

Screen-related Dependency in Children: Algorithm for Referral from Primary Care in Malaysia

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Abstract

The emergence of screen-related issues in children in recent years and the negative impacts on their development have intensified research and movements for their recognition and prevention. Studies have found multiple health concerns and significant associations with psychological disorders related to screen use, leading to the development of screening tools to identify these preschool children for early intervention. While general guidelines, such as limiting screen time by the World Health Organization (WHO), exist, there are no specific outlines or pathways provided for healthcare providers at the primary care level, especially in the Malaysian context. This algorithm, developed by a group of Malaysian experts in children and adolescent care, aims to facilitate the early screening of screen-related dependency in preschool children and referral for psychological interventions. It was also designed to raise awareness and educate parents and caretakers, with a focus on primary healthcare providers. The anticipated benefits of this algorithm include providing healthcare providers with a standardized approach to identify at-risk children, ensuring timely intervention and management. For children, early identification may reduce the risk of developmental and behavioural issues associated with excessive screen exposure. Its strengths lie in its evidence-based approach and feasibility for implementation in primary care settings. However, potential challenges include variability in provider training, parental adherence, and accessibility to psychological services. Further validation through pilot studies is necessary to assess its real-world effectiveness and sustainability.

Keywords

Screen-related dependency, preschool children, early screening algorithm, primary healthcare providers, psychological intervention

Introduction

Screen-related dependency refers to the problematic use of any type of media conveyed through screens, such as smartphones, tablets, laptops, televisions, and portable video games ¹. This phenomenon has become increasingly prevalent in young children due to the widespread accessibility of digital devices. Prolonged screen use, and subsequent screen dependency, can lead to addiction symptoms identical to those seen in substance addiction, such as negative emotional responses (irritability and anxiety) and loss of control when there is no screen access ². Unlike in the past, when screen use was primarily limited to television, screen usage is now common, even at an early age. A recent study in Malaysia of 340 parents of 3- to 5-year-old children reported that 60% allowed screen time before the age of 18 months, with an average screen time of more than two hours daily ³.

In the early stages of development, a child's immediate environment and social interactions play crucial roles in shaping both behaviour and neurobiological growth ⁴. Although screen media offers certain benefits, particularly in education and language development, excessive usage is associated with numerous health concerns. These include physical problems such as obesity, behavioural issues, developmental delays, difficulties in emotional regulation, poor academic performance, and sleep disturbances ⁵⁻⁷. Additionally, excessive screen exposure may contribute to psychosocial impairments, such as reduced quality of relationships with peers and family due to displaced time spent on screen media ^{8,9}.

Given the growing global concern, international bodies have outlined general guidelines to address this issue. For instance, the most recent recommendation by the World Health Organization (2019) for children aged two to four states that screen time should not exceed one hour daily ¹⁰. The American Academy of Pediatrics (AAP) in 2016 encouraged the use of "high-quality programming" to be viewed alongside parents to enhance interaction and learning ⁸.

These recommendations so far only cover screen time. There are no guidelines locally or internationally on how to screen for screen-related dependency or what medical doctors should do in response. This is because there was no suitable questionnaire available to screen for Screen Dependency Disorder among young children. In response to this, a screening tool called the Screen Dependency Scale (SDS) was developed in the Malay language and was validated in the local population, making this tool suitable for medical doctors to use in the clinic ¹¹. However, there are no guidelines on the management of the children based on this questionnaire.

This study aims to address this gap by developing a structured and practical screening algorithm tailored based on the SDS, for use in primary care. The algorithm is expected to provide a systematic approach for healthcare providers to identify children at risk of screen-related dependency, facilitate timely referrals for psychological intervention, and offer clear guidance to parents and caregivers on managing screen use effectively. By implementing this algorithm, primary care practitioners may play a critical role in early detection, ultimately improving developmental, behavioural, and psychosocial outcomes in young children.

Method

This algorithm was developed as a continuation of the main study that designed and validated the Screen Dependency Scale (SDS) ¹¹. The SDS is a parent-report questionnaire designed to assess screen dependency among pre-school children aged 4 to 6 years. A cross-sectional study was conducted in two phases. In Phase 1, the initial version of the SDS was developed in Bahasa Malaysia and underwent content and face validity assessments by a panel of four experts. In Phase 2, a total of 386 parents were recruited and divided into two independent samples for psychometric testing. Sample 1 was used for exploratory factor analysis

(EFA), where items with factor loadings above 0.4 were retained. Sample 2 underwent confirmatory factor analysis (CFA), which confirmed the four-factor structure identified in the EFA. Good model fit was indicated by RMSEA and CFI indices, and the final version of the SDS consisted of 15 items with strong internal consistency. These findings support the SDS as a valid and reliable tool for assessing screen dependency in Malaysian pre-school children. In this study, the cut-off score was also determined via statistical analyses.

This algorithm was also developed based on the results of a cross-sectional study to determine the prevalence of screen dependency and its associated factors among preschool-aged children in Kuala Lumpur¹². The validated Screen Dependency Scale (SDS) was used to assess children's screen dependency, and 300 parents of children aged 4 to 6 years were involved. The prevalence of screen dependency was found to be 65.7%. Analysis identified several significant predictors: the use of screens to manage children's quarrels, children's use of smartphones, screen time exceeding two hours on weekends, and having a television in the child's bedroom. Active co-use mediation by parents was found to be a protective factor against screen dependency. The classification of screen dependency into no dependency, mild, moderate, and severe categories was established through tertile analysis from the study.

Development Process

A final expert meeting was convened in February 2022 to review the classification and ensure its alignment with clinical observations and intervention needs. The development process was guided by findings from the SDS study, expert clinical experience, and any additional review. The goal was to create a practical algorithm that could be implemented in primary care settings to assist medical practitioners in the early screening, assessment, and management of screen dependency in children.

Selection of Experts and Consensus Process

A total of five experts participated in the development of this algorithm. The expert panel consisted of two family medicine specialists with expertise in Child and Adolescent Health, one child psychiatrist, one addiction psychiatrist with experience in screening tool development, and one public health expert. These experts were selected based on their experience in child behavioural health, addiction medicine, and direct clinical management of children.

During the final expert meeting in February 2022 in Kuantan, the panel reviewed the SDS cut-off points to evaluate whether they accurately reflected clinical severity based on questionnaire items. The discussion was informed by real-world clinical cases, literature evidence, and professional experience. Experts deliberated on whether the stratification of screen dependency into no dependency, mild, moderate, and severe categories corresponded to observable clinical behaviors and appropriate intervention strategies.

Voting Process for Consensus

A structured voting process was used to achieve consensus on the algorithm's components. The discussion phase began with a detailed presentation of each component, including screening criteria, score interpretation, and management guidelines. Experts engaged in discussions, drawing insights from clinical experience, the SDS study findings, and supporting literature.

Following discussions, each expert independently voted on whether they agreed, disagreed, or recommended modifications to each component. A decision was finalized when at least 80% agreement was reached among the panel. If consensus was not initially achieved, further deliberations were conducted, revisiting relevant literature and clinical case examples to refine the proposal. A second round

of voting was conducted for the revised component, ensuring that all decisions were deliberate, evidence-based, and widely accepted by the expert panel.

This structured two-round voting approach provided a systematic, transparent decision-making process that ensured the development of a clinically applicable and standardized referral algorithm for primary care settings.

Results

Consensus Analysis

The main focuses of the algorithm were organized into three distinct components (A.I.M): Assessments, Interpretation, and Management. The development of these components was based on expert consensus, achieved through a structured two-round voting process, ensuring evidence-based decisions in determining the screening approach, classification criteria, and management pathways. Table 1 summarises the consensus decisions and voting outcomes.

Table 1: Consensus decisions and voting outcomes.

Decision Component	Voting Outcome - Round 1	Voting Outcome - Round 2	Final Decision
Identification of High-Risk Groups for Screening	4/5 (80%) - Further discussion required	5/5 (100%) - Consensus achieved	High-risk groups identified (mobile phone users, >2 hrs screen time, TV in bedrooms, screen as pacifier).
Cut-off Score for SDS (24.5) based on ROC Analysis	3/5 (60%) - Further statistical justification requested	4/5 (80%) - Consensus achieved after sensitivity/specificity review	SDS cut-off score set at 24.5 (Sensitivity = 55%, Specificity = 80%).
Stratification of SDS into Mild, Moderate, Severe	4/5 (80%) - Minor adjustments proposed	5/5 (100%) - Final tertile categories confirmed	Stratification into Mild (24.5-29.0), Moderate (29.1-35.0), Severe (>35.0).
Validation of Tertile Stratification using Chi-Square	4/5 (80%) - Further validation requested	5/5 (100%) - Statistical validation accepted	Chi-Square analysis validated tertile stratification (P = 0.013, Cramer's V = 0.19).
Management of No/Mild Dependency (Parental Education & Follow-Up)	5/5 (100%) - Accepted	5/5 (100%) - No changes required	No/Mild cases to receive parental education and follow-up at primary care level.
Management of Moderate/Severe Dependency (Referral to Psychiatry)	3/5 (60%) - Clarification on referral criteria needed	4/5 (80%) - Consensus achieved after defining referral criteria	Moderate/Severe cases to be referred to psychiatry for further assessment.

Assessment

At the top of the algorithm lies the assessment and general surveillance to identify children with screen dependency. Based on the findings of the Screen Dependency Scale (SDS) cross-sectional study, certain children are at higher risk of developing screen dependency. These include children who use mobile phones, have 2 or more hours of screen time, have televisions in their bedrooms, and whose parents regularly use screens as a pacifier ¹². The expert panel initially had a split opinion in Round 1, with 80% agreement, on whether general screening should be recommended for all children or only high-risk groups. Some experts argued that general screening would be more inclusive, while others emphasized feasibility and resource limitations. After further discussions, consensus was reached in Round 2 with 100% agreement to prioritize screening for high-risk groups, ensuring practical implementation and feasibility. The decision was made to screen children who met these risk factors using the SDS. In addition to these risk groups, the panel agreed that any concerns raised by parents or caretakers regarding a child's behaviour with screen media, daily functional disruptions, or impairments should warrant an assessment by clinicians.

Interpretation

The SDS has a possible range of 15 to 60, where higher scores indicate higher dependency. To determine the optimal cut-off point for distinguishing dependent and non-dependent individuals, Receiver Operating Characteristic (ROC) analysis was conducted. The best cut-off score was determined using the Youden index, which balances sensitivity and specificity. The ROC curve for SDS was measured against screen time, and the optimal cut-off score was determined to be 24.5, with a sensitivity of 55% and specificity of 80% ¹³. The area under the curve (AUC) for SDS was 0.7, which indicates an acceptable level of diagnostic accuracy ¹⁴.

During Round 1 of voting, only 60% of the panel agreed on using 24.5 as the cut-off point, with some experts requesting further justification for sensitivity and specificity. The discussion focused on whether a higher cut-off point would be more accurate, but after a review of the statistical evidence, the experts reached 80% agreement in Round 2, finalizing 24.5 as the threshold for dependency classification.

Further categorization of screen dependency severity was discussed, as it was deemed necessary to enhance clinical management strategies. For individuals scoring above 24.5 (dependent group), a tertile percentile analysis was conducted to classify dependency into mild, moderate, and severe categories. Based on this analysis, the dependent group was divided into mild dependency (24.5 - 29.0; below 33rd percentile), moderate dependency (29.1 - 35.0; 33rd - 66th percentile), and severe dependency (> 35.0; above 66th percentile) ¹².

In Round 1 of voting, 80% of the experts supported the tertile categorization, but there was a request for additional validation through statistical testing. Further Chi-square analysis was conducted, and the validation results showed a statistically significant association between SDS tertile categories and screen time (Table 2). Following this statistical confirmation, 100% agreement was reached in Round 2 on the final classification system.

Table 2: Association between screen-media dependency level and screen time.

Variables		Screen time, n (%)			χ^2	V	p-value
		<1 hour	1 – 2 hours	>2 hours			
Screen-media dependency level	Mild (24.5 – 29.0)	29 (32.2%)	34 (37.8%)	27 (30.0%)	13.14	0.16	0.011
	Moderate (29.1 – 35.0)	22 (24.4%)	29 (32.2%)	39 (43.3%)			
	Severe (> 35.0)	40 (45.5%)	29 (33.0%)	39 (43.3%)			

Minimum expected frequency: 27.91

Cells with expected < 5: 0%

Chi-square test (χ^2) at 0.05 level of significance; * $p < 0.05$.

The P-value was 0.011, confirming that the stratified categories meaningfully distinguish children based on their screen dependency severity.

Management

The management component was divided into two main intervention pathways based on screen dependency severity. For children classified as having no dependence or mild dependence, the experts reached a unanimous agreement that these cases should receive preventive measures, including parental education and regular follow-up. The discussion emphasized that parental education should include raising awareness about screen dependency, understanding the risks and their impact on child development, and teaching preventive strategies such as parental mediation and screen time limits.

For children classified as having moderate and severe dependency, the experts agreed that more intensive interventions were required. However, in Round 1 of voting, only 60% of the experts initially supported psychiatric referral, with some members requesting further clarification on referral criteria. The discussion centred on which symptoms or behaviours should warrant psychiatric evaluation. After defining clinical indicators and reviewing case examples, 80% of the experts reached a consensus in Round 2, finalizing the decision to refer moderate and severe cases to psychiatry for further assessment.

Discussion

The main approach to addressing screen-related dependency is early detection and prevention. This algorithm was designed to be implemented in primary healthcare settings, kindergartens, and daycares, as the target age group is 4 to 6 years old. In Malaysia, 73.3% of children under 2 years old were exposed to screens, as reported in the 2016 National Health Morbidity Survey (NHMS)¹⁵. Given this high prevalence, general surveillance should ideally be conducted for all children in this age group. However, due to practical constraints, the algorithm prioritizes high-risk groups to ensure effective and feasible implementation.

Parents, as primary observers of a child's behaviour, play a significant role in identifying early signs of screen dependency. This algorithm was developed to raise awareness among parents and caregivers and to serve as a tool for parental education. The Screen Dependency Scale (SDS) consists of 15 items covering domains relevant to screen dependency in children and can be completed within five minutes, making it a practical tool for busy parents and clinicians. Using the cutoff score of 24.5, children can be categorized as dependent or non-dependent. However, expert consensus determined that further stratification into mild, moderate, and severe categories was necessary to guide appropriate intervention strategies. This

stratification allows for a more tailored approach in addressing varying levels of screen dependency severity.

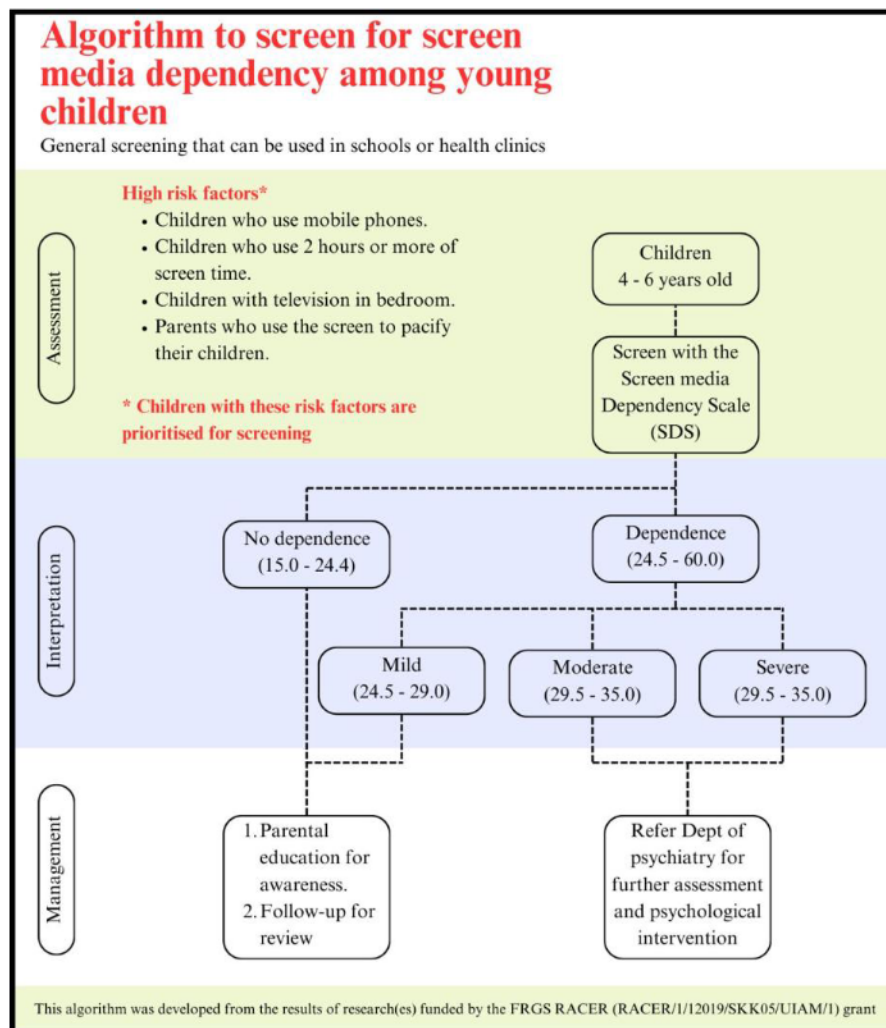


Figure 1: Algorithm to screen for screen-media dependency among young children.

Parents, as primary observers of a child's behaviour, play a significant role in identifying early signs of screen dependency. This algorithm was developed to raise awareness among parents and caregivers and to serve as a tool for parental education. The Screen Dependency Scale (SDS) consists of 15 items covering domains relevant to screen dependency in children and can be completed within five minutes, making it a practical tool for busy parents and clinicians. Using the cutoff score of 24.5, children can be categorized as dependent or non-dependent. However, expert consensus determined that further stratification into mild, moderate, and severe categories was necessary to guide appropriate intervention strategies. This stratification allows for a more tailored approach in addressing varying levels of screen dependency severity.

The primary intervention for children categorized as no dependence or mild dependence is parental education and structured follow-up. Addressing underlying factors that contribute to problematic screen exposure is crucial in parental education. A qualitative study in Malaysia identified key reasons for excessive screen exposure, including lack of awareness about screen time risks, uncertainty about the

appropriate age for digital media exposure, a belief that digital media is educational, and using screens as a pacifier with minimal supervision. Recognizing these factors helps shape intervention strategies tailored to specific parental concerns.

Another important aspect of parental education is guiding parents in implementing strategies to regulate their child's screen use effectively. Parental strategies into restrictive strategies, such as setting time and content limits, and active mediation, where parents engage in discussions with their children about screen content ¹⁶. While restrictive strategies are effective in limiting screen exposure, active mediation is the preferred approach, as it encourages parent-child interaction and promotes digital literacy. Similarly, technical restrictions, such as parental control tools, were also beneficial in regulating screen time ¹⁷. Counselling for parents should emphasize time restrictions, which help shift the child's focus from screens to face-to-face interactions, a crucial element in early childhood development. Parental engagement techniques, including co-viewing media content and actively discussing it with children, have been shown to enhance cognitive and language skills ¹⁸.

For children categorized as moderate and severe dependency, the algorithm recommends referral to the Department of Psychiatry for further assessment and psychological intervention. Currently, the nearest clinical classification for screen-related dependency is Internet Gaming Disorder (IGD), which is listed as a condition for further study in the DSM-5. Although not yet officially recognized as a formal psychiatric disorder, the management strategies for screen dependency closely resemble those used for IGD.

Interventions for screen dependency include cognitive-behavioural therapy (CBT) to address underlying psychological conditions, such as social anxiety or attention-related issues. Skills training programs focusing on time management and promoting alternative real-life rewarding activities are also recommended. Additionally, interpersonal therapy helps children develop social and personal functioning skills, while family therapy addresses dysfunctional family dynamics that may contribute to excessive screen use ¹⁹.

Despite its strengths, this study has several limitations. One limitation is the language specificity of the SDS, as it was developed and validated in the Malay language. This may limit its applicability in non-Malay-speaking populations and necessitates further validation in different linguistic and cultural groups. Another limitation is that parental reporting of a child's screen time may be subject to recall bias or social desirability bias. Some parents may underreport their child's screen time due to concerns about judgment, while others may overestimate educational screen use. Future studies should incorporate objective screen time tracking methods, such as screen monitoring applications, to obtain more precise data. Additionally, this algorithm does not account for potential comorbidities, such as neurodevelopmental disorders (e.g., ADHD, autism spectrum disorder), which may influence screen dependency behaviours. Future research should explore how screen dependency interacts with neurodevelopmental conditions, allowing for better-tailored interventions.

Cultural factors play a significant role in shaping parental attitudes and practices related to screen use in Malaysia. The widespread belief that digital devices enhance early learning has led many Malaysian parents to introduce screen-based educational content at an early age. Additionally, multigenerational households are common, and grandparents often serve as primary caregivers. This may contribute to differences in screen time rules, as older caregivers may be less aware of digital media guidelines or may use screens as a convenient babysitting tool. Another cultural factor influencing screen dependency is Malaysia's rapid digitalization. With high smartphone penetration rates and affordable internet access, children are often

exposed to screens as part of their daily routines. Furthermore, socioeconomic disparities influence screen time patterns, as children from low-income families may have fewer outdoor play opportunities, leading to greater reliance on digital devices for entertainment.

Further research is needed to expand the evidence base for screen dependency interventions. Longitudinal studies should investigate the long-term impact of screen dependency on cognitive, emotional, and social development in children. Additionally, research should explore the effectiveness of different intervention strategies, including family-based interventions, school-based digital literacy programs, and technology-assisted parental controls. The integration of behavioural neuroscience methods, such as functional MRI (fMRI) and eye-tracking studies, may help understand the neurobiological mechanisms underlying screen dependency. Such insights could lead to more targeted intervention strategies that address both behavioural and neurocognitive aspects of screen dependency.

Primary care providers play a crucial role in engaging parents and caregivers in utilizing the algorithm effectively. Clinicians should receive training on digital health literacy to help them recognize screen dependency symptoms and provide guidance on healthy screen use. Incorporating the algorithm into routine paediatric check-ups would ensure early identification and intervention. Additionally, collaborations with educators could help extend the algorithm's application to school environments, promoting healthy digital habits among young children. Schools could implement structured digital literacy programs alongside the algorithm to ensure consistent messaging between healthcare providers, teachers, and parents.

This algorithm provides a structured approach to the early detection and management of screen dependency in young children, particularly within primary healthcare settings. While the current model offers a solid foundation, further refinements, including digital integration and expanded training for healthcare providers, could enhance its effectiveness. Future research should continue to explore new intervention strategies and optimize screening methods, ensuring better developmental outcomes for children at risk of screen dependency.

Conclusion

Early detection of screen dependency in children is essential in preventing the negative effects that can impede their cognitive, behavioural, and emotional development during this critical stage. The A.I.M. approach, which integrates Assessment, Interpretation, and Management, provides a structured and systematic method for identifying, categorizing, and managing screen dependency in young children. Through this algorithm, healthcare providers can effectively screen children using the Screen Dependency Scale (SDS), a validated tool that categorizes screen dependency into no dependence, mild, moderate, and severe based on a statistically validated cutoff score of 24.5. Stratification further enhances clinical decision-making, ensuring that interventions are tailored to each level of dependency.

The algorithm is particularly relevant for primary care settings, where early intervention plays a crucial role in addressing screen dependency before it leads to more severe developmental concerns. Primary healthcare providers, kindergartens, and daycare centres can implement this algorithm as part of routine child health assessments, allowing for early identification of at-risk children. The expected benefits of implementing this algorithm include raising awareness among parents, equipping healthcare providers with a standardized approach for early intervention, and providing a structured referral pathway for moderate to severe cases that require psychiatric evaluation and intervention.

Preventive measures remain a challenge that requires a multi-level approach, beginning with parents, educators, and healthcare professionals. The role of parental education is crucial, as active parental mediation and behaviour modification strategies can significantly reduce the risk of screen dependency. Healthcare providers should engage in counselling efforts to educate parents about screen time guidelines and effective strategies for managing screen use.

Despite its strengths, the study has some limitations. The SDS was developed in Bahasa Malaysia, making it a suitable tool for use among Malaysians who are fluent in this language. Therefore, it is recommended that this questionnaire be validated in other languages to expand its applicability across different populations. Additionally, this study focused solely on preschool-aged children, highlighting the need for further research to bridge the gap in age groups and assess screen dependency in older children and adolescents.

Moving forward, the integration of this algorithm into primary care settings will facilitate a proactive, evidence-based approach to managing screen dependency. Future research should focus on refining intervention strategies, validating the algorithm across different populations, and incorporating digital tools to enhance screening and follow-up mechanisms. With proper implementation, this algorithm has the potential to improve early identification, provide targeted interventions, and ultimately contribute to healthier digital habits among young children.

Declaration

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