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# Curated Childhoods: Developmental Milestones and Learning in the Algorithmic Age

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Education

by

Allison Starks

Dissertation Committee:
Professor Stephanie M. Reich, Chair
Professor Kylie Peppler
Professor Mizuko Ito
Professor Katie Salen

2024

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**DEDICATION**

To

my family

and

those who hope for something better from a digital world

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### FIELD OF STUDY

Digital learning, child development, media literacy, algorithmic literacy, research-practice partnerships, digital equity, children's rights online

### PUBLICATIONS


Starks, A. (2024). Children's critical media literacy & the era of Big Tech. In C. Wright (Ed.). Getting the best from the digital world. Media literacy across the lifespan. Cambridge.

Starks, A. & Reich, S.M. (accepted for publication, Information and Learning Sciences). Children's sensemaking of algorithms and data flows across YouTube and social media.

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Starks, A. & Reich, S. M. (2023). "And we were like- 'what about special ed?" Technology use and growing gaps for special education. Computers & Education, 193. https://doi.org/10.1016/j.compedu.2022.104665

Santer, N., Manago, A., Starks, A. & Reich, S.M. (2023). Early adolescents' perspectives on digital privacy. In Ito, M., Cross, R., Dinakar, K., & Odgers, C. (Eds), Algorithmic Rights

and Protections for Children (pp.123-160), MIT Press. 10.7551/mitpress/13654.003.0012.

Starks, A. (2022). Serving students with disabilities in K-12 online learning: daily practices of special education teachers during the COVID-19 pandemic. Distance Education. https://doi.org/10.1080/01587919.2022.2144138

Reich, S.M., Starks, A., Santer, N., & Manago, A. (2021). Modeling media use: How parents and other adult posting behaviors relate to young adolescents posting behavior. Frontiers in Human Dynamics, Digital Impacts(3) 595924. https://doi.org/10.3389/fhumd.2021.595924

## ABSTRACT OF THE DISSERTATION

Curated Childhoods: Developmental Milestones and Learning in the Algorithmic Age

by

Allison Starks

Doctor of Philosophy in Education

University of California, Irvine, 2024

Professor Stephanie M. Reich, Chair

Children spend a great deal of time in digital spaces in middle childhood and these digital environments are increasingly shaped by artificial intelligence. But little is known about the digital experiences of children between the ages of 8 and 11, or how they might be making sense of algorithmically curated experiences across platforms (Odgers & Jensen, 2020; Radesky et al., 2023; Stoilova et al., 2021). Given the commercial and algorithmically driven digital contexts in which many children spend time, this mixed-methods dissertation seeks to highlight the voices of young digital media and technology users, specifically between the ages of 8 and 11 years old, as well document the opportunities young learners have to develop their skills and understandings about technology and new digital media in US public schools. This dissertation, and especially Study 1, is framed within a developmental affordances approach (Moreno & Uhls, 2019) to make connections between children's unique developmental strengths and capacities in middle childhood and the opportunities and risks of technology use in the algorithmic age. The focus on children between the ages of 8 and 11 is meaningful because this is the time when most youth in the United States acquire their own device and use social media, despite platform age requirements. Study 1 draws on focus groups with socioeconomically, racially, and

ethnically diverse children (N=34) ages 8 to 11 to explore smartphone ownership as a potentially meaningful rite of passage and how smartphone ownership aligns with developmental needs, highlighting children's stories, feelings, and experiences of getting a smartphone in childhood. Study 2 draws on the same focus group data to document children's sensemaking of data flows and algorithms in middle childhood, speaking to issues of algorithmic literacy, corporate surveillance, and critical media literacy. Study 3 uses survey data from a large sample of US educators (N=1,325) to examine patterns of instruction related to corporate surveillance, algorithmic literacy, and media literacy in the 2022-2023 academic year, as well as which educator-level predictors are associated with more instruction. Together, these studies have implications for supporting children's development in the digital age across individual, social, and regulatory environments.

# INTRODUCTION

Though society has always been invested in the effects of new media on children, the rise of artificial intelligence and specifically the increasing role of algorithms in many of our daily interactions has created new areas of inquiry and challenge for those interested in promoting positive youth outcomes in an algorithmic age. Access to digital spaces is an important part of modern childhood and is considered by many countries around the world to be a central part of children's rights (UN Committee on the Rights of the Child, 2021). Children have opportunities to learn, play, talk, share, create, and connect in countless ways, across various platforms. Just like other spaces children spend time in, digital spaces come with risks and opportunities. Unlike many other child-directed spaces, there are powerful commercial forces shaping children's opportunities and risks, raising questions about how best to support children's agency on for-profit digital platforms.

Broadly, society is concerned with whether certain devices or platforms (e.g., social media) are good or bad for children. Research is still attending to the nuances of these investigations, but an emerging consensus is that digital media and technology are "both/and", where certain combinations of child, context, and content (Guernsey, 2012) can be beneficial while other combinations will be harmful. An often overlooked piece of this puzzle is the process by which content is presented to children and how they make sense of it in digital spaces, given their developmental strengths and vulnerabilities. Artificial intelligence, and particularly algorithms employed at the platform level, make decisions about what, who, and how children interact in digital spaces, is a crucial aspect of children's digital activities but little research has explored children's sensemaking of

algorithms in their daily lives, what kinds of opportunities they have to learn about aspects of digital literacy such as algorithmic awareness, or how algorithms can play a role in the opportunities and risks they encounter online.

Algorithms shape where we live and how we live, constituting what some refer to as the "algorithmic age" (Rainee & Anderson, 2017). Algorithms drive children's direct experiences online but automated decision making powered by algorithms may also affect aspects of their physical environment. For example, algorithms may decide if their family receives social security benefits, which academic track they will be assigned at school, whether their family gets approved for a rental application or home loan, or whether their caregiver's application progresses in the hiring process. In the digital world, algorithms play a heavy-handed role in determining what content children see, who they are suggested to make contact with, and to what information they have access (or not). Although some scholars point out that we all have agency in our online interactions to like, view, post, etc., thereby shaping our algorithmic experiences, the algorithms influencing the most popular platforms among children, as well as adults, are "black boxes" (Pasquale, 2015) in which it is unclear how much personal decisions impact digital experiences compared to corporate decision making.

Black box algorithms (Pasquale, 2015) are opaque and mainly protected as a form of intellectual property by technology corporations that have dodged regulations historically applied to other media companies through legal loopholes and powerful lobbying efforts. Thus, the algorithms shaping our everyday access to information, socialization, and opportunity are largely unknown and unregulated. Perhaps unsurprisingly then, most adults do not even recognize algorithms in their everyday feeds (Eslami et al., 2015) and

adults have the advantage of advanced cognitive capacities and abstract thinking. For children, the presence of algorithms in their digital interactions along with algorithmic curation and profiling practices may be more difficult to understand given that children are still developing their abilities to think and reason about abstract concepts (Collins & Madsen, 2019; Piaget, 1970). It is currently unclear whether children are aware of algorithms or the sorting mechanisms shaping their digital interactions. Most of the work around algorithmic folk theories and algorithmic literacy has been done in the last 10 years (Ng et al., 2021) and has not sufficiently addressed the experiences of children or how they make sense of algorithms in daily life. This is an important gap given the amount of time children spend online, their developmental susceptibilities, and the lack of legal protections.

Given the commercial and algorithmically driven digital contexts in which children spend time, this three-study dissertation makes several important contributions including (1) documenting digital experiences of children in late middle childhood (ages 8 to 11 years old), which is an understudied developmental period in media research (Stoilova, Livingstone, & Khazbak, 2021; Odgers & Jensen, 2020), (2) describing what children understand about the more critical aspects of digital life and its underlying structures (e.g., business models, algorithms, data flows), and (3) what opportunities children have to learn about these topics across a national sample of K-12 educators.

The focus on children between the ages of 8 and 11 is meaningful because this is the time when most youth in the United States acquire their own device and use social media, despite platform age requirements. Study 1 draws on focus groups with socioeconomically, racially, and ethnically diverse children ages 8 to 11 to explore smartphone ownership as a

potentially meaningful rite of passage and how smartphone ownership aligns with developmental needs, highlighting children's stories, feelings, and experiences of getting a smartphone in childhood. Study 2 draws on the same focus group data to document children's sensemaking of data flows and algorithms in middle childhood, speaking to issues of algorithmic literacy, corporate surveillance, and critical media literacy. Study 3 describes patterns of digital citizenship instruction reported by K-12 educators, addressing topics related to corporate surveillance, algorithmic literacy, and media literacy, as well as which educator-level predictors are associated with more of this kind of instruction. This dissertation, and especially Study 1, is framed within a developmental affordances approach (Moreno & Uhls, 2019) to make connections between children's unique developmental strengths and capacities in middle childhood and the opportunities and risks of technology use in the algorithmic age.

**Researcher Positionality**

To tackle this work, especially in conversation with youth, it is important to acknowledge my position as a researcher and educator in the digital media and technology space. I am a white, female doctoral candidate in an Education department in California. Before pursuing a PhD, I worked in K-12 school districts in the United States as a special education teacher, literacy teacher, and educational technology coordinator. I worked primarily with racially and ethnically diverse students in a large school district in the mid-Atlantic region of the United States, however I also spent time teaching internationally in South Korea prior to earning a graduate degree in teaching. My lived experience working with diverse learners and building partnerships with families as a special educator shape my interest in digital inclusion and equity, as well my focus on the experiences of

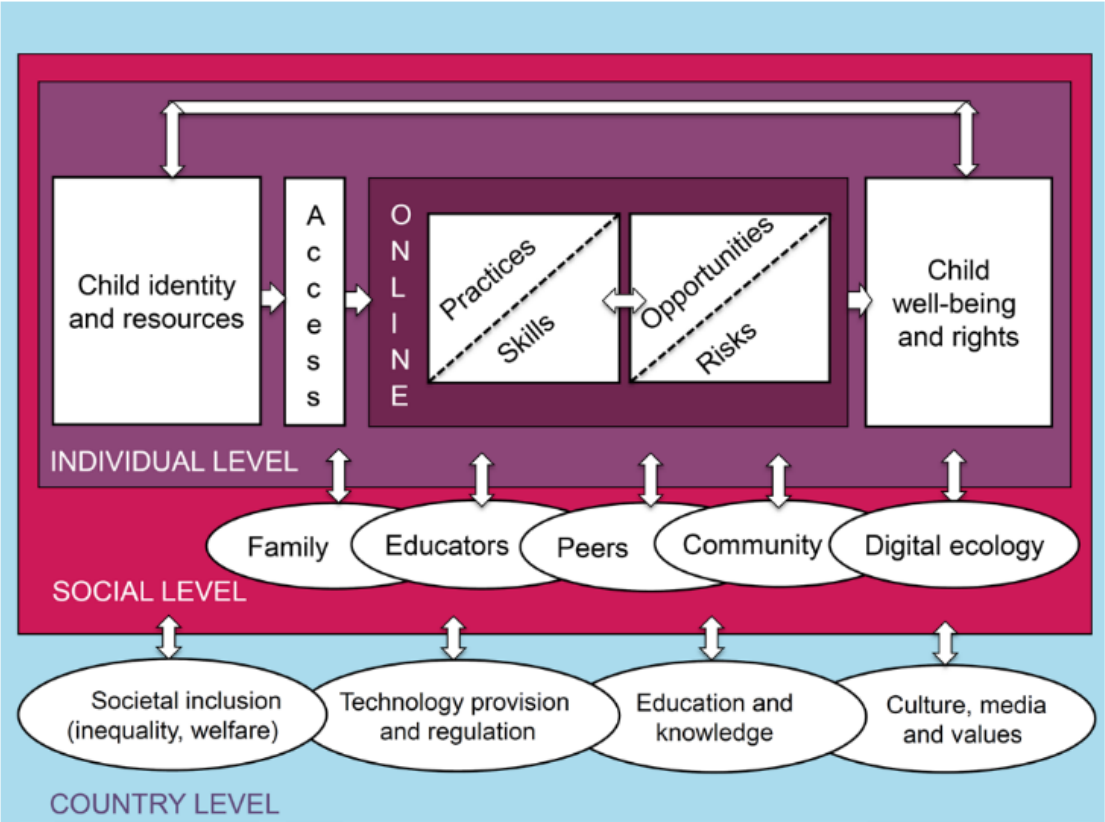
minoritized youth in the United States. Prior work supporting smartphone use in learning settings, facilitating family-school partnerships around technology, and observations of student digital privacy practices inform my interests and approach to developmentally aligned uses of technology and (re)design of digital environments.

**Theoretical Framing**

The organizing theory of this three-paper dissertation is an ecological model of opportunity and risk for children online, developed through decades of research with children all over the world, called the Global Kids Online framework (see Figure 1). The framework was developed by Sonia Livingstone and colleagues (2015) and is grounded in a child's rights perspective, outlined in the United Nations Convention on the Rights of the Child (UNCRC, 1989) and UN General Comment No. 25 (2021) on children's rights in relation to the digital environment, wherein children have specific rights for provision, protection, and participation in the digital age. General Comment No. 25 (2021) includes specific language acknowledging that while the internet was not designed for children, adults should prioritize the "best interests of the child" when making decisions about the design and use of digital spaces children are likely to access. Importantly, the "best interests of the child" is meant to signal alignment with the spectrum of rights laid out in the UNCRC and General Comment No. 25, and it not meant to represent a one-size-fits-all approach where all children should have the same exact experience online (Livingstone et al., 2024). Building in choice, flexibility, and adaptability to online decision making for children is key for considering children's best interests so that certain designs could be more universal for an age-bound group of children and others more flexible for specific situations and child identities (Livingstone et al., 2024). The Global Kids Online framework

is a helpful way of organizing the different nested factors that shape children's interactions with media and technology, as well as how children's actions shape the digital environment. Specifically, the framework posits that there are factors at the individual child level, the social level, and country level that are meaningful for children's digital lives.

Figure 1. Global Kids Online framework




Both Study 1 and Study 2 examine individual level experiences of the child while acknowledging social factors such as peer dynamics and the digital ecology that shape individual experiences. At the individual level, a child's unique developmental strengths, evolving capacities, and vulnerabilities are considered part of a child's identity and resources, informing several other interactions depicted in the model.

Study 1 and Study 2 attend to the relationship between children's identity and resources (e.g., developmental stage), practices and skills (e.g., algorithmic literacy), the type of access children had to digital media and technology (e.g., platforms used), with implications for the opportunities and risks children encounter in a commercialized digital ecology. Study 1 examines the social and developmental significance of transitioning to smartphone ownership in childhood. Given children's unique cognitive and social-emotional resources in middle childhood, we look at the affordances of smartphone ownership and the gradual transition into device use and digitally connected spaces, knowing that the actions of peers, families, and the digital ecology are important factors in this process. Study 3 is situated at the social level of the Global Kids Online framework, analyzing the extent educators are able to provide learning opportunities about digital environments.

Though the Global Kids Online framework is a unifying way of thinking about this dissertation across studies, each of the three studies draws on relevant concepts and related theories to position findings in the literature and make sense of children's experiences in the algorithmic age. More information about each study's framework can be found in the corresponding chapters.

## Background

### *Children's Use of Digital Spaces*

The overall amount of time children spend with digital technology has been increasing. Young people are using digital technologies at increasing rates, at earlier ages,

and in more diverse ways than ever before (Auxier et al., 2020a; Rideout & Robb, 2019). Compared to prior years, children under the age of 13 are spending more time using apps to send messages, make voice/video calls, post, view, stream content and play online (Ofcom, 2024a). These shifts are largely driven by the rise in mobile technologies (e.g., smartphones and tablets) and youth's entry into social media spaces at earlier ages (Rideout et al., 2022). By age 4, over 50% of children in the U.S. use a tablet and/or smartphone regularly (Auxier et al., 2021). Meanwhile, children ages 8-12 years spend almost 5 hours a day with screen media on average, excluding time spent with technology for school (Rideout & Robb, 2019). It should be noted that media consumption can vary significantly from one child to another. For example, a recent in-depth report of smartphone usage among 11 to 17-year-olds showed that some children used their phones for only a few minutes while others spent 16 hours a day on their phone according to objective sensing data (Radesky et al., 2023). Similarly, the median number of smartphone pick-ups was 51 times day, but this ranged from 2 to 498 times in one day (Radesky et al., 2023).

## Smartphone Use

Smartphones are a particularly meaningful aspect of children's digital lives for several reasons. Children are getting their own smartphones at earlier ages than in previous years and once they own a smartphone, this often replaces other devices for accessing the internet such as a tablet (Ofcom, 2024a). According to recent survey data from thousands of children in the UK, approximately 90% of children had their own smartphone by the age of 11. In the US, over half of 11-year-old own their own smartphone, with this number jumping to two-thirds at age 12 years (Rideout & Robb, 2019), although

these data may be somewhat dated and were collected before the COVID-19 pandemic. Once children have their own smartphone, they are more likely to use the phone to go online than any other device (Ofcom, 2024a). Thus, the smartphone and its associated affordances become a primary gateway through which children access digital media and technology.

### *Platforms and Activities*

Some of the most recent data we have about children's online habits suggest that half of children under the age of 13 use social media sites, despite the minimum age requirements (Ofcom, 2024a). Across preteens and teens, the most popular digital spaces include TikTok, YouTube, Snapchat, Instagram, and digital games (Anderson et al., 2023; Ofcom, 2024b; Radesky et al., 2023). TikTok and YouTube tend to dominate overall time spent online, with 1 in in 5 teens reporting they are 'almost constantly' on YouTube and TikTok (Ofcom, 2024a). Interestingly, survey data from the UK suggests there are age-related differences in how children spend their time on social media. Among minor users, children ages 8-11 showed the largest amount of liking, following, and consuming content and the lowest amount of sharing, commenting, or posting. These trends change for children ages 12 to 15 and for children ages 16-17, with sharing, commenting, or posting increasing with age, as a proportion of overall time spent on social media (Ofcom, 2024a). Recent research with tweens and teens suggests that online videos are a major part of media diets for this age group (Auxier et al., 2020a; James, Weinstein & Mendoza, 2021; Radesky, Schaller, Yeo, Weeks & Robb, 2020). Browsing social media through search and recommendation features are increasingly common ways for youth to discover and interact

with content, which may be an important influence on the intense identity work unique to middle childhood and adolescence (Collins & Madsen, 2019; Maunder & Monks, 2019; National Research Council, 1984). Surveys of young people specifically mention the role of TikTok's "For You" page and YouTube's recommended videos in determining what content they consume (Bulger, Madden, Sobel, & Davison, 2021). Platforms like YouTube and TikTok gather information about users and use engagement-based algorithms to determine which content youth see, with the goal of keeping youth on their sites longer. However, few studies have documented what youth understand about these processes, how it shapes their behavior (if at all), and their perceptions of the content curated for them. The few studies that do exist suggest that older adolescents have significant challenges understanding data flows across technologies and the ways these processes are driven by technology industry business models (Stoilova, Nandagiri, & Livingstone, 2021). Thus, it is important to explore what youth understand about these critical digital processes driving content and to do so specifically during middle childhood. Youth in middle childhood, youth are transitioning into new digitally and socially connected spaces and increasingly adopting social media. Developmentally, they are experiencing rapid expansion of their social networks, engaging in new forms of self-comparison, and are increasingly invested in peer relationships and acceptance. Children in this stage of development are still developing higher order thinking, attention and self-regulation skills in ways that are different than adolescents (Finch & Obradović, 2017; Sasser, Bierman, & Heinrichs, 2015). Few studies to date have attended to the unique developmental strengths and vulnerabilities of younger users in algorithmically driven digital spaces.

### *Children's Rights Online and the Commercial Context*

This early and frequent access to digital technologies in childhood creates new opportunities and risks for positive youth development. Within this digital context, technology companies and the decisions they make regarding platform design, data collection and monetization, and accountability policies (e.g. harassment policies, child protections) are major factors shaping digital environments for children—and these decisions are typically profit-driven. Many of the consumer-facing apps, platforms, and websites that youth interact with regularly are commercial platforms whose express purpose is to generate profit, primarily through monetizing the data they collect from users. Zuboff (2015, 2016, 2019) calls this "surveillance capitalism" wherein technology platforms extract, commodify, and control behavior by collecting vast amount of data from users in ways that concentrate power in the hands of a select few. Within this system, children are explicitly or implicitly agreeing to surveillance from corporations simply by connecting to the internet or using an app (Montgomery, Chester, & Milosevic, 2017).

Technology platforms are largely self-regulated and unencumbered by legal or industry standards. Digital platforms such as YouTube, TikTok, Instagram and Snapchat often claim that children are not permitted on their platforms (Protecting Kids Online: Snapchat, TikTok and YouTube, 2021; Disrupting Dangerous Algorithms: Addressing the Harms of Persuasive Technology, 2021) but there is evidence that platforms take specific steps to "strategically ignore" children under the age of 13 who are using their services (Lenhard & Owens, 2021). When a platform sets a minimum user age of 13 years and requires all users to enter a birthdate attesting to that age, they can say that they do not collect data on children under 13 years, making them compliant with current privacy legislation in the US (e.g. COPPA) and giving them the opportunity to pretend they do not

know younger users are on the site (Lenhart & Owens, 2021). If technology companies can ignore the presence of young users on their platforms by not collecting certain information, they can avoid responsibility for any negative effects arising from the mismatch between content/experiences and a user's developmental needs (Lenhart & Owens, 2021). Thus, children are largely left to their own devices to avoid risk and maximize the opportunities digital technologies provide (5Rights Foundation, 2021). This has implications for the ways that families and schools socialize children as they begin using connected technologies such as social media, messaging apps, or gaming platforms that connect them with known and unknown others. However, the dynamics of learning to navigate digital platforms and the experience of both risk and opportunity along the way are not well understood and are especially understudied in middle childhood. Research does not sufficiently attend to how children enter and make sense of newer digital spaces in middle childhood or what kinds of messaging they receive about more critical aspects of digital literacy (e.g. algorithms, business models, persuasive design) that influence the content they engage with online.

Children are a unique group of digital media and technology users, and many have argued that they are entitled to specific human rights in the digital age (UN Committee on the Rights of the Child, 2021), especially in commercial digital ecosystems. Globally, children make up over 1/3 of all internet users (Livingstone et al., 2015). Despite their significant presence online, children lack any form of digital rights in the United States, with the exception of some privacy for teens through COPPA. In 2021, the United Nations met the growing challenge of navigating human rights in the digital age by providing a framework for children's rights online, outlined in the UN General Comment No. 25 on children's rights in relation to the digital environment (2021) and grounded in the UN

Convention on the Rights of the Child (UNCRC, 1989). The UNCRC is an international treaty aimed at guaranteeing certain rights of children around the world. Although the UN Convention on the Rights of the Child is the most widely ratified treaty in history, with 195 countries signing it, the United States, along with Somalia, have not signed. US lawmakers argued that ratifying the treaty would conflict with US laws emphasizing parental rights, especially around access to education and the ways families discipline their children. Others argue that the UNCRC is well-aligned with supporting parents and families, while protecting children from rights infringement and forms of abuse (Congressional Research Service, 2015).

The UNCRC (1989) and General Comment No. 25 (2021) particular to digital spaces articulates children's rights to participation, protection, and provision, introducing the notion of "best interests of the child". This framework values child and youth agency, balanced with the need to provide safe and appropriately "risky opportunities" children need to thrive. Other spaces children spend time in (e.g., playgrounds, schools) balance the tension between protecting children and providing risky opportunities, yet some researchers and scholars view the calls for safer online experiences as patronizing and as underestimating youth capacities and agency. A children's rights perspective does not seek to overprotect, but instead acknowledges the power differentials that make true child agency online a major challenge. Right now, digital spaces are powerful, self-governing entities "moving fast and breaking things" (Taplin, 2017) without any moral code, legal accountability, or industry standards.

The United States' refusal to sign the UNCRC and General Comment No. 25 is a glaring absence given the massive amount of power centralized in the United States. The

"Big Five" technology companies—Alphabet, Amazon, Apple, Meta, and Microsoft—were founded and are currently headquartered in the United States. If these companies were countries, they would be the most economically powerful and populous in the world. Meta, formerly known as Facebook, had a global revenue of $134.9 billion in 2023 (Meta, 2024), earning more than the world's biggest economies such as China, India, or the US. In 2023, Meta had 2.11 billion active daily users, which would have made it the most populous country in the world.

The collective power Big Tech has over the world's daily experiences is staggering. A small circle of corporate stakeholders makes decisions impacting billions of children and adults across the world. Yet, Big Tech's decision-making is not required to align with human-centered design, children's development, or even basic privacy protections. One recent example of Big Tech's failure to center human rights was reported by the New York Times in 2024 (Valentino-DeVries & Keller, 2024). Parents of children with Instagram accounts (Instagram is owned by Meta) reported various instances of child abuse happening on the Instagram platform, including cyberflashing (a child receiving erect male genitalia sent through direct message), parent report of an account reposting pictures of a child with explicit captions, and a user who propositioned a child for sex, offering $65,000.

According to the New York Times,

> In response to those three reports, Meta said either that the communications did not violate "community guidelines" or that its staff did not have time to review them. In other cases, Meta told parents that it relied on its "technology" to determine the content was "probably" not a violation…Former Meta trust and safety employees

described an organization overwhelmed despite knowing about the problem for years (Valentino-DeVries & Keller, 2024).

Companies, including Meta, prove time and time again that they are not interested in child safety or "best interests of the child", opting instead to rely on insufficient algorithms to detect harms as well as the "responsibilization" of parenting in the digital age (Mauk, 2021). By extolling the virtues of parental controls that do not actually do much in practice, parental controls are framed as tools for "good" parents while shifting the responsibility of protecting children online away from government and the technology industry. Meanwhile, technology platforms make billions of dollars a year from user engagement, for better (or much worse). Any attempts to regulate have been blocked by lobbying organizations like NetChoice, who argue it is too messy to determine age-appropriate experiences or that the government cannot tell platforms how to regulate speech or behavior of users (Miller, 2023). But there is a growing body of interdisciplinary research that offers insights, areas of inquiry, and potential frameworks to guide the creation of more human-centered and child-centered digital spaces. It is possible to design in alignment with children's developmental needs and capacities, but to do so we must understand developmental strengths and capacities at different stages.

### *Developmental Context of Middle Childhood*

Children are growing up, moving through developmental stages, learning, laughing, playing, growing, making mistakes—in the context of commercialized, algorithmically driven environments. Children in middle childhood, typically considered ages 5 to 11, are

expanding their social contexts and relationships, as well as developing abilities to manage social relationships (managing conflict, goal directed behavior), self-concept, self-regulation, and social responsibility. Notably, children in this stage expand their social contexts dramatically as they spend more time outside of the family. Children in middle childhood often attend formal schooling, begin participating in organized activities, and spend more time with their peers. This is also an intense time for children to engage in self-evaluation, likely a result of exposure to more people and social settings (Collins & Madsen, 2019). Thus, digital spaces that provide opportunities to expand a child's social interactions are attractive places for children to meet developmental needs in middle childhood. Recent research suggests that children in later middle childhood and early adolescence use social media to expand their social circle beyond the family and to explore their emerging sense of sexuality and identity (Charmaraman et al., 2022) At the same time, these children may be more vulnerable to what they are exposed to online due to their still developing cognitive and social emotional skills.

Prior research has proposed a developmental affordances framework for social media use in adolescence (Moreno & Uhls, 2019), articulating the ways various features and affordances of social media intersect with developmental characteristics of adolescent users. This dissertation takes a similar approach, putting developmental strengths and needs of middle childhood in conversation with the features and affordances of various digital platforms. Particularly, these studies explore the cognitive and social strengths of children and as well as vulnerabilities that shape digital interactions. I pay particular attention to the ways development intersects with algorithmic awareness and thinking

about data collection practices, as well as the developmental affordances of smartphone ownership in middle childhood.

Given the uptake of newer technologies in middle childhood, current gaps in research, and the lack of government and technology industry regulation in the US, it is worthwhile to understand how youth experience their digital ecology in middle childhood (ages 8-11) as well as the formal or informal learning opportunities they have to learn about various topics, including data flows and algorithms in their daily lives. Because smartphones are increasingly becoming the primary access point for children in digital spaces, it is also useful to understand their transitions to smartphone ownership and associated risks and opportunities. Thus, the present three-study dissertation addresses these three areas:

Study 1: Children's Experience of Smartphone Ownership in Middle Childhood

1) How does getting a smartphone function as a rite of passage or modern developmental transition point in middle childhood?
2) How does smartphone access in childhood align with developmental needs and capacities?

Study 2: Children's Sensemaking of Algorithms and Data Flows

1) What do children understand about data flows and algorithms in social media and YouTube feeds?
2) Which strategies do children use to control the flow of their personal data and/or their algorithmically curated experiences online?

Study 3: Digital Learning Opportunities in K-12 Schools

1) What kinds of technology access, challenges, and practices do educators report in K-12 schools?
2) What digital citizenship content do educators report teaching in K-12 schools and how often?
3) What educator and school level characteristics are associated with digital citizenship instruction in a sample of K-12 schools?

## Study 1

## Transitions to Smartphone Ownership in Childhood: A Modern Developmental Milestone with Associated Affordances

*Andrés (11 yr old) got his own phone at age 9 as part of a "buy 2 phones, get one free" deal. His father purchased the phones, gave one to his uncle and kept one as the 'house phone' that anyone could use, but Andrés was the one using it most. Soon, Andrés' father decided it was time for Andrés to have his own phone and officially gave the 'house phone' to him. On a typical day, he uses his phone to play Pokemon Go! while walking the dog. After that, he heads home to use his iPad to play FIFA and he calls and texts his friends for about 2 hours.*

*Sophia (8 yr old) got her first smartphone at age 6 and used it to "play Roblox and text and stuff". Her little sister threw this phone in the toilet, so she got a new one at age 7 and uses it for Roblox and online shopping. Sophia uses her phone for texting people outside of school and uses her phone to "zone out" from her little sister because "she is a little monster and a maniac".*

*Adriana (9 yr old) got her first phone at age 6 after getting her own tablet in preschool. Adriana's mother told her not to download Roblox when she got her first phone, but Adriana downloaded it anyway and still uses it without her mother knowing. She got a different phone when she was 8 years old and a new iPad when she was 9. On a typical day, she watches lifehacks on YouTube, texts her family members (some of which live in Mexico), watches TikTok videos, and plays games.*

## Background

These profiles of real children highlight the range of access young people have to smartphones and the various ways they use them. Rapid uptake of smartphones in childhood (Rideout et al., 2021) and among teens (Vogels et al., 2022) has prompted questions about the unique benefits and risks that come with smartphone ownership at certain developmental stages, yet we do not know much about the experiences of young smartphone owners. Extant literature tends to focus on older adolescents or young adults (Radesky et al., 2023), with less focus on school-age children (Stoilova, Livingstone, & Khazbak, 2021; Odgers & Jensen, 2020) who have different developmental capacities and needs compared to teenagers, likely shaping their smartphone experiences in various ways. Survey data suggest half of children ages 8 to 12 have their own smartphone (Charmaraman et al., 2022; Rideout et al., 2022), and that middle childhood is becoming the normative time for children to get their own phones (Rideout & Robb, 2019). Getting your own smartphone has also been discussed as a rite of passage (Selkie, 2019; Oksman & Turtiainen, 2004) and indicative of some level of maturity according to adolescents and parents (Moreno, Kerr, Jenkins, Lam, & Malik, 2019; Vaterlaus, Aylward, Tarabochia, & Martin, 2021), similar to driving a car or other important milestones. But it is unclear how younger children are getting access to and using smartphones on a day-to-day basis, and how this rite of passage is experienced by children themselves in the context of developmental transitions through middle childhood.

Given these gaps, the current study was designed to explore children's perspectives of (1) the transition to smartphone ownership as a rite of passage or developmental turning point and (2) the opportunities and risks that come with specific kinds of smartphone access in middle childhood (ages 8-11). We expand on Moreno and Uhls's (2019) developmental affordances framework to shape our analysis, which draws on both media (e.g., Uses and gratifications theory; Katz, Blumler & Gurevitch, 1973) and developmental theory (e.g., Piagetian stages of development, Piaget, 1970).

**Opportunities and Risks of Smartphone Ownership**

Concerns about the effects of newer technologies such as smartphones on children are not new, and previous research has examined connections between childhood outcomes and television exposure, video games, or Internet use (Fisch, 2004; Orben, 2020). However, smartphones are unique in that they can be several media devices in one. A smartphone can function as a small television where youth stream content and a communication device as they text, call, and chat with friends, as well as a mobile video game console (not to mention radio, clock, calculator, etc.). This kind of multifunctionality can make it difficult to draw conclusions about what overall benefits and risks exist for children (Yan, 2018), as these can vary based on a combination of not just overall time spent on a device, but the content children interact with, people children communicate with, activities not done while on a device (displaced by use) and child level factors such as temperament, parental monitoring, and rules about phone use (Charmaraman et al., 2021; Lee & Kim. 2021; Przybylski et al., 2020). Children likely use smartphones in ways that benefit their development as well as ways that may negatively impact them or expose them to risks, but the unique experiences of children between the ages of 8 and 11 as

smartphone owners and users is understudied (Stoilova, Livingstone, & Khazbak, 2021; Odgers & Jensen, 2020).

Prior research does attempt to unpack the different opportunities and risks of smartphones for older youth and young adults. Commonly reported benefits include family communication (Auxier et al., 2020; Vaterlaus et al., 2020) and building positive social relationships with peers (Kim & Davis, 2017; Weinstein & James, 2022; Yau & Reich, 2019), echoing rationales from several decades ago for teens getting basic cell phones (Oksman & Turtiainen, 2004). Digital devices such as smartphones offer increasingly important ways for young people to maintain current relationships with peers, make more friends, experience validation from peers, and facilitate self-disclosure (Yau & Reich, 2019) as well as a way to avoid the social isolation and teasing that comes with not having a smartphone (Vaterlaus et al., 2020). Avoiding social isolation is important for both short-term and long-term developmental outcomes. Longitudinal data suggest that social isolation in childhood predicts poor health as an adult, even when controlling for environmental (e.g., socioeconomic status) and person level factors (e.g., exercise, substance abuse habits; Caspi et al., 2006). Teens report that they can keep up with friends, access the same social networks, and make plans with peers when they have their own smartphone, preventing feelings of social isolation or unwanted attention due to lack of smartphone (Vaterlaus & Tarabochia, 2020). These kinds of benefits may help explain parabolic relationships between time spent online and youth well-being (i.e. The Goldilocks Principle) where too little time spent online is associated with poorer outcomes, but just the right amount can be beneficial for many youth (Przybylski et al., 2020). However, it is unclear whether children

in middle childhood experience these benefits in similar ways as adolescents and young adults.

Research has also found evidence of risks, primarily through covariation between adolescents' overall screen time or smartphone use and negative psychosocial outcomes, such as poor mental health (Keles et al., 2020), lower quality friendships (Knop et al., 2016), increased cyberbullying, riskier sexual behaviors online (e.g., sexting, viewing sexually explicit images, sexual solicitation) (Eleuteri et al., 2017; Tolman & McClelland, 2010), internet addiction, and less sleep (Woods & Scott, 2016). Large scale analyses of caregiver survey data suggest significant time spent on a device (more than 5 hours a day) is associated with worse psychosocial functioning for children based on pre-pandemic data collected in 2016 and 2017 (Przybylski, Orben and Weinstein, 2020). There is also evidence that owning a smartphone is associated with later bedtime, less overall sleep, and more sleep disturbances among teens (Charmarman et al., 2022; Sohn et al., 2019) and researchers see similar trends for children when it comes to general screen time (LeBourgeois et al., 2017; Paulich et al., 2021). The connection between screen use and sleep is one of the most robust findings among children's media research (National Academies of Sciences, Engineering, and Medicine, 2023), which has implications for development given the importance of sleep for brain development, information consolidation, and social emotional wellbeing in childhood (Tamis-LeMonda, 2022).

Research on connections between mental health and smartphone use, including problematic smartphone use, have looked at the habits and outcomes of young teens and adults. Researchers still do not agree on these effects, in part due to challenges in measuring time spent and content interacted with (NASEM, 2023), but several argue that

the links between smartphone use and wellbeing are minimal, if they exist at all (Odgers, 2018). What researchers do agree on though, is that online experiences may be "reflecting and even worsening existing vulnerabilities" (Odgers, 2018, p. 432). This could include developmental vulnerabilities unique to different developmental stages, where the experience of getting a phone in middle childhood may present different risks and opportunities than those accompanying phone ownership in adolescence. Recent research supports this idea, where emerging adolescents (ages 11-15) who received their own smartphone at a later age reported getting more sleep and going to bed earlier compared to children who received their own smartphone earlier (Charmaraman et al., 2021). There is also evidence that children's concerns about online risks rise significantly between the ages of 9 and 12 years (Livingstone, Mascheroni, & Staksrud, 2015), suggesting something unique is happening for youth engagement in digital spaces during late middle childhood.

Smartphones connect to the wider internet, often in an unsupervised, extremely mobile and convenient way. Thus, questions about the impact of smartphones can get muddied because it is possible to be talking about concerns related to simple displacement by overall time spent on the phone, or concerns about the content kids have access to with a smartphone (compared to a 'dumb phone') or to the kinds of social media networks children often start accessing when they get their own device (Auxier et al., 2020). Research on these different kinds of experiences is still underway but will ideally help tease out how specific online experiences affect different children at different ages. Despite the lack of nuanced research in middle childhood, it is reasonable to think children with a smartphone may spend more time in digitally connected spaces compared to a child

without personal device access, and it is worthwhile to understand how smartphone access can create both opportunities and risks at specific developmental ages.

## A Developmental Affordances Approach to Smartphone Ownership in Middle Childhood

A developmental affordances approach (Moreno & Uhls, 2019) is helpful in understanding the ways different technologies provide opportunities and risks for children at different stages. The developmental affordances approach and framework is based on the idea that technologies support important developmental tasks and experiences, but that examining these at the specific platform level is not very helpful. Instead, we approach digital technologies and platforms by looking at the key features of each, how they are designed, what these environments enable children to do, and how this process supports as well as undermines key developmental tasks (Moreno & Uhls, 2019). Moreno and Uhls (2019) proposed this framework in the context of social media in adolescence, outlining the functional, social, identity, cognitive and emotional affordances of social media and each category's links to adolescent development. Our summary of the developmental affordances framework (Moreno & Uhls, 2019) is included in Table 1. In this study, we extend this framework by applying it to smartphones and the larger digital ecosystem popular with children in middle childhood (e.g., gaming, video streaming sites, social media), rather than solely focusing on social media affordances. We also examine the experiences of younger children ages 8-11 (i.e. middle childhood) transitioning to smartphone access and ownership, rather than focusing on adolescents.

Table 1. Developmental Affordances of Social Media in Adolescence (adapted from Moreno & Uhls, 2019)

| | Affordances of Social Media | Developmental Considerations for Adolescence | Affordances X Adolescent Development |
|---|---|---|---|
| Functional<br><br>*Main functions that affects the sharing or saving of social media content* | Replicability<br>Scalable<br>Searchable<br>Permanence<br>Unlimited composition time | Abstract thinking and perspective taking comes on board later in adolescence<br><br>Executive functioning and self-regulation developing | May post something permanent without considering consequences |
| Social<br><br>*Attributes of functions that support sense of belonging, interactivity, social interaction* | Interactive<br>Networked<br>Metavoicing<br>24/7 access to peers<br>Anonymity | Developing and engaging with peer group = developmental task<br><br>Sense of belonging/mattering | Can create important sense of belonging through networks and groups<br><br>Cannot escape harassment |
| Identity<br><br>*Attributes and tools that relate to identity development and portraying/presenting identity to wider audience* | Posting ability<br>Commenting/ Feedback loops<br>Access to information | Identity development = developmental task<br><br>Exploring and experimenting are important | Uses real name and pseudonyms across sites to curate different identities, explore, get feedback |
| Cognitive<br><br>*Attributes and tools that expand one's learning, allow reallocation of cognitive resources* | Access to news and information<br><br>Expanding learning opportunities<br><br>Create multimedia content | | Quality and accuracy of information online not guaranteed, adolescents still developing EF and abstract thinking so may be vulnerable to this |
| Emotional<br><br>*attributes that can trigger or stimulate users' emotional reactions* | Likes, comments, hearts<br><br>Context collapse—blend of known and unknown others | Reward centers very sensitive to peer feedback<br><br>Social comparisons very salient | Child may misinterpret a message and feel distraught |

| | | | |
|---|---|---|---|
| | Absences of social cues (facial expression, vocal tone)<br><br>Emotionally charged content often pushed | | |

Children ages 8 to 11 have different developmental needs and capacities than adolescents. Children in middle childhood are cognitively growing in several ways, and these cognitive changes are simultaneously informing and being shaped by other developmental processes related to social competence, sense of self, and increasing autonomy (National Research Council, 1984). Children in this age range are developing better executive functioning skills, allowing them to direct their attention, increasingly manage their own behavior, and pursue goals (Finch & Obradović, 2017; Sasser, Bierman, & Heinrichs, 2015).

The evolving executive functioning skills in middle childhood are informed by developing social skills and vice versa (Holmes et al., 2015). Peer interactions in this stage require more cognitive skills than early childhood peer interactions. Children must direct their attention and behavior to navigate increasingly complex peer relationships, and more of these interactions happen without the direct supervision of adults over the course of middle childhood (Gifford-Smith & Brownell, 2003; Lam et al., 2014). Notably, children in middle childhood expand their social connections dramatically as they spend more time outside of the family context, usually through a mix of entry into formal schooling, participating in organized activities, and spending more overall time with their peers. These expanding networks and friendships in middle childhood give children important

opportunities to learn social skills, empathize with others, and practice these skills in context with larger social networks (Bollmer et al., 2005).

As children's social networks and cognitive capacities grow, they are also developing their sense of self, differentiating themselves from others largely through self-evaluation and social comparison (Collins & Madsen, 2019; National Research Council, 1984). The developing sense of self is facilitated by increasing access to diverse groups of people, different social environments, and increased perspective-taking skills (Bengtsson & Arvidsson, 2011; National Research Council, 1984; Selman & Byrne, 1974). In middle childhood, children lose the protection of egocentrism and become especially invested in feedback from peers (Rohlf et al., 2016).

Digital spaces are compelling places for children to spend time in because they provide opportunities to initiate or maintain friendships, receive peer feedback, and develop a greater sense of self through exposure to new ideas, information, and people. At the same time, children may be more vulnerable to what they are exposed to online due to their still developing cognitive and social emotional skills, with less developed perspective-taking, emotion regulation, and inhibitory control than adolescents.

In thinking about smartphone use in middle childhood, it is likely that smartphone access and digital spaces offer important affordances unique to this developmental period, similar to the functional, social, identity, cognitive, and emotional affordances Moreno and Uhls (2019) outline for adolescence. However, research to date has not explored these connections.

**Smartphones as Modern Developmental Transition Point**

Getting a phone is increasingly seen as a rite of passage (Radesky et al., 2023; Vaterlaus & Jones, 2015) in the United States, perhaps constituting what developmental psychologists call a 'transition' or 'turning point' in development (Graber & Brooks-Gunn, 1996), where children are required to adapt to new ways of being given a new environment. Prior research on adolescent cell phone use (before smartphones) suggests that getting a cell phone often coincided with other transition or milestone events such as driving or attending high school (Oksman & Turtiainen, 2004). However, as the average age of getting a phone continues to decrease, it is worth considering the process of getting a phone as a "modern developmental transition point" that is experienced uniquely in middle childhood compared to adolescence, and mobile phone ownership as a distinct set of experiences, daily activities, and lifestyle shifts (Yan 2018) that affect developmental processes.

Children's media activities change with age, and the increased access that a smartphone offers, along with what this access represents, could constitute the kind of adaptation and exposure to new environments required for "developmental transitions" (Graber & Brooks-Gunn, 1996). In early childhood, children often engage in adult-mediated or supervised activities like video-chatting (e.g., FaceTime) or use of an adult's device to interact with standalone apps (e.g., ABCMouse) or videos (e.g.,YouTube) (Kidron & Rudkin, 2017). As children move out of early childhood, they begin to do more outside the purview of adults by playing digital games, communicating independently with others using messaging apps, and accessing entertainment media through streaming sites and YouTube (Kidron & Rudkin, 2017). In terms of devices, survey data suggest that children start using mobile devices independently starting in kindergarten, on average (Auxier et al., 2020;

James, Weinstein & Mendoza, 2021), which means children are required to navigate new environments, skills, and situations largely on their own. Typically, we see these opportunities for increasing autonomy as foundational for child development (Collins & Madsen, 2019). A child entering formal schooling will spend more time outside the home and will likely grow their social relationships and skills in various ways. Similarly, a child who owns their own smartphone is likely spending more time outside parent supervision, expanding their social networks, and having new experiences that require adaptations. What is unclear, though, is the extent that smartphone ownership and access align with developmental capacities, especially when smartphone ownership precedes other increasing autonomy activities that used to accompany phone ownership (e.g., driving, navigating high school schedules) and how this transition is viewed by children themselves.

Smartphone ownership is linked to increased social media use for children, which may be another important dimension of new environments children navigate during this developmental transition point. Children are not technically allowed on social media sites such as Snapchat, Instagram, and TikTok because these social media platforms require users to be at least 13 years old and are primarily designed for adults (Reich et al., in press). Though there are child-facing apps such as YouTube Kids or Kids Messenger that allow children under the age of 13 with parental consent, these are not as popular with young users as the main platforms (Radesky et al., 2022a). Recent survey research shows that many children are accessing social media applications for the first time in middle childhood, often using these applications to expand their social circle beyond the family and to explore their emerging sense of sexuality and identity (Charmaraman et al., 2022).

Though there is evidence that children are changing the kinds of activities (e.g., changes in gaming platforms, shift to more time on social media) and devices they use (e.g., shift from tablet to phone) through middle childhood, there are still gaps around how children transition to more independent use of connected technologies, what motivates digital transitions, and what kinds of opportunities and risks are navigated in new digital environments with various affordances.

This study explores entry into smartphone ownership and the digital spaces it enables as a modern developmental transition point (Graber & Brooks-Gunn, 1996) with unique developmental affordances (Moreno & Uhls, 2019). We hypothesize that children are entering new digital environments during middle childhood, creating novel experiences and behaviors that may both support and undermine developmental outcomes salient to middle childhood and that these new spaces are experienced differently when linked to the rite of passage of smartphone ownership. Rich, detailed descriptions of digital experiences in the transition to smartphone ownership can help advance the field's understanding of the various ways youth engage with technology and how such use intersects with developmental needs and capacities.

Thus, we documented children's (ages 8-11) experiences of getting a smartphone in middle childhood, asking:

RQ1) How does getting a smartphone function as a rite of passage or modern developmental transition point in middle childhood?

RQ2) How does smartphone access in childhood align with developmental needs and capacities?

## Method

Focus groups were conducted with children ages 8 to 11 (n=34) at four afterschool sites and summer camps in California. Efforts were made to recruit from locations serving economically, racially, and ethnically diverse families. Once recruited, both children and their caregivers completed surveys about their background and media use. Caregiver background surveys were sent home in both English and Spanish with links to online videos in each language explaining the study and forms. Each focus group had 3-6 children, with one smaller group of 2 participants due to absence. Participants were assigned to a focus group based on age, geographic location, and smartphone ownership (when available). All procedures and materials were approved by a University Institutional Review Board and groups were conducted between January 2023 and July 2023.

### Participants

The lead researcher conducted nine focus groups with children between the ages of 8 and 11 years (mean = 9 yrs old). The majority of children identified as Latine (67%) and spoke both English and Spanish as their primary languages (60%). About one third of the sample identified as white (30%), with the remainder identifying as multiethnic (3%). The sample included more females (62%) than males (38%). Children were from economically diverse families, with the majority coming from 'low income' or 'very low income' households (n=20) based on annual household income data provided by caregivers in the background survey. The median highest education level attained by caregivers in the

sample was 'some college', with 12 caregivers reporting a high school education or equivalent (e.g., GED) or less. See Table 2.

Table 2. Participants Demographics and Digital Device Profiles

| Pseudonym | Child Age | Child Gender | Owns Phone | Owns Tablet | Age first Phone | Household Income | Race or Ethnicity |
|---|---|---|---|---|---|---|---|
| Sophia | 8 | F | **Yes** | No | 6 yrs | $150K+ | White |
| Rory | 8 | F | **Yes** | Yes | 6 yrs | $150K+ | White |
| Mia | 8 | F | **Yes** | Yes | 7 yrs | $100K-150K | Hispanic/Latino/a and East Asian |
| Julian | 8 | M | **Yes*** | No | 6 yrs | $50K-99K | Hispanic/ Latino/a |
| Marisol | 8 | F | **Yes** | Yes | 7 yrs | $25K-50K | Hispanic/ Latino/a |
| Lucia | 8 | F | **Yes*** | Yes | 6 yrs | < 25K | Hispanic/ Latino/a |
| Liam | 8 | M | No | Yes | | $150K+ | White |
| Sage | 8 | F | No | Yes | | $100K-150K | White |
| Ezra | 8 | M | No | Yes | | $100K-150K | White |
| Ruby | 8 | F | No | Yes | | $100K-150K | White |
| Amalia | 8 | F | No | Yes | | $25K-50K | Hispanic/ Latino/a |
| Juan | 9 | M | **Yes** | Yes | MI | $50K-99K | Hispanic/ Latino/a |
| Alysia | 9 | F | **Yes** | Yes | 8 yrs | $25K-50K | Hispanic/ Latino/a |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bruno | 9 | M | **Yes*** | Yes | 6 yrs | $25K-50K | Hispanic/ Latino/a |
| Gabriel | 9 | M | **Yes** | Yes | 9 yrs | $25K-50K | Hispanic/ Latino/a |
| Adriana | 9 | F | **Yes** | Yes | 6 yrs | $25K-50K | Hispanic/ Latino/a |
| Rosa | 9 | F | **Yes** | Yes | 8 yrs | < 25K | Hispanic/ Latino/a |
| Alexandra | 9 | F | No | Yes | | $50K-99K | Hispanic/ Latino/a |
| Ayla | 9 | F | No | Yes | | $50K-99K | Hispanic/ Latino/a |
| Bryan | 9 | M | No | Yes | | $25K-50K | Hispanic/ Latino/a |
| Mariana | 9 | F | No | Yes | | $25K-50K | Hispanic/ Latino/a |
| Isabel | 9 | F | No | Yes | | $25K-50K | Hispanic/ Latino/a |
| Jake | 10 | M | **Yes** | Yes | 10 yrs | $150K+ | White |
| Yessenia | 10 | F | **Yes** | Yes | 6 yrs | $50K-99K | Hispanic/ Latino/a |
| Jia | 10 | F | No (SW) | Yes | | $100K-150K | White/ East Asian |
| Olivia | 10 | F | No (SW) | Yes | | MI | White |
| Mackenzie | 10 | F | No (SW) | Yes | | $50K-99K | White |
| Andrea | 10 | F | No | No | | < $25K | Hispanic/ Latino/a |
| Riley | 11 | F | **Yes*** | Yes | 5 yrs | < 25K | White |
| Sol | 11 | F | **Yes** | Yes | 11 yrs | $50K-99K | Hispanic/ Latino/a |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Luis | 11 | M | **Yes** | Yes | 8 yrs | $25K-50K | Hispanic/ Latino/a |
| Caleb | 11 | M | **Yes** | No | 8 yrs | < 25K | Hispanic/ Latino/a |
| Andrés | 11 | M | **Yes** | Yes | 9 yrs | MI | Hispanic/ Latino/a |
| Mateo | 11 | M | No | Yes | | $100K-150K | Hispanic/ Latino/a |
| Totals/Mean | X=9.2 | 22 F<br>12 M | 19/34 | 30/34 | X=7.3 | | 23 Hispanic/ Latino/a<br>10 White<br>1 White/East Asian |

*Indicates limited function through parental (e.g., screen limits, limit downloads) or device (e.g., low battery life, malfunctions) restrictions
(SW) = Owns Smartwatch

**Procedure and Data Collection**

Participants were recruited in person at afterschool programs or summer camps serving students from diverse socioeconomic and racial and ethnic backgrounds. The first author visited each site, after talking with site administrators and gaining approval, to hand out consent forms and background surveys for children to take home to a caregiver if they were interested in participating. The researchers made IRB-approved videos, in English and Spanish, to explain the consent forms and study information sheets in lay language. Child and caregiver participants completed a background survey that included demographic questions and questions about child media use, child access to devices and internet, parental monitoring, and rules about technology in the home. When forms were returned, the first author coordinated focus groups with site staff and grouped participants based on age, gender, and smartphone ownership.

The first author facilitated all nine focus groups, lasting between 45-60 minutes each. Focus groups started with an assent process with children and were then audio recorded. Focus groups took place on-site at the afterschool program or summer camp. A semi-structured protocol was used to guide conversation as well as prompts and follow-up questions. Prior to data collection, the lead researcher piloted and revised the protocol with a group of older children. The protocol focused on children's access to mobile devices and digital platforms, how and when they began using mobile devices, and perceived risks and benefits of digital devices and platforms. Children were given gift cards at the end of the focus group and researchers facilitated parent, staff, or student digital literacy workshops after data collection ended.

**Data Analysis**

Focus groups were audio-recorded and transcribed by the lead author and an undergraduate research assistant. Throughout the data collection and transcription process, reflective memos were drafted to document emerging questions, connections, and issues for continued data collection and analysis. Initial data analysis began while data collection was still underway, and the first author began drafting an initial codebook after the first five focus groups. Emerging findings were triangulated with child and parent survey data as well as reflective and thematic memos.

First cycle coding methods (Saldaña, 2016) were used to describe patterns associated with device use (e.g., smartphone or tablet, age of first smartphone, sharing device with adult, device use in transit), frequent activities (e.g., texting, gaming, social media, streaming), affordances (e.g., socializing, play, safety, family connection), and risks (e.g., content risks, contact risks, privacy risks). Second cycle coding methods were used to

categorize different forms of access, opportunity, and risk among children and themes were developed from close analysis of these categories and cross-comparison across age bands and smartphone owners vs. non owners. Although focus groups represented a range of household income levels, racial-ethnic self-identification was predominately Latine. Given the sample size, this limited our ability to look at specific differences related to class or ethnicity.

## Findings

### RQ1) How does getting a smartphone function as a rite of passage or modern developmental transition point in middle childhood?

#### Getting a Smartphone is Gradual Process

Over half of children between the ages of 8 and 11 owned their own smartphone (19/34). Most smartphone owners, did not share it with anyone, and had full internet and cellular access. However, these 8-11-year-old smartphone owners started with a transitional device before owning their own phone (see Table 3). Although getting a smartphone is often discussed as a discrete moment in time, the children in this sample talked about smartphone ownership as a gradual process with several different pathways to getting their own phone. These pathways align with ideas about rites of passage or developmental milestones because they coincide with a child's demonstrated responsibility (Vaterlaus & Tarabochia, 2020). As children in this study showed they could manage and take care of starter devices or limited devices, they graduated to more open devices with more autonomy.

Almost all children started with another device before getting their own smartphone. Sometimes this device was a personal tablet (e.g., iPad), a smartwatch, or a family member's older phone with limited functionality. Some children started their path to smartphone ownership by sharing a device with a family member, either formally or informally. Four common pathways were described among the children we spoke to, including:

- Sharing parent's smartphone → Child's own tablet → Child's own smartphone
- Parent's old, limited function smartphone → Child's own tablet → Child's own smartphone
- Other family member's (e.g., grandparent) old smartphone → Child's own tablet → Child's own smartphone
- Child's own tablet → Child's own limited function smartphone → Child's own smartphone

Across the varied pathways to smartphone ownership, it was very rare for children to go from no device access to smartphone ownership. Only two children reported getting a smartphone as a surprise (in one case, a surprise gift from an uncle) without any kind of shared or transitional device prior to getting their own phone.

The majority of smartphone owners had demonstrated being responsible with at least two different devices before getting a smartphone such as a (1) personal tablet and (2) family member's older device or a limited function smartphone. Five children were currently in this transition process, reporting that their smartphone was either limited in functionality (n=3) or shared with a parent (n=1) or sibling (n=1). Children often started using smartphones that were limited in functionality by design (e.g., parents blocked

certain apps, functions) or by practice (e.g., broken, short battery life). Many children were given hand-me-down phones from family members (e.g., grandparent, parent, older sibling) that primarily used wireless internet networks (i.e., Wifi) rather than cellular data. This hand-me-down trend was often driven by phone upgrades or deals.

Table 3. Transitional Devices for Smartphone Ownership

| | |
|---|---|
| Limited Function Device First | "Well I got my first phone when I was seven. But it was from my dad and I had restrictions on it…I couldn't call, text, or like, go online. I could only play the games my dad allowed me." --Mia (8 yr old, smartphone owner) |
| Family Member's Limited Phone First | "I use my mom's phone. I got my own phone when I was six. I was my grandpa's but then when I was like seven or eight, I stopped using it because I got a new iPad for Christmas. But then it cracked." --Rory, (8 yr old,smartphone owner) |
| Tablet before Phone | "I got my tablet when I was four years old…and I got my phone when I was eight years old." --Rosa (9 yr old, smartphone owner) |
| Family Member's Old Smartphone | "My dad got a new phone and then I used his phone. He gave me his old phone and I got my phone at 8." --Luis (11 yr old, smartphone owner) |

**Tablet Ownership as Initial Autonomy, Becomes Indicator of Immaturity Over Time**

Most children started gaming, chatting with friends, and browsing YouTube and the internet through a personal tablet, often acquired in early childhood. Almost every child (30/34) reported owning their own tablet (e.g., iPad) sometime in the preschool years (2-5 yrs old). Of the children without their own smartphones (n=15), the majority owned their own tablets with internet access (13/15) and had computer/laptop access at home (13/15). Thus, children who did not own a smartphone still had several ways to access

digital media. Yet these participants still talked frequently about borrowing their parent's or sibling's smartphone when at home or out in the community/in transit (e.g., car ride, waiting).

Children used a tablet to meet important developmental needs for digital play, time with friends, and entertainment, but this digital access began to feel insufficient when they perceived more of their peers transiting into smartphone ownership. Children reported using tablets primarily to text friends through the iMessages app or Meta's Messenger app, play videogames, and stream YouTube videos. Younger children (8-9-yr-olds) often used YouTube to support their videogame play, researching hacks or watching popular YouTubers to learn how to do things in games such as Roblox, Fortnite, and Minecraft. As more of children's classmates and friends got their own phones, children began to feel like they had outgrown their tablet and were ready for a smartphone.

Smartphones were pathways for children to signal a certain status to others, showing that they had crossed an important threshold and achieved a level of maturity and freedom. Despite the fact that children with phones often reported engaging in the same activities as done on the tablet (e.g., texting, gaming, YouTube), the tablet was not sufficient because it was less mobile, less personal, and less socially desirable than a phone. Mateo (10 yr old) spoke about the embarrassment of a tablet and portability of a phone, saying *"it would be kind of weird just carrying like, a big iPad everywhere, but a phone you could just put in your pocket. So, it's like, more portable."* Children also tended to view their smartphones as more personal than a tablet. Andrés (11 yr old) compared his tablet to his smartphone saying, *"the phone is more personal…on my iPad I only play games, but on my phone, I text, I talk, I search up stuff."*

Children perceived owning a phone as protection from embarrassment or from being different than their peers. Riley (10 yr old) explained *"if I'm going to sixth grade without a phone, it'd be kind of embarrassing because everyone would have a phone by then."* However, it may be that children overestimate how many children actually have smartphones. Across all nine focus groups, when asked whether the majority of their peers had a smartphone, each group said yes, no matter the grade level. Third graders and fifth graders alike perceived the majority of their classmates to have personal smartphones.

**Getting a Phone as (Earned) Freedom & Responsibility**

Having your own smartphone, rather than a tablet, shared device, or smartwatch, was talked about as a kind of freedom among children. This freedom came in several forms including (1) freedom of digital movement (e.g., to do anything they want online, to access internet) (2) freedom from parental oversight (e.g., no parental monitoring, ability to text non-approved contacts) and (3) freedom to personalize device (e.g., install apps without permission, change wallpaper and features).

Table 4. Smartphone as Freedom

| | |
|---|---|
| Freedom to do Whatever/Anything | "I want a phone so I can do anything on it."--Sage (8 yr old)<br>"I get to do whatever I want." --Rory ( 8 yr old) |
| Freedom to Access Internet | "Getting my own phone means internet. Because the phone I have doesn't have internet." --Gabriel (9 yr old) |
| Freedom to Socialize Outside Parent Approved Contacts | "My parents have to add people I can't just add people…and like on a phone you could just look up a number and call them and put it as a contact." --Olivia (10 yr old)<br><br>"I want an iPhone 14 right now…Cuz then I can text Mia and she's a bad girl." --Ruby (8 yr old) |

| | |
|---|---|
| Freedom from Parental Oversight | "Something good about getting your own phone is that you don't have to ask for permission if you can call one of your friends. Or like ask people if you can play with your phone. And you can download some games, whatever you want." --Andrea (10 yr old) |
| Freedom to Personalize Device | "I could change the wallpaper. I can move apps wherever I want. On my phone–on my mom's phone–I'm not allowed to move apps. So that's another reason." --Riley (11 yr old) |

Children also talked about getting a phone as something that requires responsibility and maturity. According to children, you should be able to use your own device without breaking it or losing it, and you should also know what kinds of content and interactions are inappropriate, in order to get your own smartphone. Often, children proved this level of responsibility by successfully navigating a different digital device first. Jia (10 yr old) owns a smartwatch instead of a phone, but illustrated how owning a smartwatch factors into smartphone decisions, saying:

> My cousin has to wait longer than me because she was at school fiddling with her smartwatch and her watch fell and it cracked. So, her parents are saying she needs to be more responsible before she can get a phone. So, I think I might get a phone before she does.

Lucia (8 yr old) and Bruno (8 yr old) were both young smartphone owners, but suggested that children should not get smartphones in the first decade. Instead, they suggested that youth get a phone between the ages of 11 and 13 years old. Lucia and Bruno explained their rationale for older smartphone acquisition,

Lucia: Because bigger kids know more stuff and they can take care of their stuff better.

Bruno: Yeah. And they're much more responsible.

Lucia: Yeah.

Bruno: Little kids, they just like, put inappropriate stuff and they're like–they don't know what it is. They just put it on [the phone]. And they become toxic…Like mean and stuff.

Lucia and Bruno were drawing connections between age, responsibility, and a kind of developmental susceptibility to online harms prior to adolescence. Several participants expressed that younger children might be more prone to misbehavior or 'toxic' behavior than older peers. Sophia (8 yrs old) had similar thoughts saying, *"the littler ages can do something wrong with it, or break it."* Julian (8 yrs old) added that the earliest age kids should get a smartphone is 9 years old because *"they can do a lot of like inappropriate things because they don't know what to do."*

Although many children framed smartphone ownership as a responsibility earned through child level actions, they also recognized that perceptions of readiness may vary between child and parent, or between two parents. Mackenzie (10 yr old) explains the smartphone decision-making process, saying,

> [your parents] will see how you behave and maybe will think you are ready…And that's what it's like for a phone. My mom says, "We will see if you are ready for it and we might give it to you." My dad is like, "8th grade."

To children, owning a smartphone represented a meaningful rite of passage, signifying a level of maturity, responsibility, and increased freedom. Similarly, owning a phone functioned as a developmental milestone, indicating a kind of status to peers, a sense of growing up, and demonstrated capacities. To explore the "goodness of fit" (Graber & Brooks-Gunn, 1996) or developmental match there was between owning a smartphone in childhood and the opportunities and risks a smartphone affords, we documented children's positive and negative experiences of smartphone ownership (RQ2).

**RQ2) How does smartphone access in childhood align with developmental needs and capacities?**

Children reported several beneficial affordances of smartphone ownership in middle childhood, as well as ways that time spent in digital spaces can support developmental needs for increased social connections with peers, greater autonomy and privacy, cognitive growth and learning, and a developing sense of self—depending on the features of platforms. Risks of smartphone ownership were less about the features of the phone itself and more about the structures and features of the digital ecosystem that children spent time in through the phone. Specifically, children talked about risks to privacy through contact with unknown others, online harassment, exposure to mature content, and loss of time due to phone use. The risks most commonly discussed were tied

to platform features more than individual devices, highlighting how the current lack of online regulation combined with specific features and uses can create risk for children, not necessarily the device itself. For example, children talked about risks related to sexually mature content, but this content was reported across different kinds of devices (e.g., smartphone, tablet, shared phone) and platforms (e.g., YouTube, TikTok, Cool Math Games). Drawing on the developmental affordances framework (Moreno & Uhls, 2019), we highlight the ways that affordances of smartphones and digital ecosystems (often facilitated through the smartphone) interact with developmental considerations to present different risks and opportunities. See Table 5 for a summary of the opportunities and risks children shared.

### *Smartphone Specific Affordances and Development*

**Functional Features (Smartphone Specific).** Similar to Moreno and Uhls (2019), children talked about functional features unique to the smartphone. They described the ways in which smartphones are *searchable, multifunctional, connected to the Internet, customizable, and immersive.* These features allowed young users to easily add contacts, find information, access unlimited applications for various pursuits, and customize their digital device.

***Self-Management.*** Children in middle childhood often gain more autonomy and begin doing more things by themselves when environmental conditions allow. Several children talked about greater freedom through smartphone ownership. For instance, Andrea (10 yr old) shared about the ways her smartphone allowed for more independence from parents, saying,

> Something good about getting your own phone is that you don't have to ask for permission if you can call one of your friends. Or like ask people if you can play with your phone. And you can download some games, whatever you want.

***Privacy.*** Smartphones seemed to offer children a distinct level of privacy from parents and family members. In Table 4, Olivia (10 yr old) and Ruby ( 8 yr old) shared about the freedom to independently add contacts, even if your parents would disapprove of them. There was a strong desire among children for social connection, but also for the independent access to peer connections without parent approval or parental mediation.

**Physical Features (Smartphone Specific).** Smartphones were uniquely valuable to children, primarily because they are *mobile*, *connected to the internet*, and *smaller than tablets*. Children were most excited about getting a smartphone to text and call friends on their phones, but also experienced opportunities to develop self-management skills and experience a sense of increased privacy. A smartphone's portability meant that children could access their friends at any time and communicate with caregivers about safety and logistics when outside the family home,

***Mobile and Social.*** Almost every child who owned a smartphone talked about the unique benefits of texting or calling friends through a phone, compared to other devices. Prior to getting a phone, Andrés (11 yr old) relied on videogames to chat with his friends, but was able to text with his friends outside gaming platforms when he got his own phone. This was helpful because chatting through a game required friends to be online at the same time, whereas texting was a constant connection. Andrés also talked about how timing of

getting a phone in relation to the school year can matter, sharing that "*I got [my smartphone] toward the ending of school. Cause when it was, like, summer, I would just mostly lose contact with my friends."*

***Responsibility with Reachability***. Most children start spending more time with peers in middle childhood, often with less direct adult supervision (Lam et al., 2014) and the *mobility* of a smartphone can help support these developmental activities. Some children begin walking to or from school by themselves, coordinating pick-ups and drop offs, and meeting up with friends without adults. Children shared that having their own smartphone can be uniquely beneficial because it allows them to have easy access to a parent when away from the family home and to communicate in emergency situations, such as getting lost or needing help. Caleb (11 yr old) explained, *"just for emergency situations, to see when they are going to pick me up, cause we live 10-20 minutes away from the school, and my mom works far away…so I see who is going to pick me up."* A few students talked about how having a phone is especially helpful when parents forget or schedules get busy with Alexandra (9 yr old) saying, *"I want a phone because I could call my dad to come and pick me up because sometimes he forgets."*

***Private Use.*** The *mobility* and *immersive* nature of smartphones also provided a sense of mental or physical distance from family members and some degree of privacy for children. Sophia (8 yr old) talked about the benefits of having her own smartphone, saying *"I get to like text people when I'm not around them. And I get to like zone out from my family especially, I get to zone out from my sister cuz she's a little monster and a maniac."* Similarly, Gabriel (9 yr old) talked about how having his own smartphone means "*I don't have to share…I don't have to share with my siblings."* This independent and private access means

children could have more control over the interpersonal context of media use. Bruno (9 yr old) talked about this in relation to co-viewing, saying *" [a smartphone] is little and like if you want to watch something that your brother wants to watch, but like, you don't want your brother to watch, he can't watch it [on your smartphone]".*

***Risks to Self-Management.*** The physical features of a smartphone also presented challenges for children's self-management. Children talked about how having a smartphone sometimes displaced time spent on other things they saw as important, often driven by the constant *access to the internet, mobility*, and *portability* of a smartphone. Although it should be noted that this was often talked about in conjunction with social media use and the unlimited and endless stream of content available among smartphone owners. Children felt that losing track of time was connected to having their own phone (compared to a tablet) and part of that was easy and constant access to short form video apps like TikTok and YouTube Shorts. A group of older children, who got their phones at age 9, recommended getting a phone in adolescence because *"sometimes hours can pass by and you're own on your phone and you don't feel it"* (Andrés, 11 yr old).

One group of smartphone owners (age 11 years) looked at their screen time metrics and were surprised to find they spent over 6 hours a day on their phones, with the greatest proportion on TikTok. They said things like *"when I think about it, I think it's a lot"* and *"that's like the whole day, a quarter of a whole day".* Children considered why they might be spending more time than they realize on TikTok, reflecting that TikTok clips are short which made them want to keep watching, even when the content was not interesting to them. It is also possible that a smartphone provided them with more frequent access to digital spaces, and thus increased time use through more overall access.

### *Affordances of Digital Spaces (Not Smartphone Specific) and Development*

Although the affordances of smartphone ownership were pronounced, especially around the *mobility* and *internet connectivity* features, the opportunities and risks children experience online manifested more often through the affordances of broader connected digital spaces (e.g., gaming platforms, YouTube, social media). Specifically, the platforms popular with children in this study had relevant social-emotional, commercial, and cognitive features that were not specific to a device. Instead children who owned smartphones as well as those that used tablets, computers, gaming systems, and shared and limited devices mentioned these affordances.

**Social-Emotional Features.** Many of the digital spaces children used facilitated social interactions through the presence of social features, as well as those related to emotional cues and processing. These technologies often had *private messaging* features, were *connected to open networks* of known and unknown others, were *anonymous*, and offered *quantifiable emotions* (e.g., likes, comments, hearts) with an *absence of physical social-emotional cues* (e.g., facial expression, vocal tone). These features often offered children important opportunities for social connection. At the same time, they also presented different risks related to contact with unknown others and online harassment.

***Social Connections***. Though children talked about a smartphone as an especially beneficial way to connect with friends, they often started texting friends and family prior to smartphone ownership by using a tablet or a parent's phone, as shown in the following exchange among a group of 9-year-old children:

Rosa: Me! Earlier they saw me literally texting on my tablet.

Facilitator: Yeah? I want to hear from everybody. Okay, let's go around. Adriana?

Adriana: I text my cousin sometimes [on my tablet]. My tías. My mom, my dad, and my brother. But not random people.

Facilitator: Okay, so mostly family. Yeah. Okay, Gabriel, what about you?

Gabriel: I text my friend.

Adriana: Messages, WhatsApp. That's it.

Andrea: Um, I text on my phone, dad's phone, my brother's phone. Sometimes, sometimes on my friend's phone, and then the computer. I'm more quicker on the computer.

Facilitator: Who do you usually text with?

Andrea: Mom, dad, my friend. And in my brother's phone, I can text with my grandma.

Facilitator: Yeah, okay. Bryan, do you text on a phone?

Bryan: No, I text on a tablet or my parent's phone.

Across all age groups, children socialized through gaming. Younger children especially tended to connect with others through gaming platforms, and some also used

text messaging apps (e.g., Messenger Kids, iMessage). Many enjoyed talking to other children on Roblox explaining that you sometimes develop friendships with people online. Children played a variety of games and many spoke about the particular benefits of gaming with friends. The most popular gaming platforms were Roblox, Minecraft, and Fortnite, especially among the 8- and 9-year-old participants. As children got older, they tended to expand to games such as Pokemon Go! or FIFA, and spent more time on Fortnite. All the children we talked with mentioned gaming as an important part of their digital lives.

***Risks in Social Interactions***. In addition to connecting with friends and family in positive ways, children also talked about the ways social features connected them with unknown others in ways that presented risks to digital and personal privacy. Riley (11 yr old) spoke to the ease with which children can sign up for social media accounts and the ways that these platforms connect to wider social networks, sharing *"I used to have an Instagram account on my iPad…and everyone wanted to follow me and I didn't have a rule at the time. So, I was like okay, okay, okay, okay (mimics accepting friend requests/tapping screen)."*

For underage social media users, there were very little default privacy protections built into their experience and it was very easy to connect with unknown others online. Children in middle childhood have lower inhibitory control compared to older peers (National Research Council, 1984), which creates situations where they may accept invitations from unknown others out of a combination of developing executive functioning and a strong desire for social connections. Because effective privacy protections are not built into platforms, children experienced risky opportunities by way of opening access to

both known and unknown others, as well as agreeing to data tracking and extraction embedded in user agreements and sign-up pages.

Interactions with unknown others occurred primarily by *messaging* with people through stand-alone apps, in-app messaging, or through gaming platforms. These interactions were shaped by the *anonymity* and *interactivity* of platforms, sometimes presenting particular risks to personal and digital privacy. Children talked about "sus", or suspicious, behavior from unknown others in gaming chats or through text messages. Lucia (8 yr old) explained that "sus" people will say things like *"What's your name? What's your password and everything? Where do you live?"*

Children reported that many users tried to friend them on Roblox. Ruby (8 yr old) explained what this looks like in context, saying *"A bunch of random people try to friend me [on Roblox]...And sometimes it pops up like right in the right bottom corner of your game and it's like accept and decline".* Children agreed that it is a good idea to make sure you know someone before accepting, but they also demonstrated some susceptibility to unknown others either through blind trust or curiosity. Mia (8 yr old) said *"It's only if it's like a famous person I would accept",* not attending to the ways anonymity can allow people to misrepresent themselves as celebrities online. Ruby (8 yr old) showed a global curiosity about the reach of online networks, saying *"I'll just choose, like search up a random name and see what pops up."*

Bryan (9 yr old) used a tablet and laptop to connect with unknown others, sharing that he started texting with "*this sketchy Amazon guy I found"* and *"this other sketchy 8th grader I found at this random school"*. In both cases, Bryan initiated contact because of a promise of free items. Bryan explained that the Amazon contact promised him a free

Microsoft computer if he followed a certain link, but "*then a few days after that my parents got charged $500 on the credit card*." Bryan also connected to the unknown 8th grader by checking his school email account and seeing an email for "*a free Lego Katana"* so Bryan emailed the address to express his interest, then *"a few days later, a box went to my house written to my name. And I opened it and it was a Lego turd."*

Children with and without smartphones shared concerns about text messages from strangers. Caleb (11 yr old) owned his own phone and reported *"I keep getting random messages on my phone…It's like join this WhatsApp group."* Text messages from strangers were not limited to smartphone users. Isabel (9 yr old) has her own tablet and talked about getting texts from a random number *"And it was a picture of a baby wearing a costume of Hulk. And they were like, do you guys think he is cute? And there was this random person will say like, 'yeah he's cute'."* Other children in confirmed they had received similar messages, with Andrés explaining why he engages in these chats, saying *"Cuz it says WhatsApp and since I have it, I don't think it's going to be anything bad, so I click it."* In Andrés' group, children shared that these random messages were often attempts to get them to purchase Bitcoin or were links to potential viruses.

Children talked about online harassment as a risk of digital platform use, and Roblox in particular emerged as a challenging platform for this age group. Riley (11 yr old) said, *"Roblox is the worst of the worst. Because like, you can get cyberbullied."* Amalia (9 yr old) talked about changes she has noticed on Roblox, saying,

> Roblox was meant to be for kids back in the day. It was supposed to be like a nice game for kids to have fun and play with their friends. But then it turned into, like,

older people playing, online daters, and all sorts of stuff…they just make people disturbed and like kids don't like it.

Several children in this 9-year-old focus group talked about their experiences on Roblox with unknown others including online harassment and attempts to start romantic relationships, including the following exchange,

Amalia: They were bullying you?

Mariana: Yeah, like saying bad words to me.

Isabel: Don't tell us the bad words.

Amalia: She could say the, like, what type of bad words. Like the b-word? The f-word?

Mariana: Yeah. The b-word and the s-word and another s-word.

Facilitator: And what did you do?

Mariana: And my feelings were sad.

Facilitator: Yeah. Is there a way to like, block them or report them?

Isabel: Yeah, you can report that.

Alexandra: You can block them.

Facilitator: Did you do that?

Mariana: Yeah.

Facilitator: Yeah. Does it work?

Mariana: No.

Amalia: Yeah kind of.

Isabel: Kind of.

Alexandra: No

Facilitator: Why do you say no?

Alexandra: It doesn't really work. Because this person was like swearing a lot. So, I reported them and they're still not banned.

Facilitator: And you still see them and they're still doing the same kind of stuff?

Alexandra: [nods]

Children in this study cautioned that group-chats in Roblox could be particularly ill advised because they never knew whether users were adults or children. Children labeled these suspected adults as "od-ers" or "online daters". Amalia (9 yr old) explained that *"older people are playing [Roblox] just to date people"* but attempts to date were not just limited to *"elderly people–like 50 or 40",* she also believed *"little kids play because they want to date people too".*

**Commercial Features.** Digital spaces popular with children were largely commercial, for-profit platforms. These platforms have relevant commercial features that

are worth noting. Many platforms offer in-app purchases and will autofill payment information, reducing friction for young users making purchases inside an app. Julian (8 yr old) talked about the commercial nature of platforms, saying that they *"make you try and buy stuff and get stuff"*, then he shared a story about his little sister, *"Once there was a calling app and my sister bought it on my dad's account. And it was actually fake and my dad's phone got hacked. And like we had to take it to the Apple Store and get it fixed."*

In service of commercial goals, platforms often include advertising, are algorithmically curated, and include age-gates to ensure they can legally collect data on registered users. Children generally disliked the commercial aspects of platforms, and especially advertisements. Liam (8 yr old) explained why ads exist in his preferred platforms, saying *"Because they want to annoy you and make you buy stuff…But you have to buy no ads. It's like 30 dollars."*

Digital platforms have built in age gates to ostensibly protect children's privacy and ensure data are not collected on any users under the age of 13, as part of the for-profit incentive structure. All of the 8- to 11-year-old children we talked with reported lying about their age to bypass age gates and regularly used several social media platforms such as Instagram, TikTok, and YouTube that had age requirements of 13 years or older

**Cognition and Connectivity.** There are several features of digital spaces that likely facilitate changes in cognition, primarily through changes in knowledge, ways of thinking and sense of self. Some features of digital spaces may also be challenging for children with still maturing cognitive capabilities such as pushed content, consent to cookies, pop-ups, etc. Platforms such as YouTube, TikTok, and Roblox offer *unlimited content*, *unlimited access*, and the *ability to create and upload your own content*. Children's cognitive growth

and development of middle childhood is often related to more experiences in diverse environments and peer interactions outside the family home (Finch et al., 2019; National Research Council, 1984). The expansive nature of digital platforms similarly provides important opportunities for children to learn and develop a sense of self. However, it is important to note that in the current digital ecosystem, there is not much differentiation in quantity or subject matter of content by developmental stage (partly through the ease with which youth bypass age gates). As such, the affordances of digital spaces intersect with middle childhood cognitive development in promising and risky ways.

***Cognitive Growth and Knowledge.*** Children described YouTube as a popular place to learn about a wide variety of topics and relevant interests. Marisol (8 yr old) explained why she liked YouTube, saying *"I think there's like cool videos. And there's like life hacks. And like how to play a game or something. They can give you tutorials and stuff too. And you can search it up."* Similarly, Riley (11 yr old) talked about how much she has learned on YouTube and particularly how she uses that learning to do in-person activities with her mother, though this was not tied to having her own smartphone, just YouTube access.

> Personally, I've learned a lot on YouTube…Like me and mom, we got this new lawnmower. And it taught us how to make it and like use it. And how you should use it and what mode you should have it on…And I've learned a lot of like cool riddles too, like jokes…I've learned a lot of recipes, tons of recipes…We searched up how to make a bunny coconut cake. And then we did it and it looks so cute.

***Needs for Sense of Self.*** Children were able to access *unlimited content* about a wide range of topics, which helped with the identity work involved in developing, extending, and

refining their sense of self. Access to information about their own interests and to larger communities and affinity groups were described as a significant opportunity. Both Liam (8 yr old) and Ruby (8 yr old) used YouTube specifically to watch videos related to sports they play, including hockey videos and baseball videos. Ruby shared *"I love to watch baseball [videos] because I have tryouts for baseball on Sunday."* Liam (8 yr old) expressed a common practice of crowdsourcing information online for children to pursue a hobby or make progress towards a goal. He liked *"talking to people in Roblox because if I need to know something, in some games I am like, 'How do you do this?' And there are like 100 people in Roblox or there's just 10 of them answer and I'm just like which one to choose?"*

Platforms popular with children offered a vast array of content, often in short form video formats such as TikTok or YouTube Shorts, that continuously populated in a user's feed (e.g., infinite scroll). Lucia shared *"when we get free time then I'll watch YouTube shorts".* In our discussions, children often found YouTube shorts and TikTok to be interchangeable with the exception that YouTube Shorts will not pause after 100 videos.

***Short Form, Unlimited Content Risk: Self-Management.*** Children struggled with the *unlimited content*, especially when it was presented in shorter video clips (e.g., short form video). In talking about TikTok, Andrés made it seem like the short duration of TikTok clips specifically made disengaging difficult. He explained that TikTok will feature "*like a movie and it's just a little part. And it could be a really bad movie, but you still watch the video."* Caleb (11 yr old) talked about the pull of TikTok, even after he deleted it once, saying

My sister started watching [TikTok] when it came out. I downloaded it and was like 'ack' then I deleted it. I kept watching YouTube but my sister downloaded it again and I kept watching it and then I got addicted to it.

***Unlimited Content Risk: Exposure to Mature Content***. The large amounts of information available online, coupled with algorithmic recommendation systems, sometimes created situations where children were surprised or disturbed by content they saw online. In particular, children consistently reported overtly sexual and sometimes graphic content that was pushed to them or embedded in child-directed games. Most children in middle childhood have not yet gone through or are only starting puberty and do not experience the same sexual cognitions and interests typical of puberty and adolescence (Tolman & McClellan, 2011). Thus, children encountered content that they may not have normally sought out.

Children encountered mature, sexualized content across streaming apps, gaming sites, and social media, accessed through tablets or smartphones. Exposure to mature, sexualized, or extreme content happened in the context of popular social media platforms as well as child-directed websites. Several children reported seeing content they vaguely referred to as "inappropriate," indicating awareness of what might be appropriate for them or normative for children their own age. In one of the 9-year-old mixed gender focus groups, children discussed sexual material they saw online, in this case on YouTube.

Andrea: There's like a… there's like some like they do um weird stuff [on YouTube]

Gabriel: Inappropriate stuff.

Andrea: Yeah, inappropriate stuff. Like they do the thing for having a child.

Rosa: Si Si Si, no no no.

Andrea: The si si si si no no no no like that. But different for how to have a child. Like they do that. And there's some anime. And then there's some anime like—

Gabriel: Yeah, like anime that girls–

Rosa: Like inappropriate stuff.

Andrea: Yeah, like anime that people just like, there's girls that take off their bras and their t-shirts. Yeah, like that.

Gabriel: It's like on the, like, picture that it shows the video. It's like oh it's good, but when we see it, when we see it it's like oh this is inappropriate.

Facilitator: So, let me make sure I understand this—the thumbnail image for the video is something you think you would like but then when you click on it, it's something different?

Gabriel: Yeah

Rosa: Yeah

Andrea: When they click it, it is the thing, or sometimes it's just another thing.

Gaming sites were not free of mature content either. Within this same group, another child said they encountered sexualized content on a popular site called Cool Math

Games. Bryan (9 yr old) shared, *"this one game where you do the math, and every math equation you get right you jump once, but it's a woman. You start with a woman and she moans every time you jump."* In another group, Riley (11 yr old) felt that younger users were particularly vulnerable to seeing mature content and being negatively affected by it, saying that *"there's some inappropriate games on [Roblox] and there's creepy games that a lot of people who are too young, who had like just gotten Roblox, they click on those not knowing what it is, and they click on it. And they get really scared. And like traumatized."*

Children used TikTok frequently, and they encountered mature content through the app, reporting lots as "inappropriate content". Sometimes, mature content was disguised as an attempt to tag the child in a video or make a social connection, which can motivate children to click into or engage with a message due to their needs for social interactions and expanding social networks in middle childhood. Luis and Andres (11 yr olds) discussed this:

> Luis: It is also like kind of weird, like kids to have younger, to have TikTok under the age of like 10. Because like there's like weird messages like--
>
> Andrés : Oh yeah, especially when it's like someone has sent you 5 pictures.
>
> Luis: Of girls. Yeah.
>
> Andrés: Yeah. And it's like weird.
>
> Luis: And they recommend you in certain videos and they say 'come watch me dance'.

Andrés: Yeah, it's like stuff like that.

Most of the time, sexualized content was mentioned by boys in the focus groups. It was unclear whether boys saw more of this content or boys simply discussed it more often than girls in the groups. Though sexualized content in media is linked with adolescent sexual identity (reference global or LGBTQ+ literature), for these younger children it was viewed as not wanted and not appropriate.

Violent content also came up as a concern, with Lucia (8 yr old) sharing that she had seen people beaten up on YouTube and in one particularly disturbing incident she said, *"once I saw a video that a person said 'It's time for a ranch and they killed six persons".* After talking a bit more, it was clear Lucia felt the footage was an actual event and that she had seen three police officers and three children murdered on YouTube. She talked to her older brother about it afterwards, so she was not left to process this totally by herself, but it does raise questions about what children do when they see this kind of content. Lucia was not the only one who saw violent content, Bruno (8 yr old) also talked about the "bloody" and violent videos on YouTube.

| Table 5. Developmental Affordances of Smartphone and Associated Digital Spaces in Middle Childhood | | | | |
|---|---|---|---|---|
| **Smartphone** | | | | |
| | Features of the Smartphone | Affordances of Environment (what it enables them to do) | Developmental Considerations for Middle Childhood | Affordances X Development Interactions (opportunities & risks) |
| Functional | Searchable<br>Multifunctional<br>Connected to internet<br>Immediate<br>Immersive<br>Customizable | Easily add contacts<br><br>Easily find information<br><br>Access internet<br><br>Customize device<br><br>Access unlimited apps<br><br>Easily download/install apps | Need to expand social network and peer relationships<br><br>Need to develop sense of self and how fit in with peers<br><br>Inhibitory control lower than older children and adults<br><br>Still developing self-regulation and attention | • Meets needs for independence and social connection by easily adding contacts without parent oversight/approval<br>• Facilitates identity development and social group affiliation through customization (wallpaper, choice of apps)<br>• Children easily lose track of time spent on platforms that serve up content automatically, algorithmically curated to be interesting to them |
| Physical | Mobile<br>Connected to Internet<br>Physically smaller than tablet or laptop<br>Physically larger than smartwatch | Take device anywhere<br><br>Manipulate device and platforms easily (compared to smartwatch) | Still need adult supervision<br><br>Increasing Autonomy | • Freedom to go places and do things without adult or sibling<br>• Facilitates physical safety through family/child communication for emergencies, for pick-ups, for logistics<br>• Children exhibit increased independence and autonomy by downloading apps without permission, even if apps are restricted by parents<br>• Child can feel sense of privacy when device can be used and customized outside of parental purview |

| | | | | |
|---|---|---|---|---|
| | | | | • Use device to get rid of feelings of boredom, can be at home, in transit, out in community |
| **Digital Spaces** | | | | |
| | Features of the Digital Environment | Affordances of Environment (what it enables them to do) | Developmental Considerations for Middle Childhood | Affordances X Development Interactions (opportunities & risks) |
| Social & Emotional | Private messaging (e.g., chat features embedded in games, standalone apps)<br>Multiplayer<br>Networked<br>24/7 access to peers<br>Anonymity<br>Quantifiable emotions (e.g., likes, comments, hearts)<br>Absence of social-emotional cues (facial expression, vocal tones) | Communicate with friends, family, others<br><br>Play with friends, family, unknown others<br><br>Access communication and games at all times of day<br><br>Extend and deepen knowledge within community with same interests | Developing self-concept<br><br>Developing ideas of social norms, social responsibility<br><br>Need for positive peer interactions<br><br>Increasingly better at understanding causes and consequence of emotions, based on in person cues<br><br>Looks to peers to know how and when to act | • Children text, chat, and play with both known and unknown others online<br>• Children expand their online and offline networks through digital interactions<br>• Younger children may not understand that a person can misrepresent themselves online as a same age peer or celebrity<br>• Children share personal information such as name and address with unknown others for immediate, short term gain, without considering abstract risks<br>• Younger kids susceptible to developing "toxic behavior" by learning from misbehavior of others online, developing social norms by looking to peers (online and offline) and possible to develop amoral norms<br>• Child may experience peer conflict in a digital space without social-emotional cues, at a time when they are still developing their ability to understand and anticipate emotions |

| | Features of the Digital Environment | Affordances of Environment (what it enables them to do) | Developmental Considerations for Middle Childhood | Affordances X Development Interactions (opportunities & risks) |
|---|---|---|---|---|
| Commercial | For-profit platforms<br>In app purchases<br>Autofill payment information<br>Algorithmically curated | Personalized content<br><br>Curated content, engagement as goal<br><br>Purchase apps, games, products | Low inhibitory control compared to older children/adolescents<br><br>Still developing ability to think about abstract concepts<br><br>Needs approx. 9-12 hours of sleep per night | • Children can easily buy things within apps or platforms, with or without parental consent, may make in-the-moment decisions<br>• Children may be susceptible to scamming and phishing online (e.g., sharing parent credit card information to "win" a computer)<br>• Pull of engagement-driven content partnered with lower self regulation make it difficult to disengage from platform or device, may disrupt or delay sleep |
| Cognitive | Unlimited content<br><br>Unlimited access (no ratings/differentiation; age gates)<br><br>Unlimited network building --blend of known and unknown others<br><br>Creation tools for multimedia content | Stream endless content<br><br>Infinite scroll in feeds<br><br>Access information and resources about wide range of topics, wide range of audiences<br><br>Access known and unknown others at global scale<br><br>Can create digital products and projects | Developing self-concept<br><br>Thinking and reasoning limited to topic they are familiar with, more concrete<br><br>Increased self-evaluation<br>Increasing ability to think flexibly<br><br>Developing self-concept | • Uses platforms to search for interest-driven content and information to accomplish a goal<br>• May access sexually explicit content that makes them feel uncomfortable or confused<br>• May access content with antisocial themes or content that endorses gender or racial stereotypes at a time when they are developing own ideas about these concepts<br>• Child can compare self to others across a large range of influencers, friends, friends of friends, and unknown others<br>• Child can create and share their own original content with diverse audiences |

| | | | | |
|---|---|---|---|---|
| | | Can upload creations without friction | Developing ideas of social norms, social responsibility | |

## Discussion

Middle childhood is an often overlooked developmental stage in media and technology research (Odgers & Jensen, 2020; Radesky et al., 2023; Stoilova et al., 2021). Yet, there is evidence that children between the ages of 8 and 11 are acquiring their first smartphone and using social media platforms for the first time in this period, if not before. Our study of transitions to smartphone ownership in middle childhood found evidence that getting a smartphone is a modern rite of passage and one that is taking place firmly in childhood. Similar to other developmental transition points, parents and children have to renegotiate certain roles, decision making, and freedoms when a child gets their own smartphone. Thus, viewing new smartphone ownership as a rite of passage may help to explain some of the conflict common between parents and children when it comes to smartphones (Anderson et al., 2024). Our data suggest that children move through graduated levels of device ownership and associated freedoms, starting with a limited function device and/or shared device and eventually moving to smartphone ownership. As a modern developmental transition point, migrating to smartphone ownership requires children to adapt to novel environments and a distinct set of experiences, daily activities, and lifestyle shifts (Selkie, 2019; Yan, 2018) that affect developmental processes. Though smartphone ownership was viewed as an important marker of older age and responsibility, much of the activities and interactions accompanying the phone were not new and few were linked exclusively to smartphones specifically.

Among our sample of socioeconomically diverse and predominantly Latine children, over half owned their own smartphone and almost all owned their own tablet capable of

common smartphone activities (e.g., texting, streaming, social media, gaming) according to children. However, tablets were seen as undesirable when children believed that the majority of their peers had their own smartphones and that not having their own smartphone would be a source of embarrassment or a signal that they do not belong. This echoes findings from Vaterlaus and Tarabochia (2020), who asked young adults (ages 18 - 19) to reflect on their motivations for smartphone acquisition as a teenager. Among the sample, young adults got their first basic phone at 13 years and their first smartphone at 15.5 years, on average. Social acceptance and the desire to fit in were major drivers for this decision (Vaterlaus & Tarabochia, 2020). Children in our sample got their phones at 9 years of age, on average, and the majority expressed that this was too early. When asked what was a good age for having a phone, many children often reported sometime in adolescence, rather than childhood, citing concerns about early access to inappropriate content, the potential for kids to become "toxic" by what they learn through smartphone access, and their evolving capacities to be responsible (both physically and metaphorically) for what happens with a smartphone.

Transitioning to smartphone ownership in childhood was more of a gradual process than a discrete turning point for most children. By using a tablet first, children gained experience navigating the actual hardware and software of digital devices and most reported using tablets to engage in activities common to older teens such as streaming media, connecting with friends, and playing games. This allowed them to fulfill developmental needs for social connection, play, and learning through the various affordances of digital spaces prior to smartphone ownership. Many children reported sharing a smartphone (either officially or informally) with a parent or sibling, granting

them opportunities to use the smartphone and navigate issues under the supervision of a more knowledgeable other before owning their own device. This is consistent with other research suggesting that younger children experience more scaffolded media experiences compared to older children and teens (Odgers & Robb, 2020).

Transitional time with tablets or shared devices was seen as important to children, with cascading effects on media use as they got older. Andrés (11 yr old) described how what a child does on an iPad in childhood matters for later phone habits, explaining,

> *So if you don't have the control—because if you use the iPad every time you get the chance—you're gonna be using the phone every time you get the chance. And since you have the phone all the time…*

Children in our study used digital devices in several overlapping ways, but saw transitioning to a personal smartphone as a significant change. Owning a smartphone required responsibility, maturity, a sense of what is inappropriate and what is not, and came with an elevated sense of freedom. Children shared that a smartphone was different from a tablet in several ways, even though a tablet could do many of the same things and grant access to the same platforms. Smartphones had several key functional and physical affordances according to children. Smartphones were more personal, more mobile, more independent, and offered access to more contacts than ever before. Being outside of parental control and oversight was key to this shift, with several children reporting that getting a smartphone meant that they were free of parental monitoring and able to engage in whatever communications or content they wanted, even if they believed their parents would disapprove. It is then possible that risks associated with smartphone use may be driven in part by reduced parental monitoring, echoing previous research with fifth grade

children in Taiwan, where less parental restrictions were associated with more child-perceived smartphone addiction (Chang et al., 2019).

In our findings, we saw children beginning to adapt to novel digital spaces through time spent on tablets or limited function devices, where they gained experience navigating both opportunity and risk online. For those who had transitioned to smartphone ownership, children talked about how the mobility and connectivity of the phone facilitated connection with family and friends, more autonomous behavior, and greater privacy. We also heard about features of popular digital platforms that opened up children to more social connections, play, and opportunities to learn across devices (e.g., tablets, laptops, phones). But these were somewhat overshadowed by the significant risks inherent in current digital ecosystems. Children used smartphones in mature, playful, creative ways, but they also felt an eroding sense of agency over their own time and experiences because of the pull and design of smartphones and social media (e.g., infinite scroll; 5Rights Foundation, 2021; American Psychological Association, 2024). They shared stories of compromised privacy (sharing home address) and exposure to upsetting and inappropriate content.

Part of what makes the question of when to get a smartphone so compelling is that it involves anxieties about growing up and the tensions and difficulties that come with it. From our talks with children, it is not the smartphone itself that created risk (beyond time loss), but rather a combination of unique affordances that connect with development in middle childhood, coupled with the for-profit digital ecosystems. Risks are elevated through increases in children's unsupervised time spent online that included connections with unknown and anonymous others. Children felt that having their own smartphone

meant they could do anything on it–talk to anyone, watch anything, go anywhere on the open Internet–and they reported that having their own smartphone meant being beyond their caregivers' oversight online. This contrasted with the limited function devices or tablets that children used before smartphones. Importantly, children reported similar risks across devices such as talking with strangers, sharing personal information, experiencing cyberbullying or harassment, loss of digital privacy and corporate surveillance, and exposure to mature and sexualized content.

Such findings have several implications for promoting positive developmental outcomes for children growing up in a digital age.

1. Regulations are necessary to ensure children reap benefits of digital spaces and avoid risks

Children connect with friends and family, make new friends, play digital games, conduct online research, and even co-create with family members online. These activities have important developmental affordances and should be available to children. However, in the current technology landscape, spending time online also comes with unavoidable risks that can be driven by embedded features of platforms. In the absence of any safety standards for technology platforms, the design of digital spaces can introduce unnecessary risks in childhood whether a child is using a tablet or a smartphone. There are currently no significant protections for children online, despite various attempts, and we see some of the on-the-ground realities of this in the stories of children exposed to graphic, violent, and

sexualized content, online harassment, as well as major risks to personal privacy (e.g., child sharing physical address, open network settings, connecting with strangers).

2. Differentiated online environments (and devices) should be used to promote positive developmental outcomes for children

One implication from this work is that children need baseline safety features built into technology platforms and mandatory and accessible safety features that can be installed over applications, much like car seats and booster seat attachments can be added to a space designed for adults (i.e. the car) to be child friendly. In fact, rather than a one-size-fits all approach to child safety, there are several different transitional stages of child safety devices between infant seat and adult seat belt (rear facing car seat, forward facing car seat, booster seat, seat belt), and these allow for individual trajectories in child growth. Similar to car seat regulation, digital devices and spaces could be conceptualized as a gradual set of supports and restraints that match individual developmental needs, capacities, and contexts. Digital features should be differentiated to accommodate not just differences in age, but also differences in developmental capacities and contexts for use. And just like car seat and seat belt uptake, these safety features will likely be underutilized until there is enforced regulation that requires their use and a set of undesirable fines for individuals and corporations who do not utilize safety features such as privacy by design (Australian eSafety Commissioner, 2019; Livingstone et al., 2017).

3. Caregivers should understand that parental monitoring and mentorship can continue with a smartphone and that there are several options for scaffolded use

Most children we spoke with used transitional devices and shared devices before using their own smartphone, and these transitional devices provided less constant and broad access to connected digital spaces, partly by functionality and partly by parent driven restrictions. According to children, when they got their own phone, adult oversight and limits tended to disappear. It seems that to both adults and children, a smartphone symbolizes a kind of freedom to access the unfiltered internet, social media, and all the contacts and content that comes with it. It is worth considering whether this kind of access aligns with the best interests of the child given the lack of regulation and child safety protections, especially when we are thinking of younger children and their developmental capacities. In the physical world, we do not have as much pushback on the idea of scaffolding children's experiences for safety. We have playground regulation, car seat laws, laws about leaving children unattended in public spaces–but when it comes to online life, there can be hesitation and reluctance to employ similar strategies.

4. Children should be given tools for regulating smartphone use given their developing capacities for self-regulation and the compelling nature of short-form video content (e.g., TikTok, YouTube shorts)

Questions about how smartphone use impacts young people and when is the best time for a young person to get a smartphone are not always about the device so much as the access they offer (both in content and availability) facilitated through platform features (e.g. unlimited content, unfiltered content, direct messaging, anonymity). Children's capacity to regulate their own use is still developing in middle childhood, and when they are spending time in spaces that are designed to keep them online, they need actionable, explicit strategies to help them continue accessing information and building peer relationships but retain a sense of control over their time and attention.

## Limitations

Our analysis of developmental affordances was based on both smartphone ownership and the access it affords, rather than an in-depth analysis of common platform features such as short-form video content or embedded private messaging in gaming platforms. Thus, our analysis was limited in detail and depth. Future work could analyze platform or smartphone affordances more explicitly by leveraging a variety of methodologies to capture child experiences and cognitions. Our study involved 34 children in Southern California, with the majority identifying as Latine. While the sample includes economic diversity, these data cannot speak meaningfully about ethnic, racial, or class differences or how culture may contribute to this digital rite of passage. Future studies should expand on this work by exploring transitions to smartphone ownership among different children across demographic characteristics.

## Conclusion

Smartphone ownership appears to be an important transition in middle childhood, according to children. Though often linked to existing activities and connections, smartphone ownership still represented greater responsibility, autonomy, and access than previous device uses. Instead of unilateral support for or against smartphone ownership and digital media use in childhood, our findings show that children experience meaningful opportunities as well as potentially harmful risks through the affordances and features of smartphones and digital platforms. Many of the risks arise from the commercial and decontextualized features of digital environments, which could be redesigned or better regulated to consider the presence and developmental needs of children online.

## Study 2

# Children's Sensemaking of Algorithms and Data Flows Across YouTube and Social Media

## Introduction

Most US children engage with screen media daily (Rideout *et al*., 2022), with youth consistently reporting learning new things and finding information online (James *et al*., 2021; Stoilova *et al.,* 2021). Digital technologies have numerous affordances for learning (National Academies of Sciences, Engineering, and Medicine, 2018), but the profit-driven nature of popular technologies among youth such as YouTube and social media platforms creates strong incentives for keeping users online, regardless of learning or wellbeing (Reich *et al.,* forthcoming). While access to information is valuable, technologies that sort, curate, and push information to young users are not neutral. Many platforms popular with youth utilize for-profit business models, relying on advertising revenue, engagement metrics, and the sale of user data. These kinds of platforms routinely violate children's digital privacy rights and expose them to harmful content or misinformation in service of profits (Smith & Shade, 2018; National Academics of Sciences, Engineering, and Medicine, 2023). These technologies need users' data (e.g., prior search history, interests, and contact profiles from other applications) in order to classify, curate, and sort information using algorithms. Thus, algorithms and the data collected to power them can heavily shape everyday access to information, people, and content for young users in both beneficial and exploitative ways, but few studies have explored how younger children generally make

sense of the algorithms driving their online content or how they think about the flow of their personal data in the context of their own social feeds.

**Algorithmic Literacy as Everyday Knowledge of Algorithms**

Scholars and educators have begun using terms such as 'AI literacy' or 'algorithmic literacy' to talk about the skills and understandings needed for youth to learn and participate in a world where much of their daily interactions are driven by algorithms and artificial intelligence, often in subtle and invisible ways (Long and Magerko, 2020; Ng *et al.,* 2021; Ridley and Pawlick-Potts, 2021). Though these terms are relatively new, they overlap with concepts already used across disciplines such as 'digital literacy', 'media literacy', 'data literacy', 'digital citizenship', 'information literacy', and 'computational literacy'. An exploration and analysis of the overlap of these terms is beyond the scope of this paper, but we use the term 'literacy' to refer to a domain specific set of skills or understandings necessary for meaning making in a digital context. To date, the various 'literacy' terms do not sufficiently attend to the ways algorithms drive much of what people see, whether they are actively searching, scrolling through a feed, or clicking through to the next video on a platform such as YouTube.

Drawing from Ridley and Pawlick-Potts (2021), we use 'algorithmic literacy' to refer to the ability to notice algorithms in daily interactions (awareness), understand how these technologies generally work (decoding), use algorithms for personal goals (fluency), know the benefits and risks associated with algorithmic systems (comprehension), and understand personal rights and responsibilities in algorithmic decision making (comprehension). Algorithmic literacy is a subset of digital literacy. Though traditional

notions of digital literacy tend to focus on just skills needed to use digital devices or online safety (Selwyn, 2022), the increasingly powerful role of algorithms in daily life necessitates 'algorithmic literacy'—what algorithms are, how they work, how to spot them in our everyday digital interactions, strategies to use them for own goals, and how to have control *over*, rather than be controlled *by,* them. We also see overlap with 'data literacy' due to the data collection technologies that power many of the algorithms that users interact with most.

### YouTube and Social Media for Under 13-year-olds

Youth are using digital technologies at increasing rates, at earlier ages, and in more diverse ways than ever before (Auxier *et al*., 2020; Rideout and Robb, 2019). These shifts are partially driven by the rise in mobile technologies (e.g. smartphones, tablets) and youth's entry into social media spaces. Children under 13 spend, on average, almost 5 hours a day with screen media, excluding digital work for school (Rideout and Robb, 2019), with much of this on YouTube and TikTok (Radesky *et al.,* 2023).

Browsing social media through search and recommendation features are increasingly common ways for youth to discover and interact with content. Surveys with youth highlight the role of TikTok's "For You" page and YouTube's recommended videos in determining what content they consume (Bulger *et al.,* 2021; Ofcom, 2019). Platforms, such as YouTube and TikTok, gather information about users and use engagement-based algorithms with the goal of keeping youth on these sites longer (5Rights Foundation, 2023; Wall Street Journal, 2021). These data collection processes pose particular privacy risks to children under 13 years. In the U.S., the Children's Online Privacy Protection Act (COPPA) limits online data

collection from children under 13, but this is often strategically ignored by large technology companies (Lenhart and Owens, 2021). Instead, platforms use ineffective age gates (e.g., entering a birthdate that makes the user at least 13 years old) that children regularly and easily bypass, placing the burden on caregivers and children to understand and manage complex data collection practices (boyd et al., 2011; Lenhart and Owens, 2021).

**Children's Understanding of Data Collections Across Platforms**

Children may not fully understand the data collection processes companies use or how such data collection shapes their online experiences. Research suggests that youth are more aware of digital privacy risks between people (e.g. sharing passwords, keeping accounts private) than privacy risks associated with online data tracking, profiling, and data exploitation for profit (Gelman *et al.,* 2018; Santer *et al*., 2023; Stoilova *et al.*, 2019). Recent research with children and teens suggests that younger users are aware companies collect data about them, but do not understand the full scope of just how much data are collected, who has access to their data, their own digital privacy rights, and how companies profit from youth's online activities (Perez Vallejos *et al.,* 2017; Stoilova *et al*., 2021; Wang *et al.*, 2022, 2023). Studies do not often consider what children understand about how their data are tracked and used across digital spaces or how data flows and privacy practices may influence their behavior online (Stoilova *et al.,* 2021).

Because children under 13 are still developing their ability to think critically, reason abstractly, and regulate behaviors, there may be unique challenges to managing digital privacy for this age group. Gelman and colleagues' (2021, 2018) experimental studies found that children under 13 were more accepting of digital tracking behavior and photo sharing with unknown others compared to teens and young adults. Researchers hypothesized that

the abstract nature of digital information and digital privacy as concepts may be barriers to younger children's understanding of digital information ownership and potentially harmful consequences of digital tracking (Gelman *et al.,* 2018, Gelman *et al.,* 2021).

**Children's Understandings of Algorithms Across Platforms**

Research in the past decade has documented adults' awareness of algorithms in their everyday digital platforms and explanations for how these algorithms work (Bucher, 2017; Eslami *et al.,* 2015, 2016; Gran *et al*., 2020), with some studies showing more than half of adults are not even aware of algorithms in their social media interactions (Eslami *et al.,* 2015). In contrast to conversations about AI literacy or algorithmic literacy among students, human-computer interaction literature uses "algorithmic folk theories" to describe the ways non-expert adults explain algorithms and their ability to select, curate, and present information (Eslami *et al.,* 2016). These everyday interpretations often emphasize personal control over algorithms, either through decisions when using platforms (e.g. Personal Engagement Theory) or use of specific settings (e.g. Control Panel Theory), with adults expressing confusion and uncertainty about the platform level decisions over what they see and who they interact with. Little research to date has explored younger users' explanations of how algorithms work in preferred platforms (e.g., YouTube, social media) and their possible concerns related to algorithms, despite the significant role algorithms play in daily digital interactions.

To date, studies of algorithmic knowledge (e.g. folk theories, algorithmic literacy) tend to focus on adults and older teens, with little attention to unique understandings of children, especially those under 13. Interviews and social media walk throughs with Dutch

youth (16-22 years) found significant variation in their awareness of algorithms, and how they made sense of curation algorithms depended on the platform, feature, and type of content. Thus, youth who understood algorithms in one specific context did not necessarily transfer that to another. When asked about what they could do to control their feeds, interviewees could name several simple strategies (e.g., not clicking on posts, using mute functions or Virtual Private Network; Swart, 2021). However, few used any of these strategies because they viewed their own agency as limited and requiring too much additional effort (Swart, 2021). Even when older youth were aware of algorithms, other studies found that they do not understand the massive scale of data sharing that happens with third parties, how their data are used, or how data pulled across platforms could shape their social feeds and search results (Perez Vallejos *et al*., 2017). Thus, it may not be surprising that older youth report major concerns about their digital privacy, sense of agency and control, and the invisibility of AI in their everyday life, as well as feelings of powerlessness when dealing with large technology companies (Perez Vallejos *et al*., 2021).

Emerging evidence suggests that younger children are less aware than older youth of how online recommendations work and the presence of algorithmic bias, highlighting a need for more support in noticing and evaluating algorithmically curated content (Solyst *et al*., 2023; Zhao *et al.,* 2019). Even older youth struggle to understand how algorithms shape the content they see (Perez Vallejos *et al.,* 2017) or how search engine results are curated and contain bias (Tynes *et al*, 2021). Therefore, it is worthwhile to document how younger children think about algorithms and data collection practices given that (1) algorithms shape youth's basic access to information and search inquiries, (2) youth under 13 spend significant amounts of time on these platforms, and (3) children under 13 are legally

entitled to certain digital privacy protections in the U.S., but these protections are weak and regularly violated (Mascheroni and Holloway, 2019) putting children in this age range in particularly vulnerable positions.

The current study explores children's (ages 8-11) understandings of algorithms and data collection practices across their preferred social media and streaming platforms and identified the strategies children use to exert more control over their algorithmically curated experience.

Research questions include:

3) What do children understand about data flows and algorithms in social media and YouTube feeds?
4) Which strategies do children use to control the flow of their personal data and/or their algorithmically curated experiences online?

## Method

Focus groups were conducted with socioeconomically, racially, and ethnically diverse children (n=34) with survey data from the youth and their caregiver(s). Each group consisted of 3-6 children, with one group of 2 due to an unexpected absence. All procedures and materials were approved by a University Institutional Review Board. Focus groups were conducted between January 2023 and July 2023 at four different afterschool programs and summer camps in California. Prior studies show that focus groups are especially helpful for discussing digital behavior with youth (Bryant and Marmo, 2012:

Manago *et al.,* 2008) and surveys were used to gather baseline information about media use and demographic characteristics.

**Participants**

Nine focus groups were conducted with children (n=34) between 8 and 11 years old (M = 9 yrs). The majority identified as Latine (67%), followed by white (30%) and multiethnic (3%). Over half identified as female (62%), 93% were born in the United States, and both Spanish and English were the primary languages for 60%. Most participants (n=20) came from households that qualified as 'low income' or 'very low income' based on caregiver data, though a portion (n=8) reported household incomes of more than $100,000. The median education attainment for caregivers was 'some college', with 12 caregivers reporting a high school education/GED or less.

**Procedure/Data Collection**

Participants were recruited in-person at their afterschool program or summer camp. We purposefully reached out to afterschool programs serving socioeconomically, racially, and ethnically diverse children in Southern California. After being granted permission to recruit, the first author visited each site to talk with students about the study and hand out consent forms and background surveys for caregivers to complete. Forms were in English and Spanish and included a link for an online video explanation of the IRB forms and research procedure. Participants were assigned to focus groups based on age, gender, and smartphone ownership status. Four focus group included mixed gender participants,

though these skewed female, and five groups included children with the same gender identity.

The first author facilitated all nine focus groups, after running a pilot focus group with the second author. The focus groups, lasting 45-60 minutes, were conducted in a classroom during regular operating hours at the afterschool program or summer camp. A semi-structured protocol was used (described below) to guide conversation, along with prompts and follow-up questions to probe thinking further. A screenshot of the sign-up screen for the popular gaming platform Roblox was used to facilitate conversations about age gates and digital privacy when signing up for platforms. In some instances, think aloud strategies from user experience (UX) research methods were used to walk through a child's behavior or thought process on a device. Participating children received a gift card and researchers often hosted student and/or parent digital literacy workshops with partner sites after data collection was complete.

## Measures

### *Background Information*

Children and caregivers completed surveys about their demographic characteristics, technology use, parental monitoring, and knowledge of critical digital literacies (e.g. algorithms, privacy policies). Surveys took less than 10 minutes. Children completed the survey during the focus group, after introductions and assent procedures. The surveys were drafted at a second-grade reading level and were read out-loud for younger participants.

### *Focus Group Protocol*

The semi-structured protocol focused on how children began using mobile devices and social media, parent and school rules/guidance about technology use, and children's understanding of critical literacies related to algorithms, content feeds, user privacy, and data flows. Given the complexity of some more critical concepts in the protocol (engagement-based algorithms, data flows), questions were piloted with a small sample of children prior to data collection and then revised. Rather than asking directly about the term "algorithm" in content feeds and recommendation systems, researchers used language such as "How do you think YouTube knows what to play next?" or "Why do you think you see these videos in your YouTube Shorts feed?"

### *Data analysis*

Focus groups were audio-recorded and transcribed verbatim. After each group, reflective memos were drafted to document emerging questions, connections, and issues for continued data collection and analysis. Initial data analysis began while data collection was still underway, and the first author began drafting an initial codebook after the first five focus groups. The two authors worked together to analyze transcripts and revise the codebook in an iterative process. Emerging findings were triangulated with child and parent survey data as well as reflective and thematic memos.

First cycle coding methods (Saldaña, 2016) were used to describe children's knowledge, perspectives, and strategies for managing data flows and algorithmic

experiences. In vivo and descriptive codes were used to describe youth knowledge of various critical competencies online (e.g. algorithms, user privacy). Codebook development was iterative, occurring alongside data collection. As data analysis progressed, the authors used peer debriefing to revise and finalize the codebook. To develop themes, we used the second cycle coding methods, pattern coding, and focused coding to categorize patterns of children's knowledge, thinking, and behaviors. The thematic analysis considered feelings of control have over online experiences as well as strategies children shared. After data collection and codebook revision, another doctoral student trained in qualitative methods coded a subsection of the focus groups using the codebook to speak to the consistency and dependability of the analysis.

## Findings

Overall, discussions with children highlighted four main patterns, that children: (1) access YouTube and social media platforms often, everywhere, and at an early age, (2) do not fully understand the privacy policies and related data collection consent procedures in their preferred platforms despite their expressed preference for more privacy online, (3) make sense of recommendation and curation algorithms in a variety of ways, with younger children having more misconceptions, and (4) use several strategies to ostensibly control the flow of their data and curate their algorithmic experience, however these largely appear to be ineffective or inaccurate.

### 8-11-Year-Olds' Access to YouTube and Social Media

Children reported regularly using YouTube starting between 1.5-7 years, with most being 5 years old. Participants reported accessing YouTube when bored, waiting for a parent to finish a task inside (e.g., cooking) or outside the home (e.g., haircut), in transit (e.g. car, bus), and for general entertainment purposes. YouTube was constantly available to children through a parent's device, their own tablet or smartphone, a shared device, a gaming device (e.g., Nintendo), the television, or school-issued laptop. Of all the apps and sites children accessed, YouTube was talked about most consistently and most positively, though many children still expressed concerns about content they encountered there.

Children accessed social media accounts in various ways including their parent's, sibling's, or own device. Despite platforms like TikTok, Snapchat, and Instagram requiring children to be 13 to use—almost all children had used or were regular users of social media platforms. Not surprisingly, 10-11-year-olds were using social media more often than 8-9-year-olds, who preferred gaming platforms such as Roblox and Fortnite. Younger children talked about accessing social media through their parents' accounts, with Juan (8 years) sharing "My mom always puts on Instagram. And I always look at hers." Eleven-year-olds tended to have their own accounts.

TikTok was often discussed in conjunction with YouTube shorts, which children described as being "like TikTok but just in YouTube" (Lucia 8 years). For many children, YouTube shorts was their way of viewing TikTok content when not allowed to use TikTok or as a way to bypass limits on content. For example, Lucia (8 years) described how she "erased TikTok because it didn't let me scroll and when I already did like 100 videos, it stopped. And YouTube Shorts…I said 'ohhhh there's infinity!'"

Children described their TikTok and YouTube Shorts experiences as "watching" and consuming content. Children also noted the significant overlap between TikTok and YouTube Shorts and how the same videos flowed freely between them, with creators easily uploading across the platforms.

## RQ1: Children's Understandings of Data Flows and Algorithms

### *Awareness of Data Consent Process*

Information about what data are collected and shared is typically available on platforms' sign-up pages. Because COPPA restricts data collection for children under 13, platforms ask users to enter a birthdate (i.e., age-gate) when signing up. Children in this study were unaware that they had agreed to platforms' privacy policies and data collection practices when they signed up and entered a false birthdate. Such oversight is perhaps unsurprising when privacy policies on popular platforms are easy to miss, often in smaller print at the bottom of the page of the sign-up process (See Figure 2).

During the focus groups, a print-out of the sign-up form and privacy policy agreement from the popular gaming platform Roblox was used to help children walk through the different parts of the data consent process. Children identified these pages as "a sign-up thing" or "a place to create your account" with no mention of the privacy policy on the same page. When asked if they ever clicked on the privacy policy, all participants reported that they had never viewed the privacy policy. Two participants (9 years), in separate focus groups, reported they knew what a privacy policy was, with one saying "It's when you gotta click on it so the game can start" and another saying "Privacy policy means that you have your privacy." When asked if they read a policy, participants responded "no"

and when asked to explain why, Samantha (10 years) said “Because I know already. I don’t need to know.”

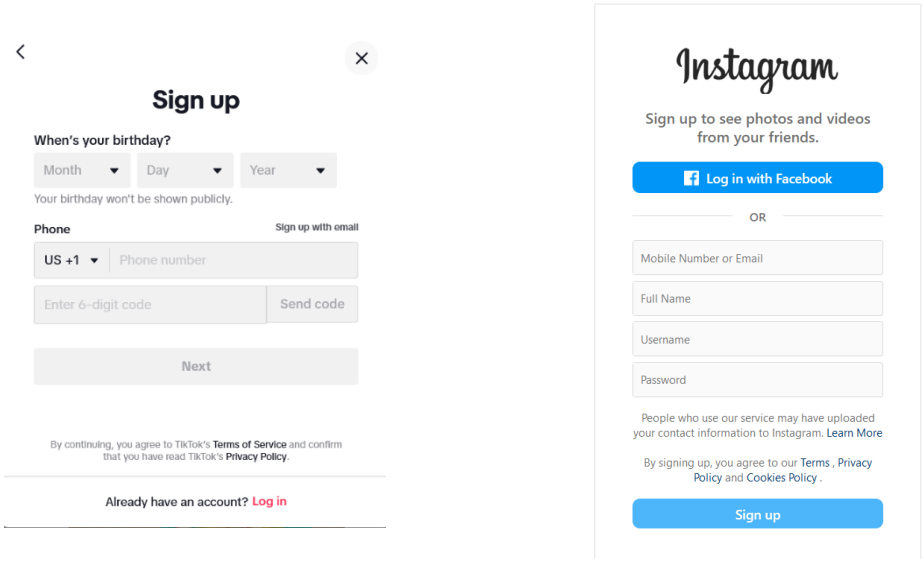



Figure 2. TikTok sign up agreement (left) and Instagram sign up agreement (right) functioning as consent to privacy policy as of December 2023.

Most participants (with the exception of two 8-year-old girls) reported lying about their ages when signing up for their preferred platforms. Some children explained their strategy for lying about their birth year, saying “I’ll just put like, I go down down down (mimics scrolling) to 1915, that’s what I usually do” (Bruno, 9 years) or “you put whatever, you just guess” (Lucia, 8 years). Children lied about their ages primarily to try and protect their own privacy. Lucia explained, “The trick is to never never—you never put your right age…because they might rob you, they might do something, they might search you up.” Common reasons for providing fake birthdates are presented in Table 6.

| Table 6. Common Reasons for Lying about Age on Platform Age Gate | |
|---|---|
| To avoid hacking | "I put I was 15 [years old] for them not to hack me"—Lucia |
| To protect private information | "I don't like using [my real birthdate] because I don't want them to know, like, it's private…My cousin says like 'do not put your real birthday, they could probably find your address or something' "—Amalia |
| To gain access to more platform features | "I put it in right here but if you put like your real birthday like 2014 for both of us, it won't allow you to do anything."—Julian |
| To gain access to the platform | "Because it does not let you [on the platform] sometimes"—Isabel |

***Data Privacy Concerns***

Children's primary data privacy concern was keeping information safe from "hackers." Bryan (9 years) explained hacking:

> Hacking is when somebody tries to get into your private information and …they go in and they use hacks to, like, find out the past passwords and numbers entered into the phone to just automatically open it and go through your private information, photos, passwords, phone number, direction, address, email, credit card.

Hackers were described by most children as people who collect your personal information and do something with it. Children were concerned about their name, address, or other personal information being obtained by "hackers." When asked why hackers want children's data, some children suggested money while others thought hackers wanted personal addresses and come to children's home, presumably to do some kind of harm.

Children had misconceptions that if they used their real birthday on platforms, hackers would then gain access to several other pieces of personal data. The concern about hacking and hackers was introduced by children, rather than the researcher, and came up as a concern in all nine focus groups across age and gender groups.

Alternately, concern about platforms or companies obtaining private information about children did not appear often. Only a few older participants in the 11-year-old groups discussed concerns about a phone listening to what is said or tracking locations. Andrés went on to explain, "That's one of the reasons I deleted Snapchat. Because they can like see where you're at."

Children generally expressed desires for strong privacy protections. They did not want to share personal information or have data collected about them. Riley (11 years) describes her mounting discomfort with the information available online:

> Another thing, like I don't like about social media and stuff, is like my mom's friend Vivian, she found this app where it shows you *everything* about any person. She searched me up. Thankfully I was not there. Because it said it has to be 18 plus. But when we turn 18 everything about us is going to show up on there. Absolutely everything. Where we live, our phone number, our social security number, our passwords, like our emails, our address, like what we look like, crime rates, like everything.

### *How Data are Collected*

Few participants talked about if or how platforms and companies might be collecting information about them online. However, most 11-year-olds thought that their

behavior and search history were used in some way to shape their online content in the form of feeds or recommendations (see Table 7).

Children primarily thought of data being collected by hackers, unknown others, or through the initial sign-up page for a platform. When asked why they see the content they do on YouTube or in social media feeds, some older children hypothesized that data are being pulled from their online behavior both inside and outside the app. However, this knowledge rarely translated into the ability to describe privacy concerns or practices for addressing online tracking or corporate surveillance.

### *Awareness of Algorithmic Curation*

Children had various explanations for why they see the content they do in feeds and recommendations. Younger children (8-9 years) seemed unaware of the intentional ways content is curated for different users. One group thought that everyone sees the same YouTube ads, while another believed TikTok shows users videos at random. When probed about these processes, children mentioned data collection practices, hypothesizing "if you search something specific and you stay there, like, for a long time, they're going to start popping up in your For You page" (Bruno, 9 years). Another participant explained user actions and explicit preferences likely determine the content one sees, saying "Maybe [you see YouTube content] because you like it? You like the channel and you subscribe to them and then it knows you like the channel" (Olivia, 9 years).

| Table 7. Children's explanations for content on social media and YouTube, by age | | |
|---|---|---|
| 8-9-year-olds | 10-year-olds | 11-year-olds |

| | | |
|---|---|---|
| Randomly chosen content<br><br>Everyone sees same ads<br><br>Based on user action (liking a YouTube video, subscribing to channel) | Based on age you sign up with<br><br>"mystical" process<br><br>Based on search history, interests<br><br>Based on popular, new content | Apps listen to you on your phone and push content based on conversations<br><br>Based on search history, interests<br><br>Based on what you watch before<br><br>Based on what you do on other apps and internet connected devices (e.g. gaming devices)<br><br>Based on trends, popular content<br><br>A few videos pushed are random |

Older children mentioned data collection practices and personalized content more often. Some ten-year-olds generated theories, describing the algorithmic curation process as "mystical," related to age "if you are 18 or older, that tells what videos you are able to watch," and "probably from my search history…And then like new dances or trends that come out." The oldest children in the focus groups (11 years) had the most complex ideas about why specific videos appear in their feeds, with Andrés explaining:

> Cause, for example my For You page, like let's say it's just Minecraft and memes, and then, like, my friend tells me you should download FIFA and then I start playing FIFA. Then, out of nowhere, I get videos of FIFA on my phone. And also, when you download the app, it says 'allow app to track outside of TikTok.'

Other children linked data collection practices with personalized content, but saw this as innocuous or unavoidable, as shown in the excerpt below:

Facilitator: How do you think YouTube knows what videos to show you?

Mateo: It's because, like, the videos you watch, the type of videos you watch, like, the more, like it, like, let's say you watch like a bunch of, like, DIY videos, it's gonna recommend DIY videos to you.

Riley: Oh yeah. And then, like, another reason is, like, all apps, they all listen to you. And it's kind of creepy. And then on YouTube, especially, like, if I'm talking about like slime ASMR. Then I'm talking about it with my mom and like stuff. And then, like, I try and do it sometimes, like, with my slime. And then it hears that because — that's what it does. And your phone's probably listening in right now (motions to researcher's phone) Yeah. So, like, it's yeah, so like, and then, like, it listens in and, like, pops up on your screen. And, like, based on, like, what you search sometimes too, then it pops up. And then, like, stuff based off of that. And then after you're done searching it up, like, maybe, like the next day so you don't get that suspicious. They'll be like (whispers) 'here's some things you watched yesterday. Oh, here's some things you watched the week before.'

Facilitator: Why do you think it does it? Like, why does it collect all this information?

Mateo: So, it can give you like, like umm, so it can, it can know the content you enjoy and give you more content like that. Yeah.

Riley: Well, also, cuz every video you watch, they get paid. And then they use that money to pay the YouTubers and then the YouTubers get happy. So, they make, YouTube or like other apps like that, they make them keep popping them up, or like other content like that up, so that you can watch it more. And they get more money because—yeah, cuz money's amazing.

Mateo: Yeah, and then it's just a cycle.

Facilitator: Yeah. What do you think about all that?

Riley: I think it's like, I mean, I don't have to pay money. So why do I care?

Mateo: True.

### *Effects of Algorithmic Curation for Children*

Children perceived a mixed level of control over their algorithmically curated content and were not always pleased with the content pushed to them. When asked if they felt they had control over the content they saw, some children responded positively, while others said, "No and yes" (Sophia, 8 years), and some expressed extreme feelings saying

"No, I hate the videos that come next" (Ruby, 8 years) or described recommended videos as "horrible" (Liam, 8 years).

With their current curation algorithms, children reported accessing content that they thought was inappropriate, scary, annoying, low quality, distracting to the point of distressing, or weird, in addition to the content they enjoyed. Groups reported seeing videos about "dumb ways to die" (Ruby, 8 years old) or "anime where girls take off their bras and their t-shirts" (Andrea, 9 years). Children also shared about sexual content they encountered focused on masturbation as well as a particular online hoax where children were told if they drank the Grimace Shake from McDonald's, they would die. Children joked about it, but also seemed unsure whether it was true. One child reported having a nightmare about the Grimace Shake and his own death after seeing this content on YouTube Shorts.

When children chose content from thumbnail images in their feeds, which lacks regulations about content, they often found it deceptive. As Gabriel (9 years) described, "It's like on the picture that shows the video. It's like oh it's good, but when we see it, when we see it, it's like, oh this is inappropriate." Children also described the process of clickbait, explaining how thumbnails make it hard to evaluate which content they want to see, because "when you click it, it is the thing, or sometimes it's just another thing."

Some children shared that the ways that personalized content is available all the time was sometimes problematic. For instance, Julian (8 years) talked about how the frequent pushing of Fortnite related content on YouTube made it difficult to comply with his family's rule about no Fortnite during the week, saying:

> Every time I watch [YouTube] on the week—I always, like, log onto YouTube and there's like videos of Fortnite and guess what? I can't play. Because I am grounded from Fortnite on the week. So that makes me so mad because I always want to play.

Because many of the children accessed online spaces through shared or other family members' devices, gaps in meaningfully protection from harmful or inappropriate content existed, especially when algorithms that push content were shaped by multiple users, as Julian (8 years) shared,

> My little sister, when she was little, she would go on TikTok, she wouldn't search anything up—but my mom…searched how to put on a bra correctly, like that's what she searched. And my sister just pressed on it, and she saw a lot of inappropriate things she wasn't supposed to see.

## RQ2: Strategies for Managing Flow of Data and Algorithmically-Curated Content

### *Data Flows and Privacy Protection Strategies*

As mentioned earlier, children were largely concerned about malicious others stealing their information, so the bulk of their privacy protecting strategies were driven by desires to protect their information from "hackers." The main strategy children, especially 8-10-year-olds, used to protect private information and control the flow of their data was a fake birthdate and name when signing up for platforms. When asked how to prevent someone from taking your personal information, or prevent hacking, some children responded with broad, generic statements like "by keeping your accounts safe" or "making sure every single day you don't get hacked." Others presented a more futile perspective saying "[The hackers] won't stop bothering you until they get your information." Some

older children expressed the importance of keeping accounts private or only letting known others follow them.

Older children described various strategies, though many appeared to be ineffective or inaccurate. One participant, Riley (11 years), had concerns about the phone listening to private conversations and using overheard information to push content. She believed that if she told the phone not to listen, then her private conversations would be safe. Riley explained:

> My mom curses them out so much, she's like 'I know you're listening. I know you're listening. So, you better, you better tell your boss-boss, we need to stop doing this. Because we are going to get in trouble by these people'…And whenever we say that [don't listen], they never do. But other times when we don't say that, they will do it.

Andrés (11 years) reported two different strategies for managing personal data and was one of the few participants who specifically talked about maintaining control of personal data from platform data collection. He shared having deleted a social media app because it could see his location, but did not seem to recognize that several apps and the device itself used location tracking constantly. Andrés also talked about denying TikTok the ability to track outside of the app, but he went on to express doubts about the effectiveness of this strategy, saying, "I clicked 'no' because I don't want them to see what I do…but I still feel like it pulls from other apps. Maybe it's just a coincidence but…"

### *Algorithmically-Curated Content Management Strategies*

To manage what they see in digital spaces, children relied on scrolling past content they perceived as inappropriate, annoying, or boring. Lucia (8 years) says, Digi

Perceptions of control seemed to vary depending on the platform and feature. Mackenzie (10 years) said, "Well it depends if I am watching YouTube Shorts, you can't really tell what you are watching. You're just scrolling. Then like video-wise, I don't really watch videos. I am usually in Shorts." Marisol (8 years) expressed that she felt a greater sense of control when she stayed within the same YouTube channel and watched videos from the same YouTuber, creating a more closed system for her content recommendations.

Older children talked about intentionally watching certain content or indicating preferences to platforms. Andrés (11 years) talked about this process:

> My sister she likes everything. And then she just like messes up your For You Page. I let my little cousin use my phone and then when I see, it was just like Merlina and then ASMR. I was like why do I keep on getting this? And he, like followed, like, 50 other people…So I like unfollowed and then like every single video of those, I unliked it, gave it a dislike. I told her next time 'switch your account'. And I taught her how to do it, because she keeps messing it up.

A group of eleven-year-old boys talked about how there was only a one-time opportunity to influence their own TikTok feed, during the account creation process. They explained how TikTok asks about users' interests when signing up, in order to make relevant recommendations. Importantly, they also talked about how TikTok pulls from search histories to inform these decisions.

None of the children mentioned the built-in features on TikTok, YouTube Shorts, or YouTube for resetting the curation algorithms, blocking or reporting content, or indicating preferences (e.g., Not Interested, Filter video keywords).

## Discussion

Given the prevalence of algorithms and data collection in children's everyday digital lives and the harms associated with data profiling and algorithmic bias, we set out to explore how children are thinking about data collection and curation algorithms in their daily online use. We see this as important for ensuring youth are empowered learners in digital spaces, capable of leveraging the affordances of technology for learning and connection while minimizing risks. Importantly, we focus on the thinking and behaviors of children 8-11 years, who are frequent users of social media and YouTube, despite age requirements. In light of our findings, we outline several key implications for children's digital interactions: (1) there is a need for more algorithmic literacy and digital literacy initiatives, (2) current age gates do not work and privacy consent processes must be redesigned to be more transparent and user-friendly, (3) users need more effective and easy to access controls over algorithmically-curated content, and (4) implementing basic child safety regulation (similar to other telecommunication industries) would help incentivize platforms to acknowledge young users online and design digital spaces with them in mind.

### 1. Need for Algorithmic and Digital Literacy

The goal of algorithmic literacy is to "use algorithms and not be used by them" (Ridley and Pawlick-Potts, 2021, p 9). Our data show that children need more opportunities to

develop algorithmic literacy, which includes how personal data are used to power algorithmic decision making. Digital literacy instruction (including algorithmic literacy) should be a part of modern education and attend to social implications of technology so that children can make meaning of the visual, audio, and digital print of daily life, including how and what data are collected, used, and sold as well as their own digital rights. Specific to algorithmic literacy, children need opportunities to learn about algorithms and impacts of algorithms that have low barriers to entry. This knowledge cannot be kept in advanced Computer Science and Mathematics courses. In the U.S., teaching of algorithms is mainly in computer science courses (Ciccione, 2021), which are often limited to high school ages and more affluent schools (Code.org, 2022). Digital literacy and algorithmic literacy need to be made widely available in lower grades and in ways that make sense for school structures (e.g., mandatory stand-alone class, embedded in content courses).

Educators seeking to address digital literacy competencies, and more specifically algorithmic literacy, do not have to start from scratch. Akgun and Greenhow (2021) detailed several different strategies and open-source materials for teaching K-12 students about the basics of artificial intelligence, machine learning, and ethics in an algorithmic age. The AI Education project offers free online resources for teachers to embed AI activities into content lesson plans, as well as standalone lesson plans. Other organizations such as Code.org, the International Society for Technology in Education (ISTE), and the 5Rights Foundation offer teacher and student resources for learning about AI and algorithms in daily life.

**2. Age-Gate Failures & Redesigning Privacy Consent Process**

Our findings highlight two problems with the current privacy consent process: (1) Age gates are easily bypassed by children lying about their age and (2) Privacy policies are easy to bypass and frequently ignored when only displayed in the sign-up process. Children in this study were unaware of privacy policies, did not read them, and largely saw them as a place to click to play. Privacy policies are notoriously difficult to understand, even for adults (Obar and Oeldorf-Hirsh, 2020), who are not newer readers and cognitively immature, and children have major incentives to sign-up (e.g., connections to friends, learning new things, play). Further, privacy policy consent and terms of service typically involve users to either agree to data collection or not use the platform, thus leaving youth to choose between digital access and digital privacy from unknown and largely unseen collection processes.

Redesigning privacy consent processes to be clearer and written in plain language would help prevent misconceptions and be more accessible to young users. Prior research has documented promising strategies to increase youth's understandings of datafication practices by platforms (Wang *et al*., 2023). For example, information about what data are collected and how they are used and monetized could be provided in multiple formats such as cartoons, videos, infographics or even a chatbot that children could prompt with their own questions.

Similar to previous research (boyd *et al.,* 2011), the children we talked with overwhelmingly and quite easily bypassed age-gates by lying about their ages. Notably, one of children's main reasons for bypassing the age-gates was to *preserve* their digital privacy. They felt that sharing their real birthdate would open them up to hacking by unknown others. Many did not realize that this same sign-up page where they misled the platform

about their birthdate was also functioning as the privacy policy agreement, effectively granting the platform permission to track, profile, and monetize their data. Nor did they consider that entering adult ages (sometimes 109 years old) bypassed any restrictions on content afforded to children 13-17 years. Age verification processes need to be designed in ways that cannot be easily bypassed or abandoned altogether in favor of other solutions such as widespread privacy by design (e.g. location tracking turned off, personalized advertisements disabled) (European Digital Rights, 2023). Allowing children to enter their actual birthdate on platforms would create opportunities for age-appropriate content, profiling, and data collection. As discussed later in this section, these kinds of large-scale changes would require significant regulation, some of which is already happening in the European Union.

**3. More User Controls Over Algorithmically-Curated Content**

Users (adults and children) currently have little control over the recommendation and curation algorithms used in popular platforms. Children in our study reported several benefits to personalization driven by algorithms, but also expressed concern about the kinds of content they see, citing several instances of deceptive marketing, pornographic, scary, or shocking content, and misinformation or deepfakes that were difficult to evaluate. When asked to explain why they see what they do in feeds or recommendations, younger children tended to explain algorithmic curation as random or universal, where everyone is shown the same content, not realizing the intentionality of algorithmically pushed content. The 11-year-olds' explanations were more complex, generating theories related to surveillance, search history, user behavior, and content. To have more agency over what they saw online, children relied on strategies like scrolling past content and unfollowing

users or accounts. Users should have more tools for controlling the content they see, especially options that reduce exposure to commercialized and pushed content and increase visibility for accounts the user prefers such as friends, families, or particular influencers. Youth should be able to opt-in to data driven algorithms, choose how their data are used to shape algorithms, and have easily accessible ways to reset their algorithmic profile. Though these tools already exist on some platforms, they are often difficult to find and require multiple steps to access.

**4. Increased Regulation for Digital Platforms**

Children's online experiences are increasingly shaped by algorithms that determine search results, video recommendations, assessments of learning, and social media feed content (Ito *et al.*, 2021) but these processes are completely unregulated in the U.S. Despite platforms being reluctant to share the specifics about how their algorithms work or allow outside researchers to conduct impact analyses, we do know that algorithmic harms exist. Algorithms are used to push original and sponsored posts and advertisements, and these processes have produced biased and harmful outcomes for users. Facebook's algorithms were shown to discriminate by race and gender when pushing advertisements for housing and employment opportunities (Ali *et al*., 2019), even when advertisers explicitly indicated they wanted a balanced audience. Facebook's own internal documents, leaked by a whistleblower, show that the company knew its algorithms pushed harmful and hateful content to users, including teenagers (Wall Street Journal, 2021) and TikTok's algorithms and content moderation have also been found to suppress disabled, fat, and LGBTQ content (Botella, 2019; Bacchi, 2020). Though these harms are well documented, regulation

attempts have stalled. Technology platforms are unlikely to changes to their practices when giving users more privacy and control will likely decrease advertising revenue.

To empower children in an algorithmic age, we need multi-level approaches that involve legislation, regulatory policy, education efforts (with funding to enable it), and a wider conversation about children's rights online. In the absence of explicit guidance and instruction, children must navigate digital spaces based on their own algorithmic folk theories of how things work and how to best protect themselves. With easy to bypass age gates as the only protection, children are engaging in spaces at ages that are explicitly prohibited by platform policy. Importantly, their selection of adult ages when signing up (e.g., born 1915), opens all access to adult levels–and should be a flag for companies, whose algorithms should capture the elderly age in conjunction of child-like content consumed and connections to other young (or perhaps exceedingly old) users.

Though our study was limited to a small sample of children, who predominately identified as Latine, it provides much-needed viewpoints among ages less often studied in media and educational research. Future studies could expand this line of work, to involve larger and more diverse child samples and examine patterns based on children's media exposure, digital literacy knowledge, and family mentoring around technology.

## Conclusion

Children are using YouTube and social media prior to adolescence and many years younger than the site-required ages. Our findings suggest that children need more learning opportunities around digital media literacy to ensure they are making fully informed choices about digital privacy and that platforms need to provide more algorithmic agency for users. Currently, children rely on their own everyday folk theories, which are not

necessarily accurate, and this kind of user knowledge becomes even more important in the absence of privacy and AI legislation. Few US states require digital, media, or algorithmic literacy education (Media Literacy Now, 2023; Walters *et al.,* 2023) and rarely in younger grades. Consequently, digital literacy education is needed that includes updated literacy curriculum, teacher training programs, and opportunities for students to think critically about data and algorithms in their digital lives.

## Study 3

## Digital Citizenship in the Algorithmic Age: Patterns of Instruction in K-12 Schools

### Introduction

Technology is a significant presence in most children's lives in the United States. With the rise of computers in the classroom and increased uptake of mobile devices among children, educators, families, and policymakers have been considering which skills and understandings students need to succeed in a digital society. As such, it appears that more schools are starting to formalize their commitments to support students' digital skills, given recent increases in policies and federal guidance (Media Literacy Now, 2024; US Office of Educational Technology, 2024).

Discussing digital skills in the context of K-12 school can be difficult because the same constructs (e.g. source evaluation, digital privacy) are included across different umbrella terms such as 'digital literacy', 'media literacy', '21st century skills', or 'digital citizenship' efforts (See Table 8) with content analyses of major digital skills frameworks and curricula showing significant overlaps between the terms (Cortesi et al., 2020). These categories can vary in scope, including topics such as safety and well-being, positive behavior online, digital privacy, media literacy, data security, digital laws, information evaluation, identity exploration, digital access, digital economy, data management, content production, digital literacy, civic and political engagement online, computational thinking, artificial intelligence and understanding context online (Cortesi et al., 2020).

When computers first started entering classrooms, conversations about digital literacy focused more on the use of technologies and navigating digital spaces (e.g., using

hyperlinks). As technology has advanced, educators have attempted to keep pace with emerging technologies and challenges they may bring by updating lessons about topics such as source evaluation. For example, when disinformation became a concern, digital literacy and media literacy shifted beyond standalone source evaluation to include lateral reading strategies and understanding the nature of disinformation online. The rise of algorithms in daily digital interactions, privacy risks introduced by developments in artificial intelligence and generative artificial intelligence, and the for-profit nature of platforms has similarly introduced new issues that impact everyday access to information.

For the purposes of this paper, we use the term 'digital citizenship' to mirror language used in the most recent National Educational Technology Plan from the US Office of Educational Technology (2024). We focus on these domains of learning and participation, digital rights and responsibilities, commercial/big data, and online safety, which some literature refers to as 'digital literacy', 'media literacy', 'data literacy', or 'critical media literacy'. We summarize definitions of the more commonly discussed concepts, 'digital literacy', 'digital citizenship', and 'media literacy', in Table 8.

As of 2024, there are 19 US states trying to address media literacy or digital citizenship instruction (Media Literacy Now, 2024) but these efforts are by no means universal. In 2024, the US Department of Education explicitly named digital safety and citizenship skills as an area of concern for educational equity (US Office of Educational Technology, 2024).

Despite the consensus that students need newer digital skills instruction and concern over equitable access to high quality, digital learning opportunities (US Office of Educational Technology, 2024), not much is known about patterns of digital literacy and

digital citizenship instruction in US schools (Cortesi et al., 2020; Öztürk, 2021). Thus, we set out to describe which topics educators are discussing with students, how often, and how educator and school level characteristics might be related to digital literacy instruction using survey data from over 1,300 educators across the U.S.

| Table 8. Common Categories and Definitions of Digital Skills for K-12 Education | |
|---|---|
| Digital literacy | • "the skills associated with using technology to enable users to find, evaluate, organize, create and communicate information" (Museum and Library Services Act, 2010)<br>• "ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes skills such as computer literacy, ICT literacy, information literacy and media literacy which aim to empower people, and in particular youth, to adopt a critical mindset when engaging with information and digital technologies, and to build their resilience in the face of disinformation, hate speech and violent extremism" (UNESCO, 2024) |
| Digital citizenship | • Applying "the standards of appropriate, responsible and healthy online behavior, including cyberbullying presentation and response…digital ethics, etiquette, safety, and security…media literacy including the ability to access, analyze, evaluate, create and act on all forms of digital communication" (Texas H.B. No 129)<br>• "ethical, safe and responsible use of Internet technologies" (US Office of Educational Technology, 2017 p. 11). |
| Media literacy | • "The ability to:<br>  ○ Decode media messages (including the systems in which they exist)<br>  ○ Assess the influence of those messages on thoughts, feelings, and behavior, and<br>  ○ Create media thoughtfully and conscientiously" (Media Literacy Now, 2024) |

**Current State of K-12 Digital Citizenship Instruction**

Currently, public education in the U.S. does not have agreed-upon standards for digital citizenship education in K-12 schools (Walters, Gee, & Mohammed, 2019). Though the US National Education Technology Plan recommends digital literacy and digital citizenship education for both teachers and students, the details of what exactly should be

taught remains unclear (US Office of Educational Technology, 2017, 2024). Several digital citizenship frameworks and curricula are available, with some of the more popular ones being Common Sense Media's digital citizenship curriculum and the International Society for Technology in Education (ISTE) technology standards for schools. However, only three states require digital citizenship or media literacy instruction in K-12 classrooms (Delaware, New Jersey, Ohio) according to a recent policy analysis (Media Literacy Now, 2024).

Prior to the shift to remote learning and influx of technologies in K-12 schools prompted by the COVID-19 pandemic, survey data with a sample of 1,200 K-12 educators suggested that the most commonly taught topics in K-12 schools included cyberbullying, online safety, digital drama, and responding to hate speech online (Vega & Robb, 2019). According to a systematic review of digital citizenship research (Richardson, Martin, & Sauers, 2021), media and information literacy was a common focus with less work attending to issues of participation and engagement, ethics of technology use, and critical resistance. Researchers also noted the lack of consistent conceptual frameworks among these studies, where digital citizenship was often conceptualized differently across studies. Cortesi and colleagues (2021) attempted to clarify the term digital citizenship by conducting a content analysis of 17 popular digital citizenship, digital literacy, and media literacy frameworks around the world, finding that current frameworks and resources do not adequately address artificial intelligence, computational thinking, the role of data in digital interactions, or digital economy.

The emphasis on internet safety and protection from particular risks such as cyberbullying has been criticized as overly narrow and does not match the current realities

of digital spaces for young people and the commercial nature of the platforms with which they interact most (Henry, Vasil, & Witt, 2021). However, there is a financial incentive for K-12 schools to prioritize internet safety and cyberbullying because they align well with the requirements for discounted or free internet access through a federal program called E-rate. For schools to qualify for E-rate, they must educate students about "appropriate online behavior, including interacting with other individuals on social networking websites and in chat rooms and cyberbullying awareness and response" (Children's Internet Protection Act, 2011). Though these issues are important, focusing only on topics such as cyberbullying promotes an "individual responsibility model" for online safety (Radesky et al., 2022b), ignoring the systematic structures in technology platforms that introduce risk to young people.

Despite the absence of formal standards, curriculum or policies, the education field largely agrees on the importance of digital media literacy (Kidron & Rudkin, 2017). There is evidence that different forms of digital citizenship instruction are happening, but few details exist about the nature of this instruction or how it may look in post remote-learning settings. Survey data collected prior to the COVID-19 pandemic from a representative sample of 1,200 teachers found that 60% used a digital citizenship resource or curriculum in the past year (Vega & Robb, 2019). However, these data do not speak to which topics were discussed, how often teachers were able to talk about digital citizenship over the course of the year, where instruction took place, or who facilitated it. Other studies suggest digital citizenship instruction occurs at much lower rates (Martin et al., 2020; Gleason & Von Gillern, 2018; Lauricella et al., 2020). Among a sample of over 200 middle school students in a rural school district in the Southeastern U.S., only 37% of students reported

digital citizenship being taught in the past year at all, and 49% reported that they were unsure whether they were taught these skills (Martin et al., 2020). Results from a 2018 representative survey (Lauricella et al., 2020) suggest that most elementary school teachers talked about some aspect of digital citizenship at least once in the academic year with their students, but one-third of all K-5 teachers did not talk about digital citizenship at all. There has yet to be a large-scale inventory of digital citizenship instruction across K-12 schools in the United States (Öztürk, 2021), or one that attends to differences by grade level. Because of these gaps, it is important to study what schools are teaching about digital citizenship within different grade bands, and whether teachers in different school settings (e.g. Title I, high levels of tech access) are more likely to facilitate this kind of instruction.

**Digital Access and Equity Concerns**

Schools have largely recognized the need to teach students about technology in some way, especially with the onset of remote learning during the COVID-19 pandemic, and many educators have expressed concerns about digital skills gaps that are manifesting in K-12 education (Hohlfeld, Ritzhaupt, Dawson, and Wilson, 2017; Rideout, Peebles, Mann, & Robb, 2022; Starks & Reich, 2023). The recent National Educational Technology Plan (NETP) from the US Department of Educational Technology (2024) draws attention to the common digital access divides in K-12 schools, including disparate access to high-speed internet connectivity, devices, and also points out access to "digital health, safety, and citizenship" (p. 60) instruction as an area of concern. Importantly, the plan articulates the importance of key knowledge and skills needed to navigate and use digital tools and spaces, with significant consequences for employment and postsecondary success. The plan

defines "digital health, safety, and citizenship" skills as those that "empower students to use technology meaningfully and safely" (p. 60).

When it comes to digital citizenship and literacy instruction, prior research points to certain school and teacher characteristics that may influence whether this instruction happens at all and to what extent. Lauricella and colleagues (2020) found from surveys with 585 educators that digital citizenship instruction in elementary school differed based on teacher experience, student grade, school racial and ethnic diversity, and school setting (e.g. urban, suburban, rural). Teachers in schools with more racially and ethnically diverse student populations and those in suburban areas were more likely to teach more digital citizenship competencies. However, this research is limited to the six domains of digital life included (media balance and wellbeing, privacy and safety, digital footprint and identity, relationships and communication, digital drama, cyberbullying and hate speech, news and media literacy) and questions only asked whether instruction occurred, not how frequently (Lauricella et al., 2020).

**Digital Media Literacy in the Algorithmic Age**

Even though schools have requirements to teach some topics related to internet safety to quality for E-Rate funds and many states are adopting formal policies, there is reason to think the current efforts are falling short. In a survey of 1,000 youth ages 13-24 years, half reported feeling that they did not have access to resources to manage their online safety, expressing concern for both physical and emotional safety as well as data security (Family Online Safety Institute, 2021).

One understudied aspect of digital citizenship and literacy is youth understandings and strategies around algorithms and artificial intelligence in their online interactions.

Children's everyday experiences for learning, play, and socializing are heavily shaped by the algorithms that media and technology platforms create and use to influence user behavior. Search results, video recommendations, assessment of student learning, suggested friends, and social media feeds are all driven by algorithms invisible to the young user. Yet, these technologies are often omitted from media education focused on protecting children online and empowering them to use technologies in responsible, safe, and ethical ways.

One of the few studies exploring student awareness of algorithms (Tynes et al., 2021) found that students had a difficult time evaluating the credibility of social media posts, recognizing and understanding propaganda, and understanding how algorithms drive online search results. These findings indicate that current instruction does not sufficiently attend to digital literacy skills such as algorithmic bias, misinformation, and disinformation (Tynes et al., 2021). Buckingham (2015) highlighted the limitations of digital literacy as it is taught in K-12 schools, arguing that digital literacy is too narrowly focused on whether young people can use specific technologies rather than the critical thinking needed to understand student experiences with technology and media, especially persuasive technology (e.g. how design of technology influences user behavior) and the structures driving the information we see. Given recent advances in artificial intelligence and increased attention to how algorithms can shape basic access to information and social connection, it is worthwhile to understand what digital citizenship topics are being discussed, how often, and whether certain students are having more opportunities to develop digital skills than others. Given the lack of attention to algorithmic awareness, data flows, and the design of digital environments, our study intentionally included these topics in our survey design and analysis.

## Current Study

To better understand digital citizenship patterns in K-12 schools, we asked the following research questions:

**RQ1**: What kinds of technology access, challenges, and practices do educators report?

**RQ2**: What digital citizenship content do educators report teaching in K-12 schools and how often?

**RQ3:** What educator and school level characteristics are associated with digital citizenship instruction in a sample of K-12 schools?

# Method

The authors developed survey questions for the national SpeakUp survey to describe patterns of digital citizenship instruction in K-12 public schools, with a specific focus on the content, frequency and context of digital citizenship instruction. The SpeakUp survey is a cross-sectional survey about key educational issues distributed nationally to a nonrandom sample of K-12 educators, representing a mix of urban, suburban and rural schools. Participating schools and districts opt-in to the SpeakUp survey by partnering with Project Tomorrow, an education non-profit organization, and administering the online questionnaire. The survey was distributed to a national sample of educators across K-12 schools in the United States during the 2022-2023 academic year. The complete sample

included 1,325 educators, and a subset of completed surveys had digital citizenship variables (n=742; see Table 9).

**Participants**

Participants were mostly K-12 classroom teachers (71%) and special education teachers (14%), with a combination of paraprofessionals, librarians, instructional coaches, counselors, and ELL/ESOL teachers making up the remaining 15% of educator responses (See Table 9). Educators were working across 35 states in the United States during the academic year of 2022-2023. Educators were asked to complete the survey at the school or district level through an established partnership with Project Tomorrow for the annual SpeakUp Survey. Schools can participate in the SpeakUp Survey free of charge and receive customized reports about trends in digital learning and school use of technology. There is no cost for the survey or to get access to local data.

Grade levels were evenly distributed, with 44% of respondents teaching in elementary grades (K-5), 50% teaching at the secondary level (6-12), and 6% teaching "all grades." Educators teaching "all grades" were included in all analyses except those comparing elementary and secondary teacher responses. Teachers were most commonly teaching elementary school content (e.g. general elementary), followed by special education, Math, English Language Arts, Science, and Other.

The majority of educator responses (88%) came from five states, while the remaining responses were spread out across another 30 states. Most commonly represented states include Kentucky (32%), Florida (24%), California (14%), Alabama (11%), and Wisconsin (8%).

Not all participants completed the digital citizenship section of the survey, resulting in a smaller subsample for digital citizenship analysis (n=742). These questions were at the end of the survey and potentially more likely to be skipped if respondents were short on time, tired of the survey, or interrupted while completing it. When comparing those with digital citizenship responses (n=742) to those without (n=583), there were several statistically significant differences. Educators in the digital citizenship subsample had more students with school issued device access than the no-digital citizenship sample ($t=-2.16$, $p<0.05$), and they were more likely to work at a majority white school ($t=-2.91$, $p<0.01$), compared to those who did not have digital citizenship responses.

Table 9. Educator Demographics

| | Digital Citizenship Sample (n= 742) | Full Sample (n=1,325) | Comparison of samples |
|---|---|---|---|
| **Grade Level Taught** | | | |
| Elementary | 43% (319) | 44% (583) | ns |
| Secondary | 51% (378) | 50% (662) | ns |
| All grades | 6% (45) | 6 % (80) | ns |
| **Subject Taught** | | | |
| General Elementary | 29% (218) | 29% (381) | ns |
| Special Education | 11% (81) | 12% (150) | ns |
| Math | 11% (78) | 10% (133) | ns |
| English/Language Arts | 10% (75) | 10% (126) | ns |
| Science | 8% (59) | 8% (101) | ns |
| Social Studies/ History | 7% (48) | 6% (78) | ns |
| Other | 24% (178) | 25% (331) | ns |
| **Primary Role** | | | |
| Classroom Teacher | 71% (528) | 69% (905) | ns |
| Special Education | 14% (100) | 14% (179) | ns |
| Paraprofessional | 4% (30) | 6% (72) | ns |
| Librarian | 3% (19) | 2% (30) | ns |
| Instructional or Tech Coach | 1% (10) | 2% (22) | ns |
| Counselor | 1% (8) | 2% (22) | ns |
| ELL/ESOL Teacher | 1% (7) | 1% (12) | ns |

| | | | |
|---|---|---|---|
| Other | 5% (40) | 6% (83) | ns |
| **Teaching Experience (years)** | | | |
| 1 | 5% (35) | 5% (40) | ns |
| 2-3 | 9% (58) | 8% (65) | ns |
| 4-10 | 26% (167) | 24% (189) | ns |
| 11-15 | 18% (115) | 17% (135) | ns |
| 16+ | 43% (281) | 45% (354) | ns |
| **State** | | | ns |
| Kentucky | 34% (255) | 32% (421) | ns |
| Florida | 21% (153) | 24% (314) | ns |
| California | 15% (108) | 14% (187) | ns |
| Alabama | 11% (80) | 10% (134) | ns |
| Wisconsin | 9% (68) | 8 % (103) | ns |
| Other State | 10% (74) | 12% (166) | ns |
| **School Demographics** | | | |
| Title I (schoolwide) | 76% (564) | 76% (1,007) | ns |
| One-to-one device access | 90% (668)* | 88% (1,166)* | t=-2.16, p<0.05 |
| **School Racial and Ethnic Diversity** | | | |
| Majority White students (50%+) | 87%* | 84%* | t=-2.01, p<0.01 |
| Majority Students of Color | 13% | 16% | ns |
| N | 742 | 1325 | |

**Speak Up Survey Sections**

***Educator demographics***

Educators (e.g. special education teachers, librarian/media specialist, instructional coaches) were asked to report their job assignment, grade(s) taught, subject(s) taught, years of teaching experience, and racial and ethnic identity.

***School demographics***

Administrative data were also gathered for each school or district including Title I status (at least 40% of students identify as low income), geographic location, school racial and ethnic demographics, school enrollment, and grade levels served.

***Student and Educator Technology Access/Use***

Educators reported on student access to technology (e.g., school issued device, bring your own device, none), classroom uses of technology (e.g., digital, video or online games, online curriculum), teacher comfort using technology (e.g., using mobile devices for learning, teaching digital citizenship), challenges for using technology in the classroom (e.g., internet is too slow, unreliable, students are off task), and attitudes about impact of technology on students (e.g., information and media literacy skills, disciplinary problems)

### *Digital citizenship instruction*

Educators reported how often they taught 17 different digital citizenship topics. The survey defined digital citizenship as "the set of norms of appropriate, responsible behavior with regard to technology use" and educators were asked "Which of these digital citizenship topics are you explicitly covering in your class this year with your students? Share how frequently by ranking each topic using: Never, Annually, Monthly, Weekly, or Daily."

## Analytic Plan

Data were cleaned and analyzed using the statistical program STATA (version 18). Participants who did not complete any of the content questions were excluded from the sample. Analysis of missing data patterns suggests drop off from the survey towards the end. Digital citizenship questions were located in the final sections as were questions about teachers' comfort with technology and a few educator demographic questions (e.g., years teaching, race and ethnicity). Because not much is known about predictors for the outcome of interest (digital citizenship instruction), data were not inferred and instead noted as missing. Educators (e.g., special education teachers, librarian/media specialist,

instructional coaches) with complete responses were included in the digital citizenship analysis sample (n=742). School and district level data were merged with educator response data to give more contextual information for digital citizenship instruction. Because certain states were represented more than others, dummy variables for the state an educator worked in were created and included in regression analyses to control for state level factors.

***RQ1: Access, Challenges, and Teacher Practices with Technology***

Since little is known about digital citizenship instruction, we ran descriptive statistics to understand more about educator contexts for teaching digital citizenship including student access to technology, challenges for teaching with technology, and educator practices with technology (see Table 10). The proportion of responses indicating student access to devices and digital tools (e.g., school issued laptops, Google for Education Suite) were reported as a percentage of the total sample and by grade level (elementary vs. secondary). To understand more about the challenges educators face in using technology in the classroom, we ran an exploratory factor analysis (EFA) to explore whether similar challenges tended to cluster around similar themes (e.g., student level issues, loss of time, lack of educator decision making for technology). Access to technology, challenges for teaching with technology, and educator practices with technology were reported overall across the entire sample, then by grade level (elementary vs. secondary), see Table 10.

***RQ2. Frequency of Digital Citizenship Instruction***

To describe patterns of digital citizenship instruction in K-12 schools, descriptive statistics were calculated for overall frequency of digital citizenship teaching by topic. Mean frequency of instruction (0=never, 1=yearly, 2=monthly, 3=weekly, 4=daily) was

calculated for each topic across K-12, and then by elementary (K-grade 5) vs. secondary (grade 6-12) to compare across grade bands. Because of the incentives for schools to teach about online safety and cyberbullying to comply with E-rate, digital citizenship categories were created to reflect E-rate topics and non-E-rate topics and then the frequency of instruction was compared.

***RQ3. What educator and school level characteristics are associated with digital citizenship instruction in a sample of K-12 schools?***

To examine relationships among educator and school characteristics with digital citizenship instruction, we used ordinary least squares multiple regression with three outcomes: (1) total digital citizenship instruction across 17 topics (2) E-rate digital citizenship instruction across 4 topics and (3) commercial/big data digital citizenship instruction across 5 topics.

To examine predictors for frequency of digital citizenship instruction across all topics, a discrete sum score was created for digital citizenship teaching across all topics, where the reported frequency for each topic (0=never taught, 1=yearly, 2=monthly, 3=weekly, 4=yearly) was added together across all topics. Sum scores represent the number of topics and frequency of instruction.

Based on previous literature, we used educator demographics, educator uses of technology in the classroom, and student access to devices as predictors for digital citizenship instruction. Because 89% of educator responses came from 5 states, we wanted to assess whether working in a certain state was associated with digital citizenship instruction given differences in state policies around digital literacy and citizenship instruction. We created indicator variables for the state educators were working in

(Kentucky, Florida, Alabama, California, Wisconsin, Other States) and used Kentucky as the reference group in OLS multiple regression analyses described above because it had the greatest number of participants among states.

Given there are unique incentives for teaching internet safety and cyberbullying due to E-rate requirements, we examined digital citizenship instruction for topics that would fall under E-rate in a separate regression model. From our topic list, we identified four topics well aligned with E-rate requirements: "Being safe with others online", "Being empathetic and kind online", "Responding to cyberbullying", and "Protecting personal and private information online". We created a discrete sum score across the four E-rate topics and used this as the outcome of interest for our E-rate regression analysis.

Similarly, we created a category of digital citizenship topics called "commercial systems/big data" to examine patterns of instruction for these topics specifically: "maintaining privacy from corporations", "being aware companies profit off of time users spend online", "understanding how bias and unequal access to tech impacts society", "understanding how tech features designed to increase time spent online (e.g., notifications, autoplay)", and "understanding algorithms in daily activities (e.g., search results)". Given research gaps around student knowledge of algorithms in daily life, data flows, and commercial interests online, we saw utility in analyzing instruction related to these topics in a separate regression analysis than E-rate digital citizenship instruction and overall digital citizenship instruction.

Some educators in the digital citizenship sample did not complete demographic information at end of the survey, so there were 98 observations missing years information about their years of teaching experience. To test whether missing years teaching

experience was systematically related to total commercial/big data digital citizenship teaching, we dummy coded observations as missing and used this as a predictor in the regression analysis. Missing years teaching experience was not a significant predictor for commercial/big data outcomes. Because this relationship was nonsignificant, we felt comfortable used multiple imputation to impute years experience for these 98 observations based on predictor variables.

## Findings

### RQ1: Access

#### *Access*

The majority of educators reported that their schools had one-to-one device access (85%), where students were issued a device from the school either to use just at school (46%) or at both school and home (39%). See Table 10.

#### *Challenges*

Teachers were asked whether they encountered 21 different challenges for teaching with technology. To examine internal consistency of these sets of challenges, we ran a Cronbach's alpha analysis was run with all challenges, resulting in a reliability coefficient of 0.83. To explore the dimensionality of the challenges scale, an exploratory factor analysis (EFA) was performed to determine the extent to which these challenge items grouped together into meaningful categories. EFA results suggested six factor components, using the cutoff of eigenvalues greater than 1. We labeled these six factor components as (1) student level issues, (2) time, (3) educator lack of decision making, (4) lack of training, (5) educator hardware and software, and (6) student access to devices. Two items ("student lack of basic skills", "student devices need updates or repairs") did not load well onto the six

factors, so we ran the regression analyses with these as unique predictors alongside covariates to determine salience to outcomes of interest. The two items were non-significant so they were left out of the regression analysis. Details about factor loadings can be found in Appendix D.

When asked about challenges for teaching with technology in the classroom, educators reported student level issues most frequently (e.g. off task behavior due to tech, student devices not charged, student lack of basic digital skills). The most frequent challenge among educators was "off task student behavior or distraction from learning" due to technology (48%). Other common challenges included inconsistent or slow internet access (36%) followed by loss of class time due to student log-in issues (36%). When asked whether "student lack of digital citizenship training" got in the way or limited use of technology in the classroom, 25% of secondary educators reported this as an issue compared to 14% of elementary educators.

***Educator Practices with Technology***

Educators reported the most common uses of technology in the classroom were online curriculum and videos found online (used at least once a week on average), followed by digital or online games, online reading sites, and software/apps for curriculum knowledge (used at least once a month). See Table 11 for details. The vast majority of participants reported feeling "somewhat" or "very" comfortable using mobile devices such as laptops or tablets with students (89%), facilitating remote learning (86%), and using data from online tools to inform instruction (88%). When it came to digital citizenship, 50% of teachers reported feeling somewhat comfortable teaching digital citizenship with 35% feeling very comfortable. See Table 11.

Table 10. Percentage of Educators Reporting Teaching with Technology Practices and Challenges

| | Total | Elementary | Secondary |
|---|---|---|---|
| **Student Tech Access** | | | |
| School issued device: school only use | 46% | 63% | 35% |
| School issued device: school and home use | 39% | 27% | 58% |
| Google for Education Suite | 27% | 22% | 33% |
| Hotspot loaner | 7% | 4% | 9% |
| Microsoft Office 365 for Education student accounts | 6% | 5% | 1% |
| None | 6% | 10% | 2% |
| Bring your own device | 4% | 0% | 1% |
| **Challenges for Teaching with Tech** | | | |
| (proportion of sample selecting) | Total | Elementary | Secondary |
| Student Lack of Responsibility (3 items) | | | |
| Students display off task behaviors/distractions | 49% | 38% | 59% |
| Student devices are not charged for class | 34% | 21% | 47% |
| Students do not consistently bring their devices to class | 16% | 7% | 25% |
| Time (4 items) | | | |
| Loss of instructional time due to student log-in issues | 36% | 38% | 34% |
| Internet too slow, inconsistent or unreliable | 36% | 35% | 36% |
| Time constraints | 30% | 34% | 26% |
| Lack of planning time with colleagues | 24% | 24% | 24% |
| Educator Lack of Decision Making (6 items) | | | |
| School blocks websites/apps needed for teaching | 25% | 19% | 32% |
| Cannot access online video | 22% | 19% | 24% |
| Lack of autonomy for choosing apps and digital content | 17% | 17% | 17% |
| Cannot use social media tools | 12% | 9% | 16% |
| Educator concerns about security/safety of technology override desire to use tech for instructional growth | 9% | 8% | 10% |
| Too many school rules (e.g. students cannot charge in class, devices stay at school) | 6% | 5% | 8% |
| Lack of Training/Support (3 items) | | | |
| Lack of digital citizenship training for students | 19% | 14% | 25% |
| Need PD on effective teaching with tech | 16% | 14% | 19% |
| Lack of just in time support in classroom | 10% | 10% | 10% |
| Educator Hardware and Software Needed (2 items) | | | |
| Educator devices need repairs | 10% | 11% | 9% |
| Educators need tools to support tech integration | 7% | 8% | 6% |
| Classroom Devices Needed (1 item) | | | |
| No class set of devices | 5% | 5% | 4% |
| Other Student Level Issues | | | |
| Student lack of basic tech skills | 26% | 28% | 24% |
| Student devices need updates or repairs | 23% | 19% | 27% |
| **Digital Citizenship Instruction** | Total | Elementary | Secondary |

| (proportion of sample that has ever taught the topic this year) | | | |
|---|---|---|---|
| **Learning and Participating** | | | |
| Using technology to learn new things | 87% | 83% | 90% |
| Managing technology use (media balance) | 73% | 66% | 80% |
| Using digital communication tools with audience in mind | 58% | 47% | 68% |
| Participating in public forums including social media | 44% | 31% | 57% |
| **E-Rate Topics** | | | |
| Being empathetic and kind online* | 84% | 78% | 89% |
| Being safe with others online* | 83% | 79% | 86% |
| Responding to cyberbullying* | 67% | 57% | 73% |
| Protecting personal and private information online* | 65% | 57% | 73% |
| **Digital Rights & Responsibilities** | | | |
| Being an informed consumer | 62% | 49% | 74% |
| Appreciating everyone has digital rights | 59% | 58% | 63% |
| Understanding laws that apply to digital tools (privacy, copyright) | 55% | 44% | 65% |
| Risks and consequences of sexually explicit content | 47% | 34% | 60% |
| **Commercial Systems/Big Data** | | | |
| Maintaining privacy from corporations (data tracking, privacy policies) | 49% | 37% | 59% |
| Being aware companies profit from time users spend online | 44% | 33% | 55% |
| Understanding how bias and unequal access to tech impacts society | 43% | 30% | 55% |
| Understanding how tech features designed to increase time spent online (notifications, autoplay) | 43% | 33% | 53% |
| Understanding algorithms in daily activities (e.g. search results) | 39% | 27% | 51% |
| N | 1300 | 661 | 639 |

Notes: * Considered an E-rate topic, aligned with federal requirements for E-rate funding where schools receive free/discounted internet services

Table 11. Educator Uses of Technology and Comfort Level Teaching with Technology

| **Educator Uses of Technology** *scale: 0 (never/no access), 1 (yearly), 2 (monthly), 3 (weekly), 4 (daily)* | Total M (SD) | Elementary M (SD) | Secondary M (SD) |
|---|---|---|---|
| Online curriculum | 2.8 (1.4) | 2.9 (1.4) | 2.6 (1.4) |
| Videos found online | 2.5 (1.2) | 2.6 (1.3) | 2.4 (1.1) |
| Software/apps for student curricular skills/knowledge | 2.2 (1.6) | 2.3 (1.6) | 2.0 (1.5) |
| Digital, video, or online games | 2.1 (1.4) | 2.5 (1.4) | 1.8 (1.3) |
| Online reading sites/subscriptions | 2.1(1.6) | 2.5 (1.6) | 1.6 (1.5) |
| Virtual whiteboards | 1.5 (1.6) | 1.5 (1.7) | 1.4 (1.5) |
| Tools for students to create multi-media content | 1.3 (1.3) | 1.0 (1.3) | 1.5 (1.3) |
| Online animations, simulations, or labs | 1.2 (1.3) | 1.2 (1.4) | 1.3(1.3) |
| Two-way communication tools for student communication/ texting | 1.0 (1.4) | 0.7 (1.3) | 1.3 (1.5) |
| Videos that teacher creates themselves | 0.9 (1.1) | 0.7 (1.1) | 1.0 (1.1) |
| Social media tools | 0.8 (1.3) | 0.7 (1.3) | 0.8 (1.3) |
| Class discussion board | 0.7 (1.2) | 0.5 (1.0) | 0.9 (1.3) |
| Virtual voice assistants (Siri, Alexa, Google) | 0.6 (1.1) | 0.5 (1.1) | 0.6 (1.2) |
| Coding or computer programming | 0.5 (1.0) | 0.5 (1.0) | 0.4(1.0) |
| **Educator Comfort with Technology Practices** | | | |
| *scale: 0 (not comfortable), 1 (somewhat comfortable), 2 (very comfortable)* | Total | Elementary | Secondary |
| Taking advantage of students' 1:1 access to a mobile device | 1.4 (0.7) | 1.4 (0.7) | 1.4 (0.7) |
| Using data from online tools and apps to inform my instruction | 1.3 (0.7) | 1.3 (0.7) | 1.2 (0.6) |
| Facilitating online remote learning when necessary | 1.2 (0.7) | 1.2 (0.7) | 1.3 (0.7) |
| Leveraging technology to differentiate instruction | 1.2 (0.6) | 1.1 (0.6) | 1.2 (0.6) |
| Teaching positive digital citizenship behaviors and strategies to my students | 1.2 (0.7) | 1.3 (0.7) | 1.2 (0.7) |
| Facilitating student collaborations using digital tools | 1.1 (0.7) | 1.0 (0.7) | 1.2 (0.6) |
| Using a learning management system | 0.9 (0.7) | 0.8 (0.7) | 1.0 (0.7) |
| Infusing computational thinking and computer science concepts across all core curriculum | 0.7 (0.7) | 0.6 (0.7) | 0.7 (0.7) |

## RQ2: Digital Citizenship Instruction Frequency

### *Most Taught Topics*

Educators were asked to report how frequently they taught 17 different digital citizenship topics. Across participating K-12 educators, four topics were taught on a

monthly basis, on average (See Table 12). These popular topics included: (1) using technology to learn new things, (2) being empathetic and kind online, (3) being safe with others online, and (4) managing tech use/media balance. Notably, all these covered monthly topics focused on individual level actions and responsibilities, rather than an awareness of system structures or impact of technology on self and society. All other topics were taught either once a year or less, on average across K-12, suggesting that even among schools with high levels of digital device access represented in this sample, there was not much digital citizenship instruction occurring – with a limited scope of topics and infrequent coverage, on average.

Table 12. Average Frequency of Digital Citizenship Topic Teaching Across K-12

| Across K-12 | Elementary (grades K-5) | Secondary (grades 6-12) |
|---|---|---|
| **Daily**<br>• None | **Daily**<br>• None | **Daily**<br>• None |
| **Weekly**<br>• None | **Weekly**<br>• None | **Weekly**<br>• None |
| **Monthly**<br>• Using technology to learn new things<br>• Being empathetic and kind online<br>• Being safe with others online<br>• Managing technology use (media balance) | **Monthly**<br>• Using technology to learn new things<br>• Being empathetic and kind online<br>• Being safe with others online<br>• Managing technology use (media balance) | **Monthly**<br>• Using technology to learn new things<br>• Being empathetic and kind online<br>• Being safe with others online<br>• Managing technology use (media balance)<br>• Protecting personal and private information online<br>• Responding to cyberbullying |

| | | |
|---|---|---|
| | | • Using digital communication tools with audience in mind |
| **Yearly**<br>• Protecting personal and private information online<br>• Responding to cyberbullying<br>• Using digital communication tools with audience in mind<br>• Being an informed consumer<br>• Appreciating everyone has digital rights<br>• Understanding laws that apply to digital tools (e.g. privacy, sharing graphic content, copyright) | **Yearly**<br>• Protecting personal and private information online<br>• Responding to cyberbullying<br>• Using digital communication tools with audience in mind<br>• Appreciating everyone has digital rights | **Yearly**<br>• Being an informed consumer<br>• Appreciating everyone has digital rights<br>• Understanding laws that apply to digital tools (e.g. privacy, sharing graphic content, copyright)<br>• Identifying the risks and consequences of sexually explicit content<br>• Participating in online public forums including social media<br>• Maintaining privacy from corporations (preventing data tracking, reading privacy policies)<br>• Understanding bias and unequal access to technology impacts society<br>• Understanding how technology features are designed to increase time spent online (e.g. nudges, notifications, autoplay)<br>• Being aware that companies profit from increasing time users spend online |
| **Less than Yearly**<br>• Maintaining privacy from corporations (preventing data | **Less than Yearly**<br>• Being an informed consumer | **Less than Yearly**<br>• Understanding algorithms and how they affect everyday |

| | | |
|---|---|---|
| tracking, reading privacy policies)<br>• Identifying the risks and consequences of sexually explicit content<br>• Participating in online public forums including social media<br>• Understanding bias and unequal access to technology impacts society<br>• Understanding how technology features are designed to increase time spent online (e.g. nudges, notifications, autoplay)<br>• Understanding algorithms and how they affect everyday experiences (e.g. search results)<br>• Being aware that companies profit from increasing time users spend online | • Understanding laws that apply to digital tools (e.g. privacy, sharing graphic content, copyright)<br>• Maintaining privacy from corporations (preventing data tracking, reading privacy policies)<br>• Identifying the risks and consequences of sexually explicit content<br>• Participating in online public forums including social media<br>• Understanding bias and unequal access to technology impacts society<br>• Understanding how technology features are designed to increase time spent online (e.g. nudges, notifications, autoplay)<br>• Understanding algorithms and how they affect everyday experiences (e.g. search results)<br>• Being aware that companies profit from increasing time users spend online | experiences (e.g. search results) |

***Least Frequently Taught***

Across K-12 educators, several topics were taught less than yearly on average in this sample, including maintaining privacy from corporations, risks and consequences of sexually explicit material, participating in online public forms such as social media, how bias and unequal access to technology impacts society, how technology is designed to keep

users online, algorithms in everyday experiences (e.g., search results), and how companies profit from increasing time users spend online (See Table 12). These topics were noticeably geared towards more structural understandings of digital interactions (e.g., "understanding algorithms and how they affect everyday experiences", "understanding how technology features are designed to increase time spent online") and awareness of commercial interests in digital spaces (e.g., "Being aware that companies profit from time users spend online").

Because schools with fewer resources may face unique challenges in implementing digital literacy initiatives (e.g., less personnel for tech integration, less funding available for curriculum), we used schoolwide Title I status (where 40% of students are identified as low income) to compare how often educators at higher resourced schools taught specific topics compared to educators at lower resourced (i.e., Title I) schools. We found significant, statistical differences in how often educators at higher resourced schools (non-Title I) taught these less frequently taught, structural/commercial topics compared to educators at lower resourced schools (Title I). Educators working at higher resourced schools taught algorithms in daily life [$t(790)=2.19$, $p<0.05$], understanding how technology features are designed to increase time online [$t(788)=2.27$, $p<0.05$] and maintaining privacy from corporations [$t(791)=3.35$, $p=0.000$] more frequently than educators at lower resourced schools, on average, suggesting students attending these schools may have more opportunities to learn and think about these critical topics beyond the level of individual responsibility.

***E-Rate vs. Non-E-Rate Topics***

We examined whether educators tended to teach topics that aligned with E-rate requirements more often than other topics. On average, educators reported teaching at least once a year 3 of the 4 E-rate topics, and 7 of the 13 non-E-rate. To determine whether there were significant differences between how often educators taught E-rate topics compared to non-E-Rate topics, a paired samples t-test was conducted, indicating that educators talk about E-rate topics significantly more often (X=1.68, SD=1.18) than non E-rate topics (X=1.11, SD=0.97); [t(741)=-22.19, p=0.000], though both categories were taught less than once a month.

**RQ3: Predictors for Teaching Digital Citizenship**

A regression analysis predicting total digital citizenship instruction using educator demographics, educator uses of technology in the classroom, challenges for technology integration, and student access to devices as predictors was significant $F(17, 775) = 17.54$, $p= 0.000$. See Table 13. Results indicate that classroom teachers taught less digital citizenship ($\beta=-2.47$, $p<0.05$) compared to educators in other roles (e.g. special education teachers, librarian/media specialist, instructional coaches). Educators working with older students in grades 6-12 taught more digital citizenship ($\beta=6.43$, $p=0.000$) compared to those teaching grades K-5. This is a notable difference because much of the digital literacy and digital citizenship literature discusses K-12 as a whole, rather than specific comparisons between elementary and secondary patterns of instruction.

Additionally, more educator use of classroom technology predicted more digital citizenship instruction, on average. Challenges for classroom uses of technology were not significant predictors for digital citizenship instruction when holding educator

demographics, uses of technology, and student access to technology constant, suggesting that educator perceptions of challenges do not play a major role in decisions about digital citizenship instruction for educators included in this sample.

When comparing differences in digital citizenship instruction across states, educators working in Alabama (β=7.21, *p*=0.000) taught more digital citizenship, on average, than Kentucky. Given state-related differences in educator reports, we examined state level guidance and policies for digital citizenship, digital literacy, or media literacy instruction. We found three states had explicit standards and frameworks for this type of instruction: Kentucky (Kentucky Academic Standards for Technology, K-12), Alabama (Alabama Course of Study: Digital Literacy and Computer Science), and Wisconsin (Wisconsin Standards for Information and Technology Literacy). Alabama may be unique because the Alabama Course of Study: Digital Literary and Computer Science standards claim that "Content standards in this document are minimum and required as specified in the Code of Alabama (1975), §16-35-4", citing an Alabama law granting the Board of Education to prescribe minimum content expectations. Alabama also has a "Alabama DLCS Standards Teacher Resources Companion Site" where ready-made materials, lesson plans, and student tools are available for each grade level and learning goal in the Digital Literacy and Computer Science standards (Alabama State Department of Education, 2020). Though these states all had frameworks for digital literacy instruction, educators working in Alabama were significantly more likely to address the digital citizenship topics included in this survey and this could be due to some degree of regulatory pressure and the curricular support provided to educators.

Overall, the factors we used in our regression model accounted for 28% of the variance in digital citizenship instruction. This suggests that there is much we are not accounting for when it comes to explaining why educators provide digital citizenship instruction or not.

***Instruction of E-Rate Topics***

A regression analysis examining whether covering topics required for E-rate eligibility was related to educator demographics, educator uses of technology in the classroom, challenges for technology integration and student access to devices as predictors found that the model accounted for 23% of the variance in teaching topics related to E-rate funding, $F(17, 752) = 13.17$, $p = 0.000$ (see Table 13, Model 2).

Educators working at schools that issued laptops to all students were more likely to teach E-rate digital citizenship topics compared to those working at schools without laptop programs ($\beta=1.14$, $p<0.05$). Because working at a school with school-issued laptops was not a significant predictor for digital citizenship instruction more broadly (see Model 1), suggesting that there may be something different about digital citizenship topics that fall under E-rate requirements. Additionally, educators who reported more challenges related to student device use (off task on laptop, issues charging laptop, forgetting laptop) were more likely to report teaching E-rate topics ($\beta=0.40$, $p<0.01$). It is plausible that schools with widespread student laptop programs, and thus more of the challenges associated with student laptops, also pursue discounted or free internet services through the federal E-rate program. Thus, E-rate topics may be more mandated at the school or district level compared to other digital citizenship topics.

Similar to Model 1, educators in secondary settings (6-12 grades) were more likely to report teaching E-rate digital citizenship topics than educators in elementary school settings (β=1.14, $p$<0.01) and educators working in Alabama were more likely to teach E-rate digital citizenship, using Kentucky as reference group, but we did not find any other significant differences among states.

### *Commercial/Big Data Topics*

Regressions examining the overall frequency of instruction related to commercial/big data topics indicated that classroom teachers, compared to special education teachers or other educators (e.g., librarian, media specialist), were less likely to report teaching about commercial/big data topics (β= -0.96, $p$<0.05). See Table 14. Similar to total digital citizenship and E-rate models, teaching grades 6-12 (β=2.52, $p$<0.001) and working in Alabama (β=2.51, $p$<0.001) were associated with more commercial/big data digital citizenship instruction. Educators who reported more classroom uses of technology (β=0.17, $p$<0.001) were more likely to teach digital citizenship related to commercial/big data topics compared to those who used technology less. None of the variables related to school level resources (Title I school, student access to devices) or reported challenges were associated with educators' teaching of commercial/big data topics.

## Discussion

Recent advancements in generative artificial intelligence (genAI) and its uptake by students and educators in K-12 environments (OECD, 2023; US Office of Educational Technology, 2024) has sparked renewed interest and debate over what digital citizenship instruction should look like in an algorithmic age (Ng et al., 2021). However, prior to this

study, not much was known about which digital citizenship topics are being taught and how often, across a national sample of K-12 educators in the United States. Using data from the educator SpeakUp Survey collected in 2022-2023, our study describes which digital citizenship topics educators report addressing across grades K-12, how often they talked about specific topics, and which educator and school level characteristics were associated with more digital citizenship instruction. We outline several key findings and ideas for meeting new demands of digital citizenship instruction. In addition to providing an important and overdue snapshot of current practices, these data provide insight into understudied areas of digital citizenship education such as algorithmic awareness, protecting against corporative surveillance and data profiling (e.g. 'corporate surveillance'; Zuboff, 2019) and how bias and unequal access to technology can impact society.

Our data indicate that overall, educators talk about few topics and even less in elementary school compared to secondary school. Though not a longitudinal sample, the pattern suggests that digital citizenship instruction may be "too little, too late", focusing on a narrow range of topics and introducing them late in children's K-12 experience to address current realities. Across grade levels, educators did not talk much about digital citizenship in the course of the academic year and when they did, they tended to discuss a narrow set of surface level topics that emphasize individual responsibility over more systematic and critical thinking about digital spaces. Additionally, digital citizenship instruction was more likely to occur in grades 6-12 compared to elementary grades (K-5), despite widespread use of digital technologies among younger children (Auxier et al. 2020; Rideout & Robb, 2020).

**Digital Citizenship for the Algorithmic Age**

Findings suggest that educators need more resources and supports for preparing digitally literate students and democratic citizens in the algorithmic age. Digital platforms are the main resource for young people to learn about current events (Matsa, 2023), often through social media on their phones (Ofcom, 2024b), and for accessing different opportunities related to social and economic participation (e.g., educational opportunities, jobs). Yet, we know that the ways commercial technology platforms gather data about users and use those data to power their proprietary algorithms can heavily shape the information young people see online, who they are prompted to make connections with, and what kinds of opportunities are presented to them (as well as risks) (Zuboff, 2019).

Topics such as 'using technology to learn new things' or 'being empathetic and kind online' were taught most often across all grade bands, while the topics we grouped as "commercial/big data" related to algorithms, profit incentives of tech platforms, or data tracking online were taught less than yearly. This makes sense given the state of current resources available to educators. A prior content analysis of digital citizenship curriculum and frameworks showed that they focus on interpersonal safety and prescriptive messaging such as "being kind online" and do not sufficiently address artificial intelligence, computational thinking, data privacy and data flows online, or the profit-driven nature of digital platforms (Cortesi et al., 2021). Importantly, the topics more frequently taught among our sample of educators, such as "being kind" or "maintaining a media balance" are more surface level issues and they emphasize an individual responsibility model of online

safety, where children are individually and solely responsible for the interactions they have or for having the self-regulation to engage and disengage with digital spaces.

The focus on surface level understandings and individual responsibility ignores the current structure of internet technologies. For example, the most common topic educators discussed with children was "using technology to learn new things", which likely involves some degree of internet searching. However, barely any educators talked about how algorithms work in search results or how bias impacts society. This is an important gap given that a basic knowledge of algorithms or how platforms curate information is required to make sense of any search results. Similarly, educators in our sample reported their most common challenge was students' off-task behavior with technology, yet most educators never talked about the persuasive design techniques technology platforms use to make it difficult to disengage from a device and for children to remain on task when using a device.

Recent work with young people supports the idea of more expansive digital citizenship instruction, and specifically one that calls attention to for-profit incentives and exploitation of youth experiences in technology systems. Survey data with youth ages 13-24 years shows that over half say they spend too much time on social media and 80% do not feel very safe online (Family Online Safety Institute, 2021). Half of young people think managing their online safety is overwhelming and that they do not have access to resources to manage it properly. Interview data within the same study highlight that young people feel like the harm they experience online is out of their control (Family Online Safety Institute, 2021). Expanding digital citizenship instruction to include more systematic and critical aspects of digital literacy could help youth understand why they feel a lack of

agency in their algorithmically driven experiences and provide tools and strategies for managing digital environments. We discuss this in more detail in the Implications section.

### Equity Issues and Digital Use Divides

Prior research shows that digital citizenship instruction can vary based on teacher and school demographics such as teacher experience, student grade, racial and ethnic diversity, and urbanicity (Lauricella et al., 2020). When certain students are more likely to access specific types of digital instruction over others, we must consider these patterns as potential challenges to modern educational equity and as a form of the "digital use divides" highlighted in the recent National Educational Technology Plan (US Office of Educational Technology, 2024).

Concerningly, we found significant differences in how often higher resourced schools were teaching about more "Commercial/Big Data" topics compared to lower resourced schools. Though not commonly taught in general, schools with more resources were more likely to talk to students about algorithms, persuasive design, and data tracking/profiling, suggesting another dimension of "digital use divides" previously theorized (Gran, Booth, & Bucher, 2021; US Office of Educational Technology, 2017; US Office of Educational Technology, 2024). These kinds of understandings are critical for full inclusion and participation in a digital society, but if only a select few understand these technologies, we run the risk of further stratifying society into those who profit from technologies and those who are exploited by technologies.

Discussions of algorithms in particular have traditionally been confined to computer science courses rather than more broadly discussed as part of general curriculum (Ciccone,

2023), presenting another challenge specifically to understandings of algorithms in daily life. Confining the study of AI to computer science classes means that older students and those attending more affluent schools are more likely to learn about algorithms compared to other groups of students (Code.org, 2024). Learning about how algorithms work, where they impact society and daily interactions, and the ethical use of AI should not be confined to one discipline and should rather be positioned as part of literacy studies or general curriculum. More resources that are easy for non-experts to facilitate with young people are needed to expand algorithmic awareness and understandings beyond the silos of standalone computer science courses.

**Possible Explanations for Lack of Digital Citizenship Instruction**

Our data offer several possible reasons why digital citizenship instruction does not take place at a higher rate overall across grades K-12, and specifically for commercial/big data topics that are increasingly salient for everyday life. First, only half of educators reported feeling comfortable teaching digital citizenship topics, which is significant given our sample. Educators were working at schools that had opted into the SpeakUp survey, indicating an expressed interest in technology integration, and still only 1 in 2 felt comfortable teaching digital citizenship content. Classroom teachers in our study were less likely to teach digital citizenship across all outcomes, compared to other kinds of educators. Perhaps classroom teachers have less bandwidth or confidence in teaching these topics compared to specialists such as librarians, instructional coaches, or even special educators who may navigate assistive technologies. Second, educators may not have strong incentives to prioritize digital citizenship instruction when they are balancing other curriculum demands. Educators were more likely to teach topics aligned with E-rate requirements

compared to topics unrelated to current E-rate protocols. This suggests that some kind of accountability pressure and financial incentives at the school or district level could influence how often digital citizenship topics are taught at schools. The predictive power of working in Alabama across all our digital citizenship outcomes of interests suggests that some formalized expectations and accessible library of materials might help educators teach more digital citizenship. Because schools do not currently have any financial incentives or accountability measures tied to categories beyond E-rate, non-E-rate topics may be taught less often or not at all. Third, educators working at middle and high schools were more likely to teach digital citizenship topics across all topics, compared to educators at elementary schools. Elementary school students are growing up in highly digital school and home environments, just like their older middle and high school peers, but our data suggests they may not have similar opportunities to reflect on digital citizenship practices. It is possible that stakeholders do not feel younger students need this kind of instruction or perhaps educators perceive a lack of appropriate digital citizenship curriculum and resources for younger students. Our data do not speak to why elementary school educators talked about digital citizenship less than secondary educators, but we highlight several elementary focused digital citizenship resources in our Implications section. Fourth, many of the commercial/big data topics include somewhat newer understandings of emerging technologies and data systems, so it is possible that veteran teachers may be less familiar with these terms.

**Limitations**

Our study was limited to a non-random sample of educators across the United States and not all educators completed questions towards the end of the survey, which limits

generalizability. Though the survey was distributed nationally, 5 states were particularly overrepresented (KY, AL, CA, WI, FL). A large scale, nationally representative sample of educator practices with digital citizenship would be helpful in further examining digital citizenship patterns. These are cross-sectional data so we cannot speak to what may cause more or less digital citizenship instruction, though the associations we found suggest areas for future research.

## Conclusion

Digital citizenship instruction has not kept pace with important changes in technology such as the rise of artificial intelligence, corporate surveillance and data profiling, and the unique risks posed by unregulated digital environments for children and youth in everyday digital interactions. Schools have traditionally been an important mechanism for democratic participation and social mobility in the United States (Labaree, 1997), but there are key digital skills and competencies children need to develop to navigate modern citizenship and full participation in an algorithmic age. Without consistent opportunities to learn about digital citizenship, and specifically the more commercial/big data topic areas, there will be groups of students who develop these understandings while others will be at the mercy of algorithmic profiling for employment and postsecondary opportunities.

The limitations of our data prevent us from making any causal claims about why digital instruction is happening more or less often in certain school environments, thus we can only offer potential explanations that should be further explored. Our data come from a non-representative sample of educators across the US, so generalizability is limited.

Despite these limitations, we offer an important and detailed landscape of current digital citizenship instruction in US public schools.

**Implications and Next Steps**

- Students across K-12 need more opportunities to interrogate and learn about the structures driving online interactions and information seeking. In addition to broader curriculum and frameworks available for K-12 audiences such as Common Sense Media and ISTE, there are several newer resources addressing commercial/big data topics freely available and accessible to non-expert audiences. These include Code.org's AI Curriculum Catalog, Stanford's CRAFT AI Literacy Resources, the AI Education Project, and Risky-by-Design Case Studies from the 5Rights Foundation. It should be noted that several of these sites do not have curricula available for grades K-2 and focus on grades 3-12.
- More program evaluation is needed to determine the impacts of digital citizenship education curriculum and teaching methods on student knowledge and experiential outcomes. Though several digital citizenship curricula are available, little has been done to understand what works, for whom, and under what conditions for widely available digital citizenship curriculum.
- More co-designed and youth-informed digital citizenship curriculum would likely be helpful for aligning content with the realities and priorities of young leaners.
- Schools need updated guidance and institutional supports to expand digital citizenship instruction and ensure students have opportunities to develop necessary digital citizenship skills. This could manifest through different forms of guidance

such as evidence-based School Media Plans or US Office of Educational Technology leadership on specific standards, curriculum, and currently available evidence for digital literacy and citizenship program impacts, similar to the What Works Clearinghouse or evidence tiers at IES. Institutional supports through direct financial support for digital citizenship instruction or through partnerships with universities and libraries could facilitate more opportunities to learn about digital citizenship.

- E-rate policies should be updated to include newer categories of required topics. Alternatively, additional policies could be created that provide financial incentives for teaching students about important digital citizenship topics.

Table 13. Summary of Regression Analyses Predicting Total Digital Citizenship Instruction and Total E-Rate Topic Instruction

| | (1) Total Digital Citizenship Instruction (17 topics x frequency) n =793 | (2) Total E Rate Topic Instruction (4 topics x frequency) n= 770 |
|---|---|---|
| | *b* (SE) | *b* (SE) |
| Educator Demographics | | |
| Subject Taught | 0.16 (0.15) | -0.01 (0.05) |
| **Classroom Teacher** | **-2.46 (1.25) *** | -0.71 (0.37) |
| **Teaches grades 6-12** | **6.43 (1.29) ***** | **1.14 (0.38) **** |
| **Educator working in Alabama [a]** | **7.21 (1.80) ***** | **1.79 (0.54) **** |
| Educator working at Title I school | -1.49 (1.42) | -0.01 (0.42) |
| Educator Tech Integration | | |
| **Total Classroom Use of Technology** | **0.69 (0.05) ***** | **0.18 (0.02)***** |
| Challenges for Tech Integration | | |
| **Student level issues** | 0.56 (0.60) | **0.40 (0.18)**** |
| Time | -0.16 (0.47) | -0.08 (0.14) |
| Educator lack of decision making | 0.58 (0.43) | 0.22 (0.13) |
| Lack of training | -0.63 (0.75) | -0.06 (0.22) |
| Educator hardware and software | 0.67 (1.16) | -0.10 (0.35) |
| Student Access to Devices | -0.38 (2.46) | -0.31 (0.51) |
| **Students get school issued laptops** | 3.00 (1.71) | **1.23 (0.50)*** |
| $R^2$ | 28% | 23% |

Notes. ***p<0.001, **p<0.01, *p<0.05; [a] Dummy variables for states worked were included in regression model but not included in table, working in Kentucky as omitted

Table 14. Summary of Regression Analyses Predicting Commercial/Big Data Topic Instruction

| | (3) Commercial /Big Data Topic Instruction (n=793) |
|---|---|
| | *b* (SE) |
| Educator Demographics | |
| Years Teaching | -0.20 (0.14) |
| Subject Taught | 0.04 (0.05) |
| **Classroom Teacher** | **-0.96 (0.39)*** |
| **Teaches grades 6-12** | **2.52 (0.40)***** |
| **Educator working in Alabama** [a] | **2.51 (0.56)***** |
| Educator working at Title I school | -0.59 (0.45) |
| Educator Tech Integration | |
| **Total Classroom Use of Technology** | **0.17 (0.02)***** |
| Challenges for Tech Integration | |
| Student level issues | -0.09 (0.19) |
| Time | 0.05 (0.15) |
| Educator lack of decision making | 0.09 (0.13) |
| Lack of training | -0.34 (0.23) |
| Educator materials and supports | 0.34 (0.36) |
| Student Access to Devices | |
| Students get school issued laptops | 0.33 (0.52) |
| $R^2$ | 23% |

## Conclusion

Children are growing up, playing, negotiating new roles, and strengthening important social connections in digital spaces. However, there are several features of the digital ecosystem that can create tensions for children's lives online (Livingstone et al., 2024). These tensions are still largely underexplored in middle childhood, though children are increasingly acquiring their own phone and entering socially networked spaces during this unique developmental stage.

Children in middle childhood are different than young adults and adolescents. They are thinking in new ways, moving towards more abstract and complex thought (Piaget, 1970), expanding their capacity for perspective taking (Selman & Byrne, 1974), and taking on more and more responsibility in their social environments and in their own self-management (Finch & Obradović, 2017; Sasser, Bierman, & Heinrichs, 2015). Therefore, it is no surprise that they are drawn to the vast opportunities digital technologies offer for social connection, play, learning, and new environments.

Although children under the age of 18 account for at least 1 in 3 global internet users (Livingstone et al., 2015), the digital technologies and platforms that are used most by young users are largely not created with the needs of children in mind (Ito, Cross, Dinakar & Odgers, 2021) and do not consider how those needs change over the course of development (5Rights Foundation, 2021; Lenhart & Owens, 2021). In fact, many of the platforms most popular with younger children (e.g., TikTok, Instagram, Snapchat, YouTube) do not recognize their presence because everyone who signs up must attest to being 13 years old or older, typically by entering a birthdate. As our findings show, these age gates are quite ineffective for keeping younger users off of platforms designed for

adults. Even platforms that allow users under the age of 13 and those that attempt to differentiate their platforms for children, such as Roblox, still fall short of providing age-appropriate experiences. Though platforms like Roblox have child settings in theory, children in our study shared several incentives for not using their real birthdates and registering as older users with all the privileges and permissions of an adult.

Across three studies, this dissertation highlights the benefits children reap from their digital experiences, as well as some of the ways platforms can undermine developmental processes and introduce risks related to privacy and victimization. Children's rights scholars assert that technology platforms and the choices they make to employ certain design features perpetuate known harms to children in favor of engagement for profit (Livingstone, Lansdown, & Third, 2017; Valentino-DeVries & Keller, 2024). Through these three studies, we shed light on the processes where "…tensions arise among children's rights to agency (including access to information), protection (from harm and exploitation) and privacy, and when their rights are at risk in a commercial and data-driven digital world" (Livingstone et al., 2024, p. 5).

These three studies highlight several important aspects of children's lives in the algorithmic age and have particular implications for the ongoing conversation about children's rights online and for specific design decisions aligned with children's rights (i.e., Child Rights by Design, Livingstone & Pothong, 2023). The stories and experiences presented in this dissertation underscore how children are active agents in their digital life, seeking information and experiences to meet their needs and creating inventive workarounds for challenges they face. But traditional notions of agency are complicated in the digital and global sphere of online life, where it can be difficult to see the underlying

structures and platform-level decision making shaping our digital lives. The Digital Futures Commission (now the Digital Futures for Children organization), offered a vision for children's agency online, defining it as:

> children can decide freely how to engage with the digital environment. This includes being able to start and stop using digital products and services of their choice easily, without feeling they are losing out, knowing and getting precisely what they have signed up for, and not being tempted, manipulated, or nudged into doing anything that undermines their safety, privacy, development and wellbeing (Livingstone & Pothong, 2023)

Children in our focus groups wanted more privacy and more control over what they saw online and over the interactions they had in digital spaces, echoing prior work with older adolescents (Agosto & Abbas, 2017; Santer et al., 2023). They did not realize that they had signed some of these rights away with one click when creating platform accounts on pages that also functioned as consent for exploitative privacy policies and terms of service.

Platform features played a key role in perpetuating misunderstandings and harms. For example, privacy policies and agreements are not easy to understand and they are often hidden at the bottom of sign-up pages in small print. Consenting to these extractive privacy policies are a key step in the process of algorithmic profiling, because they grant platforms permission to track, aggregate, sell and use a child's personal behavior and data online. This information is then used to pick which ads are shown to children and to create a mix of videos that will keep the child watching for longer—whether or not that content aligns with their developmental needs. Children in our focus groups lamented the time they

felt they had lost to mindless scrolling and spoke about the difficulty of disengaging from algorithmically curated content. Educators were also concerned about children's ability to regulate their use of technology, where student off task behavior and distraction with technology was the most common challenge among the 1,325 educators in our survey sample.

The consistent lack of choice for young users stands in tension with the vision for children's agency online and recent legislative efforts to codify children's rights in the digital age. Recent legislation such as the UK Age Appropriate Design Code and the EU Digital Services Act has prompted platforms to change certain features to be more aligned with children's rights, but research to date has not documented whether recent changes catalyzed by European regulation translate to meaningful shifts in children's experiences or whether children across the globe benefit, rather than changes being geographically specific (Mootz & Blocker, 2024). According to our data, it is clear that there is more work to do.

Children described using digital technologies to meet crucial needs for peer socialization, family connection, play and learning. However, they also shared about being tracked, profiled, deceived, harassed, and disturbed by the content and interactions enabled on social media and gaming platforms. Right now, with much of the popular internet being privately held and unregulated in the United States, the cost of participation in online life is high for children. Our data suggest several ways to make platforms more aligned with the rights of children articulated in the UN Convention on the Rights of the Child (1989) and General Comment No. 25 specific to children's rights in the digital

environment, though these changes will likely need to be incentivized by regulatory work within the United States. Potential changes aligned with children's rights online include:

- Offer more prominent (and effective) reporting and blocking tools (e.g. brightly colored, large and easy to identify buttons); these could be co-designed and iterated with young people
- Provide easy access tools for resetting and customizing feeds in developmentally appropriate ways
- Offer clear, prominent reset buttons for curated feeds (e.g., ForYou page, Instagram feed or Reels)
- Provide a prompt where users choose their age range (i.e., "I am 8-10 yrs old" button) at top of feed rather than rely on them to self report accurate age at sign up
- More investments in content moderation and quality control
- Built-in friction for endless scrolling
- Design hard stops at 50 videos on platforms like YouTube Shorts and TikTok
- Allocate resources for Child Impact Assessment research with youth users
- Default to strongest privacy settings across all apps
- When images are sent or received, automatically present pop-up window that asks if you are consenting and providing resources for sexploitation and harassment.

Right now, children must balance the opportunities provided by online contexts with a number of risks related to digital privacy, algorithmic systems, online victimization, and inequality. With new media landscapes and a lack of child-centered design, it is important to understand what it looks like on the ground for children spending time on

these platforms. This dissertation draws on rich conversations with a diverse group of 8- to 11-year-old children to highlight their cognitions, perspectives, and experiences in today's digital ecosystem. Additionally, we sought to understand what educators were teaching about digital technologies and especially understandings related to commercial and big data systems in K-12 school settings. A discussion of children's development and learning in the digital world needs to include a critical awareness of digital ecosystems and the power relations within them. Judy Wacjman, a feminist theorist of science and technology writes, technology is "the result of conflicts and compromises, the outcomes of which depend primarily on the distribution of power and resources between different groups in society" (Wajcman, 1991, p. 62). Children, as a group, have not had an active role in shaping the ways digital media and technologies are designed, regulated, or moderated in daily life. Instead, the power in digital spaces largely rests with a handful of select technology platforms and their corporate leaders. This dissertation offers insight into the ways children are making sense of algorithmically driven experiences and data collection practices embedded in their favorite digital spaces. Findings suggest that children do not have many opportunities in formal learning settings to develop their awareness and thoughts about commercial structures such as algorithmic curation or dataveillance, as evidenced in our analysis of digital citizenship instruction in K-12 schools. At the school level, educators across the US reported low rates of digital citizenship and literacy instruction, suggesting an overall lack of opportunities to talk about issues relevant for modern participation. Discussions with children in our focus groups similarly yield little evidence of digital citizenship education or algorithmic awareness.

From a child's rights perspective, there are tensions between supporting children's access to information and participation with ensuring freedom from harm. The children we talked to wanted freedom and this freedom came in many forms, from owning their own smartphone to being free from advertising, harassment from unknown others, and distressing content online as well as freedom to make more choices about their online experiences. We found that although owning a phone had unique benefits—risks were largely not device-bound (with the exception of time loss). Rather, the risks children most often encountered were a byproduct of commercial, platform-based decisions to put profits over people.

Developmental psychologists have argued that risk is unavoidable in childhood and that taking risks is essential for development (Tamis-LeMonda, 2022). Thus, it can seem condescending or antithetical to children's rights when adults start talking about online safety and avoiding risk. However, the conversation about children's agency and necessary risk in digital ecosystems is incomplete without acknowledging the underlying structures shaping children's everyday experience of risk and opportunity, namely the for-profit digital ecosystem and the algorithmic underpinnings of digital content.

Children need freedom to make mistakes, and better design and regulation can build scaffolds so that children can stumble without plummeting. Children would benefit from opportunities to learn about the digital structures where they spend time as well as space to consider their own rights. To gain a sense of agency in their preferred platforms, some children we talked to developed innovative workarounds or original ways to "outsmart" platforms, but the majority were unaware of the vast data collection and exploitation efforts of the platforms they spend time on, and most did not understand how algorithms

work in their daily digital interactions. Older children and emerging adolescents had more advanced explanations for how algorithms worked but still struggled to effectively exert more control over their own experiences. The oldest group of children we talked with (11-year-olds) spoke about the limited choices they have when it comes to digital privacy versus accessing the benefits of artificial intelligence. This trade-off is exemplified well by this except of 11-year-olds talking about Snapchat's AI and algorithms in general:

> Caleb: Imma ask it "Do you know where do I live?" [types into Snapchat AI]
>
> Andrés: Or like where's my location? It says it doesn't know but then I ask it for the nearest McDonald's and it says it's like right there [points to map]
>
> Caleb: [reading from Snapchat AI chat] You are currently located in [blank] City, California. So, it knows where you are at any point.
>
> Luis: That it is really weird.
>
> Caleb: Sketch. Sketchy.
>
> Luis: Cause, like, why would you need… Cause I asked my Snapchat AI 'do you know where I live?' and then it says like 'I don't have the power to know, to know, to track your location' but then I asked it—
>
> Andrés: For like the nearest McDonald's. It is trying to hide that they know--

Luis: Where you live.

Andrés: Or like your location.

Facilitator: How are we feeling about AI in general right now?

Caleb: Freaky, but helpful.

Caleb: Cuz you can ask it for tips for stuff.

Luis: With math. Or like schoolwork.

Caleb: You can ask it tips for stuff and it will sometimes say oh I can't do this. Or oh yeah you do this.

Andrés: It helps you.

Luis: Or like schoolwork.

Andrés: Uh huh. It's kinda like knowing your location is good and bad. Just like AI is good and bad.

Andrés demonstrates thoughtfulness about the compromises of using artificial intelligence. Characteristic of the later stages of middle childhood, Andrés also shows his ability to think in abstract terms and use more advanced reasoning (Dumontheil, 2014; National Research Council, 1984; Piaget, 1970), accepting that the "good" of AI also comes with the "bad" of AI. But it is important to consider whether children have all the information they need to make decisions about these kinds of tradeoffs. From a developmental standpoint, most children in middle childhood do not yet have this cognitive capacity. As such, it is also worth considering whether we, as a society, want to accept these risks as the necessary cost of participating in modern life or whether there is a way to move towards more human-centered artificial intelligence. The data scientist and scholar Cathy O'Neil (2017) writes:

> Big Data processes codify the past. They do not invent the future. Doing that requires moral imagination, and that is something only humans can provide. We have to explicitly embed better values into our algorithms, creating Big Data models that follow our ethical lead. Sometimes that will mean putting fairness ahead of profit.
>
> -- *Weapons of Math Destruction*, pg. 204

Children, young people, and adults need to understand how algorithms work, where they show up in daily life and where their limitations lie. They need to know that their "free" access to a platform is not really free. Rather, our data and behaviors are extracted and then used to shape our daily access to information, people, and opportunity. O'Neil

(2017) talks about how if Big Data algorithms were trained on historical data sets to decide who would be accepted to college, most colleges would likely only accept white, male students. In this sense, they codify what has been done in the past instead of moving us forward towards a more expansive future. Algorithms are not good at dreaming, and by nature exhibit more convergent than divergent logic, drawing on vast amounts of data documenting what has already been done. Thus, we should be critical of where and when human thinking, human creativity, and human morality needs to play a key role in algorithmic decision making and the digital ecosystems it creates.

Digital spaces could be built in ways that provide "risky opportunities" (Livingstone et al., 2024) rather than a wide array of just risks. Our data show that children experience crucial developmental benefits through time spent online and by having access to their own smartphone. The risks become more pronounced when they enter socially networked spaces that are unregulated, unmoderated, and designed for engagement over children's best interests (Livingstone et al., 2024). The United Nations General Comment No. 25 (2021) outlines children's rights in the digital age, considering everyone under the age of 18 to be a child and deserving of human rights in the algorithmic age. Our analysis shows that it is also important to consider the developmental strengths, capacities, and vulnerabilities of children across age groups, especially the second half of elementary school when many children are getting their own smartphones and engaging with social media. Children in middle childhood have unique needs as well as susceptibilities that influence their online interactions. To be online means navigating opaque algorithmic systems and data extraction practices. These are abstract concepts and our data show that children are savvy media users, but they still need help understanding these systems.

Children are engaging in these spaces without really knowing how they work and without many opportunities to learn about emerging technologies such as artificial intelligence. Instead, most children relied on folk theories and work arounds to navigate life online.

Collectively, this three-study dissertation highlights the voices of young digital media and technology users, specifically between the ages of 8 and 11 years old, as well documents the opportunities young learners have to develop their skills and understandings about technology and new digital media in US public schools. The three studies presented here offer unique contributions, including (1) documenting the experiences of underrepresented voices in digital media and communications research (2) considering the tensions between certain features of the digital environment and children's developmental needs and (3) highlighting areas of growth for digital learning practices in K-12 schools. When we understand how children are experiencing digital spaces, along with risks and opportunities they encounter, we can help them dream and create the spaces they want, make more informed decisions about developmentally appropriate design, and think about ways to support their increasingly important digital literacy skills. It also important to recognize the limits of children's agency online, even with strong digital literacy skills, and where regulations and oversight are needed.

Technology regulatory policy in the US currently relies on users to manage their own risk online, often resulting in a forced choice between online participation with accompanying risk of datafication and exploitation or not participating at all. This trad eoff is a difficult balance for children to consider. The risks associated with datafication are largely abstract and algorithmic curation processes are invisible to many users (Eslami et al., 2015). Thus, it is questionable how much agency children have in these interactions

when they are still developing the capacities for abstract thought and more complex cognition (Collins & Madsen, 2019; Piaget, 1970) required to understand basic structures of digital spaces. At the same time, children have very real, concrete incentives to accept risk, known or unknown, in order to meet needs for social connection, play, and learning.

Online environments offer a number of benefits for children, but the absence of large-scale protections and child-centered design places the burden on parents and teachers to protect children's interests and on the child to figure out these spaces, invent workarounds, and try their best to encounter more good than bad. These capacities require a great deal of critical thinking, self-regulation, and abstract thought, which are all in various stages of development in middle childhood. These dissertation findings suggest this is an imbalanced and flawed approach. Most platforms popular with youth have not been transparent about the data they collect about children's experiences on their platforms. Thus, the insights shared by children in this dissertation offer critical information about the opportunities and risks 8-11-year-olds experience navigating digital spaces, in a time when the absence of regulation likely shapes their digital lives. These studies fill meaningful gaps in the literature by providing rich descriptions of children's transitions into smartphone ownership, their increasing capacity for identifying benefits and managing different kinds of risk, and the kinds of information and supports they need to ensure their rights in the algorithmic age.

## References


5Rights Foundation. (2021). *Pathways : How digital design puts children at risk.* 5Rights Foundation. https://5rightsfoundation.com/uploads/Pathways-how-digital-design-puts-children-at-risk.pdf

5Rights Foundation. (2023). *Disrupted Childhood: The cost of persuasive design*. 5Rights Foundation. https://5rightsfoundation.com/in-action/disrupted-childhood-the-cost-of-persuasive-design-2023.html

Agosto, D. E. & Abbas, J. (2017). "Don't be dumb—that's the rule I try to live by": A closer look at older teens' online privacy and safety attitudes'. *New Media and Society*, *19*(3), 347–365. https://doi: 10.1177/1461444815606121

Ali, M., Sapiezynski, P., Bogen, M., Korolova, A., Mislove, A., & Rieke, A. (2019). Discrimination through Optimization: How Facebook's Ad Delivery Can Lead to Biased Outcomes. *Proceedings of the ACM Conference on Computer- Supported Cooperative Work and Social Computing*, *3*, CSCW (Article 99), 1-30. https://dl.acm.org/doi/10.1145/3359301

Akgun, S. & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI and Ethics*. 2(3), 431–440. https:// doi: 10.1007/s43681-021-00096-7.

American Psychological Association. (2024). *Potential Risks of Content , Features , and Functions: A closer look at the science behind how social media affects youth*. https://www.apa.org/topics/social-media-internet/youth-social-media-2024

Anderson, M., Faverio, M. & Park, E. (2024). How teens and parents approach screen time. *Pew Research Center.* https://www.pewresearch.org/internet/2024/03/11/how-teens-and-parents-approach-screen-time/

Anderson, M., Faverio, M., & Gottfried, J. (2023). Teens, social media, and technology 2023. *Pew Research Center*. https://www.pewresearch.org/internet/2023/12/11/teens-social-media-and-technology-2023/

Australian eSafety Commissioner (2019). *Safety by Design Overview.* eSafety Commissioner. https://www.esafety.gov.au/sites/default/files/2019-10/SBD - Overview May19.pdf

Auxier, B., Anderson, A., Perrin, A. & Turner, E. (2020a). Children's engagement with digital devices, screen time. *Pew Research Center*. https://www.pewresearch.org/internet/2020/07/28/childrens-engagement-with-digital-devices-screen-time/

Auxier, B., Anderson, A., Perrin, A. & Turner, E. (2020b). Parenting in the age of screens: Children's engagement with digital devices, screen time. *Pew Research Center*. https://www.pewresearch.org/internet/2020/07/28/childrens-engagement-with-digital-devices-screen-time/

Bengtsson, H., & Arvidsson, Å. (2011). The Impact of Developing Social Perspective-taking Skills on Emotionality in Middle and Late Childhood. *Social Development*, *20*(2), 353–375. https://doi.org/10.1111/j.1467-9507.2010.00587.x

boyd, d., Hargittai, E., Schultz, J., & Palfrey, J. (2011). Why parents help their children lie to Facebook about age: Unintended consequences of the 'Children's Online Privacy Protection Act.' " *First Monday*. https://firstmonday.org/ojs/index.php/fm/article/download/3850/3075

Bucher, T. (2017). The algorithmic imaginary: exploring the ordinary affects of Facebook algorithms. *Information, Communication & Society*, 20(1), 30–44. https://doi.org/10.1080/ 1369118X.2016.1154086

Botella, E. (2019). TikTok Admits It Suppressed Videos by Disabled, Queer, and Fat Creators. *Slate*. https://slate.com/technology/2019/12/tiktok-disabled-users-videos-suppressed.html

Bacchi, U. (2020). TikTok apologises for censoring LGBT+ content. *Reuters*. https://www.reuters.com/article/idUSL5N2GJ459/

Bollmer, J., Milich, R., Harris, M., & Maras, M. (2005). A friend in need: The role of friendship quality as a protective factor in peer victimization and bullying. *Journal of Interpersonal Violence*, 20, 701–712. https://doi.org/10.1177/0886260504272897

Büchi, M., Fosch-Villaronga, E., Lutz, C., Tamò-Larrieux, A., & Velidi, S. (2023). Making sense of algorithmic profiling: user perceptions on Facebook. *Information, Communication & Society*, *26*(4), 809-825. https://doi.org/10.1080/1369118X.2021.1989011

Bryant, E. M., & Marmo, J. (2012). The rules of Facebook friendship: A two-stage examination of interaction rules in close, casual, and acquaintance friendships. *Journal of Social and Personal Relationships*, 29, 1013– 1035. https://doi.org/10.1177/0265407512443616

Bucher, T., & Helmond, A. (2017). The affordances of social media platforms. In J. Burgess, A. Marwick, & T. Poell (Eds.), *The SAGE handbook of social media* (pp. 233–253). London: Sage Publications

Buckingham, D. (2015). Defining digital literacy: What do young people need to know about digital media? *Nordic Journal of Digital Literacy*, *2015*(4), 21–34.

Bulger, M. & Davison, P. (2018). The Promises, Challenges, and Futures of Media Literacy. *Data & Society*. https://datasociety.net/library/the-promises-challenges-and-futures-of-media-literacy/

Bulger, M., Madden, M., Sobel, K., & Davison, P. (2021). *The missing middle: Reimagining a future for tweens, teens, and public media*. Joan Ganz Cooney Center at Sesame Workshop. https://joanganzcooneycenter.org/publication/missing-middle/

Caspi, A., Harrington, H. L., Moffitt, T. E., Milne, B. J., & Poulton, R. (2006). Socially isolated children 20 years later: Risk of cardiovascular disease. *Archives of Pediatrics and Adolescent Medicine*, *160*(8), 805–811. https://doi.org/10.1001/archpedi.160.8.805

Charmaraman, L., Lynch, A. D., Richer, A. M., & Grossman, J. M. (2022). Associations of early social media initiation on digital behaviors and the moderating role of limiting use. *Computers in Human Behavior*, *127*(August 2021), 107053. https://doi.org/10.1016/j.chb.2021.107053

Chang, F. C., Chiu, C. H., Chen, P. H., Chiang, J. T., Miao, N. F., Chuang, H. Y., & Liu, S. (2019). Children's use of mobile devices, smartphone addiction and parental mediation in Taiwan. *Computers in Human Behavior*, *93*(November 2018), 25–32. https://doi.org/10.1016/j.chb.2018.11.048

Children's Internet Protection Act, 2011, Title 47, 47 CFR § 54.520, Sec. c (i) (2011). https://www.congress.gov/bill/106th-congress/senate-bill/97/text

Ciccione, M. (2023). Algorithmic literacies: K-12 realities and possibilities. In Ito, M., Cross, R., Dinakar, K., & Odgers, C. (Eds), *Algorithmic Rights and Protections for Children* (pp.123-160), MIT Press.

Code.org, CSTA, & ECEP Alliance. (2022). *2022 State of Computer Science Education: Understanding Our National Imperative*. Code.org. https://advocacy.code.org/stateofcs

Code.org (2024). Code.org's approach to diversity and equity in computer science. *Code.org*. https://code.org/diversity

Collins, W. A., & Madsen, S. D. (2019). Parenting during middle childhood. In M. H. Bornstein (Ed.), *Handbook of parenting: Children and parenting* (3rd ed., pp. 81–110). Routledge/Taylor & Francis Group. https://psycnet.apa.org/doi/10.4324/9780429440847-3

Congressional Research Service (2015) The United Nations Convention on the Rights of the Child. *Congressional Research Service.* https://crsreports.congress.gov/product/pdf/R/R40484/25

Cortesi, S. C., Hasse, A., Lombana, A., Kim, S., & Gasser, U. (2020). Youth and Digital Citizenship+ (Plus): Understanding Skills for a Digital World. *SSRN Electronic Journal*, 7641. https://doi.org/10.2139/ssrn.3557518

DeVito, M. A., Birnholtz, J., Hancock, J. T., French, M., and Liu, S. (2018). How people form folk theories of social media feeds and what it means for how we study self-presentation. *CHI 2018: Proceedings of the 36th annual CHI Conference on Human Factors in Computing Systems*, pp. 1-12. https://doi.org/10.1145/3173574.3173694

Disrupting Dangerous Algorithms: Addressing the Harms of Persuasive Technology: Hearing before the US Senate Committee on Commerce, Science, & Transportation, 117th Congress. (2021). https://www.commerce.senate.gov/2021/12/commerce-committee-announces-algorithms-hearing-on-december-9-2021

Dumontheil, I. (2014). Development of abstract thinking during childhood and adolescence: The role of rostrolateral prefrontal cortex. *Developmental Cognitive Neuroscience*, 10, 57–76.

Eleuteri, S., Saladino, V. & Verrastro, V. (2017). Identity, relationships, sexuality, and risky behaviors of adolescents in the context of social media. *Sexual and Relationship Therapy*. Taylor & Francis, 32(3–4), pp. 354–365. https://doi: 10.1080/14681994.2017.1397953.

Eslami, M., Rickman, A., Vaccaro, K., Aleyasen, A., Vuong, A., Karahalios, K., Hamilton, K., & Sandvig, C. (2015). "I always assumed that I wasn't really that close to [her]": Reasoning about invisible algorithms in news feeds. *CHI 2015: Proceedings of the 33rd annual CHI Conference on Human Factors in Computing Systems*, pp. 153– 162. http://dx.doi.org/10.1145/2702123.2702556

European Digital Rights. (2023). *Online age verification and children's rights*. European Parliament. https://www.europarl.europa.eu/RegData/etudes/ATAG/2023/739350/EPRS_ATA(2023)739350_EN.pdf.

Family Online Safety Institute. (2021). *Managing the narrative: Young people's use of online safety tools*. Family Online Safety Institute & The Harris Poll. https://www.fosi.org/policy-research/managing-the-narrative

Finch, J. E., Garcia, E. B., Sulik, M. J., & Obradović, J. (2019). Peers Matter: Links Between Classmates' and Individual Students' Executive Functions in Elementary School. *AERA Open*, *5*(1), 1–14. https://doi.org/10.1177/2332858419829438

Finch, J. E., & Obradović, J. (2017). Independent and compensatory contributions of executive functions and challenge preference for students' adaptive classroom behaviors. *Learning and Individual Differences*, 55, 183–192.

Fowler, G. (2022). Your kids' apps are spying on them. *Washington Post.* https://www.washingtonpost.com/technology/2022/06/09/apps-kids-privacy/

Eslami, M., Karahalios, K., Sandvig, C., Vaccaro, K., Rickman, A., Hamilton, K., & Kirlik, A. (2016). First I 'like' it, then I hide it: Folk theories of social feeds. *CHI 2016: Proceedings of the 34th annual CHI Conference on Human Factors in Computing Systems* ,pp. 2371–2382. https://doi: 10.1145/2858036.2858494.

Gelman, S.A., Martinez, M., Davidson, N.S., & Noles, N.S. (2018). Developing digital privacy: Children's moral judgements concerning mobile GPS devices. *Child Development,* 89, 17-26. https://doi: 10.1111/cdev.12826

Gelman, S. A., Cuneo, N., Kulkarni, S., Snay, S., & Roberts, S. O. (2021). The Roles of Privacy and Trust in Children's Evaluations and Explanations of Digital Tracking. *Child Development*, *92*(5), 1769–1784. https://doi: 10.1111/cdev.13572.

Gibson, J. J. (1986). *The ecological approach to visual perception*. Lawrence Erlbaum Associates, Inc., Publishers.

Gifford-Smith, M. E., & Brownell, C. A. (2003). Childhood peer relationships: Social acceptance, friendships, and peer networks. *Journal of School Psychology, 41*(4), 235–284. https://doi:10.1016/ S0022-4405(03)00048-7

Gleason, B., & von Gillern, S. (2018). Digital citizenship with social media: Participatory practices of teaching and learning in secondary education. *Educational Technology and Society*, *21*(1), 200–212.

Graber, J. A. and Brooks-Gunn, J. (1996) 'Transitions and turning points: Navigating the passage from childhood through adolescence', *Developmental Psychology*, 32(4), pp. 768–776. doi: 10.1037/0012-1649.32.4.768.

Gran, A-B., Booth, P., & Bucher, T. (2020). To be or not to be algorithm aware: A question of a new digital divide? *Information, Communication & Society*, *24*(12), 1779–1796. https://doi.org/10.1080/1369118X.2020.1736124

Guernsey, L. (2012). *Screen time: How electronic media—from baby videos to educational software—affects your young child*. Basic Books.

Henderson, M. J., Shade, L. R. & Mackinnon, K. (2020). Every Click You Make: Algorithmic Literacy and the Digital Lives of Young Adults. *AoIR Selected Papers of Internet Research*. https://doi: 10.5210/spir.v2020i0.11233.

Henry, N., Vasil, S. & Witt, A. (2021). Digital citizenship in a global society: a feminist approach. *Feminist Media Studies*, https://doi:10.1080/14680777.2021.1937269

Hohlfeld, T. N., Ritzhaupt, A. D., Dawson, K., & Wilson, M. L. (2017). An examination of seven years of technology integration in Florida schools: Through the lens of the Levels of Digital Divide in Schools. *Computers and Education*, *113*, 135–161. https://doi.org/10.1016/j.compedu.2017.05.017

Holmes, C. J., Kim-Spoon, J., & Deater-Deckard, K. (2015). Linking executive function and peer problems from early childhood through middle adolescence. *Journal of Abnormal Child Psychology, 44*(1), 31–42. https://doi:10.1007/s10802-015-0044-5

Imana, B., Korolova, A. & Heidemann, J. (2023). Having your Privacy Cake and Eating it Too: Platform-supported Auditing of Social Media Algorithms for Public Interest. *Proceedings of the ACM on Human-Computer Interaction*, 7(CSCW1), pp. 1–33. https:// doi: 10.1145/3579610.

Ito, M., Cross, R., Dinakar, K., & Odgers, C. (2021). Introduction: Algorithmic Rights and Protections for Children. In Ito, M., Cross, R., Dinakar, K., & Odgers, C. (Eds), *Algorithmic Rights and Protections for Children* (pp. 3-13), MIT Press.

James, C., Weinstein, E., & Mendoza, K. (2021). *Teaching digital citizens in today's world: Research and insights behind the Common Sense K–12 Digital Citizenship Curriculum (Version 2).* Common Sense Media. https://www.commonsense.org/system/files/pdf/2021-08/common-sense-education-digital-citizenship-research-backgrounder.pdf

Katz, E., Blumler, J. & Gurevitch, M. (1973). Uses and gratifications research. *Public Opinion Quarterly*, 37, 509–523.

Keles, B., McCrae, N., & Grealish, A. (2019). A systematic review: the influence of social media on depression, anxiety and psychological distress in adolescents. *International Journal of Adolescence and Youth*, *25*(1), 79–93. https://doi.org/10.1080/02673843.2019.1590851

Kidron, B., Evans, A., & Afia, J. (2018). *Disrupted childhood. The cost of persuasive design*. 5Rights Foundation. http://eprints.mdx.ac.uk/25600/

Kim, A. S., & Davis, K. (2017). Tweens' perspectives on their parents' media-related attitudes and rules: an exploratory study in the US. *Journal of Children and Media*, *11*(3), 358–366. https://doi.org/ 10.1080/17482798.2017.1308399.

Labaree, D. F. (1997). Public goods, private goods: The American struggle over educational goals. *American Educational Research Journal*, 34(1), 39–81. https://doi: 10.3102/00028312034001039.

Lam, C. B., Mchale, S. M., & Crouter, A. C. (2014). Time with peers from middle childhood to late adolescence: Developmental course and adjustment correlates. *Child Development*, *85*(4), 1677–1693. https://doi: 10.1111/cdev.12235.

Lauricella, A. R., Herdzina, J., & Robb, M. (2020). Early childhood educators' teaching of digital citizenship competencies. *Computers and Education*, *158*(August), 103989. https://doi.org/10.1016/j.compedu.2020.103989

Lee, E. J. & Kim, H. S. (2021). Effect of maternal factors on problematic smartphone use among elementary school children. *International Journal of Environmental Research and Public Health*, *18*(17). https://doi: 10.3390/ijerph18179182.

LeBourgeois, M. K., Hale, L., Chang, A. M., Akacem, L. D., Montgomery-Downs, H. E., & Buxton, O. M. (2017). Digital media and sleep in childhood and adolescence. *Pediatrics*, *140*(November), S92–S96. https://doi.org/10.1542/peds.2016-1758J

Lenhart, A. & Owens, K. (2021). The unseen teen: the challenges of building healthy tech for young people. *Data & Society*. https://datasociety.net/library/the-unseen-teen/"https://datasociety.net/library/the-unseen-teen/

Livingstone, S., Carr, J., & Byrne, J. (2015). One in Three: internet Governance and Children's Rights. Reportno, January 2016. *UNICEF Office of Research – Innocenti.*

Livingstone, S., Mascheroni, G., & Staksrud, E. (2015). Developing a framework for researching children's online risks and opportunities in Europe. *EU Kids Online*, *November*, 1–21. www.eukidsonline.net

Livingstone, S. (2016) A framework for researching Global Kids Online: Understanding children's well-being and rights in the digital age. *Global Kids Online*. www.globalkidsonline.net/framework

Livingstone, S., Lansdown, G., & Third, A. (2017). *The Case for a UNCRC General Comment on Children's Rights and Digital Media*. *April*, 1–63. https://www.childrenscommissioner.gov.uk/wp-content/uploads/2017/06/Case-for-general-comment-on-digital-media.pdf

Livingstone, S. & Pothong, K. (2023). *Child Rights by Design: Guidance for Innovators of Digital Products and Services Used by Children*. Digital Futures Commission, 5Rights Foundation. https://digitalfuturescommission.org.uk/wp-content/uploads/2023/03/CRbD_report-FINAL-Online.pdf

Livingstone, S., Cantwell, N., Özkul, D., Shekhawat, G., & Kidron, B. (2024) The best interests of the child in the digital environment. *Digital Futures for Children Centre, LSE and 5Rights Foundation*.

Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1-16. https://dl.acm.org/doi/10.1145/3313831.3376727

Manago, A. M., Graham, M. B., Greenfield, P. M., & Salimkhan, G. (2008). Self-presentation and gender on MySpace. *Journal of Applied Developmental Psychology*, 29, 446–458. https://doi.org/10.1016/j.appdev.2008.07.001

Martin, F., Gezer, T., & Wang, C. (2019). Educators' Perceptions of Student Digital Citizenship Practices. *Computers in the Schools*, *36*(4), 238–254. https://doi.org/10.1080/07380569.2019.1674621

Martínez-Bravo, M., Sádaba-Chalezquer, C., & Serrano-Puche, J. (2020). Fifty years of digital literacy studies: A meta-research for interdisciplinary and conceptual convergence. *Profesional de la información*, 29(4), https://doi.org/10.3145/epi.2020.jul.28

Matsa, K. (2023). More Americans are getting news on TikTok, bucking the trend seen on most other social media sites. *Pew Research Center.* https://www.pewresearch.org/short-reads/2023/11/15/more-americans-are-getting-news-on-tiktok-bucking-the-trend-seen-on-most-other-social-media-sites/

Mascheroni, G., & Holloway, D. (2019). The quantified child: Discourses and practices of dataveillance in different life stages. In Erstad, O., Flewitt, R., Kummerling-Meibauer, B., & Pereira, I. (Eds.), *The Routledge Handbook of Digital Literacies in Early Childhood*, (pp.354–365). Routledge. https://doi.org/10.4324/9780203730638

Maunder, R. & Monks, C. P. (2019). Friendships in middle childhood: Links to peer and school identification, and general self-worth. *British Journal of Developmental Psychology*, 37(2), 211–229. https://doi: 10.1111/bjdp.12268

Media Literacy Now. (2024). *Snapshot 2024: The State of Media Literacy Education in the U.S.*. Media Literacy Now. https://namle.org/wp-content/uploads/2024/01/Snapshot-2024-State-of-Media-Literacy-FINAL.pdf

Meta. (2024). Meta reports fourth quarter and full year 2023 results; initiatives quarterly dividend. *Meta*. https://investor.fb.com/investor-news/press-release-details/2024/Meta-Reports-Fourth-Quarter-and-Full-Year-2023-Results-Initiates-Quarterly-Dividend/default.aspx

Media Literacy Now. (2023). *U.S. Media Literacy Policy Report 2022*. *Media Literacy Now.* https://medialiteracynow.org/policyreport/

Miller, G. (2023). Evaluating the argument over the California Age Appropriate Design Code. *Tech Policy Press*. https://www.techpolicy.press/evaluating-the-argument-over-the-california-age-appropriate-design-code-act/

Montgomery, K. C., Chester, J., & Milosevic, T. (2017). Children's privacy in the big data era: Research opportunities. *Pediatrics*, *140* (November 2017), S117–S121. https://doi.org/10.1542/peds.2016-1758O

Moreno, M. A. & Uhls, Y. T. (2019). Applying an affordances approach and a developmental lens to approach adolescent social media use. *Digital Health*, 5, 1–6. https://doi: 10.1177/2055207619826678.

Moreno, M. A., Kerr, B. R., Jenkins, M., Lam, E., & Malik, F. S. (2019). Perspectives on Smartphone Ownership and Use by Early Adolescents. *Journal of Adolescent Health*, *64*(4), 437–442. https://doi.org/10.1016/j.jadohealth.2018.08.017

Museum and Library Services Act, 2010, Title 1, 20 U.S.C. § 9101, Sec. 101, Statute 3595 (2010) https://www.congress.gov/111/plaws/publ340/PLAW-111publ340.pdf

National Academies of Sciences, Engineering, and Medicine. (2018). *How people learn II: Learners, contexts, and cultures.* The National Academies Press. https://doi.org/10.17226/24783

National Academies of Sciences, Engineering, and Medicine. (2023). *Social Media and Adolescent Health*. The National Academies Press. https://doi.org/10.17226/27396

National Research Council. (1984). *Development During Middle Childhood: The Years From Six to Twelve*. The National Academies Press. https://doi.org/10.17226/56.

Ng, D. T. K., Leung, J.K.K., Chu, K.W.S. & Qiao, M.S. (2021). AI Literacy: Definition, Teaching, Evaluation and Ethical Issues. *Proceedings of the Association for Information Science and Technology*, 58(1), pp. 504–509. https://doi: 10.1002/pra2.487

Noble, S. U. (2018). *Algorithms of oppression: How search engines reinforce racism.* New York University Press.

O'Neil, C. (2016). *Weapons of math destruction: How big data increases inequality and threatens democracy*. Crown Publishing Group.

Ofcom. (2019). *Life on the small screen: What children are watching and why*. Ofcom. https://www.ofcom.org.uk/research-and-data/media-literacy-research/what-children-are-watching-and-why

Ofcom. (2024a). Children and Parents: Media Use and Attitudes Report. Ofcom. https://www.ofcom.org.uk/media-use-and-attitudes/media-habits-children/children-and-parents-media-use-and-attitudes-report-2023

Ofcom. (2024b). Children's Media Lives 2024: Ten years of longitudinal research. Ofcom. https://www.ofcom.org.uk/media-use-and-attitudes/media-habits-children/childrens-media-lives

Obar, J. A., & Oeldorf-Hirsch, A. (2020). The biggest lie on the internet: Ignoring the privacy policies and terms of service policies of social networking services. *Information, Communication & Society*, *23*(1), 128-147. https://doi.org/10.1080/1369118X.2018.1486870

Odgers, C. L. (2018). Smartphones are bad for some adolescents, not all. *Nature, 554*(7693), 432–434. https://doi.org/10.1038/d41586-018-02109-8

Oksman, V. & Turtiainen, J. (2004). Mobile communication as a social stage: Meanings of mobile communication in everyday life among teenagers in Finland. *New Media and Society*, *6*(3), 319–339. https://doi: 10.1177/1461444804042518.

Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behaviour*, *3*(2), 173–182. https://doi.org/10.1038/s41562-018-0506-1

Öztürk, G. (2021). Digital citizenship and its teaching : A literature review. *Journal of Educational Technology & Online Learning*, *4*(1), 31–45.

Paruthi, S., Brooks, L. J., D'Ambrosio, C., Hall, W. A., Kotagal, S., Lloyd, R. M., … Wise, M. S. (2016). Consensus Statement of the American Academy of Sleep Medicine on the Recommended Amount of Sleep for Healthy Children: Methodology and Discussion. *Journal of Clinical Sleep Medicine*, *12*(11), 1549–1561. https://doi.org/10.5664/jcsm.6288

Paulich, K. N., Ross, J. M., Lessem, J. M., & Hewitt, J. K. (2021). Screen time and early adolescent mental health, academic, and social outcomes in 9- And 10-year old children: Utilizing the Adolescent Brain Cognitive Development℠ (ABCD) Study. *PLoS ONE*, *16*(9 September), 1–23. https://doi.org/10.1371/journal.pone.0256591

Pasquale, F. (2015). *The black box society: The secret algorithms that control money and information*. Harvard University Press.

Perez, S. (2020). Google exec suggests Instagram and TikTok are eating into Google's core products, Search and Maps. *TechCrunch*. https://techcrunch.com/2022/07/12/google-exec-suggests-instagram-and-tiktok-are-eating-into-googles-core- products-search-and-maps/?tpcc=tcplustwitter

Perez Vallejos, E., Koene, A., Portillo, V., Dowthwaite, L., & Cano, M. (2017). Young people's policy recommendations on algorithm fairness. *WebSci 2017 - Proceedings of the 2017 ACM Web Science Conference*, pp. 247–251. https:// doi: 10.1145/3091478.3091512.

Perez Vallejos, E., Dowthwaite, L., Creswich, H., Portillo, V., Koene, A., Jirotka, M., McCarthy, A., & McAuley, D. (2021). The impact of algorithmic decision-making processes on young people's well-being. *Health Informatics Journal*, 27(1). https://doi: 10.1177/1460458220972750.

Piaget, J. (1970). *Science of education and psychology of the child*. Oxford University Press.

Protecting Kids Online: Snapchat, TikTok and YouTube: Hearing before the US Senate Committee on Commerce, Science, & Transportation, 117th Congress. (2021). https://www.commerce.senate.gov/2021/10/protecting-kids-online-snapchat-tiktok-and-youtube

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 and Adolescent Psychiatry*, *59*(9), 1080–1088. https://doi: 10.1016/j.jaac.2019.06.017.

Radesky, J. S., Schaller, A., Yeo, S. L., Weeks, H. M., & Robb, M.B. (2020). Young kids and YouTube: How ads, toys, and games dominate viewing, 2020. San Francisco, CA: Common Sense Media.

Radesky, J. S. Seyfried, J., Weeks, H., Kaciroti, N., & Miller, A. (2022a) 'Video-Sharing Platform Viewing among Preschool-Aged Children: Differences by Child Characteristics and Contextual Factors', *Cyberpsychology, Behavior, and Social Networking*, 25(4), pp. 230–236. doi: 10.1089/cyber.2021.0235.

Radesky, J., Hiniker, A., McLaren, C., Akgun, E., Schaller, A., Weeks, H., Campbell, S., Gearhardt, A. (2022b) 'Prevalence and Characteristics of Manipulative Design in Mobile Applications Used by Children', *JAMA Network Open*, 5(6), p. E2217641. doi: 10.1001/jamanetworkopen.2022.17641.

Radesky, J., Weeks, H.M., Schaller, A., Robb, M., Mann, S., & Lenhart, A. (2023). Constant Companion: A Week in the Life of a Young Person's Smartphone Use. San Francisco, CA: Common Sense.

Rainee, L. & Anderson, J. (2017). Code-dependent: Pros and cons of the algorithm age. *Pew Research Center*. https://www.pewresearch.org/internet/2017/02/08/code-dependent-pros-and-cons-of-the-algorithm-age/

Reich, S.M., Starks, A., and Su, Z. (forthcoming) One size does not fit all: The importance of development in digital design and utilization. MIT Press.

Ridley, M. and Pawlick-Potts, D. (2021). Algorithmic literacy and the role for libraries. *Information Technology and Libraries*, *40*(2), 1-15. https://doi.org/10.6017/ital.v40i2.12963

Rideout, V., Peebles, A., Mann, S., & Robb, M. B. (2022). *Common Sense census: Media use by tweens and teens, 2021*. Common Sense Media. https://www.commonsensemedia.org/research/the-common-sense-census-media-use-by-kids-age-zero-to-eight-2020.

Rideout, V. & Robb, M. (2019). *The Common Sense Census: Media use by tweens and teens*. Common Sense Media. https://www.commonsensemedia.org/research/the-common-sense-census-media-use-by-tweens-and-teens-2019

Rohlf, H., Krahé, B., & Busching, R. (2016). The socializing effect of classroom aggression on the development of aggression and social rejection: A two-wave multilevel analysis. *Journal of school psychology*, *58*, 57–72. https://doi.org/10.1016/j.jsp.2016.05.002

Saldaña, J. (2016). *Coding Manual for Qualitative Researchers (3rd ed)*. SAGE.

Santer, N., Manago, A., Starks, A. & Reich, S.M. (2023). Early adolescents' perspectives on digital privacy. In Ito, M., Cross, R., Dinakar, K., & Odgers, C. (Eds), *Algorithmic Rights and Protections for Children,* pp.123-160, MIT Press.

Sasser, T. R., Bierman, K. L., & Heinrichs, B. (2015). Executive functioning and school adjustment: The mediational role of pre-kindergarten learning-related behaviors. *Early Childhood Research Quarterly, 30*, 70–79. https://doi:10.1016/j.ecresq.2014.09.001

Selkie, E. (2019). Smartphone Ownership as a Developmental Milestone. *Journal of Adolescent Health*, *64*(4), 419–420. https://doi.org/10.1016/j.jadohealth.2019.01.018

Selman, R. L., & Byrne, D. F. (1974). A structural developmental analysis of levels of role taking in middle childhood. *Child Development.*, *45*(3), 803–806. https://doi.org/10.2307/1127850

Selwyn, N. (2022). What should 'digital literacy' look like in an age of algorithms and AI? London School of Economics (LSE) Blogs. https://blogs.lse.ac.uk/parenting4digitalfuture/2022/04/06/digital-literacy-and-ai/

Smith, K. L., & Shade, L. R. (2018). Children's digital playgrounds as data assemblages: Problematics of privacy, personalization, and promotional culture. *Big Data & Society*, 1-12.

Sohn, S., Rees, P., Wildridge, B., Kalk, N. J., & Carter, B. (2019). Correction to: Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: A systematic review, meta-analysis and GRADE of the evidence (BMC Psychiatry (2019) 19 (356) DOI: 10.1186/s12888-019-2350-x). *BMC Psychiatry*, *19*(1), 1–10. https://doi.org/10.1186/s12888-019-2393-z

Solyst, J., Yang, E., Xie, S., Ogan, A., Hammer, J., & Eslami, M. (2023). The Potential of Diverse Youth as Stakeholders in Identifying and Mitigating Algorithmic Bias for a Future of Fairer AI. *Proceedings of the ACM Conference on Computer- Supported Cooperative Work and Social Computing*, 7(October). https://doi: 10.1145/3610213.

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in cognitive sciences*, *9*(2), pp. 69-74.

Stoilova, M., Nandagiri, R., & Livingstone, S. (2019). Children's understanding of personal data and privacy online–a systematic evidence mapping. *Information Communication and Society*, 1–19. https://doi.org/10.1080/1369118X.2019.1657164

Stoilova, M., Livingstone, S., & Khazbak, R. (2021). Investigating Risks and Opportunities for Children in a Digital World: A rapid review of the evidence on children's internet use and outcomes Media and Communications. *UNICEF Office of Research – Innocenti*, https://www.unicef-irc.org/publications/pdf/Investigating-Risks-and-Opportunities-for-Children-in-a-Digital-World.pdf

Swart, J. (2021). Tactics of news literacy: How young people access, evaluate, and engage with news on social media. *New Media and Society*. https://doi.org/10.1177/14614448211011447

Tamis-LeMonda, C. (2022). *Child development: Context, culture, and cascades.* Oxford University Press.

Taplin, J. (2017). *Move fast and break things: How Facebook, Google, and Amazon cornered culture and undermined democracy*. Little, Brown and Company.

Tolman, D. L., & Mcclelland, S. I. (2011). Normative sexuality development in adolescence: A decade in review, 2000-2009. *Journal of Research on Adolescence*, *21*(1), 242–255. https://doi: 10.1111/j.1532-7795.2010.00726.x

Tynes, B. M., Stewart, A., Hamilton, M., & Willis, H. A. (2021). From Google Searches to Russian Disinformation: Adolescent Critical Race Digital Literacy Needs and Skills. *International Journal of Multicultural Education*, *23*(1), 110–130. https://doi.org/10.18251/ijme.v23i1.2463

UNCRC (United Nations Convention on the Rights of the Child). (1989). *Convention on the Rights of the Child*. United Nations. https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-child

UN Committee on the Rights of the Child. (2021, 2 March). *General comment No. 25 (2021) on children's rights in relation to the digital environment*. CRC/C/GC/25. www.ohchr.org/en/documents/general-comments-and-recommendations/general-comment-no-25-2021-childrens-rights-relation

UNICEF. (2019).Growing up in a connected world. *UNICEF Office of Research –Innocenti, Florence*. https://www.unicef-irc.org/growing-up-connected

United States (US) Office of Educational Technology. (2024). *A call to action for closing the digital access, design and use divides: 2024 National Educational Technology Plan*. US Office of Educational Technology. https://tech.ed.gov/netp/

United States (US) Office of Educational Technology. (2017). *Reimagining the role of technology in education: 2017 national education technology plan update*. US Office of Educational Technology.

UNESCO. (2024). What you need to know about literacy. *UNESCO*. https://www.unesco.org/en/literacy/need-know

Valentino-DeVries, J. & Keller, M. (2024). A marketplace of girl influencers managed by moms and stalked by men. *The New York Times.* https://www.nytimes.com/2024/02/22/us/instagram-child-influencers.html

Vaterlaus, J. M., & Tarabochia, D. (2020). Adolescent Smartphone Acquisition: An Exploratory Qualitative Case Study with Late Adolescents and Their Parents. *Marriage and Family Review*, 1–22. https://doi.org/10.1080/01494929.2020.1791302

Vaterlaus, J. M., Aylward, A., Tarabochia, D., & Martin, J. D. (2021). "A smartphone made my life easier": An exploratory study on age of adolescent smartphone acquisition and well-being. *Computers in Human Behavior*, *114*(July 2020), 106563. https://doi.org/10.1016/j.chb.2020.106563

Vega, V., & Robb, M. B. (2019). *The Common Sense census: Inside the 21st-century classroom*. Common Sense Media.

Vogels, E., R. Gelles-Watnick, & N. Massarat. (2022). Teens, social media and technology 2022. *Pew Research Center.* https://www.pewresearch.org/internet/2022/08/10/teens- social-media-and-technology-2022/

Wajcman, J. (1991) *Feminism confronts technology*. The Pennsylvania State University Press.

Wall Street Journal. (2021). Inside TikTok's algorithm: A WSJ video investigation. *The Wall Street Journal.* https://www.wsj.com/articles/tiktok-algorithm-video-investigation-11626877477

Walters, M. G., Gee, D., & Mohammed, S. (2019). A literature review: Digital citizenship and the elementary educator. *International Journal of Technology in Education (IJTE), 2*(1), 1–21.

Wang, G., Zhao, J., Van Kleek, M., & Shadbolt, N. (2022), "Don't make assumptions about me!": Understanding Children's Perception of Datafication Online. *Proceedings of the ACM on Human-Computer Interaction*, 6(CSCW2), pp. 1-24. https://doi.org/10.1145/3555144

Wang, G., Zhao, J., Van Kleek, M., & Shadbolt, N. (2023). "Treat me as your friend, not a number in your database": Co-designing with Children to Cope with Datafication Online. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, pp. 1-21. https://dl.acm.org/doi/10.1145/3544548.3580933

Weinstein, E. & James, C. (2022) . *Behind their screens: What teens are facing (and adults are missing).* MIT Press.

Yan, Z. (2018). Child and adolescent use of mobile phones: An unparalleled complex developmental phenomenon. *Child Development, 89*(1), 5–16. https://doi.org/10.1111/cdev. 12821

Yau, J. C. & Reich, S. M. (2019). "It's Just a Lot of Work": Adolescents' Self-Presentation Norms and Practices on Facebook and Instagram, *Journal of Research on Adolescence*, *29*(1), 196–209. https://doi: 10.1111/jora.12376.

Ytre-Arne, B., & Moe, H. (2021), Folk theories of algorithms: Understanding digital irritation. *Media, Culture & Society*, *43*(5), pp. 807-824.

Zhao, J., Wang, G., Dally, C., Slovak, P., Edbrooke-Childs, J., Van Kleek, M., & Shadbolt, N. (2019)."I make up a silly name": Understanding children's perception of privacy risks online". *Conference on Human Factors in Computing Systems - Proceedings*, pp. 1–13. https://doi: 10.1145/3290605.3300336.

Zuboff, S. (2015). Big other: surveillance capitalism and the prospects of an information civilization*. Journal of Information Technology, 30*(1): 75–89.

Zuboff, S. (2016). Google as a fortune teller: the secrets of Surveillance Capitalism. *Frankfurter Allgemeine Zeitung.* 5 March 2016.

Zuboff, S. (2019). *The age of surveillance capitalism: The fight for a human future at the new frontier of power*. Public Affairs.

APPENDIX A: Focus Group Background Questionnaire for Caregivers

## Parent Background Questionnaire

*Please tell us a little about yourself.*

**1. Are you:**

___ Male ___ Female ___ Non-binary ___ Prefer not to say

**2. What grade is your child in?___ Age?____**

**3. What is your relationship to the child?**

☐ parent

☐ grandparent

☐ aunt/uncle

☐ foster parent

☐ other: please specify_____

**4. What is <u>your child's</u> gender?**

___ Male ___ Female ___ Non-binary ___ Prefer not to say

**5. Which days does your child typically attend their after school program? Please check all that apply.** (This helps us schedule the focus groups)

☐ Monday

☐ Tuesday

☐ Wednesday

☐ Thursday

☐ Friday

**6. What time is your child usually picked up from their after school program?**

**___ pm**

**7. Does your child receive special education services (like an IEP, a 504 plan, gets extra services?**

__ yes ___no

**8. What is the highest level of school you have completed?**

☐ Less than high school diploma

☐ High school degree or equivalent (e.g. GED)

☐ Some college

☐ Associate degree

☐ Bachelor's degree

☐ Graduate degree

**9. What is your household income?**

☐ Less than $25,000

☐ $25,000-49,999

☐ $50,000-99,000

☐ $100,000-150,000

☐ more than $100,000

**10. What is your race/ethnicity** (check all that apply)**?**

- ☐ White
- ☐ Hispanic or Latino/a
- ☐ Black or African American
- ☐ East Asian American or East Asian (e.g. Chinese, Japanese, Korean)
- ☐ Southeast Asian American or Southeast Asian (e.g. Filipino/a, Thai, Vietnamese)
- ☐ East Indian
- ☐ Middle Eastern
- ☐ Native Hawaiian or Pacific Islander
- ☐ American Indian or Alaskan Native

☐ Other (Please specify): _____

**11. Does your child have a cellphone?** ___ yes ___no

**11a. if *yes*, at what age did your child get a phone?** ___ years

**12. Does your child have an account on:**

Instagram ___ yes ___no

SnapChat ___ yes ___no

TikTok ___ yes ___no

BeReal ___ yes ___no

Gas ___ yes ___no

Reddit ___ yes ___no

Facebook ___ yes ___no

WhatsApp ___ yes ___no

Pinterest ___ yes ___no

Fortnite ___ yes ___no

MineCraft ___ yes ___no

Roblox ___ yes ___no

STEAM___ yes ___no

Discord ___ yes ___no

World of Warcraft ___ yes ___no

League of Legends ___ yes ___no

Other: Specify_____

**12a. if yes to any of the above, which account did your child create first?**

_____

**13. Does your child use YouTube?** ___ yes ___no

**13a. if *yes*, at what age did your child start using YouTube?**

___ years

**14. Do you follow your child on social media?** ___ yes ___no ___N/A

**15. Do you message/text with your child?**___ yes ___no ___N/A

**16. Do you use devices together (e.g. watch TikToks together, record together) ?** ___ yes ___no ___N/A

**17. Does your child have rules/restrictions about their social media or phone use?** ___ yes ___no ___N/A

**17a. if *yes*, which of these rules/restrictions does your child have? (please check all that apply)**

- ☐ Time limits (ex. no more than 2 hours a day)
- ☐ Limits on what time of day to use (ex. not after 9 PM, not during school)

- Not during mealtimes
- No devices in room/near bed
- Software that restricts use (text limits, time limits)
- Software that monitors or tracks use
- Permission needed to download apps
- Search restrictions/child settings
- Monitor or follow child's accounts
- Discussions about media use and limits
- Other:_____

**18. Have you ever had a conversation with your child about? (check all that apply)**

- Fake news
- sexting
- talking to strangers
- protecting personal information online
- privacy policies
- how apps make money
- managing technology use (media balance)
- being kind online
- how to advocate for issues they care about online
- how to report harassment online
- responding to cyberbullying
- None of these

**19. Does your child keep a phone or tablet in their room at night?**

___ yes ___no ___N/A

**20. How concerned are you about your child's well-being and their technology use?**

☐ not concerned at all

☐ a little concerned

☐ somewhat concerned

☐ moderately concerned

☐ extremely concerned

**21. How much control do you feel like you have over your child's online experiences?**

☐ no control at all

☐ a little control

☐ some control

☐ moderate control

☐ a lot of control

**22. What is the best email to reach you?**

**_____@_____**

**23. What is the best phone number to reach you?**

**(__ __ __) - __ __ __ - __ __ __**

ID# _____

APPENDIX B: Focus Group Background Questionnaire for Children

## Background Questionnaire

*Please tell us a little about yourself.*

**1. How old are you?** ___ years

**2. Are you:**

___ Male ___ Female ___ Non-binary ___ Prefer not to say

**3. Which grade are you in?**

___1st
___2nd
___3rd
___4th
___5th
___6th

**4. What is your race/ethnicity** (check all that apply)**?**

☐ African American or Black

☐ American Indian or Alaskan Native

☐ Caucasian or White

☐ East Asian American or East Asian (e.g.

Chinese, Japanese, Korean)

☐ East Indian

☐ Hispanic or Latino/a

☐ Middle Eastern

☐ Native Hawaiian or Pacific Islander

☐ Southeast Asian American or Southeast

Asian (e.g. Filipino/a, Thai, Vietnamese)

☐ Other (Please specify):
_____

**5. Were you born in the United States?**

**☐ Yes ☐ No**

**5a. If no, which country were you born in?** _____

**5b. How old were you when you first moved to the U.S.?**

_____ years

**6. Is English your primary language (the main language you speak)?**

☐ Yes ☐ No

**7. Do you have another primary language?**

☐ Yes ☐ No

**7a. If yes, please specify.**

_____

**8. Who do you live with?** (please check all that apply)

___mother
___father
___step-mother/step-father
___grandparent(s)
___aunt(s)/uncle(s)
___sister(s)
___brother(s)
___cousin(s)
___ Other: please specify
_____

**9. Do you have a computer in your home?**

___ yes ___no

**9a. if *yes*, is it connected to the Internet?** ___ yes ___no

**10. Do you have a tablet in your home?**

___ yes ___no

**10a. if *yes*, is it connected to the Internet?** ___ yes ___no

**11. Do you have a cellphone?** ___ yes ___no

**11 a. if *yes*, do you use it to send or receive texts?**

___ yes ___no

**11b. if *yes*, at what age did you get a phone?** ___ years

**12. Do you use any of these:**

Instagram ___ yes ___no

SnapChat ___ yes ___no

TikTok ___ yes ___no

Reddit ___ yes ___no

Facebook ___ yes ___no

WhatsApp ___ yes ___no

YouTube ___yes ___no

YouTubeKids___yes ___no

Fortnite ___ yes ___no

Roblox __ yes ___no

MineCraft ___ yes ___no

Discord ___ yes ___no

Pinterest ___ yes ___no

World of Warcraft ___ yes ___no

League of Legends ___ yes ___no

Other: Specify

**12 a. if *yes*, which did you use first? _____**

**12b. How old were you? _____**

**13. Do you use YouTube?** ___ yes ___no

**13a. if yes, how old were you when you started using YouTube?**

_____

**14. If you had to pick one, which app/game/online space do you use the most?**

_____

**15. Do your parents follow you on social media?**

___ yes ___no ___N/A (I don't have social media)

**16. Do you follow your parents on social media?**

___ yes ___no ___N/A (I don't have social media)

**17. Do your parents have rules/restrictions about your technology use?**

___ yes ___no ___N/A (I don't use technology)

**17a. if *yes*, which of these rules/restrictions do you have? (please check all that apply)**

- ☐ Time limits
- ☐ Limits on what time of day to use (ex. not after 9 PM, not during school)
- ☐ Not during mealtimes
- ☐ No devices in room/near bed
- ☐ Software that restricts use (text limits, time limits)
- ☐ Software that monitors or tracks use
- ☐ Permission needed to download apps
- ☐ Search restrictions/child settings
- ☐ Monitor or follow child's accounts
- ☐ Discussions about media use and limits

**18. Do you have a TV in your room?** ___ yes ___no

**19. Do you keep your phone or a tablet in your room at night?**

___ yes ___no ___N/A (I don't have a phone or tablet)

**20. What is the highest level of education <u>any of your parents</u> have completed?**

___ less than high school

___ some high school

___ finished high school

___ some college

___ college degree

___ graduate degree

APPENDIX C: Focus Group Semi Structured Protocol

**Smartphone Owners & Non Smartphone Owners**

Introduction
- Welcome
- Description of project–really here to listen to you all as experts
- Confidentiality, consent, recording

Child Questionnaire Completion

Assent
- Ground rules
- Any questions
- For user group–prompt to have phone with them

Warm Up
- Introductions, share name and grade

**Topic: Devices & Smartphones**

Question 1: What kinds of devices do you all use? What do you like about using them? What don't you like?

Question 2: Does anyone here use a smartphone?

- Who does it belong to
- What do you use it for? (use along, co use, etc.?)
    - Do you ever text on it?
    - If yes–Are your parents ever there or watching when you text?
- How old were you when you started using it?--depends on whether you have old phone and using for own purpose (ex. Old phone and gaming on it)
    - Follow up–did you ask for it or parents give it to you?
- What about kids in your grade? How many kids do you think have a phone? What about watches?
- Any rules about how you use it–from parents, from school
    - Mealtimes
    - Bedtime
    - What you can do on phone
    - Potential probe: why do you think parents have these rules?

**Topic: Benefits of Smartphone**

Question3: Do you want a phone?

Probe–Why?
What would be easier? What would be fun?
Do you have access to an iPad? How is it different?

**Topic: Downsides of Smartphone**

Question 4: So some of you said that you don't want a phone–what might be some reasons why.

What might be some problems? Why might your parents not want you to have a phone?

Question 5: When do you think kids should get a smartphone/ what's the best age to get a phone? Why?

**Topic: Social Media & Gaming**

Question 6: Do you have a profile or account–something you log into– on any gaming or social media sites (could be YouTube, Roblox, Fortnite)?

- Which ones
- When did you set up the account–which grade
- Remember why?
- Likes? What are some things you really like about using…what would you miss if it disappeared tomorrow?
- Dislikes? (about specific app/site)
- Paid account or not? Modes? Etc. (tailor to platform)

- Can you talk to other people on _____(YouTube, Roblox, Fortnite)?
  - Who do you usually talk to?
  - When you are using any of these games, do you communicate with anyone? Who do you usually talk to? What do you usually talk about?

- How did you learn how to use it?
  - Follow Ups:
    - Who helped you?
    - What did they teach you?
    - What did you do if you didn't know how something worked?

- Any rules about using Youtube, Roblox, Fortnite, etc?
  - Who you can play with
  - Who can you chat with? public/private account
  - Post, watch, comment
  - Time limits

  - Bedtime
  - Where you play/watch

- What about school? Does school have any rules about _____?

Question 6: Are you on any group chats? Which ones?
Who is on the chat with you? Mostly friends? Family? People you don't know in real life

Question 7: Have you ever seen something like this (show privacy policy) when signing up for an app?

- What is it?
- What do you usually do when you see it?
- Some of these things have age limits–for wahy you want to do how often do you use real birthdate? Fake birthdate?

Question 8: Are there any social media apps that you want to use but don't use right now? Any apps you want to make an account on?

**Topic: Critical Understandings**

Question 9: I know a lot of you use YouTube and I am wondering what kinds of videos you usually watch?
How do you pick which videos to watch?
Do you have lots of control over what video comes next?
How do you think YouTube knows what to play next?
Are you usually interested in what the next video is?
Have you ever seen something on YouTube that made you feel upset or uncomfortable? Something you did not want to see?

Lots of my former students would complain about the ads on Youtube. Do you see any ads? What kinds of ads do you see?

- Do you ever see ads?
- What kind of ads? Do you know why?
- Why are these ads there?
- How does the app decide whether you see an ad for _____ or for _____? (insert examples from opening question)

**Wrapping Up:** This has been such a good conversation. Is there anything else you want to say about technology for kids your age or about smartphones?

APPENDIX D: Rotated Component Matrix for Challenges Exploratory Factor Analysis

| | Factor Components | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Items | | | | | | |
| Loss of instructional time due to student log in issues | 0.690 | | | | | |
| Internet too slow, inconsistent or unreliable | 0.700 | | | | | |
| Time constraints | 0.700 | | | | | |
| Lack of planning time with colleagues | 0.492 | | | | | |
| School blocks websites/apps needed for teaching | | 0.642 | | | | |
| Cannot access online video | | 0.492 | | | | |
| Lack of autonomy for choosing apps and digital content | | 0.651 | | | | |
| Cannot use social media tools | | 0.707 | | | | |
| Educator concerns about security/safety of technology override desire to use tech for instructional growth | | 0.598 | | | | |
| Too many school rules (e.g. students cannot charge in class, devices stay at school) | | 0.510 | | | | |
| Students display off task behaviors/distractions | | | 0.598 | | | |
| Student devices are not charged for class | | | 0.853 | | | |
| Students do not consistently bring their devices to class | | | 0.803 | | | |
| Lack of digital citizenship training for students | | | | 0.414 | | |
| Need PD on effective teaching with tech | | | | 0.717 | | |
| Lack of just in time support in classroom | | | | 0.498 | | |
| Educator devices need repairs | | | | | 0.806 | |
| Educators need tools to support tech integration | | | | | 0.709 | |
| No class set of devices | | | | | | 0.8658 |
| *Student lack of basic tech skills* | *0.378* | | | *0.348* | | |
| *Student devices need updates or repairs* | *0.317* | | *0.3212* | | | |

APPENDIX E: Speak Up Survey Questions

1) What is your primary job assignment this year?

   Classroom Teacher
   Coach (Instructional or Technology Integration)
   Counselor
   ELL/ESL/ESOL Teacher
   Librarian/Media Specialist
   Paraprofessional or Instructional Aide
   Special Education Teacher/Interventionist
   Other

2) What grade(s) do you primarily teach?

   Preschool - Transitional Kindergarten
   Kindergarten - Grade 1 - Grade 2
   Grade 3 - Grade 4 - Grade 5
   Grade 6 - Grade 7 - Grade 8
   Grade 9 - Grade 10 - Grade 11 - Grade 12
   Multiple Elementary Grade Levels
   Multiple Secondary Grade Levels
   All grades

3) What subject is your primary assignment?

   General Elementary (all subjects)
   Career Technical Education/Vocational Education
   Computer Science/Technology Applications
   ELL/ESL/ESOL
   English/Language Arts
   Math
   Physical Education (P.E.)/Health
   Reading/General Literacy
   Science
   Social Studies or History
   Special Education
   Visual and Performing Arts (includes Music, Art, Drama, Media Arts, Yearbook)
   World Languages
   Other

4) Are you teaching in a setting where your students each have access to at least one mobile device and online collaborative tools to use regularly within instructional time and outside of school hours? Which initiatives support this opportunity? Choose all that apply.

1:1 program – where students are assigned devices to use in school only
1:1 program – where students are assigned devices to use in school and at home
Expansion or implementation of Bring Your Own Device (BYOD)
Google for Education Suite student accounts
Microsoft Office 365 for Education student accounts
Mobile hotspot loaner program for student/family connectivity outside of school
None of the above are available to my students

5) How often do you use any of these types of digital content, tools and resources in your classroom to support student learning?

Response Options
Daily or almost daily
At least once a week
At least once a month
A few times a year
Rarely/never/no access

Class blog or student discussion board
Coding or computer programming resources
Digital, video, or online games
Online animations, simulations or virtual labs
Online curriculum
Online databases
Online reading sites or subscriptions with access to books and articles
Online reading sites or subscriptions with access to books and articles
Social media tools
Software/apps to help students develop curricular skills or knowledge
Tools for students to create multi-media content
Two-way communication tools for student communications (texting)
Videos that I create myself
Videos that I find online
Virtual white boards
Virtual voice assistants (Siri, Alexa, Google)

6) Do you face any of the following challenges when trying to use technology in your classroom? (Check all that apply)

Cannot access online videos
Cannot use social media tools
Internet is too slow, inconsistent or unreliable
Loss of instructional time due to student login issues

Need classroom set of computers or mobile devices for students to use
School blocks websites or apps needed for teaching
Student devices are in need of update or repairs
Student devices are not charged for class
Students display off task behaviors and distractions
Students do not consistently bring their devices to class
Teacher devices are in need of update or repairs
Teacher tools needed to support integration
No challenges - I choose not to use technology in my classroom
No challenges
Other

7) When thinking about using technology within your classroom, do any of these conditions stand in your way or limit your effectiveness? (Check all that apply)

Lack authority to make decisions about apps or online content to use in my class
Lack of adequate planning time with colleagues
Need just-in-time technology support in my classroom
Need professional learning on skills and strategies for using technology effectively within instruction
Security/safety concerns override instructional growth
Students lack basic technology skills such as keyboarding, navigation, and troubleshooting
Students lack digital citizenship training
Time constraints
Too many rules prevent using technology in school (eg not allowing students to charge devices in class, devices stay at school and cannot be used for extended learning)
None of the above
Other

13) Digital citizenship has been defined as the set of norms of appropriate, responsible behavior with regard to technology use. Which of these digital citizenship topics are you explicitly covering in your class this year with your students? Share how frequently by ranking each topic using: Never, Annually, Monthly, Weekly, or Daily.

Appreciating that everyone has digital rights
Being an informed consumer
Being aware that companies profit from increasing time users spend online
Being empathetic and kind online
Being safe with others online
Identifying the risks and potential consequences of sexually explicit content

Maintaining privacy from corporations (preventing data tracking, reading privacy policies)
Managing technology use (media balance)
Participating in online public forums including social media
Protecting personal and private information online
Responding to cyberbullying
Understanding algorithms and how they affect everyday experiences (e.g. search results)
Understanding how bias and unequal access to technology impacts society
Understanding how technology features are designed to increase time spent online (e.g. nudges, notifications, autoplay)
Understanding laws that apply to digital tools (e.g. privacy, sharing graphic content, copyright)
Using digital communication tools with audience in mind
Using technology to learn new things

19) How would you rate your comfort with the following?

Allowing student choice about the strategies and tools they use to demonstrate learning
Allowing student choice in identifying a problem or question to address a learning standard
Allowing students to set their own learning goals and plan for how they will learn
Facilitating online remote learning when necessary
Facilitating student collaborations using digital tools
Infusing computational thinking and computer science concepts across all core curriculum
Leveraging technology to differentiate instruction
Partnering with parents to engage with their children around learning goals with provided resources and strategies
Personalizing learning within my classroom for each student
Supporting students' social and emotional well-being
Taking advantage of students' 1:1 access to a mobile device
Teaching positive digital citizenship behaviors and strategies to my students
Using data derived from online tools and apps to inform my instructional practices
Utilizing a learning management system (LMS)

24) At the end of this school year, how many years of teaching experience will you have?

This is my first year
2 to 3
4 to 10
11 to 15
16+

25) Racial/Ethnic/Cultural Identity

American Indian/Alaskan Native
Asian
Black/African-American
Caucasian/White (non-Hispanic)
Hispanic/Latinx
Native Hawaiian/Other Pacific Islander
Multiracial
Decline to state
Other