Review

A Scoping Review of Digital Wellbeing in Early Childhood: Definitions, Measurements, Contributors, and Interventions

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Abstract: Digital wellbeing concerns the balance and health we may experience in digital use, and the existing studies have focused on adolescents and adults. However, young children are more vulnerable to digital overuse and addiction than adults; thus, their digital wellbeing deserves empirical exploration. This scoping review synthesized and evaluated 35 collected studies on young children's digital use and their wellbeing that were published until October of 2022 to understand the definitions, measurements, contributors, and interventions. The synthesis of evidence revealed that: (1) there was no consensus about its definition; (2) there were no effective measurements of young children's digital wellbeing; (3) both child factors (duration and place of digital use, child demographic characteristics) and parent factors (digital use, parental perception, and mediation) contribute to young children's wellbeing; and (4) there were some effective applications and interventions. This review contributes to the theoretical development by mapping the existing work on young children's digital wellbeing, proposing a model, and identifying the research gaps for future studies.

Keywords: young children; early childhood; digital; wellbeing; review; definition; measurement; contributor; intervention

1. Introduction

The COVID-19 pandemic has caused repeated lockdowns and the associated (pre-)school closures that forced young children (ages 3-8) to learn from home using digital devices [1,2]. Young children are sensitive and vulnerable to digital overuse and problematic use[3]. Therefore, their digital wellbeing is in crisis or at least compromised. However, the existing studies have focused on the digital wellbeing of adolescents and adults, leaving young children unexplored. In fact, young children have started to become 'digital natives' since the turn of this millennium [4], while the COVID-19 pandemic hugely accelerated the digitalization of their lives [5-7]. This drastic transformation has significantly increased digital use and screen time in young children globally [2,8]; thus, many countries have issued national guidelines to tackle the problem [9,10]. These guidelines, however, only provide advice on how to limit young children's screen time and digital use, which is highly relevant but not necessarily translated into young children's digital wellbeing [11]. Moreover, there is a lacking national guideline specifically on young children's digital wellbeing, an emerging and underexplored research area. Therefore, a scoping review is needed urgently to map the literature on this topic systematically. To meet this end, this scoping review was conducted to identify the definition, measurements, contributors, and interventions that could inform practice and research in the field.

1.1 Digital Wellbeing: Definitions, Nature, and Constructs

Since the turn of this millennium, digital health and wellbeing have emerged as a public concern and research topic, focusing on how to maintain a good and healthy lifestyle in the digital era [12]. In 2012, Nansen coined the term 'digital wellbeing' to situate

online risk within the concept of wellbeing, aiming to highlight children's online resilience and critical capacities to cope with online risks and achieve online safety [13]. Later, Beetham explicitly defined it for educational purposes: digital wellbeing refers to the balance between potential risks as well as benefits of digital engagement [14]. This definition underscored the supporting role of teachers in students' digital wellbeing. Therefore, digital wellbeing has been widely regarded as a strategy or solution to prevent digital overuse or even digital addiction and has caught drastically increased attention during the past decade [3]. Recently, Abeele defined digital wellbeing as 'a subjective individual experience' of optimal balance and health in digital use [15]. The above-mentioned, however, are general definitions of digital wellbeing, not specific to young children. Therefore, Johnston defined digital wellbeing as how digital use could be integrated into children's lives to enhance their learning, development, and long-term outcomes [16]. This scoping review, thus, aims to collect and analyze all the existing definitions to figure out the best-fit one for young children's digital wellbeing.

Definition reflects our understanding of the nature of the target phenomenon, but there have been arguments about the nature of digital wellbeing. For instance, Gui et al. defined digital wellbeing as 'a state' where subjective wellbeing is maintained in an overabundant digital environment [3], which is, per se, a balance between the flipside effects and benefits. In contrast, Royal defined it more positively: digital wellbeing is 'a way of life' with digital technology promoting optimal health and wellbeing. This 'way of life' has integrated body, mind, and spirit to enable an individual to live more fully within the human, natural, and digital communities. Therefore, it is the ideal state of health and wellbeing that each digital citizen is capable of achieving [17]. Later, Google officially defined the nature of digital wellbeing as 'a state of satisfaction' when digital technology supports people's intentions [18]. So, technology should be designed for 'crafting and maintaining a healthy relationship with technology', and the focus should be on how technology serves us and moves us towards our goals rather than distracting and interrupting us. Hence, Google launched an application named 'digital wellbeing', empowering users to track their using time on various applications and balance digital and non-digital activities. The same function could be found in iPhone and iPad in 'Screen Time'. Since then, digital wellbeing has been discussed frequently among technology designers, educators, policymakers, and so on. Recently, Abeele defined digital wellbeing as 'a subjective individual experience' of optimal balance between the advantages and disadvantages associated with digital use [15]. In summary, the existing literature tends to define the nature of digital wellbeing as 'a state of balance' [3], 'a way of life' [17], 'a state of satisfaction' [18], and 'a subjective individual experience' [15]. This scoping review will synthesize and analyze the existing evidence to clarify the nature of digital wellbeing.

Recently, Yue et al. proposed a 3-dimension framework: (1) crafting and maintaining a 'healthy relationship' with technology that can be used in a balanced and civic way; (2) identifying and understanding the 'positive and negative impacts' of engaging with digital activities; (3) being aware of ways to 'manage and control factors' that contribute to digital wellbeing [19]. This 3-dimension framework, however, has not been verified by other studies. In addition, very few studies have proposed and validated the other constructs of digital wellbeing. Therefore, this scoping review also aims to explore the existing studies to identify the possible constructs of digital wellbeing in the early years.

1.2 Digital Wellbeing in Early Childhood

Evidence demonstrates that early digital use is a double-edged sword for young children. On the one hand, young children can use digital technology for learning, communicating, creating, and entertainment [20,21], which are beneficial for early learning and development [22]. Hence, digital technology is labeled as 'early childhood educators' and 'integral learning tools' [23]; and accordingly, many countries have launched standards or policies to promote children's digital literacy and digital citizenship [22]. However, on the other hand, inappropriate early digital use may cause severe physical and mental

health problems in young children [12], such as obesity [24], sleep disturbance [25], postural effects and visual disorders [26], hinder cognitive and brain development [27], execute function [28] and social and emotional development [29]. In particular, Meng et al. (2022) reported that the global rates for smartphone and social media addiction were 26.99% and 17.42%, respectively, and the rates for the South-East Asia region were 41.63% (smartphone addiction) and 59.36% (social media addiction) [30]. Furthermore, Anitha et al. (2021) investigated 613 children between 18 months and 12 years and found that the prevalence of screen addiction was 28.1%[31]. Therefore, digital wellbeing in early childhood has recently emerged as a global concern.

To address this global concern, many national guidelines for young children's digital usage have been released. For example, the American Psychological Association (APA) has published a specific guideline for children's digital use, Digital Guidelines: Promoting Healthy Technology Use for Children [9]. This guideline suggested that children younger than 18 months should not use any screen-based digital technologies, and those aged 2 to 5 should not watch screens for more than 1 hour per day. In addition, according to it, parents should be responsible for: (1) choosing high-quality programming; (2) teaching kids about technology from a young age; (3) discussing with kids the benefits and risks of technology; (4) establishing family rules for technology use; (5) restricting digital use for at least 30 minutes before bed; and (6) helping child to develop social skills through establishing real-life relationships [9]. Later, the Canadian Paediatric Society (CPS) issued the '4 Ms' guides for parents of young children (0-5 years old): 'Minimize, mitigate, be mindful, model Minimize screen time' [32]. Meanwhile, the Department of Health of the Australian government published the 24-hour Movement Guidelines for the Early Years, which recommended more physically active time and less sedentary screen time [33]. Recently, the India Academy of Pediatrics (IAP)published the "Indian Academy of Pediatrics Guidelines on Screen Time and Digital Wellness in Infants, Children and Adolescents" in 2021, suggesting controlling screen time, keeping normal routine activities, building a good home environment, and monitoring children's daily digital use [10]. However, the main purpose of these guidelines is to reduce or limit screen time, reflecting their negative views and reservations about early digital use [34].

In 2021, Minnesota State issued a "Digital Wellbeing Bill" and provided 1 million in funding support for training educators, parents, and adolescents with knowledge and skills to promote physical and mental wellbeing [35]. This initiative was based on the positive view of early digital use and aimed to advocate balanced, intentional, and responsible digital use. However, this meaningful program was designated for school children [36] rather than young children whose digital wellbeing is still unknown [16]. Therefore, a synthesis of existing evidence about early childhood digital wellbeing is needed urgently for policymaking and practical improvement. To address this research gap, this study aims to collect all the studies on digital wellbeing in young children and provide the knowledge base for policy improvement and future studies.

1.3 Research Objectives and Questions

The above literature review has demonstrated the inconsistencies and arguments regarding the definitions, nature, and constructs of digital wellbeing in the early years. And there is a lacking of systematic knowledge framework of young children's digital wellbeing across studies. Therefore, this scoping review aims to synthesize, display and evaluate the latest literature on young children's digital wellbeing, focusing on the definitions, measurements, contributors, and interventions. Based on the previously published literature, the present scoping review focuses on young children's digital wellbeing and further establishes a theoretical basis for exploring the topic in the future. In particular, the following questions guided this study:

1. What is the digital wellbeing of young children?
2. What are the effective measurements of young children's digital wellbeing?
3. What are the contributors to young children's digital wellbeing?

4. How to improve young children's digital wellbeing?

2. Materials and Methods

This study aims to review current literature about young children's digital wellbeing o (under 8 years old). A scoping review approach is useful for clarifying the definition and influence factors in an emerging area [37]. This scoping review followed the PRISMA extension for scoping reviews (PRISMA-ScR) statement [38].

2.1 Search strategy

The electronic databases used for the literature search included Scopus, EBSCO, Web of Science, ProQuest, PubMed, and PsycINFO. After discussion by the research team, search terms were used in combination: ("wellbeing" OR "well-being" OR "wellness") AND ("digital" OR "technology" OR "mobile" OR "smart*" OR "internet" OR "screen") AND ("young child*" OR "preschool*" OR "kindergarten*" OR "infant" OR "toddler" OR "pre-k*" OR "early childhood"). To explore the scope of digital wellbeing, this study investigated all kinds of academic articles (including peer-review articles, book chapters, dissertations, and technical reports) published until 26 October 2022.

2.2 Inclusion and exclusion criteria

This review set three inclusion criteria. First, the articles should be related to the definition, measurement, influence factor, or intervention to young children's digital wellbeing. Second, the articles should be full-text and be written in English. Third, the articles should focus on young children (under 8 years old). As few studies focus on young children's digital wellbeing, the third criterion has changed to under 18 years old. Meanwhile, the articles should be removed based on the following exclude criteria: (1) focus no more than young children's physical health and medicine studies; (2) participant or target samples are children with special needs; (3) application design and test studies; (4) wellbeing of other stakeholders (teachers or parents).

2.3 Study selection

Figure 1 displays the flow chart of the study selection. As shown in Figure 1, a total of 1,677 articles were found by searching the electronic databases. Among these articles, 871 were from Scopus, 85 from EBSCO, 406 from Web of Science, 16 from ProQuest, 271 from PubMed, and 28 from PsycINFO. These articles were removed in the following steps. First, remove the duplicate articles (n=913) by Endnote. Second, 764 articles were imported into Covidence and screened by title and abstract, and 653 studies were excluded because of irrelevance, leaving 111 articles for further scrutiny. Third, the 111 articles were assessed for full-text eligibility, and 80 were excluded because of (1) irrelevant with young children (n=47); (2) irrelevant with digital use (n=11); (3) pediatric or adult population only (n=16); (4) no full-text (n=4); and (5) not in English (n=2). Finally, after checking the references of the included 31 articles, we found four additional articles and included them in this study. Eventually, 35 articles were chosen and analyzed in this study.
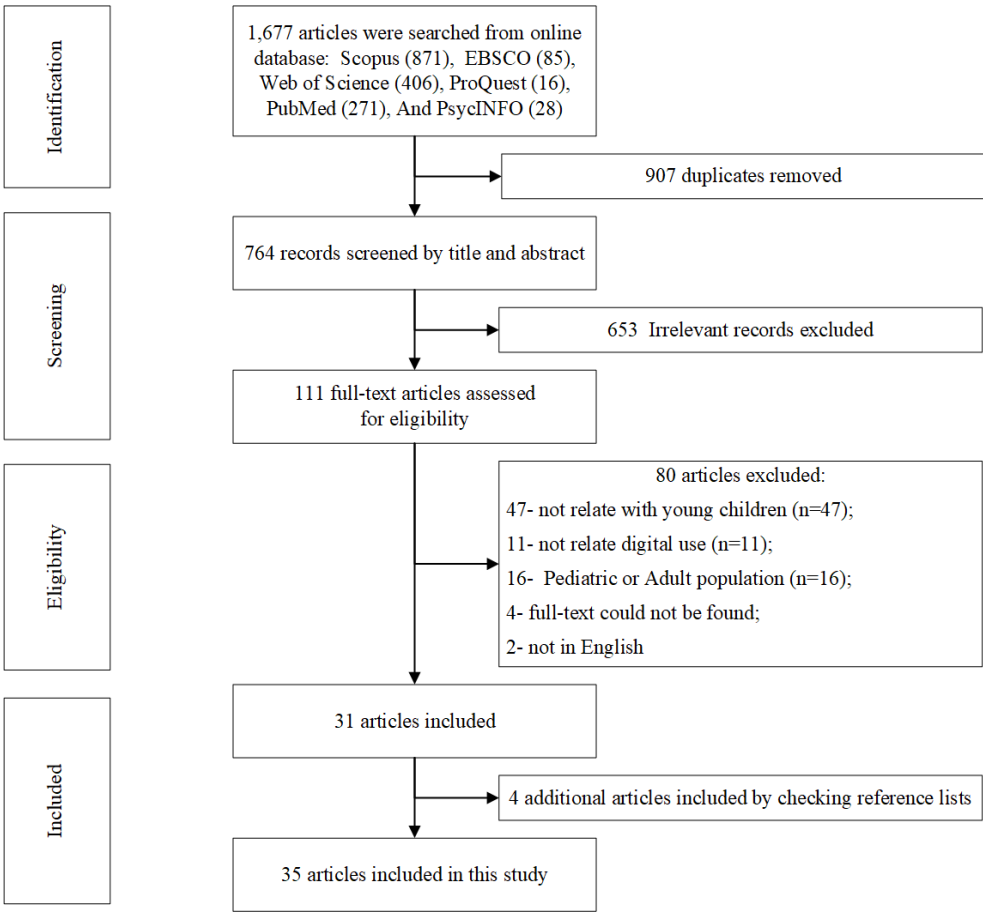
Figure 1. Flowchart of literature selecting.

2.4 Analysis

The data from 35 collected articles were converted into useful code, themes, and categories by the "RADaR" Technique [38]. The "RADaR" Technique (Rapid and Rigorous Qualitative Data Analysis) adopts spreadsheets and word processing software to develop all-inclusive data tables through several revisions in a 'Rapidly and Rigorously' manner. It has 5 steps: formatting data, placing formatted data transcripts into an all-inclusive table, reducing all-inclusive data, reducing data, draft project deliverables [39]. This study followed these five steps in the following way:

1. Summary the selected articles by author, published years, title, type, method, and main conclusion so that all articles are formatted similarly.

2. Code and Place basic information into an all-inclusive table, which includes the following Row Title: Doc Number, First Author, Publishing year, Title, Type, Method, Theoretical framework, Age of aim population, Samples, Country, Main Conclusion, Quality, Definition of digital wellbeing, Measurement of digital wellbeing, Influence factors, Correlation between digital use and wellbeing, Intervention of digital wellbeing, Research Suggestion, Code 1 (Meet which include criteria), Code 2 (Meet which include criteria), Note, Cite, DOI.

3. Reduce useless information. The research team discussed the usefulness of all information in the all-inclusive table and removed the useless data. In this phrase, the "theoretical framework" column has been removed because very few studies reported their theoretical framework. Based on the focused code suggested by Watkins, the information that could not answer the research questions has also been removed, such as Cite and DOI.

4. Draft and code the theme table. We drafted the themes from the all-inclusive table first and then placed the relevant information into the theme table. Four tables were formulated: definition table, measurement table, contributor table, and intervention table. Then, each table was coded separately to develop the "focused code" [39].

5. The data used for the analysis comprised authors, titles, keywords, and the main text. We converted all the textual data into useful codes, themes, and categories using the data charting technique [39]. This approach has been widely employed to identify knowledge gaps and research trends. In this study, data charting was done by the first author independently, with the other author as the auditor, to ensure the reliability of this study.

3. Results

Although an important topic, early childhood digital wellbeing has rarely been studied. Among the 35 studies investigating this topic, only 4 were conducted in developing countries/regions, including Turkey, India, and Malaysia. The rest were all conducted in developed countries/regions. For example, 11 studies were conducted in the United States and 10 in European countries, including Germany, the UK, Italy, Belgium, Netherlands, Singapore, Italy, Poland, Slovenia, and Spain. In addition, five studies were conducted in Australia and 3 in Canada. More characteristics of the included studies, such as the age of the target population, research method, and instruments, can be found in Table A1.

3.1 The Definitions of Digital wellbeing

We decomposed the concept of digital wellbeing from the literature and encoded them by two dimensions: key connotation and constructs. First, synthesis of the existing evidence indicated a commonly used word defining digital wellbeing: "balance", which means equilibrium between maximizing the benefits and minimizing the harm of digital use. Four types of balance were found: (1) Johnston (2021) defined digital wellbeing as 'a balance' between offline and online life [16]; (2) Abeele (2021) defined it as 'a subjective individual experience' of optimal balance between the benefits and drawbacks [15]; (3) Yue (2021) defined it as a healthy relationship with technology that can be used in a 'balanced and civic way' [19]; and (4) JISC (2019) defined it as using digital technology in a balanced way, to 'enjoy the benefits and avoid potential risks of digital use'[40]. Therefore, the core nature of digital wellbeing is 'balance'.

Some studies have explored the constructs of digital wellbeing. Initially, McMahon and Aiken (2015) proposed a 3-construct model of digital wellbeing: physical wellbeing (e.g., posture), mental wellbeing (e.g., level of attachment to devices, impulsiveness in responding to device notifications), and psychosocial wellbeing (e.g., online security, privacy) [41]. Later, JISC (2019) in the UK followed this 3-construct model: physical, mental, and emotional health [40]. Recently, Johnson (2020) proposed three levels of digital wellbeing: physiological, behavioral, and emotional [42]. These studies jointly indicated that digital wellbeing might include at least three constructs: physical, mental, and social-emotional. However, Yue (2021) proposed a comprehensive 9-construct model of digital wellbeing: digital safety and security, digital rights and responsibilities, digital health and self-care, digital creativity, digital emotional intelligence, digital communication, digital consumerism, digital employment and entrepreneurship, and digital activism/civic engagement [19]. In addition, Yue added three dimensions to the digital wellbeing framework to further reflect the relationship between digital wellbeing and digital citizenship: digital skills, identity, empowerment, and agency [19]. This framework, however, has some overlaps with digital citizenship or digital literacy. But Yue is not alone, as JISC also placed digital wellbeing in the digital literacies framework [40], Vissenberg also described digital literacy as similar to digital wellbeing [43], and Johnston indicated digital wellbeing should overlap with digital citizenship [16].

3.2 Measurements of Digital Wellbeing

Ong (2021) has reviewed 63 relevant studies and found no specific online wellbeing scale [44]. Despite the lack of scales precisely to measure an individual's digital wellbeing, some scholars have tried to measure young children's wellbeing and digital use separately. In the existing studies reporting the measurements of young children's wellbeing, social and emotional competence was the most measured. Przybylski (2021) measured 19,930 American young children's digital screen time and psychological wellbeing, which was measured by parental reports of their responses to four questions: caregiver attachment, resilience, curiosity, and positive affect in the past month. However, these variables have not been combined into a composite wellbeing measure, and the reliability of these items was relatively low (a = .57) [45].

Therefore, some other pediatric scales have been borrowed to measure early digital wellbeing. Monteiro (2021) adopted the Baby Pediatric Symptom Checklist (BPSC) to test the emotional and behavioral problems of infants (younger than 18 months) and the Preschool Pediatric Symptom Checklist (PPSC) to test the emotional and behavioral problems of young children (from 18 to 66 months) [46]. Both were developed from the Pediatric Symptom Checklist (PSC). As part of the survey of wellbeing of young children, the BPSC and PPSC showed strong internal and retest reliability [47]. Oliva (2021) employed the BPSC and PPSC to explore the risks and protective factors of mental health symptoms of Italian children during the covid-19 pandemic [48].

In addition, traditional parent surveys such Strengths and Difficulties Questionnaire parent version (SDQ) were also borrowed to measure the outcomes of young children's digital use [49-51]. For example, Tezol adopted SDQ to assess the psychosocial wellbeing of young children (ages 2 and 6). SDQ is a widely used instrument to measure mental health problems in children and adolescents, as it has good reliability and predictiveness on mental disorders in preadolescence [52].

However, the above measurements focused on 'wellbeing', leaving the other keyword 'digital', unmeasured. Recently, Byrne et al. (2021) reviewed the measurement of screen time among young children (ages 0-6) and found that 60% of the measurements only assessed screen time by inquiring one to three items, and few (11%) measurements assessed the content of media. And 24% of articles measured television watching only, whereas only 3% focused on young children's digital use (e.g., smartphones and tablets). Furthermore, the psychometric properties (reliability and validity) were rarely reported in these articles. Therefore, Byrne highlighted the need for improved measurements to capture the complexity of digital use and digital wellbeing [53].

Obviously, there is a need to develop a specific scale to measure young children's digital wellbeing. Domoff (2019) developed a scale to measure the problematic media use of children aged 4 to 11 years based on 9 criteria for Internet gaming disorder in the DSM-5 [54]. This scale had high internal consistency and validity (Cronbach α =.97) [55]. It was composed of 27 items that could be grouped into five dimensions: emotional symptoms, conduct problems, hyperactivity/impulsivity, peer relationship problems, and prosocial behaviors. Based on these 27 items, Domoff selected 9 items to develop a problem media use measurement scale short form (PMUM-SF) and reported the Cronbach alpha reached .93, confirming it a reliable instrument. Accordingly, Domoff's measurement has already been validated and used in Arabian, Chinese and Spanish societies [56-58].

3.3 Contributors to Digital Wellbeing in Young Children

Many studies have explored the associated factors with young children's digital wellbeing, which could be classified into two domains: (1) child variables include child's digital usage (e.g., duration and place of digital use) and child demographic characteristics; (2) parent variables include parents' digital use, parental perception, and mediation.

3.3.1. Child Variables

First, screen time (or duration of digital use) was found to be the most influential factor on young children's wellbeing [53], and in most cases, the impact was negative. For example, Ricci found that excessive screen time resulted in a higher risk of the fear of sleeping alone and fear of the dark [25]. Stiglic and Viner reviewed 13 articles and concluded that higher screen time levels were associated with various health harms such as obesity, unhealthy diet, depressive symptoms, and quality of life [59]. However, some studies reported a positive association between digital use and young children's wellbeing. For example, in a longitudinal study, Hinkley et al. (2017) reported a positive association between sedentary digital use and young children's intrapersonal and stress management and social and emotional skills [60]. This discrepancy might be caused by the varying effects of digital use, which might depend not only on screen time but also on the type and content of media and the characteristics of the individual child [61].

Second, the place of digital devices is another influential factor for young children's digital use and wellbeing. For example, in a cohort study including 907 girls and 952 boys participants, Pagani (2019) found that the children who lived in a bedroom with a television at age 4 had higher body mass index, more unhealthy eating habits, higher levels of emotional distress, depressive symptoms, victimization, physical aggression, and lowers levels of sociability at age 12 or 13 [62].

Third, demographic characteristics such as SES could impact young children's digital use and wellbeing. After analysis of nearly twenty thousand children aged 2–5 years, Przybylski found that daily digital screen use increased with age, most were male, non-White, children with less educated caregivers, and in less affluent households [45]. Tezol found that the amount of time spent on digital technologies significantly differed according to young children's age, gender, screen time, birth order, and first screen exposure [51]. Family SES (income and educational levels) was a significant predictor of young children's digital use [63].

3.3.2. Parent Variables

Generally, parents play three key roles in young children's digital usage: facilitator, teacher, and gatekeeper [64]. Parents' digital usage, perception, and mediation of young children's digital use jointly influence young children's digital use and wellbeing. First, parental digital use affects young children's digital use. Wong et al. (2020) investigated parents of 1254 three-year-old children in Hongkong and found that parent distraction and problematic digital technology use predicted their child's screen time and psychosocial difficulties [49]. Similarly, by investigating 477 parents of kindergarteners (ages 3-6) in China, Li et al. (2022) found that parental screen addiction can affect young children's screen addiction both directly and indirectly. This effect is mediated by parental anxiety and the parent-child relationship [65].

Second, parents' perception and mediation of early digital use play a key role in young children's digital use and wellbeing. Parents with a negative view of young children's digital use may employ more restrictive strategies to mediate young children's digital use. In contrast, parents who positively perceive early digital use prefer to mediate young children's digital use by actively talking or co-viewing [1,66]. The different mediation strategies may cause various outcomes for young children's wellbeing. For example, parental guidance and support can result in cognitive or social-emotional benefits and self-regulation in children's digital engagement [16]. In contrast, restrictive strategies have no such help and are less effective in controlling digital use time [67]. Therefore, by encouraging active discussion and supporting early digital use, parents could optimize the messages from positive digital content [68] and build children's skills and agency [16].

3.4 Early Interventions for Digital Wellbeing

The existing evidence demonstrates two effective approaches for improving young children's wellbeing: (1) digital applications; (2) early interventions.

3.4.1. Digital Applications

More than three hundred apps have been designed to prevent or correct attention deficit and hyperactivity disorder [69]. Some of them have the potential to enhance therapy [70]. Two techniques have attracted much attention: (1) serious games: a kind of technology-based game enabling us to interact, explore and learn about the world [71], and is used more than 'entertainment'; (2) exergames: a kind of programs that promote healthy behaviors by combining video game technologies and exercise [72]. For example, Play Attention is a computer attention-training system that could measure brain activity and provide feedback in a game-like environment. Existing evidence has demonstrated its usefulness in improving students' attention, hyperactivity, and executive functioning through one-hour weekly sessions with practice [73]. In exergames, more gross motor activities are required, and players' motivation for physical activity increases because of their willingness to pass the game [74]. Therefore, players may engage in more physical activities when using digital technologies. These exergames have proved to be effective in increasing physical activity, cognitive function, and anti-depression in individuals [75].

3.4.2. Early Interventions

Some studies have reported early interventions on reducing screen time and improving wellbeing. Schmidt systematically reviewed the intervention strategies and found four school-based and two family-based early education interventions for young children [74]. The four school-based interventional studies were all randomized controlled trials in the United States, and three tested the effectiveness of the "Hip Hop to Health" intervention program, which aimed to prevent obesity for black preschool children through teacher-delivered intervention. The results indicated that the total screen time of the "Hip Hop to Health" intervention program had been reduced to 28 min per day [76]. The two family-based interventional studies were also conducted in the United States. One [77] successfully reduced 17.5 hours per week of young children's (4-7 years old) screen media using time. In contrast, the other [78] failed to reduce the media time (including TV and computer viewing) of children aged 2-5 years old, demonstrating the uselessness of delivering weekly newsletters and booklets to parents for information about preschoolers' feeding practices and physical activity.

However, most of these interventions were from the western world and were specifically targeted at reducing screen time, especially TV viewing time [79]. In Jones' systematic review and meta-analysis conducted in 2021, 46 intervention studies were found on reducing young children's (under 5 years old) screen time. In these studies, 43% were school-based, 26% were home-based, and only 17% were teachers delivered. Unfortunately, a meta-analysis of these studies revealed that the effect size was insignificant (SDM=0.096, 95 CI -0.00 to 0.20), indicating that these interventions might not be as effective as expected [79].

4. Discussion

The digital lifestyle of a child will affect their physical health, academic performance, and emotional wellbeing; thus, digital wellbeing is critical to child development [16]. As a path-finding study, this scoping review has identified the definition, measurements, contributors, and interventions reported in the existing literature. This section will discuss these findings.

4.1 A Proposed Model of Young Children's Digital Wellbeing

Synthesis of the existing definitions demonstrates that the nature of digital wellbeing is 'balance', and it has three constructs: physical, phycological, and social-emotional wellbeing. Existing evidence has also demonstrated overlaps between digital wellbeing, digital literacy, and digital citizenship. However, it is not appropriate to confuse the three concepts. Although in some studies, they contain similar meanings, the cores of these three terms are very different. For instance, the nature of digital literacy is 'competence', highlighting the various capabilities we should master in the digital world [20]. The core of digital citizenship is a 'responsible' participant in the digital world, underscoring the individual's behavior style when interacting with others in the digital world [80]. The realization of digital wellbeing requires the development of digital literacy, and digital citizenship is the ultimate ideal state of digital literacy development. In other words, digital wellbeing concerns individuals, while digital citizenship contains more 'citizen' attributes.

However, most of the existing references generally defined digital wellbeing, but few were specific for young children. Johnston tried to explore young children's digital wellbeing with a focus on digital play. So, based on the literature review, we proposed a model of young children's digital wellbeing (Figure 2). First, five levels on the horizontal axis display the degree of young children's digital use: digital addiction, digital overuse, digital wellbeing, digital literacy, and digital citizenship. Second, considering young children always use digital technology under their parents' monitoring [1], their digital use is mostly influenced by the parents [64]. Therefore, the vertical axis displays seven levels of parent mediation on young children's digital use: set rules, supervise, restrict, co-use, actively discuss, design developmental digital activities, and support child's self-regulation. Although, in particular, setting rules, supervising, restricting, co-using, and active discussing have been reported in the existing literature [1,66], designing digital activities and supporting children's self-regulation are newly added strategies in this study. This is because the evidence shows that developmental digital activities might be a useful method to improve children's digital literacy [81], and self-regulation could be an important competence in children's digital wellbeing [82,83]. However, few studies have developed knowledge about the usefulness of these two strategies in young children's digital use; thus, future studies are needed. Third, young children's digital wellbeing development is a dynamic system that changes with parents' mediating, as demonstrated by the curve line. Negative mediating strategies have the effect of retrieving young children's digital addiction and digital overuse (the gray square). In contrast, positive mediating strategies affect young children's digital literacy and facilitate the development of digital citizenship (the yellow square).
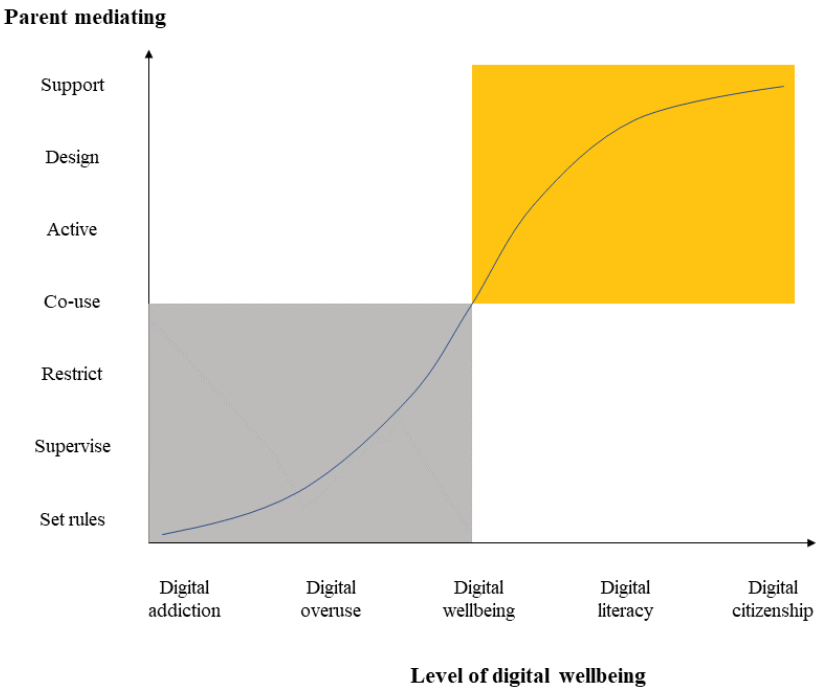
Figure 2. Young children's digital wellbeing model. This model demonstrates the dynamic system of young children's digital wellbeing development through parents' mediating—the curve line across the axis shows young children's digital wellbeing development. Negative mediating strategies have the effect of retrieving young children's digital addiction and digital overuse (the gray square). In contrast, positive mediating strategies improve young children's digital literacy and make it possible to develop digital citizenship (the yellow square).

This proposed model has based on the definition that digital wellbeing is the balanced experience of young children's use of digital technology under the guidance, mediation, and support of important adults (e.g., parents or primary caregivers). This balanced experience means that children can use digital technology to benefit development (for getting information, communication, creativity, and entertainment) and avoid potential risks (content risk, contact risk, consumption risk, and cross-risk). For young children, the guidance, mediation, and support of important adults are critical. In particular, 'guidance' means that important adults can guide the development of young children's digital literacy, unlimited in restricting young children's digital use. 'Mediation' means that important adults regulate children's digital use through formulating rules, supervision, restrictions, active discussion, and co-use. 'Support' means that important adults provide high-quality digital content, design developmental digital activities, and support children's self-regulation.

4.2 The Effective Measurements of Digital Wellbeing

The Covid-19 associated lockdowns have dramatically increased young children's screen time [84]; hence, the stakeholders (parents, teachers, governments, and so on) are concerned about their digital health. However, literature synthesis implies that there's no reliable scale to measure digital wellbeing, especially for young children. The Baby Pediatric Symptom Checklist (BPSC), Preschool Pediatric Symptom Checklist (PPSC), and Strengths and Difficulties Questionnaire parent version (SDQ) have been used to measure traditional wellbeing in several existing studies. In addition, problem Media Use Measurement (PMUM), developed by Domoff in 2019, has been used to measure digital use [55]. However, there is a research gap in measuring young children's digital wellbeing. First, traditional, offline wellbeing measurements have not been validated for the digital

world [44]. Second, the digital experience measurements might not be appropriate to evaluate individuals 'digital wellbeing' because they focused on digital use [44]. Third, lacking reliable measurements might limit research, policy, and practice development. Hence, a specific and reliable measurement of early digital wellbeing is needed for future research.

4.3 The Contributors to Digital Wellbeing

This review reveals that child and parent variables contribute to young children's digital wellbeing. First, a child's age, circumstance, maturity, context, and content might contribute to their digital wellbeing [85]. For example, children who are vulnerable offline are more likely to be vulnerable in the digital environment [84,85], so it is difficult to establish clear causality as those who already suffer from depression, or anxiety may likely be more prone to digital overdependence. However, there is a significant mismatch between the public discourse and the evidence available regarding the effects of digital use on children's wellbeing [85].

Second, parents play a crucial role in young children's digital use; the outcome of early digital use will differ according to parents' demographic characteristics, income, educational level, parental digital usage, perception, mediation of young children's digital use, and so on. For example, Ma and Chen (2022) found that parental engagement positively predicted children's social competence, whereas children's screen time negatively predicted their social competence [86]. Therefore, parents need to be trained to scaffold and support their young children, to build independence, agency, and empowerment by actively talking about engagement with digital technology [16], so that young children can be given enough knowledge about how to balance the digital use and build healthy habits to improve digital wellbeing [42].

4.4 Early Interventions and Improvements

This scoping review has identified two approaches to reducing young children's digital using time and avoiding problematic digital use. However, the effectiveness of these approaches is not scientifically sound [50,76], and some have been proven useless for improving digital wellbeing [79]. The reasons might count for the mixed results. First, the existing interventions focused on reducing screen time, which is just one factor influencing digital wellbeing. Other factors, such as the quality of digital media content and parents' perception and mediation, may play a more critical role in young children's digital wellbeing. Furthermore, digital use has been no longer limited to screens, as there are many screenless digital technologies (e.g., voice robots, VR, AI) [26,87]. Second, the existing intervention studies only followed young children for a short-term period, ranging between 2 to 20 weeks, and few studies exceeded six months [76,79]. Therefore, an integrated, long-period, systematic digital literacy improvement program is needed to enhance young children's digital wellbeing.

5. Conclusions, limitations and implications

Through a scoping review of 35 articles, this study found no consensus about the definition of young children's digital wellbeing, and effective measurements are also lacking. Nevertheless, both child factors (duration and place of digital use, child demographic characteristics) and parent factors (digital use, parental perception, and mediation) contribute to young children's wellbeing, and there were some effective applications and interventions. This review contributes to the theoretical development by mapping existing work on young children's digital wellbeing, proposing a model, and identifying the research gaps for future studies.

Although it contributes to the knowledge of young children's digital wellbeing, this study has several limitations. First, taking into account the information loading of this scoping review, this study did not review studies on digital overuse or digital addiction, which are also important for considering young children's digital wellbeing. Second, this

study only reviewed the articles written in English and did not explore articles published in other languages, which may narrow the scope of this study. Third, the proposed model of young children's digital wellbeing needs more empirical studies to confirm its effectiveness. However, this study synthesized and evaluated the literature on young children's digital wellbeing and thus proposed a valuable model which indicates the main difference between young children's digital wellbeing and adults' and adolescents' digital wellbeing: young children need more support from their parents or other important adults in achieving their digital wellbeing. Besides, this study contributes to the theoretical development by distinguishing the current confusion on concepts of digital wellbeing, digital literacy, and digital citizenship, which reaches a deeper understanding of the different states of digital use.

This scoping review implicated the requirement for more research and practices to improve young children's digital wellbeing. First, this scoping review found no effective measurements for assessing young children's digital wellbeing. Future research should construct a new measurement based on the model proposed in this study and establish the norm of young children's digital wellbeing through large-sample testing to anchor future empirical research. Second, this study found parents' importance in supporting and mediating young children's digital wellbeing. Policymakers need to consider this and provide guidance for parents based on empirical research so that parents can play their part in young children's digital wellbeing. Third, although there were some existing digital applications and early interventions, considering their less effectiveness, an integrated, long-period, systematic digital literacy improvement program is needed to enhance young children's digital wellbeing.

Table A1. Characteristics of included studies

Study (Authors/Year)	Meet include criteria	Type	Method	Instrument	Age of aim population	Country/Region
Johnston (2021)	1 definition	[J] Original Paper	Scoping Review	N/A	0-5 years old	Australia
Allers (2021)	1 definition	[D]Master Thesis	Design	N/A	Pre-school children	USA
Yue et al. (2021)	1 definition	[R]Technical Report	Integrative Review	N/A	N/A	Singapore
Nansen et al. (2012)	1 definition	[J] Original Paper	Ethnographic Study	N/A	6-10 years old	Australia
Albee (2021)	1 definition	[J] Original Paper	Theoretical	N/A	N/A	Netherlands
Gupta et al. (2022)	1 definition	[J] Original Paper	Integrative Review	N/A	0-10 years old	India
Chen et al. (2021)	1 definition	[J] Original Paper	Integrative Review	N/A	N/A	Hong Kong, China

Study (Authors/ Year)	Meet include criteria	Type	Method	Instrument	Age of aim population	Country/R egion
Feerrar (2020)	1 definition	[M] Book Chapter	Theoretical	N/A	N/A	USA
Ong et al. (2021)	2 measurement	[J] Original Paper	Scoping Review	N/A	N/A	UK
Browne et al. (2021)	2 measurement	[J] Original Paper	Scoping Review	N/A	0-25 years old	Canada
Byrne et al. (2021)	2 measurement	[J] Original Paper	Systemic Review	N/A	0-6 years old	Australia
Oliva et al. (2021)	2 measurement	[J] Original Paper	Survey	Baby Pediatric Symptom Checklist (BPSC), Preschool Pediatric Symptom Checklist (PPSC), Pediatric Symptom Checklist (PSC),Studies Depression Scale for Children (CES-DC), Screen for Child Anxiety Related Disorders (SCARED)	0-18 years old	Italy
Monteiro et al. (2021)	2 measurement	[J] Original Paper	Survey	Baby Pediatric Symptom Checklist (BPSC), Preschool Pediatric Symptom Checklist (PPSC)	6 months-6 years and 12 months old	Spain
Przybylski & Weinstein (2019)	2 measurement	[J] Original Paper	Telephone Interviews with Parents	Self-Designed Questions include caregiver attachment, resilience, curiosity, and positive affect in the past month	2-5 years old	UK
Hoehe & Thibaut (2022)	3 contributors	[J] Original Paper	Integrative Review	N/A	N/A	Germany
Stiglic & Viner (2019)	3 contributors	[J] Original Paper	Systemic Review	N/A	0-18 years old	Slovenia
Tezol et al.(2022a)	3 contributors	[J] Original Paper	Survey	Strengths and Difficulties Questionnaire parent version (SDQ)	2-6 years old	Turkey
Vissenberg et al. (2022)	3 contributors	[J] Original Paper	Systemic Review	N/A	12-18 years old	Belgium
Owenz & Fowers (2020)	3 contributors	[J] Original Paper	Theoretical	N/A	2-12 years old	USA
Tezol et al.(2022b)	3 contributors	[J] Original Paper	Survey	Strengths and Difficulties Questionnaire parent version (SDQ)	2-5 years old	Turkey
Hogan (2012)	3 contributors	[J] Original Paper	Theoretical	N/A	N/A	USA
Wilson (2008)	3 contributors	[J] Original Paper	Integrative Review	N/A	Children (not for specific age group)	USA
Ricci et al. (2021)	3 contributors	[J] Original Paper	Survey	Children's Sleep Habits Questionnaire (CSHQ, German version);	4-6 years old	Germany
Mourlam et al. (2020)	3 contributors	[J] Original Paper	Interview	N/A	8-13 years old	USA
Hinkley et al. (2017)	3 contributors	[J] Original Paper	Cohort Study	Bar-On Emotional Quotient Inventory (EQi-YV, short version)	Investigate children aged 3- to 5-year-old, and follow up when they are 6-8 years old	Australia

Study (Authors/ Year)	Meet include criteria	Type	Method	Instrument	Age of aim population	Country/R egion
Chassiakos et al. (2016)	3 contributors	[R]Technical report	Integrative Review	N/A	0-18 years old	USA
Pagani et al. (2019)	3 contributors	[J] Original Paper	Cohort Study	Children's Depression Inventory (CDI, short version)	Child having a bedroom television at age 4 was followed up when they were 12 or 13 years old	Canada
Raj et al. (2022)	3 contributors	[J] Original Paper	Survey	Self-Designed Questionnaire	Under 5 years old	Malaysia
Highfield et al. (2018)	4 intervention	[M]Book Chapter	Integrative Review	N/A	Young children	Canada
Straker et al. (2018)	4 intervention	[J] Original Paper	Integrative Review	N/A	Young children	Australia
Schmidt et al. (2012)	4 intervention	[J] Original Paper	Systematic Review	N/A	Young children	USA
Myers. (2021)	4 intervention	[R]Technical report	Integrative Review	N/A	School-age children	USA
Puzio et al. (2022)	4 intervention	[J] Original Paper	Integrative Review	N/A	Children (not for specific age group)	Poland
Schmitt (2022)	4 intervention	[D] Doctor's Thesis	mixed-methods experimental study includes survey and experiment	Center for Epidemiologic Studies Depression Scale (CES-D), Intentionally Unplugged™ (a digital wellness curriculum)	7th -12th grade	USA
Jones et al. (2021)	4 invention	[J] Original Paper	Systematic Review and Meta-analysis	N/A	0-18 years old	USA

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