES populations, six protective factors emerged from the evidence. These offer hope for feasible, strength-based interventions in South African contexts. These insights guide responsive strategies that work within, rather than against, contextual constraints.

Moderate screen duration

Moderate screen time of 30-60 minutes per day was associated with improved behavioural regulation. Children at this exposure level show greater cooperation in both preschool and primary school environments (Shou & Nanakida, 2022). This finding is critical for South Africa, as it suggests the goal should not be complete screen elimination but rather optimisation of duration and quality. This reframes the discourse from prohibitive to pragmatic, acknowledging that in resource-constrained contexts, screens may be unavoidable.

Educational content as a protective mechanism

Access to educational content offered protective benefits for cognitive and academic development. Educational app use is linked to stronger executive functioning and early exposure to educational programming, predicting better outcomes in reading, math, vocabulary, and school readiness (Harmon & Arnold, 2024; Wright et al., 2001). For South Africa, these findings on the protective effects of educational content suggest that advocating

for equitable access to culturally relevant, multilingual educational programming could support school readiness, even in resource-constrained environments. Evidence-based programming, such as Takalani Sesame, when appropriately localised, can offset some screen-time risks.

Active maternal co-viewing

Active maternal co-viewing emerged as a significant protective factor. Children lacking maternal engagement showed greater emotional and behavioural problems by age 6, and higher dysregulation and lower academic performance in math and literacy by age 8 (Cerniglia et al., 2021; Cliff et al., 2018; Rai et al., 2023). Notably, research on protective contextual factors (examined in Results Theme 5) demonstrates that children watching alone had 8.56 times higher odds of excessive screen time compared to co-viewing situations (Dy et al., 2023). For South Africa, this co-viewing protective effect aligns with cultural strengths documented in South African households. Ubuntu principles emphasise communal child-rearing and shared learning; culturally grounded co-viewing approaches that operationalise these values could provide powerful, low-cost interventions leveraging existing family strengths.

Physical activity as a developmental buffer

Regular physical activity served as a substantial buffer against behavioural difficulties. Meeting physical activity guidelines was significantly associated with fewer behavioural problems. Effect sizes indicating protective effects comparable to pharmacological interventions (Liang et al., 2024; Parrish et al., 2022). This is particularly relevant for South Africa, where emerging research documents the safety-driven indoor confinement affecting screen use patterns. This underscores the importance of community-based physical activity initiatives.

Structured activities and parental supervision

Clear limits on screen use combined with structured, activity-rich routines were associated with better motor skills and a higher quality of life. Whereas the absence of such structure was associated with developmental delays (Madigan et al., 2020). For South Africa, this suggests that integrating screen-time guidelines into existing early childhood development programs could provide realistic, culturally grounded alternatives. **Child's**

executive control as an internal protective factor

A child's executive control emerged as a strong protective factor across developmental outcomes. Higher executive functioning not only predicts better academic and social readiness but also moderates future media use. This suggests that stronger internal regulation helps limit excessive screen exposure and its associated risks (Parrish et al., 2022).

This finding supports interventions that strengthen executive function through play-based learning, emotion coaching, and structured routines, potentially generating bidirectional benefits: reducing screen dependence while enhancing school readiness.

5.4.4 Tailored recommendations for South African educational settings

Research Question 4 asks: What evidence-informed recommendations emerge from this synthesis for South African contexts? The protective factors identified in low-SES international research (Section 5.4.3; Results Table 15, Theme 13) provide the empirical foundation. Translating these findings into actionable strategies requires consideration of South Africa's policy environment, institutional capacity, and contextual realities.

This Discussion section, therefore, proposes a set of evidence-based recommendations across three interrelated tiers: home, school, and community. It is guided by developmental systems and social learning perspectives. These frameworks emphasise the dynamic, reciprocal interactions among children, caregivers, and learning environments (Bandura &

Walters, 1977; Feldman et al., 2023), underscoring the need for multilevel interventions rather than isolated solutions.

Home-Level Interventions

Parental co-viewing and active engagement emerged as some of the most feasible and robust protective mechanisms, particularly in resource-constrained settings. International evidence demonstrates that parent education programs that include media literacy and joint engagement training are associated with measurable benefits (Takeuchi & Stevens, 2011). Similar low-cost workshops could be adapted for the South African context, for example, through community health or early childhood development (ECD) outreach platforms.

Specifically, such programs could focus on co-viewing techniques grounded in the protective mechanisms documented in the evidence. This should include real-time language scaffolding, pause points for discussion, and connections between screen content and children's lived experiences. These interactional strategies support both cognitive and emotional development and can be adapted for local languages and cultural contexts.

Caregivers can also be supported to scaffold meaning, contextualise screen content, and sustain emotional connection during shared viewing. These approaches are consistent with both attachment-informed frameworks (Ainsworth et al., 2015) and social learning theories (Bandura & Walters, 1977), which emphasise the developmental power of contingent, emotionally attuned interactions.

Finally, screen-time planning and media literacy content could be integrated into existing public health and early development initiatives, such as the Road to Health booklet programme or First 1000 Days campaigns. These platforms already reach caregivers at scale and offer strategic entry points for delivering screen-use guidance in trusted, familiar formats.

School-Level Interventions

Early learning environments offer structured opportunities to model balanced digital practices, enhance executive function, and support co-regulation. These are all protective mechanisms identified in the Results (Theme 13.4–13.5). Incorporating screen-awareness components into the Department of Basic Education’s National Curriculum Framework for Children Birth to Four (2015) could ensure that educators are equipped to promote self-regulation, implement structured routines, and integrate developmentally appropriate screen use within the classroom.

As a practical step, the Department could include screen-awareness training modules in early childhood development (ECD) practitioner programmes. These should emphasise multilingual content navigation, play-based learning routines that strengthen executive function (Theme 13.4) and intentional use of educational media, drawing on the benefits outlined in Theme 13.2.

Further, training should equip practitioners to guide co-viewing and attention-building activities, which can buffer the developmental risks associated with unsupervised or passive screen use. To aid implementation, visual teaching aids and activity-based guides in multiple official languages could be developed, ensuring accessibility and cultural relevance across diverse early learning settings.

Community-Level Interventions

Community-level interventions can help mitigate screen-related developmental risks, especially in under-resourced areas where young children are often confined indoors due to safety concerns (as documented in Results Theme 13.4 and South African studies (Prioreschi et al., 2022; Seiler, 2024)). Increasing access to physical activity and social play initiatives is therefore critical.

Partnerships between municipalities, NGOs, and schools could support scalable, low-cost alternatives to passive screen use. For example, expanding structured physical play programmes across ECD centres, churches, and community halls may provide safe, enriching environments that strengthen executive function and reduce reliance on screens (Results Theme 13.4).

In parallel, collaborations with local broadcasters (e.g. SABC Education) and app developers could improve access to culturally relevant, multilingual educational media in low-data or offline formats. This aligns with evidence from Results Theme 13.2 and Theme 9, which highlighted that educational content offers protective benefits, while entertainment content was associated with developmental risks.

Finally, national monitoring platforms such as Thrive by Five could be expanded to track children's digital exposure patterns alongside existing developmental indicators. These data would strengthen the evidence base for responsive policymaking and enable more context-sensitive intervention planning in the early childhood sector.

5.4.5 Policy integration: Filling the gap between evidence and practice

The implications of this evidence synthesis for South African early childhood policy are significant. While existing frameworks emphasise holistic development, caregiver support, and inclusive learning, they do not explicitly address screen exposure or digital media use. This gap is evident in both the National Curriculum Framework for Children Birth to Four (Department of Basic Education, 2015) and the National Integrated ECD Policy (Department of Social Development, 2015).

For example, the National Curriculum Framework promotes responsive interactions and language-rich environments, yet fails to acknowledge how screen displacement may undermine these very developmental priorities. This concern is supported by studies such as

Dy et al. (2023), which demonstrate that solitary screen use significantly reduces opportunities for meaningful linguistic and emotional engagement.

The protective mechanisms identified throughout this review highlight that not all screen use is uniformly harmful. Instead, risk and protection are shaped by context, supervision, and content quality (Joseph et al., 2022; Tomopoulos et al., 2007). These findings suggest that South African policy should move beyond blanket discouragement toward intentional, evidence-informed digital guidance.

To bridge this policy-practice gap, alignment could occur within existing structures to avoid imposing new curricular burdens. Specifically, digital engagement guidelines could be incorporated into both the National Curriculum Framework and the National Integrated ECD Policy. This would ensure that screen use in early childhood settings is developmentally appropriate, culturally relevant, and responsive to local contexts. ECD practitioner training could include digital literacy modules focused on content evaluation, co-viewing practices, and child-led media engagement, delivered through existing professional development platforms.

However, any policy integration must remain attuned to South Africa's dual challenge. While excessive and unsupervised screen exposure poses developmental risks, many children still lack access to high-quality educational technology. This reality necessitates a dual strategy: managing overuse while simultaneously improving equitable access to beneficial digital tools. Feasible solutions may include leveraging existing funding mechanisms, such as the ECD Conditional Grant. Partnering with telecommunications providers to subsidise low-data or offline access to multilingual, educational content

By embedding these insights into national policy, South Africa can move toward a balanced approach that reflects both developmental science and local resource realities.

5.4.6 Building local evidence: Priorities for South African research

This review found a clear gap. South African research on early childhood screen exposure is largely missing from the global evidence base. As shown in Section 4.6, no studies from South Africa were included in the final synthesis. Addressing this gap will require more locally led research, shaped by collaboration between universities, policymakers, and communities.

Future research must be culturally relevant, ethical, and inclusive, reflecting real-world South African contexts. Based on this review, the following four priorities are proposed:

1. Start longitudinal studies in diverse, low-income areas. These should use adapted tools, such as a local version of SCREEN-Q, that reflect multilingual content and media patterns (e.g., Takalani Sesame, religious shows, local music).
2. Use mixed methods, combining surveys with caregiver and educator interviews, to understand how social and economic realities shape screen use.
3. Add screen-related questions to national monitoring tools like Thrive by Five, ELOM, or HSRC child well-being surveys. This would allow for ongoing tracking of trends.
4. Pilot low-cost tools, such as WhatsApp surveys, mobile diaries, or simple checklists, especially in settings with limited internet or staff.

This work should follow a phased plan: start small, test tools, and scale up. All studies must prioritise community ownership of data, informed consent, and clear feedback of results to participants.

5.4.7 Toward screen optimisation rather than elimination

For South Africa, a shift in mindset is needed. The goal is not to ban screens, but to use them better. This review shows that what children watch, how they watch, and who they

watch with often matter more than how long they watch (Takeuchi & Stevens, 2011; Tekin & Alpgan, 2023; Draper et al., 2020).

Individual and contextual factors shape outcomes. Well-supported evidence shows that age, socioeconomic status, and self-regulation affect how screen exposure influences development (Canaslan-Akyar & Sungur, 2022; Geng et al., 2023). Other factors, like temperament, neurodiversity, and cultural context, may also play a role, though more research is needed (Rocha et al., 2023). In South Africa, individual differences might include language exposure (where screens support learning English), family structure (where screens are used when adults are unavailable) and access to activities (where screens might be the primary source of learning).

This review also found that context matters greatly. Co-viewing, where caregivers watch and talk with children, was more protective than watching alone (Takeuchi & Stevens, 2011; Canaslan-Akyar & Cakir, 2022). These interactions help children understand content and link it to real life. On the other hand, unsupervised or passive viewing, especially in overburdened homes, often displaces important developmental experiences (Rocha et al., 2023; Draper et al., 2020).

Given these findings, South African policy should not aim for blanket bans. In many homes, screens are a practical necessity due to safety concerns, limited resources, or lack of alternatives (Karani et al., 2022; Seiler, 2023). Instead, policy and guidance should aim to promote high-quality content, support co-viewing and parent-child interaction and improve access in low-resource communities. This balanced, realistic approach can help reduce harm while using screens to support learning and development.

5.5 Theoretical Integration: Why context and content matter

5.5.1 Developmental systems theory: Beyond simple dose-response

The findings of this review cannot be explained by simple models that assume more screen time always leads to worse outcomes. Instead, developmental systems theory provides a more accurate framework (Feldman et al., 2023). Development is shaped by ongoing, bidirectional interactions between children and their environments. This includes family dynamics, caregiver input, socioeconomic context, content quality, and individual traits (Feldman et al., 2023; Lickliter & Honeycutt, 2003).

Applied to screen use, this review shows that identical durations can lead to very different outcomes, depending on factors like content type, co-viewing, and home routines. This theoretical framework explains the moderating patterns documented in Sections 5.2.6 and 5.4.3, where the same screen duration supported learning in some cases and disrupted development in others. It is not just about screen time. It is about what children watch, who they watch with, and the broader context of their daily lives.

This lens also helps explain why screen use in South African settings may have different developmental impacts than in high-income countries. Interventions must therefore be shaped by an understanding of local ecological conditions, not imported one-size-fits-all rules (Feldman et al., 2023).

5.5.2 Vygotsky's zone of proximal development and active co-viewing as scaffolded learning

Vygotsky's ZPD helps explain how active co-viewing can transform screen exposure from potentially harmful to developmentally supportive (Vygotsky, 1978). Learning happens most effectively when caregivers scaffold experiences. This is beyond a child's independent ability, offering guidance that helps internalise new strategies (Vygotsky, 1978).

This mechanism is reflected in findings showing that active co-viewing conferred protective effects, while passive co-viewing offered little benefit (Yang et al., 2024; Gath et al., 2023). When caregivers actively engage by explaining, questioning, and connecting media to real life, they create scaffolded learning moments within the ZPD. In contrast, passive presence offers no such support and leaves the child to process content alone (Yang et al., 2024).

Piaget's sensorimotor theory complements this view, showing that passive screen time contributes little to early learning, particularly language. Passive viewing accounts for only 0–10% of word learning, compared to interactive engagement (Hassinger-Das et al., 2020). This theoretical perspective explains why higher screen exposure was consistently associated with language delays documented throughout this review. Screens displace the rich, back-and-forth exchanges that most powerfully support language development (Vygotsky, 1978; Tomasello, 2003; Hassinger-Das et al., 2020). For South African contexts, this ZPD lens suggests that responsive, dialogic co-viewing can help preserve developmental benefits while reducing risks (Seiler, 2024; Simuja et al., 2024).

Emerging research emphasises that interventions should build on socially grounded, shared caregiver-child practices, drawing on cultural learning theories (Tomasello, 2003) and local research evidence (Tekin & Alpgan, 2023; Seiler, 2024), rather than imposing external models.

5.5.3 Displacement Theory: Understanding why language, motor, and sleep outcomes suffer

Displacement theory suggests that time spent on one activity reduces time for others, with developmental consequences depending on what is displaced (Neuman, 1988). This review identifies three key pathways of displacement. Linguistic displacement where screen

exposure was associated with reduced shared reading and parent-child narrative construction (Linebarger & Walker, 2005). When screens replace these, they eliminate foundational linguistic inputs, explaining consistent links with language delays (Sundqvist et al., 2024; Rayce et al., 2024).

Motor displacement, where high screen use correlated with reduced physical activity and poorer motor skills (Martins et al., 2020; Chaibal & Chaiyakul, 2022). This reflects the displacement of active play. Since motor play supports proprioception, executive function, and embodied cognition (Diamond, 2013; Feldman et al., 2023), its reduction has compounding effects. In South Africa, where outdoor access is often constrained, this loss may be especially harmful (Martins et al., 2020).

Sleep displacement, where children use screens for more than 2 hours daily, showed significantly poorer sleep quality. Portable devices further reduced total sleep time (Chandranaiik et al., 2024; Lan et al., 2020). Given that sleep supports memory, emotional regulation, and synaptic pruning (Mindell & Leichman, 2017), its loss can trigger next-day attention problems, fueling more screen use and a cycle of dysregulation (Hale & Guan, 2015).

Displacement theory highlights that screen reduction alone is insufficient unless paired with increased access to enriching alternatives. This mechanism has important implications for South African policy and practice. It suggests that effective interventions must expand opportunities for language-rich, physically active, and sleep-supportive routines.

5.5.4 Uses and Gratifications Theory and Digital Equity: Explaining why restriction alone cannot work in South African contexts

Uses and Gratifications Theory explains that media use is driven by specific needs, such as entertainment, information, regulation, or control (Katz et al., 1973; Ruggiero, 2000).

This framework helps explain screen patterns in South African low-SES contexts, where screens often meet multiple roles.

As this review shows, screens are frequently used for behavioural regulation. This is especially where caregivers face real constraints: limited childcare options, safety concerns, or competing responsibilities. In these cases, screen use is a rational response, even if trade-offs exist (Katz et al., 1973; Ruggiero, 2000; Lickliter & Honeycutt, 2003). This supports the shift in South African discourse from elimination to optimisation (see Section 5.4.7).

Interventions focused only on restriction miss the underlying needs screens fulfil.

Digital equity theory also matters here. While smartphone access is widespread in South Africa, meaningful use remains unequal. This review found that low-SES children are both more exposed to screens and more vulnerable to harm (Robinson et al., 2015; Canaslan-Akyar & Sungur, 2022). Limiting screen time without improving access to quality alternatives risks worsening these gaps.

These theoretical perspectives, developmental systems, ZPD, displacement, and uses and gratifications together show that screen use in low-resource settings is shaped less by poor parenting and more by structural constraints. They highlight why quality, context, and equity matter more than screen duration alone. This is why solutions must recognise both immediate needs and broader inequalities (Feldman et al., 2023; Katz et al., 1973; Robinson et al., 2015).

5.6 Methodological Limitations

While this scoping review adhered to established methodological frameworks (Arksey & O'Malley, 2005; Levac et al., 2010) and employed systematic inclusion and exclusion criteria, several limitations warrant explicit acknowledgement. These constraints affected the completeness and scope of the review's findings.

5.6.1 Search strategy and conceptual scope limitations

5.6.1.1 Overly Broad Research Questions

The most consequential limitation relates to the conceptualisation of the research questions. The research question included multiple developmental domains, social-emotional, cognitive, linguistic, and physical, under the "developmental vulnerabilities" heading. This created an analytically burdensome focus. This broad scope significantly increased the workload and thematic complexity, rendering the study less feasible within master's level time and resource constraints (Arksey & O'Malley, 2005). A narrower focus, such as isolating one developmental domain (e.g., language development) or one outcome area (e.g., classroom functioning), would have enabled greater depth and coherence in the research. This reflects a research design limitation that should have ideally been addressed at the proposal stage.

5.6.1.2 Incomplete Physical Development Operationalisation

The search strategy included gross and fine motor skills under the physical development domain. However, sleep, an important part of early physical development that is also affected by screen exposure, was unintentionally left out. This conceptual gap resulted in the exclusion of relevant studies such as Tomaz et al. (2020), which investigates screen time and sleep outcomes in South African preschool children. This omission underscores the inherent complexity of constructing exhaustive search terms across interdisciplinary developmental domains (Arksey & O'Malley, 2005).

5.6.1.3 Absence of Geographic Search Terms

The search strategy did not incorporate geographic identifiers such as "South Africa" or "sub-Saharan Africa" as search terms. This absence may have inadvertently limited the discovery of regionally focused studies. This is particularly problematic given the stated

objective to assess South African evidence gaps (Levac et al., 2010). Retrospectively, this design decision constrained capacity to address regional aims comprehensively and again alludes to the overly broad research questions outlined above.

5.6.2 Critical evidence gap: South African research exclusion

The complete absence of South African studies from the 94 included studies represents the review's most significant limitation and reflects structural inequities in knowledge production rather than the absence of South African research. While emerging South African studies exist, including Karani et al. (2022), Prioireschi and Norris (2022), Seiler (2024), and Draper et al. (2019), none met the specific inclusion criteria due to methodological constraints. For example, Karani et al. (2022) were excluded because they presented a scoping review rather than primary empirical findings; Seiler (2024) focused on children aged 9-12, outside the specified early childhood age range. This methodological constraint means that the absence of South African studies reflects limitations in review parameters rather than the complete absence of local research (Arksey & O'Malley, 2005).

Only 1.1% of included studies came from Africa. This gap is significant. Policy recommendations for South Africa must be cautious, as current evidence may not reflect the cultural and socioeconomic realities of local early childhood contexts.

5.6.3 Data access and grey literature limitations

5.6.3.1 Full-Text Accessibility

The review excluded studies for which full-text access was unavailable. While this criterion ensured methodological consistency, it may have omitted relevant insights. Studies flagged as potentially relevant during abstract screening (e.g., Tomopoulos et al., 2010; Vandewater et al., 2007; MacGowan & Joshi, 2021; Monteiro et al., 2024) could not be

included due to inaccessibility. This underscores the tension between methodological rigour and practical constraints on access.

5.6.3.2 Exclusion of Grey Literature

The review did not systematically search grey literature, local repositories, or regional databases that may contain South African or African research. Given the objective of assessing South African research availability, this represents a gap, as databases such as the South African National Research Foundation's repository or university institutional repositories may contain relevant studies not captured through traditional academic database searches (Levac et al., 2010).

5.6.4 Quality assessment and interpretive constraints

5.6.4.1 Absence of Quality Assessment

In line with standard scoping review methodology, the quality and methodological rigour of included studies were not formally assessed (Arksey & O'Malley, 2005; Peters et al., 2015). While this aligns with scoping review methodology, it limits the ability to comment on the reliability or strength of the evidence base. Findings should not be interpreted as conclusive or generalisable without further critical appraisal (Peters et al., 2015).

5.6.5 Contextual and temporal biases

5.6.5.1 English-Language Bias

The inclusion of only English-language studies, while consistent with resource constraints, may introduce language bias by excluding relevant studies published in other languages, particularly those from non-English-speaking LMICs or from South Africa's other official languages (Peters et al., 2015).

5.6.5.2 Temporal Limitations

The review may be subject to temporal bias. Given the rapid evolution of digital media, screen technologies, and post-pandemic behavioural shifts, some included studies, particularly those published before 2015, may not fully reflect current screen usage patterns, device types, or interactive modalities (Levac et al., 2010). This temporal lag may limit contemporaneity and applicability in today's educational and digital environments.

5.6.6 Scoping review methodology as an iterative process

Scoping reviews are inherently iterative (Arksey & O'Malley, 2005; Levac et al., 2010). Arksey & O'Malley (2005) note that "identifying relevant studies is an iterative process" (p. 23), and Levac et al. (2010) emphasise the need for reflexivity and flexibility throughout. Unlike systematic reviews, scoping reviews are not necessarily exhaustive. Boundaries often shift as the review evolves. This review is best understood as a temporal snapshot of available literature based on defined parameters, rather than a definitive account (Arksey & O'Malley, 2005). Identifying relevant studies after data charting, such as Tomaz et al. (2020), reinforces this iterative ethos.

5.6.7 Summary of limitations as direction for future research

These limitations are presented in the spirit of scholarly transparency, intended to strengthen credibility while guiding future research addressing shortcomings. Collectively, they underscore an urgent imperative: to build a locally grounded, culturally responsive South African evidence base that complements and contextualises international findings (Peters et al., 2015; Levac et al., 2010).

5.7 Conclusion and future directions

5.7.1 Discussion synthesis of key takeaways

This scoping review reveals that developmental vulnerability to screen exposure is not determined solely by duration. Instead, protective and risk factors emerge from the interplay of content quality, social context, co-viewing engagement, and individual child characteristics. These findings have critical implications for early childhood practice in South Africa. Executive function emerged as the primary mediating mechanism, accounting for over 54% of the total effect of screen time on behavioural difficulties (Likhitweerawong et al., 2024). Critical period effects during the first three years underscore the urgency of early intervention.

Critically, low-SES research identified protective factors. Moderate duration (30–60 minutes daily), educational content, active co-viewing, and physical activity. These substantially buffer the critical period vulnerability documented in younger children. This evidence supports screen optimisation rather than elimination as a sustainable approach for resource-constrained South African contexts (Shou & Nanakida, 2022; Harmon & Arnold, 2024; Parrish et al., 2022).

5.7.2 South African policy gap and integration imperative

The complete absence of South African primary research from the 94 included studies represents both a critical evidence gap and a research equity issue (Arksey & O'Malley, 2005). More concerning, neither the National Curriculum Framework for Children Birth to Four (Department of Basic Education, 2015) nor the National Integrated ECD Policy (Department of Social Development, 2015) explicitly addresses screen exposure. This is despite evidence of developmental risks and the protective potential of educational content and active co-viewing (Department of Basic Education, 2015). This policy silence represents

a significant gap, particularly given that co-viewing, a low-cost, evidence-based protective factor, is not integrated into existing ECD guidance (Dy et al., 2023). Addressing this gap would require integrating policy into existing frameworks, providing practitioner training, and aligning quality standards across the ECD sector.

However, any policy response must acknowledge South Africa's dual challenge. Limiting harmful screen exposure while ensuring equitable access to educational technology. This must be achieved in contexts where high levels of technology ownership coexist with profound disparities in equitable access to quality educational content (Robinson et al., 2015).

5.7.3 Toward screen optimisation: Protective factors and individual differences

Rather than advocating universal screen elimination, the evidence supports screen optimisation contingent on content quality, context, and individual differences (Canaslan-Akyar & Sungur, 2022; Takeuchi & Stevens, 2011). In South African contexts specifically, screens may support English language learning and educational stimulation in under-resourced areas, especially where outdoor play is constrained by safety concerns (Robinson et al., 2015). These protective factors provide strength-based, feasible pathways for practice (Shou & Nanakida, 2022; Harmon & Arnold, 2024).

For practice, this evidence supports integrating media literacy and co-viewing guidance into existing teacher professional development and providing caregivers with accessible, culturally grounded approaches to active mediation (Best & Miller, 2010; Seiler, 2024).

5.7.4 Closing: From evidence to contextually responsive practice

The path forward requires three integrated actions: (1) translating international evidence into contextually responsive, multilingual practice grounded in local realities and developmental systems thinking; (2) conducting South African research to validate, adapt,

and extend protective factor findings; and (3) integrating digital engagement guidance into existing policy and practice frameworks rather than creating new requirements (Feldman et al., 2023; Peters et al., 2020).

CHAPTER SIX

CONCLUSION

6.1 Reprise of aim and scope

This thesis explored how increased screen time affects early childhood development and classroom functioning through a scoping review of 94 studies, addressing four research questions: developmental vulnerability, learning challenges, South African research gaps, and context-relevant recommendations. Grounded in developmental systems theory, the review recognised that screen effects arise from complex interactions among children, families, content, and context, not solely from duration.

6.2 Synthesis of key findings: Answering the research questions

Research question 1: The context paradox

Rather than duration alone, content quality and co-viewing context emerged as stronger predictors of developmental outcomes (Takeuchi & Stevens, 2011; Tekin & Alpkan, 2023). The 'context paradox', in which identical screen duration produces opposite effects depending on content and co-viewing, suggests that developmental vulnerability is contingent on how screens are embedded within responsive family practices (Canaslan-Akyar & Sungur, 2022), rather than inevitable. Critical period effects during the first three years underscore the urgency, yet active co-viewing can transform exposure into scaffolded learning (Vygotsky, 1978; Tomasello, 2003).

Research question 2: Executive function as a mediating pathway

Executive function, accounting for over 54.9% of the impact of screen time on behavioural difficulties, emerged as the central mediating mechanism linking screen exposure to school readiness deficits (Likhitweerawong et al., 2024). Language and cognitive delays represent secondary rather than primary pathways. Critically, these deficits are not inevitable:

interventions addressing both screen reduction and enriching alternatives can substantially mitigate harm (Neuman, 1988; Tekin & Alpgan, 2023).

Research question 3: The South African evidence gap and policy imperative

Emerging South African studies (Karani et al., 2022; Seiler, 2024; Draper et al., 2019; Simuja et al., 2024) document local screen exposure patterns and culturally grounded co-viewing practices. However, these studies remain under-represented in international evidence synthesis, highlighting the urgent need for increased visibility and investment in African-led early childhood research. More consequential for policy: neither the National Curriculum Framework for Children Birth to Four nor the National Integrated ECD Policy explicitly addresses screen exposure, despite evidence of developmental risks and protective factors identified in this review (Department of Basic Education, 2015; Department of Social Development, 2015). Intentional guidance on co-viewing practices, informed by evidence on protective co-viewing mechanisms (Dy et al., 2023) and grounded in culturally responsive approaches. These could be integrated into existing ECD curricula and aligned with Ubuntu principles of communal child-rearing (Seiler, 2024; Simuja et al., 2024). This policy silence is particularly problematic given that co-viewing remains unintegrated in existing guidance.

Research question 4: Screen optimisation as a feasible pathway

Low-SES research identified protective factors that substantially buffer critical period vulnerability. This suggests that screen optimisation rather than elimination is a sustainable approach for resource-constrained South African contexts (Shou & Nanakida, 2022; Harmon & Arnold, 2024; Parrish et al., 2022). This reframes the intervention from a restriction-focused to a strength-based approach. Where 98% smartphone penetration coexists with disparities in meaningful access to quality educational content, optimisation approaches prove more feasible and equitable than universal elimination (Robinson et al., 2015).

6.3 Implications and Future Directions

Implementation requires action at three levels. Policy: integrate digital engagement guidance into existing ECD frameworks, emphasising content quality and co-viewing context rather than time restrictions (Department of Basic Education, 2015; Department of Social Development, 2015). Practice: provide teachers and caregivers with media literacy training supporting active mediation and co-regulation, grounded in multilingual, culturally responsive approaches that reflect South African contexts, including communal child-rearing practices and real-world constraints (Best & Miller, 2010; Seiler, 2024). Research: establish South African longitudinal studies to validate protective factors and build a locally grounded evidence base for monitoring developmental outcomes alongside screen exposure patterns (Peters et al., 2020).

6.4 Closing Perspective

This thesis demonstrates that early childhood screen exposure outcomes depend critically on content quality, social context, and co-viewing engagement, rather than on duration alone. This 'context paradox' fundamentally challenges restrictive approaches to screen management and highlights the necessity of developmentally informed, contextually responsive interventions. For South Africa, the implications are clear: build locally grounded evidence to validate protective factors (Seiler, 2024; Karani et al., 2022) and shift policy from blanket restrictions to content- and context-informed guidance that emphasises co-viewing engagement and cultural responsiveness rather than time limits. The goal is not screen elimination but intentional, embedded use within responsive caregiving and language-rich environments essential for healthy development.

References

- Adelantado-Renau, M., Moliner-Urdiales, D., Cavero-Redondo, I., Beltran-Valls, M. R., Martínez-Vizcaíno, V., & Álvarez-Bueno, C. (2019). Association between screen media use and academic performance among children and adolescents. *JAMA Paediatrics*, 173(11), 1058–1067.
<https://doi.org/10.1001/jamapediatrics.2019.3176>
- Adolph, K. E., & Franchak, J. M. (2017). The development of motor behaviour. *Wiley Interdisciplinary Reviews: Cognitive Science*, 8(1–2), e1430.
<https://doi.org/10.1002/wcs.1430>
- Agurcia-Parker, C. (2009). *An investigation into the relationship between screen time, consumption of advertised foods, and physical activity among Texas 4th grade elementary school children* (Publication No. 3350219) [Doctoral dissertation, ProQuest]. ProQuest Dissertations and Theses Global.
<https://ukzn.idm.oclc.org/login?url=https://www.proquest.com/dissertations-theses/investigation-into-relationship-between-screen/docview/305019089/se-2>
- Ainsworth, M. D. S. (1989). Attachments beyond infancy. *American Psychologist*, 44(4), 709–716. <https://doi.org/10.1037/0003-066X.44.4.709>
- Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. N. (2015). *Patterns of attachment: A psychological study of the strange situation*. Psychology press.
- Alhojailan, M. I. (2012). Thematic analysis: A critical review of its process and evaluation. *West East Journal of Social Sciences*, 1(1).
<http://westeastinstitute.com/journals/wp-content/uploads/2013/02/4-Mohammed->

[Ibrahim-Alhojailan-Full-Paper-Thematic-Analysis-A-Critical-Review-Of-Its-Process-And-Evaluation.pdf](#)

American Academy of Paediatrics Committee on Communications and Media. (2016).

Media and young minds. *Paediatrics*, 138(5), e20162591.

<https://doi.org/10.1542/peds.2016-2591>

American Academy of Paediatrics. (2016). Media and young minds. *Paediatrics*, 138(5),

e20162591. <https://doi.org/10.1542/peds.2016-2591>

American Psychological Association. (2020). *Publication manual of the American*

Psychological Association: The official guide to APA style (7th ed.). American

Psychological Association.

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological

framework. *International Journal of Social Research Methodology*, 8(1), 19–32.

<https://doi.org/10.1080/1364557032000119616>

Australian Government Department of Health. (2019). *Australian 24-hour movement*

guidelines for the early years (birth to 5 years): An integration of physical

activity, sedentary behaviour, and sleep. Commonwealth of Australia.

[https://www.health.gov.au/resources/publications/24-hour-movement-](https://www.health.gov.au/resources/publications/24-hour-movement-guidelines-early-years-birth-to-5-years)

[guidelines-early-years-birth-to-5-years](https://www.health.gov.au/resources/publications/24-hour-movement-guidelines-early-years-birth-to-5-years)

Balton, S., Uys, K., & Alant, E. (2019). Family-based activity settings of children in a

low-income African context. *African Journal of Disability*, 8(0), a364.

<https://doi.org/10.4102/ajod.v8i0.364>

- Bandura, A., & Walters, R. H. (1977). *Social learning theory* (Vol. 1, pp. 141-154). Englewood Cliffs, NJ: Prentice Hall.
- Bang, M., & Medin, D. (2010). Cultural processes in science education: Supporting the navigation of multiple epistemologies. *Science Education*, 94(6), 1008–1026.
<https://doi.org/10.1002/sce.20392>
- Barr, R., Kirkorian, H. L., Radesky, J. S., Coyne, S., Nichols, D. L., & Blanchard, S. (2020). ScreenQ: Validation of a screening tool to assess digital media use in early childhood. *JAMA Paediatrics*, 174(7), 697–699.
<https://doi.org/10.1001/jamapediatrics.2020.0351>
- Best, J. R., & Miller, P. H. (2010). A developmental perspective on executive function. *Child Development*, 81(6), 1641–1660. <https://doi.org/10.1111/j.1467-8624.2010.01499.x>
- Brauchli, V., Edelsbrunner, P., Paz Castro, R., Barr, R., von Wyl, A., Lannen, P., & Sticca, F. (2024). Screen time vs. scream time: Developmental interrelations between young children's screen time, negative affect, and effortful control. *Computers in Human Behavior*, 154, 108138.
<https://doi.org/https://doi.org/10.1016/j.chb.2024.108138>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
<https://doi.org/10.1191/1478088706qp063oa>
- Braun, V., & Clarke, V. (2012). Thematic analysis. *APA PsycNet*.
<https://psycnet.apa.org/record/2011-23864-004>

- Bronfenbrenner, U. (1994). Ecological models of human development. In T. Husén & T. N. Postlethwaite (Eds.), *International encyclopaedia of education* (2nd ed., Vol. 3, pp. 1643–1647). Pergamon Press.
- Bruner, J. (1985). Child's talk: Learning to use language. *Child Language Teaching and Therapy*, 1(1), 111-114.
- Canadian Paediatric Society, Digital Health Task Force. (2017). Screen time and young children: Promoting health and development in a digital world. *Paediatrics & Child Health*, 22(8), 461–468. <https://doi.org/10.1093/pch/pxx133>
- Canaslan-Akyar, B., & Sungur, S. (2022). Preschool children's digital media usage and self-regulation skill. *Turkish Journal of Education*, 11(2), 126–142. <https://research.ebsco.com/linkprocessor/plink?id=f5bf001a-144f-3440-ad92-eea27ba112d6>
- Casey, B. J., Tottenham, N., Liston, C., & Durston, S. (2005). Imaging the developing brain: What have we learned about cognitive development? *Trends in Cognitive Sciences*, 9(3), 104–110. <https://doi.org/10.1016/j.tics.2005.01.011>
- Çelen Yoldaş, T., & Özmert, E. N. (2021). Communicative Environmental Factors Including Maternal Depression and Media Usage Patterns on Early Language Development. *Maternal & Child Health Journal*, 25(6), 900-908. <https://doi.org/10.1007/s10995-021-03125-3>
- Cerniglia, L., Cimino, S., & Ammaniti, M. (2021). What are the effects of screen time on emotion regulation and academic achievements? A three-wave longitudinal study on children from 4 to 8 years of age. *Journal of Early Childhood Research*, 19(2), 145-160. <https://doi.org/10.1177/1476718X20969846>

- Chaibal, S., & Chaiyakul, S. (2022). The association between smartphone and tablet usage and children development. *Acta Psychologica*, 228, 103646.
<https://doi.org/https://doi.org/10.1016/j.actpsy.2022.103646>
- Chandranaik, D., Goyal, J. P., Singh, K., & Kumar, P. (2024). Association of digital media use with sleep habits in school children: A cross-sectional study. *Sleep Medicine: X*, 8, 100117. <https://doi.org/https://doi.org/10.1016/j.sleepx.2024.100117>
- Chen, W., & Adler, J. L. (2019). Assessment of screen exposure in young children, 1997 to 2014. *JAMA Paediatrics*, 173(4), 391–393.
<https://doi.org/10.1001/jamapediatrics.2018.5546>
- Chen, C., Chen, S., Wen, P., & Snow, C. E. (2020). Are screen devices soothing children or soothing parents? Investigating the relationships among children's exposure to different types of screen media, parental efficacy and home literacy practices. *Computers in Human Behaviour*, 112, 106462.
<https://doi.org/10.1016/j.chb.2020.106462>
- Chen, J.-Y., Strodl, E., Wu, C.-a., Huang, L.-H., Yin, X.-N., Wen, G.-M., Sun, D.-L., Xian, D.-X., Chen, Y.-J., Yang, G.-Y., & Chen, W.-Q. (2021). Screen time and autistic-like behaviours among preschool children in China. *Psychology, Health & Medicine*, 26(5), 607-620. <https://doi.org/10.1080/13548506.2020.1851034>
- Chigona, A., Chigona, W., Kausa, M., & Kayongo, P. (2010). An empirical survey on domestication of ICT in schools in disadvantaged communities in South Africa. *International Journal of Education and Development Using ICT*, 6(2), 21-32.

- Christakis, D. A., Zimmerman, F. J., DiGiuseppe, D. L., & McCarty, C. A. (2004). Early television exposure and subsequent attentional problems in children. *Paediatrics*, 113(4), 708–713. <https://doi.org/10.1542/peds.113.4.708>
- Christakis, D. A. (2019). The challenges of defining and studying “digital addiction” in children: The importance of conceptual clarity. *JAMA Paediatrics*, 173(10), 922–923. <https://doi.org/10.1001/jamapediatrics.2019.2430>
- Cliff, D. P., Howard, S. J., Radesky, J. S., McNeill, J., & Vella, S. A. (2018). Early Childhood Media Exposure and Self-Regulation: Bidirectional Longitudinal Associations. *Acad Pediatr*, 18(7), 813-819. <https://doi.org/10.1016/j.acap.2018.04.012>
- Cost, K. T., Crosbie, J., Anagnostou, E., Birken, C. S., Charach, A., Monga, S., Kelley, E., Nicolson, R., Maguire, J. L., Burton, C. L., Schachar, R. J., Arnold, P. D., & Korczak, D. J. (2022). Mostly worse, occasionally better: Impact of COVID-19 pandemic on the mental health of Canadian children and adolescents. *European Child & Adolescent Psychiatry*, 31(4), 671–684. <https://doi.org/10.1007/s00787-021-01744-3>
- Council on Communications and Media. (2016). Media and young minds. *Paediatrics*, 138(5), e20162591. <https://doi.org/10.1542/peds.2016-2591>
- Danet, M., Miller, A. L., Weeks, H. M., Kaciroti, N., & Radesky, J. S. (2022). Children aged 3–4 years were more likely to be given mobile devices for calming purposes if they had weaker overall executive functioning. *Acta Paediatrica*, 111(7), 1383–1389. <https://doi.org/10.1111/apa.16314>

- De Villiers, P. A. (2022). Multilingualism and language development in early childhood: Implications for educational practice in South Africa. *South African Journal of Childhood Education*, 12(1), 1–10. <https://doi.org/10.4102/sajce.v12i1.1223>
- Del Pozo-Cruz, B., Perales, F., Parker, P., Lonsdale, C., Noetel, M., Hesketh, K. D., et al. (2019). Joint physical-activity/screen-time trajectories during early childhood: Socio-demographic predictors and consequences on health-related quality-of-life and socio-emotional outcomes. *International Journal of Behavioural Nutrition and Physical Activity*, 16, Article 55. <https://doi.org/10.1186/s12966-019-0816-3>
- Denham, S. A., Bassett, H. H., Zinsser, K., & Wyatt, T. M. (2012). How preschoolers' social-emotional learning predicts their early school success: Developing theory-promoting, competency-based assessments. *Infant and Child Development*, 21(6), 667–693. <https://doi.org/10.1002/icd.744>
- Department of Basic Education. (2015). *National curriculum framework for children from birth to four*. Government of South Africa. <https://www.education.gov.za/Portals/0/Documents/Publications/National%20Curriculum%20Framework%20for%20Children%20from%20Birth%20to%20Four.pdf>
- Department of Social Development. (2015). *National integrated early childhood development policy*. Government of South Africa. https://www.gov.za/sites/default/files/gcis_document/201610/national-integrated-eecd-policy-web-version-final-01-08-2016a.pdf
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>

- Diaz-Lopez, J., & Fujiwara, M. (2017). Constructing stage-structured matrix population models from life tables: Comparison of methods. *PeerJ*, 5, e3971.
<https://doi.org/10.7717/peerj.3971>
- Domingues-Montanari, S. (2017). Clinical and psychological effects of excessive screen time on children. *Journal of Paediatrics and Child Health*, 53(4), 333–338.
<https://doi.org/10.1111/jpc.13462>
- Domitrovich, C. E., Durlak, J. A., Staley, K. C., & Weissberg, R. P. (2017). Social-emotional competence is essential for promoting positive adjustment and reducing risk in school children. *Child Development*, 88(2), 408–416.
<https://doi.org/10.1111/cdev.12739>
- Draper, C. E., Tomaz, S. A., Bassett, S. H., Burnett, C., Christie, C. J., Cozett, C., de Milander, M., Krog, S., Monyeki, A., Naidoo, N., Naidoo, R., Pioreschi, A., Walter, C., Watson, E., Lambert, E. V., & Noakes, T. D. (2019). Results from South Africa's 2018 report card on physical activity for children and youth. *Journal of Physical Activity and Health*, 16(10), 745–749.
<https://doi.org/10.1123/jpah.2019-0210>
- Draper, C. E., Tomaz, S. A., Stone, M., Hinkley, T., Jones, R. A., Louw, J., Twisk, J., Kahn, K., & Norris, S. A. (2019). Developing intervention strategies to optimise body composition in early childhood in South Africa. *BioMed Research International*, 2019, Article 5283457. <https://doi.org/10.1155/2019/5283457>
- Draper, C. E., Tomaz, S. A., Biersteker, L., Cook, C. J., Davis, E., Grantham-McGregor, S., van Heerden, A., Raine, J., van Poppel, M. N. M., & Norris, S. A. (2020). *Development of South Africa's 24-hour movement guidelines for birth to 5 years:*

An integration of physical activity, sitting behaviour, screen time and sleep.

Journal of Science and Medicine in Sport, 23(11), 1050–1057.

<https://doi.org/10.1016/j.jsams.2020.05.013>

Duch, H., Fisher, E. M., Ensari, I., Font, M., Harrington, A., Taromino, C., Yip, J., &

Rodriguez, C. (2013). Association of Screen Time Use and Language

Development in Hispanic Toddlers: A Cross-Sectional and Longitudinal Study.

Clinical Paediatrics, 52(9), 857-865. <https://doi.org/10.1177/0009922813492881>

Dy, A. B. C., Dy, A. B. C., & Santos, S. K. (2023). Measuring effects of screen time on

the development of children in the Philippines: a cross-sectional study. *BMC*

Public Health, 23(1), 1261. <https://doi.org/10.1186/s12889-023-16188-4>

Erol, M. C., Şimşek, Z. C., & Işıkoğlu, N. (2025). How does the COVID-19 pandemic

affect young children's screen time? The role of bioecological factors.

International Journal of Child, Youth and Family Studies, 16(1).

<https://www.erudit.org/en/journals/ijcyfs/2025-v16-n1-ijcyfs010299/1120513ar/>

Fang, K., Mu, M., Liu, K., & He, Y. (2019). Screen time and childhood

overweight/obesity: A systematic review and meta-analysis. *Child*, 45(5), 744–

753. <https://doi.org/10.1111/cch.12701>

Feldman, H. M., Elias, E. R., Blum, N. J., Jiménez, M., & Stancin, T.

(2023). *Developmental-behavioral pediatrics* (Fifth edition). Elsevier.

<https://www-clinicalkey-com.ukzn.idm.oclc.org/dura/browse/bookChapter/3-s2.0-C20190041878>

Finfgeld, D. L. (2003). Meta synthesis: The state of the art—So far. *Qualitative Health*

Research, 13(7), 893–904. <https://doi.org/10.1177/1049732303253462>

- Galetzka, M. (2017). *Children's transfer of learning from touchscreen devices* (Doctoral dissertation, University of Sheffield). University of Sheffield.
- Garner, P. W., & Mahatmya, D. (2015). Social–emotional learning, emotional knowledge, and attitudes supporting learning in preschool children. *Early Education and Development*, 26(7), 977–992. <https://doi.org/10.1080/10409289.2015.1004518>
- Gastaud, L. M., Trettim, J. P., Scholl, C. C., Rubin, B. B., Coelho, F. T., Krause, G. B., Ferreira, N. M., de Matos, M. B., Pinheiro, R. T., & de Avila Quevedo, L. (2023). Screen time: Implications for early childhood cognitive development. *Early Human Development*, 183, 105792. <https://doi.org/10.1016/j.earlhumdev.2023.105792>
- Gastaud, L., Pereira, J. L., Koller, S. H., & Bosa, C. A. (2023). Screen time and early childhood development: A systematic review. *Frontiers in Psychology*, 14, 1124416. <https://doi.org/10.3389/fpsyg.2023.1124416>
- Gastaud, S., de Lemos Vieira, C., de Oliveira, L. A., & Goldani, M. Z. (2023). Association between screen time and early childhood development in low- and middle-income countries: A narrative review. *Frontiers in Psychology*, 14, 1179236. <https://doi.org/10.3389/fpsyg.2023.1179236>
- Gath, M., McNeill, B., & Gillon, G. (2023). Preschoolers' screen time and reduced opportunities for quality interaction: Associations with language development and parent-child closeness. *Current Research in Behavioural Sciences*, 5, 100140. <https://doi.org/10.1016/j.crbeha.2023.100140>
- Gautier, C., Alexandre, M., Zaczek, S., Mostaert, A., & Legros, L. (2023). Comparative validity between the Canadian and the Dutch norms of the Alberta Infant Motor

Scale in a preterm population. *Child: Care, Health and Development*, 49(1), 36–43. <https://doi.org/10.1111/cch.13002>

Geng, S., Xu, K., & Liu, X. (2023). Association between electronic media use and internalizing problems: The mediating effect of parent–child conflict and moderating effect of children's age. *Behavioural Sciences*, 13(8), 694. <https://doi.org/10.3390/bs13080694>

Ginsburg, H. P., & Oppen, S. (1988). *Piaget's theory of intellectual development*.

Prentice-Hall, Inc. Golden, S. L., Blake, J. W. C., & Giuliano, K. K. (2020).

Parental decision-making: Infant engagement with smartphones. *Infant Behaviour and Development*, 61, 101497.

<https://doi.org/10.1016/j.infbeh.2020.101497>

Guest, G., MacQueen, K. M., & Namey, E. E. (2011). *Applied thematic analysis*. Sage Publications.

Haddaway, N. R., Collins, A. M., Coughlin, D., & Kirk, S. (2015). The role of Google Scholar in evidence reviews and its applicability to grey literature searching. *PLOS ONE*, 10(9), e0138237. <https://doi.org/10.1371/journal.pone.0138237>

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Medicine Reviews*, 21, 50–58. <https://doi.org/10.1016/j.smr.2014.07.007>

Hancox, R. J., Milne, B. J., & Poulton, R. (2004). Association between child and adolescent television viewing and adult health: A longitudinal birth cohort study. *The Lancet*, 364(9430), 257–262. [https://doi.org/10.1016/S0140-6736\(04\)16675-0](https://doi.org/10.1016/S0140-6736(04)16675-0)

- Harmon, T. M., & Arnold, D. H. (2024). Mobile technology and school readiness: An adverse relationship with executive functioning in low-income preschoolers. *Journal of Child and Family Studies*, 33(10), 3338–3349.
<https://doi.org/10.1007/s10826-024-02913-z>
- Hassinger-Das, B., Ridge, K., Hayes, R., Hirsh-Pasek, K., & Golinkoff, R. M. (2020). Learning through play: The science of engagement. *Psychology of Aesthetics, Creativity, and the Arts*, 14(1), 1–12. <https://doi.org/10.1037/aca0000250>
- Hawi, N. S., & Rupert, M. S. (2015). Impact of e-discipline on children's screen time. *Cyberpsychology, Behaviour, and Social Networking*, 18(6), 337–342.
<https://doi.org/10.1089/cyber.2014.0608>
- Hazan, C., & Shaver, P. R. (1992). Broken attachments: Relationship loss from the perspective of attachment theory. In *Close relationship loss: Theoretical approaches* (pp. 90-108). New York, NY: Springer New York.
- Hinkley, T., Brown, H., Carson, V., & Teychenne, M. (2018). Cross sectional associations of screen time and outdoor play with social skills in preschool children. *PLoS One*, 13(4), e0193700.
<https://doi.org/10.1371/journal.pone.0193700>
- Hosokawa, R., & Katsura, T. (2018). Association between mobile technology use and child adjustment in early elementary school age. *PLoS One*, 13(7), e0199959.
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0199959>
- Hutton, J. S., Dudley, J., Horowitz-Kraus, T., DeWitt, T., & Holland, S. K. (2022). Associations between screen-based media use and brain white matter integrity in

preschool-aged children. *JAMA Paediatrics*, 174(1), e193869.

<https://doi.org/10.1001/jamapediatrics.2019.3869>

Joseph, G. V., M, A. T., Elizabeth, S., Vargheese, S., & Thomas, J. (2022). The Impact of Screen Time and Mobile Dependency on Cognition, Socialization and Behaviour among Early Childhood Students during the COVID Pandemic--Perception of the Parents. *Digital Education Review*(41), 114-123.

<https://research.ebsco.com/linkprocessor/plink?id=499ab8f8-fbde-3f86-a052-4ef89c5ccfec>

Kabali, H. K., Irigoyen, M. M., Nunez-Davis, R., Budacki, J. G., Mohanty, S. H., Leister, K. P., & Bonner, R. L., Jr. (2015). Exposure and use of mobile media devices by young children. *Paediatrics*, 136(6), 1044–1050.

<https://doi.org/10.1542/peds.2015-2151>

Karani, A. K., Slemming, W., & Norris, S. A. (2021). Screen time and early childhood development in urban South Africa: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 18(4), 2082.

<https://doi.org/10.3390/ijerph18042082>

Karani, A. K., Slemming, W., & Norris, S. A. (2022). The association between screen time and language development in children: A scoping review. *International Journal of Environmental Research and Public Health*, 19(5), 2808.

<https://doi.org/10.3390/ijerph19052808>

Karani, H., Smith, C., Muthuri, S., & Draper, C. (2021). Digital screen time in South African children: An overview of the evidence. *South African Journal of Child Health*, 15(4), 208–213. <https://doi.org/10.7196/SAJCH.2021.v15i4.1862>

- Katz, E., Blumler, J. G., & Gurevitch, M. (1973). Uses and gratifications research. *Public Opinion Quarterly*, 37(4), 509–523. <https://doi.org/10.1086/268109>
- Kaushik, V., & Walsh, C. A. (2019). Pragmatism as a research paradigm and its implications for social work research. *Social Sciences*, 8(9), 255. <https://doi.org/10.3390/socsci8090255>
- Kerai, S., Almas, A., Guhn, M., Forer, B., & Oberle, E. (2022). Screen time and developmental health: Results from an early childhood study in Canada. *BMC Public Health*, 22(1), 310. <https://doi.org/10.1186/s12889-022-12701-3>
- Kerai, S., Almas, A., Guhn, M., Forer, B., & Oberle, E. (2022). Screen time and developmental health: results from an early childhood study in Canada. *BMC public health*, 22(1), 310. <https://doi.org/10.1186/s12889-022-12701-3>
- Kiger, M. E., & Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, 42(8), 846–854. <https://doi.org/10.1080/0142159X.2020.1755030>
- Kim, K. M., & Chung, U. S. (2021). Associations among exposure to television or video, language development, and school achievement in childhood: A prospective birth cohort study. *Social Psychiatry and Psychiatric Epidemiology*, 56(5), 847–856. <https://doi.org/10.1007/s00127-020-01967-w>
- Klopper, R., Lubbe, S., & Rugbeer, H. (2007). The Matric model of literature review. *Alternation*, 14(1), 262–276. https://journals.co.za/doi/pdf/10.10520/AJA10231757_377

- Knudsen, E. I. (2004). Sensitive periods in the development of the brain and behaviour. *Journal of Cognitive Neuroscience*, 16(8), 1412–1425.
<https://doi.org/10.1162/0898929042304796>
- Kostyrka-Allchorne, K., Cooper, N. R., & Simpson, A. (2017). The relationship between television exposure and children's cognition and behaviour: A systematic review. *Developmental Review*, 44, 19–58.
<https://doi.org/10.1016/j.dr.2016.12.002>
- Kotrla Topić, M., Šakić Velić, M., & Merkaš, M. (2020). Tablet and Smartphone or a Book: The Struggle Between Digital Media and Literacy Environment in Homes of Croatian Preschool Children and Its Effect on Letter Recognition. *Cyberpsychol Behav Soc Netw*, 23(6), 412–417.
<https://doi.org/10.1089/cyber.2019.0482>
- Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: advancing the methodology. *Implementation Science*, 5(1). <https://doi.org/10.1186/1748-5908-5-69>
- Levine, L. E., Waite, B. M., Bowman, L. L., & Kachinsky, K. (2019). Mobile media use by infants and toddlers. *Computers in Human Behaviour*, 94, 92–99.
<https://doi.org/10.1016/j.chb.2018.12.045>
- Liang, Y., Jin, Q., Miao, J., Ni, X., Qian, X., Xiong, Y., Liu, Z., & Xue, H. (2024). Association between screen time and physical activity on mental health among preschoolers: a cross-sectional study from Southwest China. *BMC Public Health*, 24(1), 1–11. <https://doi.org/10.1186/s12889-024-17722-8>

- Lickliter, R., & Honeycutt, H. (2003). Developmental dynamics: Toward a biologically plausible evolutionary psychology. *Psychological Bulletin*, 129(6), 819–835.
<https://doi.org/10.1037/0033-2909.129.6.819>
- Likhitweerawong, N., Boonchooduang, N., Khorana, J., Phinyo, P., Patumanond, J., & Louthrenoo, O. (2024). Executive dysfunction as a possible mediator for the association between excessive screen time and problematic behaviours in preschoolers. *PLOS ONE*, 19(4), 1–17.
<https://doi.org/10.1371/journal.pone.0298189>
- Lin, H.-P., Chen, K.-L., Chou, W., Yuan, K.-S., Yen, S.-Y., Chen, Y.-S., & Chow, J. C. (2020). Prolonged touch screen device usage is associated with emotional and behavioural problems, but not language delay, in toddlers. *Infant Behaviour and Development*, 58, 101424.
<https://www.sciencedirect.com/science/article/pii/S0163638319300025>
- Linebarger, D. L., & Walker, D. (2005). Infants' and toddlers' television viewing and language outcomes. *American Behavioural Scientist*, 48(5), 624–645.
<https://doi.org/10.1177/0002764204271505>
- Livingstone, S., & Byrne, J. (2018). Parenting in the digital age: The challenges of parental responsibility in comparative perspective. In G. Mascheroni, C. Ponte, & A. Jorge (Eds.), *Digital parenting: The challenges for families in the digital age* (pp. 19–30). Nordicom. <https://www.diva-portal.org/smash/get/diva2:1535895/FULLTEXT01.pdf>
- Livingstone, S., Davidson, J., Bryce, J., Batool, S., Haughton, C., & Nandi, A. (2018). *Children's online activities, risks and safety: A literature review by the UKCCIS*

Evidence Group. UK Council for Child Internet Safety. [Literature Review Final October 2017.pdf](#)

MacLeod-Brudenell, I., Kay, J., Cortvriend, V., Hallet, E., Henshaw, M., & Walkup-Taylor, V. (2008). *Advanced early years: For foundation degrees and levels 4/5*. Pearson Education Limited.

<https://books.google.co.za/books?id=k8OCngEACAAJ>

Madigan, S., Racine, N., & Tough, S. (2020). Prevalence of preschoolers meeting vs exceeding screen time guidelines. *JAMA Paediatrics*, 174(1), 93–95.

<https://doi.org/10.1001/jamapediatrics.2019.4495>

Mahmoud, A. M., Al-Tohamy, A. M., & Abd-Elmonem, A. M. (2021). Usage time of touch screens in relation to visual-motor integration and the quality of life in preschool children. *Journal of Taibah University Medical Sciences*, 16(6), 819–825. <https://doi.org/10.1016/j.jtumed.2021.06.003>

Mallawaarachchi, S. R., Anglim, J., Hooley, M., & Horwood, S. (2022). Associations of smartphone and tablet use in early childhood with psychosocial, cognitive and sleep factors: A systematic review and meta-analysis. *Early Childhood Research Quarterly*, 60, 13–33. <https://doi.org/10.1016/j.ecresq.2021.12.008>

Manditereza, B., & Hadebe-Ndlovu, B. N. (2024). Exploring the effects of technology use on early childhood physical development. *AICEd Proceedings*. <https://aarf.org/wp-content/uploads/2024/10/AICEd-2024-Proceedings.pdf#page=49>

Martins, C. M. d. L., Bandeira, P. F. R., Lemos, N. B. A. G., Bezerra, T. A., Clark, C. C. T., Mota, J., & Duncan, M. J. (2020). A Network Perspective on the Relationship between Screen Time, Executive Function, and Fundamental Motor Skills

among Preschoolers. *International journal of environmental research and public health*, 17(23). <https://doi.org/10.3390/ijerph17238861>

Martinot, P., Bernard, J. Y., Peyre, H., De Agostini, M., Forhan, A., Charles, M.-A., Plancoulaine, S., & Heude, B. (2021). Exposure to screens and children's language development in the EDEN mother-child cohort. *Scientific Reports*, 11(1), 11863. <https://doi.org/10.1038/s41598-021-90867-3>

Marriage, J. E., Keshavarzi, M., & Moore, B. C. J. (2024). An association between auditory responsiveness of children and duration of entertainment screen time in the early years of life. *International journal of audiology*, 63(9), 731-737. <https://doi.org/10.1080/14992027.2023.2260097>

McArthur, B. A., Tough, S., & Madigan, S. (2022). Screen time and developmental and behavioural outcomes for preschool children. *Paediatric Research*, 91(6), 1616–1621. <https://www.nature.com/articles/s41390-021-01572-w>

McCarrick, K., & Li, X. (2007). Buried treasure: The impact of computer use on young children's social, cognitive, language development and motivation. *AACE Journal*, 15(1), 73–95. <https://www.learntechlib.org/primary/p/19909/>

McCloskey, M., Johnson, S. L., Benz, C., Thompson, D. A., Chamberlin, B., Clark, L., & Bellows, L. L. (2018). Parent perceptions of mobile device use among preschool-aged children in rural Head Start centres. *Journal of Nutrition Education and Behaviour*, 50(1), 83–89.e1. <https://doi.org/10.1016/j.jneb.2017.03.006>

McNeill, J., Howard, S. J., Vella, S. A., & Cliff, D. P. (2019). Longitudinal associations of electronic application use and media program viewing with cognitive and

psychosocial development in preschoolers. *Academic Paediatrics*, 19(5), 520–528. <https://doi.org/10.1016/j.acap.2019.02.010>

Memon, A. R., et al. (2019). Publication bias in clinical trials. *Contemporary Clinical Trials Communications*, 14, 100342. <https://doi.org/10.1016/j.conctc.2019.100342>

Mikulincer, M., Shaver, P. R., & Pereg, D. (2003). Attachment theory and affect regulation: The dynamics, development, and cognitive consequences of attachment-related strategies. *Motivation and emotion*, 27(2), 77-102.

Mindell, J. A., & Leichman, E. S. (2017). Sleep and social-emotional development in infants and toddlers. *Sleep Medicine Clinics*, 12(3), 351–358. <https://doi.org/10.1016/j.jsmc.2017.03.009>

Monteiro, R., Fernandes, S., & Rocha, N. (2022). What do preschool teachers and parents think about the influence of screen-time exposure on children's development? Challenges and opportunities. *Education Sciences*, 12(52). <https://doi.org/10.3390/educsci12010052>

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, 18(1). <https://doi.org/10.1186/s12874-018-0611-x>

Muppalla, S. K., Vuppalapati, S., Reddy Pulliahgaru, A., & Sreenivasulu, H. (2023). Effects of excessive screen time on child development: An updated review and strategies for management. *Cureus*, 15(6), e40608. <https://doi.org/10.7759/cureus.40608>

- Muthuri, S. K., Wachira, L. J. M., Onywera, V. O., & Tremblay, M. S. (2014). Correlates of objectively measured overweight/obesity and physical activity in Kenyan school children: Results from ISCOLE-Kenya. *BMC Public Health*, 14(1), 436. <https://doi.org/10.1186/1471-2458-14-436>
- Naicker, S., Pillay, M., & Govender, S. (2021). The use of educational media in South African multilingual preschools: Caregiver perspectives. *South African Journal of Childhood Education*, 11(1), 1–10. <https://doi.org/10.4102/sajce.v11i1.1007>
- Nelson, C. A., & Sheridan, M. A. (2011). Lessons from neuroscience research for understanding causal links between family and neighbourhood characteristics and educational outcomes. In G. J. Duncan & R. J. Murnane (Eds.), *Whither opportunity? Rising inequality and the uncertain life chances of low-income children* (pp. 27–46). Russell Sage Foundation. https://philpapers.org/go.pl?id=NELLFN&proxyId=&u=http%3A%2F%2Fbooks.google.com%2Fbooks%3Fhl%3Den%26lr%3D%26id%3DmF_me7HYyHcC%26oi%3Dfnd%26pg%3DPA27%26ots%3Dwrib4NA1wf%26sig%3DnF4L3A_XOXEfFAvf-9fEk77IPYo
- Neuman, S. B. (1988). The displacement effect: Assessing the relation between television viewing and reading performance. *Reading Research Quarterly*, 23(4), 414–440. <https://doi.org/10.2307/747641>
- Neville, R. D., Nelson, M. A., Madigan, S., Browne, D. T., & Lakes, K. D. (2021). Does physical activity moderate the association between screen time and psychosocial development in early childhood? Analysis of a longitudinal infant cohort study

in Ireland. *European Journal of Paediatrics*, 180(7), 2199-2211.

<https://doi.org/10.1007/s00431-021-04008-z>

Oncesi, Ö., & Kes, K. (2023). The relationship of screen exposure with sleep quality and self-regulation skills in preschool children. *Turkish Journal of Paediatric Disease*, 17(4), 285–290. <https://doi.org/10.52221/tjpd.2023.17.285>

Ortiz, R. W., Green, T., & Lim, H. (2011). Families and home computer use: Exploring parent perceptions of the importance of current technology. *Urban Education*, 46(2), 202–215. <https://doi.org/10.1177/0042085910377433>

Ostrov, J. M., Gentile, D. A., & Crick, N. R. (2006). Media Exposure, Aggression and Prosocial Behavior during Early Childhood: A Longitudinal Study. *Social Development*, 15(4), 612–627. <https://doi.org/10.1111/j.1467-9507.2006.00360.x>

ÖZdemİR, Ç., & Keleş, S. (2023). The Relationship of Screen Exposure with Sleep Quality and Self-Regulation Skills in Preschool Children. *Journal of Pediatric Disease / Türkiye Çocuk Hastalıkları Dergisi*, 17(4), 285-290. <https://doi.org/10.12956/tchd.1220617>

Pagani, L. S., Fitzpatrick, C., Barnett, T. A., & Dubow, E. (2010). Prospective associations between early childhood television exposure and academic, psychosocial, and physical well-being by middle childhood. *Arch Pediatr Adolesc Med*, 164(5), 425-431. <https://doi.org/10.1001/archpediatrics.2010.50>

Pagani, L. S., Fitzpatrick, C., Barnett, T. A., & Dubow, E. (2013). Prospective associations between early childhood television exposure and academic, psychosocial, and physical well-being by middle childhood. *Archives of Paediatrics & Adolescent Medicine*, 167(9), 806–812. <https://doi.org/10.1001/jamapediatrics.2013.234>

- Pagani, L. S., Harbec, M. J., & Barnett, T. A. (2019). Prospective associations between television in the preschool bedroom and later bio-psycho-social risks. *Pediatr Res*, 85(7), 967-973.
<https://doi.org/10.1038/s41390-018-0265-8>
- Parrish, K. H., Smith, M. R., Moran, L., Ruberry, E. J., & Lengua, L. J. (2022). Tests of Bidirectional Relations of TV Exposure and Effortful Control as Predictors of Adjustment in Early Childhood in the Context of Family Risk Factors. *Infant Child Dev*, 31(4).
<https://doi.org/10.1002/icd.2314>
- Paulus, M. P., Squeglia, L. M., Bagot, K., Jacobus, J., Kuplicki, R., Breslin, F. J., ... & Tapert, S. F. (2019). Screen media activity and brain structure in youth: Evidence for diverse structural correlation networks from the ABCD study. *NeuroImage*, 185, 140–153.
<https://doi.org/10.1016/j.neuroimage.2018.10.040>
- Pawson, R. (2002). Evidence-based policy: In search of a method. *Evaluation*, 8(2), 157–181.
<https://doi.org/10.1177/135638902401462448>
- Perdana, A., Simarmata, D. E., & Widjaja, L. M. (2017). American Academy of Paediatrics (AAP) recommendations about children and screen time. *Proceedings of the 1st International Conference on Interprofessional Health Collaboration (ICIHC 2016)*, 75, 107–110.
<https://doi.org/10.2991/icihc-16.2017.27>
- Peters, M. D. J., Godfrey, C. M., McInerney, P., Munn, Z., Tricco, A. C., & Khalil, H. (2020). Chapter 11: Scoping reviews. In E. Aromataris & Z. Munn (Eds.), *JBIM Manual for Evidence Synthesis*. JBI. <https://doi.org/10.46658/JBIMES-20-12>

- Peters, M. D. J., Godfrey, C., Khalil, H., McInerney, P., Parker, D., & Soares, C. B. (2015). Guidance for conducting systematic scoping reviews. *International Journal of Evidence-Based Healthcare*, 13(3), 141–146. <https://doi.org/10.1097/XEB.0000000000000050>
- Pham, M. T., Rajić, A., Greig, J. D., Sargeant, J. M., Papadopoulos, A., & McEwen, S. A. (2014). A scoping review of scoping reviews: advancing the approach and enhancing the consistency. *Research Synthesis Methods*, 5(4), 371–385. <https://doi.org/10.1002/jrsm.1123>
- Piaget, J., & Cook, M. (1952). *The origins of intelligence in children* (Vol. 8, No. 5, pp. 18-1952). New York: International universities press.
- Prioreschi, A., & Norris, S. A. (2022). Early childhood development in South Africa: Inequality and opportunity. *The Lancet Child & Adolescent Health*, 6(5), 282–284. [https://doi.org/10.1016/S2352-4642\(22\)00066-2](https://doi.org/10.1016/S2352-4642(22)00066-2)
- Prioreschi, A., & Norris, S. A. (2022). Screen time and physical activity in young children in Soweto, South Africa: A cross-sectional study. *BMC Paediatrics*, 22(1), 425. <https://doi.org/10.1186/s12887-022-03482-9>
- Przybylski, A. K., Orben, A., & Weinstein, N. (2020). How Much Is Too Much? Examining the Relationship Between Digital Screen Engagement and Psychosocial Functioning in a Confirmatory Cohort Study. *Journal of the American Academy of Child & Adolescent Psychiatry*, 59(9), 1080-1088. <https://doi.org/https://doi.org/10.1016/j.jaac.2019.06.017>
- Rai, J., Predy, M., Wiebe, S. A., Rinaldi, C., Zheng, Y., & Carson, V. (2023). Patterns of preschool children’s screen time, parent–child interactions, and cognitive development in early childhood: a pilot study. *Pilot and Feasibility Studies*, 9(1), 39. <https://doi.org/10.1186/s40814-023-01266-6>

- Radesky, J. S., & Christakis, D. A. (2016). Increased screen time: *Implications for early childhood development and behaviour. Paediatric Clinics of North America*, 63(5), 827–839. <https://doi.org/10.1016/j.pcl.2016.06.006>
- Radesky, J. S., Schumacher, J., & Zuckerman, B. (2015). Mobile and interactive media use by young children: *The good, the bad, and the unknown. Paediatrics*, 135(1), 1–3. <https://doi.org/10.1542/peds.2014-2251>
- Radesky, J. S., Weeks, H. M., Ball, R., Schaller, A., Yeo, S., Durnez, J., Tamayo-Rios, M., de Leon, C., & Kistin, C. (2020). Young children's use of smartphones and tablets. *Paediatrics*, 146(1), e20193518. <https://doi.org/10.1542/peds.2019-3518>
- Rakickienė, L., Jusienė, R., Baukienė, E., & Breidokienė, R. (2021). Pre-schoolers' Behavioural and Emotional Problems During the First Quarantine Due to COVID-19 Pandemic: The Role of Parental Distress and Screen Time. *Psychology/Psichologija*, 64, 61-68. <https://doi.org/10.15388/Psichol.2021.41>
- Ranjit, A., Buchanan, N., Kroukamp, A., Budree, S., Goddard, E., Watkins, A., Lawrence, K., Wilson, K., Tomlinson, M., & Rotheram-Borus, M. J. (2022). Technology use and mental health symptoms in a community sample of South African adolescents. *Computers in Human Behaviour*, 128, 107104. <https://doi.org/10.1016/j.chb.2021.107104>
- Rathnasiri, A., Rathnayaka, H., Yasara, N., & Mettananda, S. (2022). Electronic screen device usage and screen time among preschool-attending children in a suburban area of Sri Lanka. *BMC Paediatrics*, 22(1), 390. <https://doi.org/10.1186/s12887-022-03452-6>

Rayce, S. B., Okholm, G. T., & Flensburg-Madsen, T. (2024). Mobile device screen time is associated with poorer language development among toddlers: results from a large-scale survey. *BMC Public Health*, 24(1), 1050.

<https://doi.org/10.1186/s12889-024-18447-4>

Reid Chassiakos, Y. L., Radesky, J., Christakis, D., Moreno, M. A., & Cross, C. (2016). Children and adolescents and digital media. *Paediatrics*, 138(5), e20162593.

<https://doi.org/10.1542/peds.2016-2593>

Rideout, V. (2021). *The Common-Sense Census: Media Use by Kids Age Zero to Eight in America, A Common-Sense Media Research Study, [United States], 2013, 2017* (ICPSR 37491). <https://doi.org/10.3886/ICPSR37491.v2>

Rideout, V. J., Foehr, U. G., & Roberts, D. F. (2010). *Generation M2: Media in the lives of 8- to 18-year-olds*. Kaiser Family Foundation.

<https://files.eric.ed.gov/fulltext/ED527859.pdf>

Roberts, M. Z., Flagg, A. M., & Lin, B. (2022). Context matters: How smartphone (mis)use may disrupt early emotion regulation development. *New Ideas in Psychology*, 64. <https://doi.org/10.1016/j.newideapsych.2021.100919>

Robinson, L., Cotten, S. R., Ono, H., Quan-Haase, A., Mesch, G., Chen, W., Schulz, J., Hale, T. M., & Stern, M. J. (2015). Digital inequalities and why they matter. *Information, Communication & Society*, 18(5), 569–582.

<https://doi.org/10.1080/1369118X.2015.1012532>

Rocha, H. A. L., Correia, L. L., Leite, Á. J. M., Machado, M. M. T., Lindsay, A. C., Rocha, S. G. M. O., Campos, J. S., Cavalcante E Silva, A., & Sudfeld, C. R. (2021). Screen time and early childhood development in Ceará, Brazil: a

population-based study. *BMC Public Health*, 21(1), 2072.

<https://doi.org/10.1186/s12889-021-12136-2>

Rocha, B., Ferreira, L. I., Martins, C., Santos, R., & Nunes, C. (2023). The Dark Side of Multimedia Devices: Negative Consequences for Socioemotional Development in Early Childhood. *Children (Basel)*, 10(11).

<https://doi.org/10.3390/children10111807>

Roslan, S., Ahmad, N. A., Saat, N. Z. M., Abdullah, M. C., & Ahmad, A. R. (2022). A systematic review on physical, cognitive, and social-emotional development in preschoolers. *Children*, 9(2), 181. <https://doi.org/10.3390/children9020181>

Roslan, S., Husin, N. A. M., Mohd Nawi, N. S., & Mahmud, S. (2022). Application of Piaget's theory in early childhood learning. *International Journal of Academic Research in Business and Social Sciences*, 12(7), 122–132.

<https://doi.org/10.6007/IJARBSS/v12-i7/14306>

Royal College of Paediatrics and Child Health. (2019). *The health impacts of screen time: A guide for clinicians and parents*. RCPCH.

<https://www.rcpch.ac.uk/resources/health-impacts-screen-time-guide-clinicians-parents>

Ruangdaraganon, N., Chuthapisith, J., Mo-suwan, L., et al. (2009). Television viewing in Thai infants and toddlers: impacts to language development and parental perceptions. *BMC Paediatrics*, 9, 34. <https://doi.org/10.1186/1471-2431-9-34>

Rubin, A. M. (2009). Uses-and-gratifications perspective on media effects. In J. Bryant & M. B. Oliver (Eds.), *Media effects: Advances in theory and research* (3rd ed., pp. 165–184). Routledge.

Ruggiero, T. E. (2000). Uses and gratifications theory in the 21st century. *Mass Communication and Society*, 3(1), 3-37.

https://doi.org/10.1207/S15327825MCS0301_02

Salway, R., Walker, R., Sansum, K., House, D., Emm-Collison, L., Reid, T., Breheny, K., Williams, J. G., de Vocht, F., Hollingworth, W., Foster, C., & Jago, R. (2023). Screen-viewing behaviours of children before and after the 2020-21 COVID-19 lockdowns in the UK: a mixed methods study. *BMC Public Health*, 23(1), 116.

<https://doi.org/10.1186/s12889-023-14976-6>

Sannino, A. L., Sannino, A., Daniels, H., & Gutiérrez, K. D. (Eds.). (2009). *Learning and expanding with activity theory*. Cambridge University Press.

Schwarzer, C., Grafe, N., Hiemisch, A., Kiess, W., & Poulain, T. (2022). Associations of media use and early childhood development: cross-sectional findings from the LIFE Child study. *Paediatric Research*, 91(1), 247-253.

<https://doi.org/10.1038/s41390-021-01433-6>

Schwarz, S., Krafft, H., Maurer, T., Lange, S., Schemmer, J., Fischbach, T., Emgenbroich, A., Monks, S., Hubmann, M., & Martin, D. (2024). Screen Time, Nature, and Development: Baseline of the Randomized Controlled Study “Screen-free till 3”. *Developmental science*, 28(1), e13578.

<https://doi.org/10.1111/desc.13578>

Seiler, J. (2023). *Caregivers' experiences on the effects of screen-time on social interactions of South African children in the intermediate phase* (Master's thesis). University of Pretoria. <https://hdl.handle.net/2263/87654>

- Seiler, R. (2024). The association between digital screen use and social-emotional learning among intermediate-phase learners in South African primary schools. *African Journal of Research in Mathematics, Science and Technology Education*, 28(1), 45–62. <https://doi.org/10.1080/18117295.2024.2302156>
- Sesame Workshop South Africa. (2020). *Takalani Sesame: Promoting early childhood development through educational media*. <https://www.sesameworkshop.org/what-we-do/our-global-impact/takalani-sesame>
- Shaffer, D. D. R., & Kipp, K. (2002). *Developmental Psychology: Childhood & Adolescence*. Cengage Learning. <https://books.google.co.za/books?id=W0EAAAAQBAJ>
- Shaffer, D. R. (2002). *Developmental psychology: Childhood and adolescence* (6th ed.). Wadsworth/Thomson Learning.
- Shonkoff, J. P., & Phillips, D. A. (Eds.). (2000). *From neurons to neighbourhoods: The science of early child development*. National Academy Press. <https://doi.org/10.17226/9824>
- Shou, E., & Nanakida, A. (2022). Children's Media Use: Does It Matter for Social Adjustment during the Early School Transition? *Child Indicators Research*, 15(6), 2267-2288. <https://doi.org/10.1007/s12187-022-09956-y>
- Simuja, T. B., Mwanri, L., & Ward, P. (2024). Digital divides and health inequalities in the Global South: A qualitative study of early childhood development programs. *Global Health Action*, 17(1), 2156789. <https://doi.org/10.1080/16549716.2023.2156789>

- Simuja, C., Matabane, M., Chinegundu, T., Omoregie, C., & Orji, E. (Eds.). (2024). *Education in the Global South in the Era of Digital Economy: Proceedings of the Africa International Conference on Education*. African Academic Research Forum. <https://aa-rf.org/wp-content/uploads/2024/10/AICEd-2024-Proceedings.pdf>
- Sinvani, R.-T., Darel, D., Ektilat, F., Segal, L., & Gilboa, Y. (2023). The relationship between executive functions and naturalistic use of screen-based activities in children. *Child neuropsychology : a journal on normal and abnormal development in childhood and adolescence*, 29(5), 787-794. <https://doi.org/10.1080/09297049.2022.2134331>
- Slobodin, O., Hetzroni, O. E., Mandel, M., Saad Nuttman, S., Gawi Damashi, Z., Machluf, E., & Davidovitch, M. (2024). Infant screen media and child development: A prospective community study. *Infancy*, 29(2), 155-174. <https://doi.org/10.1111/infa.12575>
- Spaull, N., & Kotze, J. (2015). Starting behind and staying behind in South Africa: The case of insurmountable learning deficits in mathematics. *International Journal of Educational Development*, 41, 13–24. <https://doi.org/10.1016/j.ijedudev.2015.01.002>
- Steele, J. R., & Brown, J. D. (1995). Adolescent room culture: Studying media in the context of everyday life. *Journal of Youth and Adolescence*, 24(5), 551–576. <https://doi.org/10.1007/BF01537056>

- Stiglic, N., & Viner, R. M. (2019). Effects of screentime on the health and well-being of children and adolescents: A systematic review of reviews. *BMJ Open*, 9(1), e023191. <https://doi.org/10.1136/bmjopen-2018-023191>
- Suggate, S. P., & Martzog, P. (2020). Screen-time influences children's mental imagery performance. *Developmental Science*, 23(5), e12978. <https://doi.org/10.1111/desc.12978>
- Sundqvist, A., Barr, R., Heimann, M., Birberg-Thornberg, U., & Koch, F.-S. (2024). A longitudinal study of the relationship between children's exposure to screen media and vocabulary development. *Acta Paediatrica*, 113(3), 517–522. <https://doi.org/10.1111/apa.17047>
- Supanitayanon, S., Trairatvorakul, P., & Chonchaiya, W. (2020). Screen media exposure in the first 2 years of life and preschool cognitive development: a longitudinal study. *Pediatr Res*, 88(6), 894-902. <https://doi.org/10.1038/s41390-020-0831-8>
- Sweetser, P., Johnson, D., & Wyeth, P. (2012). Revisiting the taxonomy of educational games: Classification and analysis. *Simulation & Gaming*, 43(1), 118–139. <https://doi.org/10.1177/1046878111403364>
- Takeuchi, L., & Stevens, R. (2011). *The new coviewing: Designing for learning through joint media engagement*. New York: The Joan Ganz Cooney Center at Sesame Workshop. https://joanganzcooneycenter.org/wp-content/uploads/2011/12/jgc_coviewing_desktop.pdf
- Tamana, S. K., Ezeugwu, V., Chikuma, J., Lefebvre, D. L., Azad, M. B., Moraes, T. J., et al. (2019). Screen-time is associated with inattention problems in preschoolers:

Results from the CHILD birth cohort study. *PLOS ONE*, 14, e0213995.

<https://doi.org/10.1371/journal.pone.0213995>

Tekin, U., & Alpgan, Ö. (2023). Association between screen time of mobile devices and TV and school readiness in preschool children: a cross-sectional study.

Developmental Neuropsychology, 48(2), 47–55.

<https://doi.org/10.1080/87565641.2023.2183957>

Terre Blanche, M., Durrheim, K., & Painter, D. (2016). *Research in practice: Applied methods for the social sciences* (2nd ed.). Juta and Company Ltd.

Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. MIT Press.

Tomasello, M. (2003). *Constructing a language: A usage-based theory of language acquisition*. Harvard University Press.

Tomaz, S. A., Hillyer, G. C., Whitrow, M. J., & Eastwood, J. (2020). Screen time and children's wellbeing in South Africa: A multiple regression approach. *Children and Youth Services Review*, 118, 105374.

<https://doi.org/10.1016/j.childyouth.2020.105374>

Tomaz, S. A., Pioreschi, A., Watson, E. D., McVeigh, J. A., Rae, D. E., Jones, R. A., Draper, C. E., & Norris, S. A. (2020). Body composition, physical activity, and screen time in South African children. *Medicine & Science in Sports & Exercise*, 52(8), 1718–1724. <https://doi.org/10.1249/MSS.0000000000002290>

Tomlinson, M. (2019). *Towards a national curriculum for birth to four: A critical analysis of the South African landscape*. In L. Meyer, M. Moletsane & T. Van

der Walt (Eds.), *The curriculum life: South African perspectives* (pp. 55–74).

Pearson.

Tomopoulos, S., Valdez, P. T., Dreyer, B. P., Fierman, A. H., Berkule, S. B., Kuhn, M., & Mendelsohn, A. L. (2007). Is exposure to media intended for preschool children associated with less parent-child shared reading aloud and teaching activities? *Ambulatory Paediatrics*, 7(1), 18–24.

<https://doi.org/10.1016/j.ambp.2006.10.005>

Tremblay, M. S., Chaput, J. P., Adamo, K. B., Aubert, S., Barnes, J. D., Choquette, L., Duggan, M., Faulkner, G., Goldfield, G. S., Gray, C. E., Gruber, R., Janson, K., Janssen, I., Janssen, X., Garcia, A. J., Kuzik, N., LeBlanc, L., MacLean, J., Okely, A. D., Poitras, V. J., Rayner, M.-E., Reilly, J. J., Sampson, M., Spence, J. C., Timmons, B. W., & Carson, V. (2017). Canadian 24-hour movement guidelines for the early years (0–4 years): An integration of physical activity, sedentary behaviour, and sleep. *BMC Public Health*, 17(5), 874.

<https://doi.org/10.1186/s12889-017-4859-6>

UNICEF. (2023). *Digital lives: Meaningful connections for every child*. United Nations Children's Fund. <https://www.unicef.org/reports/digital-lives-2023>

UNICEF. (2023). *Early childhood development: The foundation of sustainable development*. <https://www.unicef.org/early-childhood-development>

Uzundağ, B. A., Altundal, M. N., & Keşşafoglu, D. (2022). Screen Media Exposure in Early Childhood and Its Relation to Children's Self-Regulation. *Human Behaviour and Emerging Technologies*, 2022(1), 4490166.

<https://doi.org/10.1155/2022/4490166>

- Van de Vijver, F., & Leung, K. (1997). *Methods and data analysis for cross-cultural research*. Thousand Oaks: Sage Publications.
- van den Heuvel, M., Ma, J., Borkhoff, C. M., Koroshegyi, C., Lou, W., Parkin, P. C., & Maguire, J. L. (2019). Mobile media device use is associated with expressive language delay in 18-month-old children. *Journal of Developmental & Behavioural Paediatrics*, 40(2), 99–104.
<https://doi.org/10.1097/DBP.0000000000000620>
- Vanderloo, L. M., Janus, M., Omand, J. A., Keown-Stoneman, C. D. G., Borkhoff, C. M., Duku, E., Mamdani, M., Lebovic, G., Parkin, P. C., Simpson, J. R., Tremblay, M. S., Maguire, J. L., & Birken, C. S. (2022). Children's screen use and school readiness at 4-6 years: prospective cohort study. *BMC Public Health*, 22(1), 382.
<https://doi.org/10.1186/s12889-022-12629-8>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Waller, N. A., Zhang, N., Cocci, A. H., D'Agostino, C., Wesolek-Greenson, S., Wheelock, K., Nichols, L. P., & Resnicow, K. (2021). Screen time use impacts low-income preschool children's sleep quality, tiredness, and ability to fall asleep. *Child Care Health Dev*, 47(5), 618-626. <https://doi.org/10.1111/cch.12869>
- Waller, F., Prandstetter, K., Jansen, E., Nikolova, G., Lachman, J. M., Hutchings, J., & Foran, H. M. (2023). Screen use: Its association with caregiver mental health, parenting, and children's ADHD symptoms. *Family Relations*, 72(5), 2499-2515.
<https://doi.org/10.1111/fare.12869>

- Walton, M., & Donner, J. (2012). Public access, private mobile: The interplay of shared access and the mobile Internet for teenagers in Cape Town. *Global Impact Study Working Paper Series*. <https://papers.ssrn.com/abstract=2033456>
- Wartella, E., Rideout, V. J., Lauricella, A. R., & Connell, S. L. (2013). Parenting in the age of digital technology: A national survey. *Centre on Media and Human Development, Northwestern University*. <https://cmhd.northwestern.edu>
- World Health Organization (WHO). (2012). *Care for child development: Improving the care for young children*. <https://www.who.int/publications/i/item/9789241503860>
- World Health Organization. (2019). *Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age*. <https://www.who.int/publications/i/item/9789241550536>
- Wright, J. C., Huston, A. C., Murphy, K. C., St. Peters, M., Piñon, M., Scantlin, R., & Kotler, J. (2001). The relations of early television viewing to school readiness and vocabulary of children from low-income families: The early window project. *Child Development*, 72(5), 1347–1366. <https://doi.org/10.1111/1467-8624.t01-1-00352>
- Xiang, H., Lin, L., Chen, W., Li, C., Liu, X., Li, J., Ren, Y., & Guo, V. Y. (2022). Associations of excessive screen time and early screen exposure with health-related quality of life and behavioural problems among children attending preschools. *BMC Public Health*, 22(1), 2440. <https://doi.org/10.1186/s12889-022-14910-2>

- Yang, S., Saïd, M., Peyre, H., Ramus, F., Taine, M., Law, E. C., Dufourg, M.-N., Heude, B., Charles, M.-A., & Bernard, J. Y. (2024). Associations of screen use with cognitive development in early childhood: the ELFE birth cohort. *Journal of child psychology and psychiatry, and allied disciplines*, 65(5), 680-693.
<https://doi.org/10.1111/jcpp.13887>
- Zhang, Y., Zhang, D., & Lee, S. A. (2022). The longitudinal association between screen time and early childhood development: Evidence from a birth cohort study. *BMC Public Health*, 22, 475. <https://doi.org/10.1186/s12889-022-12820-7>
- Zhang, Z., Adamo, K. B., Ogden, N., Goldfield, G. S., Okely, A. D., Kuzik, N., Crozier, M., Hunter, S., Predy, M., & Carson, V. (2022). Associations between screen time and cognitive development in preschoolers. *Paediatr Child Health*, 27(2), 105-110. <https://doi.org/10.1093/pch/pxab067>
- Zhou, Y., Jiang, X., Wang, R., Guo, B., Cai, J., Gu, Y., & Pei, J. (2023). The relationship between screen time and attention deficit/hyperactivity disorder in Chinese preschool children under the multichild policy: a cross-sectional survey. *BMC pediatrics*, 23(1), 361. <https://doi.org/10.1186/s12887-023-04130-x>

Appendices

Appendix A

Chapter 3 Methodology Tables

Table A1

Primary PCC-aligned Search Terms

Population	Concept	Context
Early childhood	Screen time	Educational settings
Young children	Social development	
	Emotional development	
	Physical development	
	Cognitive development	
	Language development	

Table A2

Secondary search terms using PCC elements

Population	Concept	Context
Child	Digital devices	Preschool
Children	Media use	Early childhood education
	Television	Childcare centre
	Technology	Kindergarten
	Social skills	
	Relationships	
	Self-regulation	
	Emotional expression	

Gross motor skills
Fine motor skills
Executive function
Attention span
Verbal communication
Expressive language
Receptive language

Table A3

Search Strategies and Yields for Electronic Databases (Dates Accessed: March - May 2025)

Database	Date	Search Strategy	Search Notes	Total
	search completed			Yield
Google	23 April	Search string: ("screen time"	Due to Google	100
Scholar	2025	OR "media use" OR "digital devices" OR television OR technology) AND ("early childhood" OR "young children" OR child*) AND ("social development" OR "emotional development" OR "language development" OR "cognitive development" OR "physical development") AND	Scholar's relevance- ranking algorithm and limited advanced filtering capabilities, the search results were ordered by relevance. In line	

		("educational settings" OR preschool OR kindergarten OR "childcare centre" OR "early childhood education")	with the recommendations of Haddaway et al. (2015) for managing significant relevance-ranked result sets, only the first 100 results were selected for inclusion in the initial pool of potentially relevant literature to be charted and assessed in subsequent stages of the scoping review process.	
PubMed	17 April 2025	(("child"[Title/Abstract] OR "children" [Title/Abstract] OR "early childhood"	Not applicable	397

[Title/Abstract] OR "young
children" [Title/Abstract])
AND ("screen time"
[Title/Abstract] OR "digital
devices" [Title/Abstract] OR
"media use" [Title/Abstract]
OR "television"
[Title/Abstract] OR
"technology" [Title/Abstract])
AND ("social
development"[Title/Abstract]
OR "emotional development"
[Title/Abstract] OR "self-
regulation" [Title/Abstract] OR
"emotional expression"
[Title/Abstract] OR "social
skills" [Title/Abstract] OR
"relationships" [Title/Abstract]
OR "physical development"
[Title/Abstract] OR "gross
motor skills" [Title/Abstract]
OR "fine motor skills"
[Title/Abstract] OR "cognitive
development" [Title/Abstract])

OR "executive function"
[Title/Abstract] OR "attention
span" [Title/Abstract] OR
"language development"
[Title/Abstract] OR "verbal
communication"
[Title/Abstract] OR "expressive
language" [Title/Abstract] OR
"receptive language"
[Title/Abstract])
AND ("educational settings"
[Title/Abstract] OR
"preschool" [Title/Abstract]
OR "kindergarten"
[Title/Abstract] OR "early
childhood education"
[Title/Abstract] OR "childcare
centre" [Title/Abstract]))
AND ("2000"[Date –
Publication]: "2024"[Date -
Publication])
AND English [Language]

EBSCO	22 April 2025	Search string: (child* OR "young children" OR "early childhood") AND ("screen time" OR "media use" OR "digital devices" OR "technology use" OR television OR "mobile devices") AND ("social development" OR "emotional development" OR "self-regulation" OR "emotional expression" OR "social skills" OR relationships OR "physical development" OR "motor skills" OR "cognitive development" OR "executive function" OR "attention span" OR "language development" OR "verbal communication" OR "expressive language" OR "receptive language") AND ("preschool" OR "kindergarten" OR "early childhood education" OR	Not applicable	729
-------	------------------	---	----------------	-----

		"childcare" OR "educational setting")		
JSTOR	30 April 2025	("screen time" OR "media use" OR "digital devices") AND ("preschool" OR kindergarten" OR "early childhood education" OR "childcare centre") AND ("development" OR "cognitive" OR "language" OR "emotional" OR "physical")	Not Applicable	731
Wiley Online Library	23 April 2025	("screen time" OR "media use" OR "digital devices") AND ("early childhood" OR "young children" OR child*) AND ("development" OR "language" OR "cognitive" OR "emotional" OR "social" OR "physical") AND ("preschool" OR "kindergarten" OR "early childhood education" OR "childcare centre")	Not Applicable	299
ScienceDirect	30 April 2025	Search string 1: ("screen time" OR "media use") AND ("early	ScienceDirect restricted the	String 1: 300

childhood" OR child*) AND (development OR cognitive OR language)	number of Boolean operators per query (a	
Search String 2: ("digital devices" OR television) AND (child* OR "young children") AND (social OR emotional OR physical)	maximum of eight), which required the construction of four separate	String 2: 300
Search string 3: ("screen time" OR "media use") AND (preschool OR kindergarten) AND (development OR cognitive OR language)	structured searches. Each query was tailored to cover different	String 3: 300
Search String 4: ("digital devices" OR television) AND ("early childhood education" OR "childcare centre") AND (social OR emotional OR physical)	intersections of the PCC framework— specifically, combinations of screen time, developmental domains (e.g., cognitive, linguistic,	String 4: 154

emotional), and
educational
contexts. To
manage
significant result
sets effectively
within a
relevance-ranked
system, the first
300 results from
each query were
selected
following
established best
practices for
handling search
engine-based
database results
(Haddaway et al.,
2015).

Sage Journals	30 April	("screen time" OR "media use"	In SAGE	208
	2025	OR "digital devices" OR	Journals, the	
		"technology use" OR	PCC-aligned	
		television) AND ("early	search produced	

		childhood" OR "young children" OR child*) AND ("social development" OR "emotional development" OR "language development" OR "cognitive development" OR "physical development") AND ("preschool" OR "kindergarten" OR "early childhood education" OR "childcare centre" OR "educational setting")	1,618 results. For feasibility and in accordance with relevance-ranked scoping review protocols, only the first 208 articles—sorted by relevance—were reviewed.
SpringerLink	02 May 2025	("screen time" OR "media use" OR "digital devices" OR television OR "technology use") AND ("early childhood" OR "young children" OR child*) AND ("social development" OR "emotional development" OR "language development" OR "cognitive development" OR "physical development") AND ("preschool" OR	SpringerLink 260 yielded 1,152 results, and the first 260 articles were screened again. These sampling strategies reflect an accepted methodological adaptation in scoping reviews

"kindergarten" OR "early childhood education" OR "childcare centre" OR "educational setting")	that utilise relevance-ranked databases, where exhaustive screening is impractical and diminishing returns are observed beyond the first several hundred records (Haddaway et al., 2015).
Total Yield	3778

Table A5*Full-text articles excluded and reasons for exclusion*

Category	Reason for exclusion	Number of articles
Reported only positive associations	Only positive effects were reported; there is no evidence of developmental or classroom-related risks.	10
No significant associations	No statistically significant associations; no classroom-related or developmental outcomes.	11

Ineligible study design	Not an original empirical study (e.g., narrative review, literature review); no primary data collected or analysed.	16
Out of scope based on PCC criteria	Studies predicting screen time use only (e.g., based on parental attitudes) or determinants of screen time use – Studies focusing on how technology can be harnessed positively, Studies involving populations outside the target age range (e.g., older adolescents) – Studies addressing screen use in adults or parents, not children; studies with no developmental outcome measures; studies with no measurement of screen time; studies on guidelines for use only	20
Total		57

Appendix B

Exemption of Ethics Review Letter



11 September 2024

Miss Silvia Nikola Maarschalk (201501238)
School of Applied Human Sciences
Pietermaritzburg

Dear Miss Silvia Nikola Maarschalk,

Original application number: 00027305

Project title: The effect of increased screen time on early childhood development and its association to increased dysfunction in educational systems: A scoping review.

Exemption from Ethics Review

In response to your application received on 05 August 2024, your school has indicated that the protocol has been granted **EXEMPTION FROM ETHICS REVIEW**.

Any alteration/s to the exempted research protocol, e.g., Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through an amendment/modification prior to its implementation. The original exemption number must be cited.

For any changes that could result in potential risk, an ethics application including the proposed amendments must be submitted to the relevant UKZN Research Ethics Committee. The original exemption number must be cited.

In case you have further queries, please quote the above reference number.

PLEASE NOTE:

Research data should be securely stored in the discipline/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours sincerely,



Prof Lauren Eva Dyll
Academic Leader Research
SAHS

Appendix C

Chapter 4 Results Tables

Table C7

Combined Summary Table of Study Characteristics by Age Group

Characteristic	Infants (0–2 yrs)	Preschool (2–5 yrs)	School-aged (6–12 yrs)
Studies Involving This Group	22	85	16
Total Studies	4 (3)	73 (60)	13 (11)
Mean Daily Screen Time (hrs.)	1.8	3.75	1.75
Median Daily Screen Time (hrs.)	1.1	1.7	1.7
Compliance (n)	0	12	6
Compliance (%)	0.0%	16.4%	46.2%
Exceeds (n)	4	42	0
Exceeds (%)	100.0%	57.5%	0.0%
Mixed (n)	0	6	5
Mixed (%)	0.0%	8.2%	38.5%
Unspecified (n)	0	13	2
Unspecified (%)	0.0%	17.8%	15.4%

Note. "Total studies" refers to the number of studies for each age group; "Studies with numeric data" consist only of quantifiable daily screen time values.

Table C8

Summary of Screen Time Reporting Formats Used Across Included Studies (N = 94)

Screen time reporting format	Number of studies	Percentage (%)
Quantified daily estimate (hours/minutes)	76	80.9%
Weekday vs Weekend breakdown	21	22.3%

Unspecified or non-quantified exposure	18	19.1%
--	----	-------

Table C9

Breakdown of Screen Content Typologies Reported Across Included Studies

Theme	Description	Number of studies
Educational vs Entertainment	Differentiates between learning-focused and general entertainment content	10
Background TV vs Co-viewing	Assesses whether viewing occurred alone, with caregivers, or as background exposure	11
Violent, Fantastical, or Thematic	Specifies content such as violent, fantastical, horror, or realistic media	6
Interactive vs Passive Use	Examines whether the child actively engages with or passively consumes the content	4
Timing, Location, and Intent	Considers when, where, and why screens are used (e.g., bedtime, meals, parental intent)	4

Table C10

Vulnerability Patterns Emerging Across Developmental Domains

Theme 1 Dose-Response Relationships in Early Exposure: Non-Linear Risk Acceleration			
Theme No.	Sub-theme	No. studies	Indicative quotes
1.1	Cognitive Vulnerability and Attention Dysregulation	12	Excessive early screen time was associated with inattention, ADHD symptoms, poor self-regulation, delayed motor and language precursors, and increased odds of autistic-like behaviours (Chen et al., 2021; Geng et al., 2023; Harmon & Arnold, 2024; Joseph et al., 2022; Lin et al., 2020; Rai et al., 2023; Rocha et al., 2021; Schwarz et al., 2024; Tamana et

			al., 2019; Uzundağ et al., 2022; Waller et al., 2023; Zhou et al., 2023).
1.2	Language Delays Linked to Early and Excessive Exposure	10	Higher screen time, particularly >1–2 hours/day or before 15 months of age, was consistently associated with poorer vocabulary, expressive and receptive language outcomes from toddlerhood to early childhood (Çelen Yoldaş & Özmert, 2021; Chen et al., 2020; Dy et al., 2023; Kim & Chung, 2021; McArthur et al., 2022; Rayce et al., 2024; Rocha et al., 2021; Slobodin et al., 2024; Sundqvist et al., 2024; Tomopoulos et al., 2007).
1.3	Social-Emotional Risk from Early Screen Use	11	Screen time exceeding 2 hours/day, primarily before age 2, was associated with increased mental health problems, poorer self-regulation, and reduced school readiness outcomes (Cliff et al., 2018; Geng et al., 2023; Joseph et al., 2022; Likhitweerawong et al., 2024; Liang et al., 2024; Lin et al., 2020; Ostrov et al., 2006; Pagani et al., 2013; Shou & Nanakida, 2022; Tamana et al., 2019; Uzundağ et al., 2022).
1.4	Early Physical Vulnerability and Motor Readiness Delays	4	Screen exposure as low as 1 hour/day was linked to increased vulnerability across multiple developmental domains, including weaker physical and motor readiness by school entry (Chaibal & Chaiyakul, 2022; Kerai et al., 2022; Pagani et al., 2013; Tekin & Alpgan, 2023).

Theme 2 Screen-Linked Self-Regulation and Behavioural Vulnerabilities

Theme No.	Sub-theme	No. studies	Indicative quotes
2.1	Dose-Response Effects on Self-Regulation and	13	Increased screen time was consistently associated with lower self-regulation, reduced cooperation, and weaker behavioural control. A clear dose-response pattern

	Behavioural Control		emerged: children with ≤ 1 hour/day of screen time showed the highest self-regulation, while those exposed to 2–7+ hours exhibited significant behavioural dysregulation. This included greater impulsivity, diminished delay of gratification, and reduced capacity for self-control in preschool-aged children (Canaslan-Akyar & Sungur, 2022; Cerniglia et al., 2021; Cliff et al., 2018; Danet et al., 2022; Joseph et al., 2022; Liang et al., 2024; Likhitweerawong et al., 2024; Lin et al., 2020; Martins et al., 2020; Neville et al., 2021; Ostrov et al., 2006; Rai et al., 2023; Uzundağ et al., 2022).
2.2	Cascading Consequences: From Dysregulation to Long-Term Academic Vulnerability	21	Higher digital media exposure in early childhood was consistently linked to emotional and behavioural dysregulation, including poor self-regulation and increased behavioural problems. These difficulties were not short-term: across multiple studies, early dysregulation predicted lower academic achievement, poorer school readiness, and long-term difficulties in math, attention, and adjustment. This cascading pattern underscores how early screen-related vulnerabilities can extend into middle childhood and shape later educational outcomes (Canaslan-Akyar & Sungur, 2022; Cerniglia et al., 2021; Dy et al., 2023; Geng et al., 2023; Harmon & Arnold, 2024; Hosokawa & Katsura, 2018; John et al., 2021; Joseph et al., 2022; Kerai et al., 2022; Liang et al., 2024; Likhitweerawong et al., 2024; Lin et al., 2015; Lin et al., 2020; Madigan et al., 2020; Martins et al., 2020; Pagani et al., 2010; Poulain et al., 2019; Schwarzer et al., 2022; Uzundağ et al., 2022; Vanderloo et al., 2022; Waller et al., 2023; Zhou et al., 2023).
Theme 3 Cognitive, Language, and Developmental Pathways of Screen Exposure			

Theme No.	Sub-theme	No. studies	Indicative quotes
3.1	Language Delays and Vocabulary Deficits (threshold effects)	8	Greater screen time in infancy and early childhood was associated with poorer vocabulary, reduced expressive and receptive communication, and fewer days spent reading (Chen et al., 2020; Dy et al., 2023; McArthur et al., 2022; Pagani et al., 2013; Rayce et al., 2024; Slobodin et al., 2024; Sundqvist et al., 2024; Tomopoulos et al., 2007).
3.2	Executive Function, Attention Deficits, and Cognitive Processing	15	Screen time exceeding 2 hours per day was consistently linked to cognitive impairments in early childhood, particularly in attention, executive functioning, processing speed, and working memory. Across multiple studies, higher screen exposure predicted increased ADHD symptoms and reduced attentional control. These effects extended to lower Full-Scale IQ scores, with significant reductions in processing speed and working memory. Threshold effects were evident, with cognitive vulnerabilities emerging most clearly when daily screen time surpassed guideline recommendations (Danet et al., 2022; Harmon & Arnold, 2024; John et al., 2021; Joseph et al., 2022; Lin et al., 2015; Lin et al., 2020; Martins et al., 2020; Rai et al., 2023; Schwarzer et al., 2022; Tamana et al., 2019; Uzundağ et al., 2022; Waller et al., 2023; Zhou et al., 2023).
3.3	Mechanisms of Impact: Executive Function Mediation	11	Several studies identified key mechanisms through which screen time impacts developmental outcomes. Executive function was found to mediate a

and Displacement of Enriching Activities	significant portion (54.9%) of the relationship between screen exposure and behavioural difficulties, indicating its role as a central pathway linking digital media use to self-regulation and behavioural outcomes. Additionally, screen time frequently displaces enriching activities, such as parent-child interaction and home literacy practices. These are critical for language and cognitive development. These findings show that screen use produces both direct effects and indirect developmental interference (Chen et al., 2020; Gath et al., 2023; Likhitweerawong et al., 2024; Martins et al., 2020; McArthur et al., 2022; Poulain et al., 2019; Rai et al., 2023; Rocha et al., 2021; Schwarzer et al., 2022; Sundqvist et al., 2024; Tomopoulos et al., 2007).
---	--

Theme 4 Motor Development and Physical Health Disruption

Theme No.	Sub-theme	No. studies	Indicative quotes
4.1	Motor Development Delays	6	Higher screen time was associated with suspected motor delays, reduced motor readiness for school, and poorer visual-motor integration and physical quality of life (Chaibal & Chaiyakul, 2022; Pagani et al., 2013; Mahmoud et al., 2021; Lin et al., 2015; McArthur et al., 2022; Martins et al., 2020).
4.2	Sleep Disruption and Quality	5	Screen time exceeding 2 hours/day was linked to poorer sleep quality, bedtime resistance, and frequent night waking. Portable electronic device use was associated with measurable sleep loss and poor sleep quality, which mediated academic

			underperformance (Waller et al., 2021; Chandranaik et al., 2024; Lan et al., 2020; Kerai et al., 2022; Xiang et al., 2022).
4.3	Long-Term Metabolic Risk from Early Screen Exposure	4	Higher early television exposure was associated with elevated BMI, reduced physical activity, and poorer eating habits later in childhood. Television presence in bedrooms was associated with long-term metabolic risk indicators (Pagani et al., 2013; Pagani et al., 2010; Kerai et al., 2022; Xiang et al., 2022).
Theme 5 Content Type, Co-Viewing Context, and Quality as Moderators of Vulnerability			
Theme No.	Sub-theme	No. studies	Indicative quotes
5.1	Impact of Educational vs. Entertainment Content	4	Content type moderated developmental outcomes: Educational programming was associated with improved vocabulary, math, and readiness, while non-educational and violent content predicted lower academic performance and increased aggression (Wright et al., 2001; Harmon & Arnold, 2024; Rai et al., 2023; Ostrov et al., 2006).
5.2	Viewing Context: Supervision, Background TV, and Solitary Use	6	Screen time context influenced developmental risk: Children who viewed screens alone were significantly more likely to exceed recommended limits, and background TV disrupted parent–child interaction and language development (Dy et al., 2023; John et al., 2021; Martinot et al., 2021; Tekin & Alpgan, 2023; Tomopoulos et al., 2007; Yang et al., 2024).

5.3	Developmental Effects of Active vs. Passive Co-Viewing	6	Active, engaged co-viewing, especially with caregiver scaffolding, was associated with better outcomes, while passive co-viewing offered limited developmental protection and was linked to later dysregulation and academic underperformance (Cerniglia et al., 2021; Gath et al., 2023; Ostrov et al., 2006; Rai et al., 2023; Schwarzer et al., 2022; Yang et al., 2024).
-----	--	---	--

Table C11

Summary of Evidence Linking Screen Time to Impairment of Foundational Capacities for School Readiness

Theme 6 Foundational Capacities Undermined by Excessive Screen Time			
Theme No.	Sub-theme	No. studies	Indicative quotes
6.1	Classroom-Specific Attention Deficits: Instructional Context Vulnerability	10	Excessive screen time was consistently associated with poorer attention regulation in classroom settings, including increased inattention during instruction, reduced sustained focus on learning tasks, hyperactivity during structured activities, and executive dysfunction observable by teachers. These effects were evident even with daily screen use as low as one hour and across multiple device types. Critically, attention deficits were most pronounced when children transitioned to structured educational environments (ages 4–6), suggesting a mismatch between screen-exposed neural development and classroom demands (Cliff et al., 2018; Harmon & Arnold, 2024; John et al., 2021; Joseph et al., 2022; Likhitweerawong et al., 2024; Lin et al., 2020; Rai et

			al., 2023; Tamana et al., 2019; Waller et al., 2023; Zhou et al., 2023).
6.2	Executive Function as a Gatekeeper Capacity for School Readiness	9	Elevated screen exposure during early childhood was consistently linked to reduced executive functioning, which emerged as a critical mediating mechanism for school readiness and classroom success. Passive viewing, mobile media use, and screen exposure before age two were all associated with poorer executive control, weaker delay of gratification, and lower school readiness scores. Notably, executive function accounted for over 54% of the total effect of screen time on behavioural difficulties, establishing it as the primary cognitive bottleneck preventing school success. This suggests that interventions targeting EF development may substantially attenuate screen-related learning vulnerabilities (Harmon & Arnold, 2024; Likhitweerawong et al., 2024; Martins et al., 2020; Rai et al., 2023; Rocha et al., 2021; Schwarzer et al., 2022; Sinvani et al., 2023; Tekin & Alpgan, 2023; Uzundağ et al., 2022).
6.3	Impulse Control and Behavioural Compliance in Classroom Contexts	9	Excessive screen time was consistently associated with weakened inhibitory control in classroom-relevant behaviours, including reduced impulse regulation, cooperation, behavioural compliance, and delay of gratification. These are all essential for peer interaction and following classroom instructions. A precise dose–response relationship was observed, with as little as 2–3 hours per day associated with lower self-control in preschoolers and 3–4 hours per day linked to poorer impulse control in older children transitioning to formal schooling. Critically, these deficits were tied to long-term academic difficulties, particularly in mathematics performance, suggesting that behavioural dysregulation disrupts the sustained attention and

			rule-following necessary for academic skill acquisition (Canaslan-Akyar & Sungur, 2022; Cerniglia et al., 2021; Cliff et al., 2018; Geng et al., 2023; Liang et al., 2024; Likhitweerawong et al., 2024; McArthur et al., 2022; Neville et al., 2021; Shou & Nanakida, 2022).
6.4	Self-Regulation Deficits as Predictors of Classroom Adjustment Failure	9	Excessive screen time in early childhood consistently undermines foundational self-regulatory capacities essential for classroom adjustment and peer functioning, including emotional control, attention persistence, and behavioural flexibility. These self-regulation deficits were linked to observable classroom difficulties, including attention problems, disruptive behaviour, and reduced academic performance, particularly in mathematics. Bidirectional evidence indicates that self-regulation deficits both result from and contribute to increased media use, creating reinforcing cycles that intensify classroom adjustment difficulties across the transition to formal schooling (Cerniglia et al., 2021; Cliff et al., 2018; Harmon & Arnold, 2024; Likhitweerawong et al., 2024; Liang et al., 2024; McArthur et al., 2022; Pagani et al., 2013; Shou & Nanakida, 2022; Tekin & Alpgan, 2023).

Table C12

Summary of Evidence on Screen Time, School Readiness, and Academic Outcomes

Theme 7 Direct Assessment of School Readiness and Academic Outcomes			
Theme No.	Sub-theme	No. studies	Indicative quotes
7.1	Dose-response and	4	A precise dose–response and timing relationship was observed between early screen exposure and later school

	critical periods		readiness. Daily screen use exceeding three hours was associated with lower composite school-readiness scores. In comparison, even 1–2 hours per day was linked to deficits in specific domains, such as vocabulary, executive functioning, and numeracy readiness. Increased screen time in infancy and toddlerhood was associated with reduced vocabulary, motor coordination, number knowledge, and classroom engagement by age five. These early exposures also indirectly lowered first-grade academic achievement by undermining early language and cognitive development (Harmon & Arnold, 2024; Kim & Chung, 2021; Pagani et al., 2013; Tekin & Alpgan, 2023).
7.2	Content type effects	2	Content type emerged as a critical moderator of school readiness outcomes. Educational screen content was positively associated with vocabulary, reading, and math skills, as well as executive functioning. In contrast, entertainment-focused or non-educational content was associated with reduced vocabulary, weaker executive control, and lower overall school readiness. Mobile media use that lacked educational value was particularly linked to poorer outcomes (Harmon & Arnold, 2024; Rai et al., 2023)
7.3	Disruption of core academic skills	7	Excessive screen use was directly associated with impaired acquisition of foundational academic skills, including reduced reading and number readiness, weaker executive functioning, and lower preliteracy outcomes. Broader readiness risks were also evident, with higher screen use linked to lower language and cognitive readiness scores (Harmon & Arnold, 2024; McArthur et al., 2022; Pagani et al., 2013; Rocha et al., 2021; Schwarzer et al., 2022; Tekin & Alpgan, 2023; Vanderloo et al., 2022).

7.4	Bidirectional and feedback loops	7	Evidence indicated bidirectional relationships between screen time, self-regulation, and academic readiness. Greater television exposure was associated with lower effortful control, which, in turn, influenced later screen use, creating a feedback loop. Effortful control was itself a strong predictor of academic readiness, social competence, and fewer behavioural problems. Excessive screen use also appeared to displace enriching activities, with higher exposure linked to poorer executive functioning and motor skills, while shared reading and structured play supported stronger readiness outcomes (Cliff et al., 2018; Geng et al., 2023; Martins et al., 2020; Parrish et al., 2022; Schwarzer et al., 2022; Tekin & Alpgan, 2023; Tomopoulos et al., 2007).
-----	----------------------------------	---	--

Table C13

Screen Exposure Risks in Low-SES Contexts: Mechanisms of Vulnerability Relevant to South African Early Childhood Environments (Themes 8–12)

Theme 8 Elevated Screen Time in Low-SES Settings that is Compounded by Resource Constraints

Theme No.	Sub-theme	No. studies	Indicative quotes
8.1	Age-Related Escalation	4	Children in low-SES contexts exhibited high and rising rates of excessive screen use, with screen time increasingly exceeding recommended limits from infancy through preschool. This escalation reflects the combined effect of limited childcare alternatives, high caregiver work demands, and unregulated media access, making screen exposure a default developmental environment in

vulnerable households. In one large sample, over 90% of children aged 0–60 months surpassed guideline thresholds, with prevalence rising from 41.7% in infants to 85.2% in preschoolers. A rate substantially higher than that of middle-SES populations. This escalation reflects resource constraints limiting access to alternative childcare and enriching activities, making screen exposure a default developmental environment in vulnerable households (Chaibal & Chaiyakul, 2022; Liang et al., 2024; Rocha et al., 2021; Shou & Nanakida, 2022).

8.2	Screen as Behavioural Regulation	4	In low-resource households, screen media were often used as a substitute for direct parental regulation due to parental work burden and limited access to supervised childcare. While this practice temporarily managed child behaviour, it was associated with significant developmental risks. Preschoolers with 2–3 hours of daily screen time showed reduced cooperation and self-control, while primary-aged children with 3–4 hours of daily screen time displayed similar deficits. This screen-based regulation strategy creates a paradox: short-term behavioural compliance comes at the cost of long-term self-regulatory capacity, reinforcing the need for structural childcare solutions rather than individual parental strategies alone (Shou & Nanakida, 2022; Cliff et al., 2018; Lin et al., 2020; Chen et al., 2020).
-----	--	---	---

Theme 9 Content Quality and Educational Access Limitations: Resource Barriers in Low-SES Settings

Theme	Sub-theme	No.	Indicative quotes
No.		studies	

9.1	Educational Value of Screen Content: Quantity, Quality, and Developmental Impact	5	Children's screen use frequently exceeded guideline thresholds but lacked developmentally supportive content. This reflects a lack of access to developmentally supportive content, driven by income constraints, reliance on free platforms, and the absence of curated programming. Educational content was linked to improved executive functioning and early academic skills, while entertainment media were negatively associated with language and academic development. Most screen time was spent on passive video viewing, while only a minority engaged with educational apps. Although educational content was linked to improved executive functioning and early academic skills, entertainment media were negatively associated with language and academic development. This disparity is particularly pronounced among low-SES populations with limited access to alternative enrichment activities (Harmon & Arnold, 2024; Rai et al., 2023; Wright et al., 2001; Tomopoulos et al., 2007; Joseph et al., 2022).
-----	---	---	---

Theme 10 Socioeconomic Amplification of Screen Effects: Intersectional Vulnerability in Disadvantaged Populations

Theme No.	Sub-theme	No. studies	Indicative quotes
10.1	Income and Parental Education Effects and Racial Disparities	4	SES significantly amplified the developmental impacts of screen exposure. Children from lower-income and less educated households showed reduced social interaction, self-control, and independence, with effect sizes 40–60% larger than those in higher-SES cohorts. This indicates that poverty intensifies developmental vulnerability. While racial disparities further compounded risk, Black

children had significantly higher screen use than their non-Black peers, likely reflecting intersecting barriers to childcare, education access, and digital equity. These findings highlight how structural disadvantage in South African contexts, characterised by high unemployment, limited access to early childhood education, and entrenched educational inequality, directly amplifies screen-related developmental risks (Canaslan-Akyar & Sungur, 2022; Chaibal & Chaiyakul, 2022; Cliff et al., 2018; Shou & Nanakida, 2022).

Theme 11 Displacement of Enriching Activities and the Loss of Protective Developmental Contexts

Theme No.	Sub-theme	No. studies	Indicative quotes
11.1	Cascading Dysregulation	4	Cascading developmental disruptions were observed when passive screen use displaced enriching, co-regulatory activities that are essential for developing self-regulation, emotional competence, and secure attachment. Preschoolers with 1.5 hours of daily screen time showed greater emotional and behavioural dysregulation by ages 6 and 8, particularly when screen use occurred without parental engagement. This is a common pattern in low-resource households where parents juggle multiple employment or caregiving demands. This unsupervised exposure was also linked to later academic difficulties in math and literacy, indicating that screen displacement of parental interaction creates compounding cognitive and emotional deficits (Cerniglia et al., 2021; Cliff et al., 2018; Tekin & Alpgan, 2023; Tomopoulos et al., 2007).

11.2	Motor and Executive Function Displacement	4	Excessive screen time may displace critical opportunities for developing both motor and cognitive skills in early childhood. In low-SES settings, limited access to structured play spaces, outdoor activities, and sports programmes means screen time often directly displaces opportunities for active play. These activities are critical for motor development and the growth of executive function. Higher screen exposure was significantly associated with poorer executive functioning and fundamental motor skills, suggesting that screen use can crowd out active play and other experiences essential for attention, coordination, and problem-solving. These are outcomes particularly critical for children entering under-resourced South African schools (Martins et al., 2020; Pagani et al., 2013; Tekin & Alpgan, 2023; Rocha et al., 2021).
------	---	---	--

Theme 12 Early Screen Exposure as a Predictor of Long-Term Academic Vulnerability in Disadvantaged Populations

Theme No.	Sub-theme	No. studies	Indicative quotes
12.1	Early Screen Exposure as a Predictor of Long-Term Academic Vulnerability	6	Early screen exposure, especially during infancy, was consistently linked to long-term developmental and academic risks across multiple domains. This critical window effect suggests that early intervention in low-SES populations may have a substantial preventive impact. Increased screen use around 12 months was associated with poorer language, motor, and socio-emotional functioning by age two, with deficits compounding as children approach school entry. Mobile media use was associated with lower school readiness,

particularly in executive functioning and preliteracy. These are the precise capacities required for success in South African primary schools with limited literacy support structures. Early exposure also led to emotional dysregulation that later predicted reduced math achievement, illustrating a cascading developmental effect, where early deficits compound through missed learning and diminished peer engagement (Cerniglia et al., 2021; Harmon & Arnold, 2024; Pagani et al., 2013; Rocha et al., 2021; Slobodin et al., 2024; Sundqvist et al., 2024).

Table C14

Protective Factors and Intervention Points in Low-SES Populations (Theme 13) Evidence-Based Pathways to Attenuate Developmental Risk

Theme 13 Protective Factors from Low SES Studies			
Theme No.	Sub-theme	No. studies	Indicative quotes
13.1	Moderate Screen Duration	1	In low-SES contexts, moderate screen time, particularly 30–60 minutes per day, was associated with improved behavioural regulation. This protective effect likely operates through dose-dependent mechanisms. Exposure below 1 hour/day provides adequate time for parent-child interaction, physical activity, and sleep, essential regulatory inputs, while maintaining access to developmentally appropriate content. Children with this level of exposure showed greater cooperation in both preschool and primary school environments than peers

			with >2 hours of daily exposure, suggesting a clear intervention threshold (Shou & Nanakida, 2022).
13.2	Educational Content	3	Access to educational content offered protective benefits for cognitive and academic development. Educational content is protected through multiple mechanisms: it provides structured narrative complexity that supports language development, explicitly models problem-solving and self-regulation skills, and often facilitates parent-child discussion and shared learning. Educational app use was linked to stronger executive functioning, while early exposure to educational programming predicted better outcomes in reading, math, vocabulary, and overall school readiness. Notably, this protective effect was most pronounced when educational content was paired with parental engagement, suggesting that content quality alone is not sufficient without interactive mediation. In contrast, entertainment content was associated with poorer academic and language development (Harmon & Arnold, 2024; Rai et al., 2023; Wright et al., 2001).
13.3	Maternal Co-viewing	3	Active maternal co-viewing during screen use emerged as a significant protective factor. Co-viewing protects through enhanced parent-child linguistic input: caregivers who watch alongside children provide real-time language scaffolding, pause content for discussion, and connect screen narratives to lived experiences. This creates language-rich learning contexts that passive viewing cannot provide. When screen activities lacked maternal engagement, children showed greater emotional and behavioural problems by age six, which later contributed to higher dysregulation and reduced capacity

			to benefit from classroom instruction. These dysregulation problems persisted into later childhood, with lower academic performance in math and literacy by age eight (Cerniglia et al., 2021; Cliff et al., 2018; Rai et al., 2023).
13.4	Physical Activity	2	Regular physical activity served as a substantial buffer against behavioural difficulties. Physical activity protects through neurobiological mechanisms (enhanced dopamine and serotonin), promotes the development of executive control through sport rules and coordination, and displaces screen time with active, co-regulated play. This creates the precise conditions for self-regulatory growth. Meeting physical activity guidelines was significantly associated with fewer behavioural problems, with effect sizes indicating that physical activity's protective effect is comparable in magnitude to some pharmacological interventions, highlighting its critical role in early development (Liang et al., 2024; Parrish et al., 2022).
13.5	Structured Activities and Supervision	3	Parental supervision and structured, activity-rich routines were identified as protective factors supporting motor development and overall well-being. Supervision and structure are protective because they provide external regulation that gradually becomes internalised. This is clear screen-use boundaries that teach impulse control, predictable routines support circadian regulation essential for sleep, and organised activities provide the motor-practice opportunities that screen use displaces. Clear limits on screen use were associated with better motor skills and a higher quality of life. In contrast, the absence of such structure was associated with developmental

			delays. This finding is particularly relevant to South African contexts where household instability and irregular routines are often driven by employment insecurity (John et al., 2021; Madigan et al., 2020; Tekin & Alpgan, 2023).
13.6	Child's Executive Control	3	A child's executive control emerged as a strong protective factor across developmental outcomes. Executive control is protected through self-regulatory mechanisms: children with stronger inhibitory control naturally limit excessive screen use, maintain engagement with effortful learning activities, and sustain peer relationships through emotional regulation. Higher executive functioning not only predicted better academic and social readiness but also moderated future media use, creating positive feedback loops in which initial regulatory strength leads to both reduced screen exposure and increased engagement in developmentally enriching activities. This suggests that stronger internal regulation helps limit excessive screen exposure and its associated risks. Moreover, this indicates that interventions targeting executive function development (through play-based learning, emotion coaching, and structured activities) may have cascading effects on reducing excessive media use itself (Cliff et al., 2018; Likhitweerawong et al., 2024; Parrish et al., 2022).

Appendix D**Turnitin Similarity Report**