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FROM DIGITAL TECHNOLOGY TO HEALTHY HABITS: INTERDISCIPLINARY FOUNDATIONS FOR DEVELOPING TRAINING PROGRAMS FOR A HEALTHY LIFESTYLE AMONG CHILDREN

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Abstract/Izvleček

This article explores the impact of digital technology on children's development, focussing on the physical, cognitive, and emotional domains. The introduction emphasises the benefits of digital tools for education and language acquisition, but also points out the associated risks such as physical inactivity, sleep disturbances and mental health problems. A rigorous methodological approach ensures the inclusion of high-quality data, while subsequent sections explore key themes, including the interplay between screen time, physical activity, and diet. The conclusion emphasises interdisciplinary interventions, including the ZŽS project framework, which integrates technology, health, and environmental responsibility. This approach aims to promote healthier lifestyle choices.

Od digitalne tehnologije do zdravih navad: interdisciplinarne podlage za razvoj programov usposabljanja za zdrav življenjski slog otrok

V članku proučujemo vplive digitalne tehnologije na otrokov razvoj, pri čemer se osredinjamo na telesne, kognitivne in čustvene vidike. V uvodu so poudarjene koristi digitalnih orodij za izobraževanje in učenje jezika, vendar so izpostavljena tudi povezana tveganja, kot so telesna nedejavnost, motnje spanja in težave z duševnim zdravjem. Dosleden metodološki pristop zagotavlja vključevanje kakovostnih podatkov, medtem ko podpoglavja obravnavajo ključne teme, vključno z medsebojnim vplivom časa pred zaslonom, telesne dejavnosti in prehrane. Zaključek poudarja interdisciplinarne ukrepe, vključno z okvirom projekta Zdrav življenjski slog za trajnostni razvoj in vseživljenjsko učenje (dalje ZŽS), ki združujejo tehnologijo, zdravje in varovanje okolja. Cilj tega pristopa je spodbujati izbiro zdravega življenjskega sloga.

Keywords:
digital technology, child development, mental health, physical activity.

Ključne besede:
digitalna tehnologija, otrokov razvoj, duševno zdravje, telesna dejavnost.

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Introduction

Digital technology increasingly shapes child development, offering cognitive stimulation, educational opportunities, and social connectivity, yet posing risks such as physical inactivity, sleep disruption, unhealthy dietary behaviours, and mental health concerns. Research highlights its benefits when integrated purposefully: educational applications and co-viewing with caregivers can boost cognitive skills, language acquisition, and problem-solving (Huber et al., 2018; Hill et al., 2016; Muppalla et al., 2023). However, unregulated screen use—especially in early childhood—can diminish attention spans, impair impulse control, and reduce creative play (Takeuchi et al., 2018; McHarg et al., 2020). Excessive screen time also displaces active play, increasing obesity risks (Ricci et al., 2021), disrupts sleep through blue light exposure (LeBourgeois et al., 2017), and contributes to emotional and behavioural issues (Staples et al., 2021). Screen-based food advertising promotes energy-dense, nutrient-poor diets (Folkvord et al., 2017; Scully et al., 2012), while overuse of digital platforms may elevate the risk of anxiety, depression, and negative self-perception (Slater and Tiggemann, 2016; Hoge et al., 2017). Still, emerging evidence suggests these effects depend on context and balanced use, with overall mental health impacts possibly minor (Odgers and Jensen, 2020).

This paper systematically examines how digital technology affects child development across the domains of physical activity, nutrition, sleep, cognition, and mental health. Adopting an interdisciplinary perspective, it addresses two key questions: (1) How can digital technology be optimized to support healthy development? (2) Which evidence-based strategies can caregivers, educators, and policymakers use to reduce risks? By synthesizing current research, it identifies critical gaps and offers practical recommendations for fostering children's well-being in an increasingly digital world.

Methodology

This review is based on a rigorous methodological approach that aims to include high-quality and credible sources. The literature was selected through a comprehensive search of scientific databases, including PubMed, Scopus, and Web of Science, favouring studies with high citation indices and robust methodological foundations. Particular attention was paid to meta-analyses and systematic reviews, as these provide aggregated findings and minimise the influence of outlier results.

Key steps in the methodology include the following:

1. Identification of relevant sources: Articles addressing the intersection between digital technology and child development were prioritised, focusing on core

topics such as physical activity, nutrition, sleep, cognitive development, and mental health.
2. Emphasis on meta-analyses: Studies that combine and summarise results from multiple research papers were prioritised to ensure comprehensive and balanced conclusions.
3. Inclusion and exclusion criteria: Articles were included based on their methodological rigour, relevance to the research objectives and publication in peer-reviewed journals. Exclusion criteria excluded studies with insufficient methodological transparency, limited sample sizes or non-replicable results.
4. Thematic categorisation and analysis: The selected sources were categorised into thematic areas, allowing for a structured synthesis and facilitating a clear presentation of key findings in the manuscript.

This methodological framework ensures that the conclusions drawn in this thesis are based on a solid foundation of reliable, evidence-based research and are consistent with best practise in interdisciplinary literature reviews.

Digital technology and children's health: key challenges and interventions

The interplay between screen time, physical activity, and sleep

Excessive screen use is associated with reduced physical activity and poor sleep, especially in younger children. Janssen et al (2020) found that prolonged screen use in children under five years of age correlates with shorter sleep duration and delayed sleep onset, suggesting a limitation of evening use. During the COVID-19 pandemic, Spanish children aged 0–4 years showed high levels of screen use and insufficient physical activity, not meeting WHO recommendations (Arufe-Giráldez et al., 2020; Morrison et al., 2021). Although the WHO guidelines emphasise a balance among screen use, physical activity, and adequate sleep (Willumsen and Bull, 2020), a critical review shows that there is little high-quality evidence on the psychological effects of screen time (Ophir et al., 2021). Overall, these findings emphasise the importance of structured interventions that encourage active play, limit excessive screen use, and promote healthy habits from an early age.

Balance between exercise and screens

Sedentary screen use often replaces active play, decreasing children's fitness and increasing the risk of obesity (Ricci et al., 2021; Keane et al., 2017). Outdoor activities and moderate to vigorous physical activity (MVPA) improve physical health, sleep, and overall fitness (Kredlow et al., 2015; World Health Organisation, 2019). Engberg

et al., (2021) showed that children who engage in at least six hours of physical activity per week in their free time do not have an increased risk of obesity due to digital media. For 5–6-year-olds, each additional hour spent outdoors results in approximately 10 minutes more MVPA (Larouche et al., 2017). Despite these benefits, many do not adhere to physical activity guidelines (Keane et al., 2017). Effective strategies include encouraging outdoor play, limiting screen time, and encouraging parental involvement (Charan et al., 2024).

Digital media and nutrition: the influence of food advertising

Food advertising on television and digital platforms promotes the consumption of high-calorie, low-nutrient foods (Folkvord et al., 2017; Robinson et al., 2017; Scully et al., 2012). Passive screen use further interrupts satiety cues and leads to overeating (Hill et al., 2016). Parental feeding practises, such as forcing or restricting certain foods, can exacerbate these effects (Norman et al., 2018). Even within recommended screen limits, television viewing predicts higher intake of unhealthy foods and lower intake of fruits and vegetables (Harrison et al., 2012). Similarly, teachers' knowledge has been shown to play a crucial role in shaping children's health-related habits. Sadaf and Huma (2021) found that school health programs significantly improved teachers' understanding of nutrition, hygiene, and illness prevention, which indirectly supports children's overall well-being. Stricter food marketing regulations, parental strategies that reduce screen use during mealtimes, and transparent advertising practises are needed to mitigate harmful dietary influences (Robinson et al., 2017; Scully et al., 2012).

Digital technology and children's mental health

Prolonged use of devices can increase the risk of anxiety and depression, as self-esteem is often tied to external validation through likes, comments, or gaming achievements (Slater and Tiggemann, 2016; Hoge et al., 2017). Over-reliance on virtual interactions can limit social skills in the real world and promote isolation (Ricci et al., 2021). Digital media also carries the risk of cyberbullying and negative social comparisons (Glover and Fritsch, 2017), although large-scale studies suggest that the overall impact on mental health is small (Odgers and Jensen, 2020). Experts recommend balancing screen time with offline activities, setting limits on content and teaching critical thinking skills (Reid Chassiakos et al., 2016). Mental health professionals should consider online behaviour in their treatment plans to control potential negative consequences (Glover and Fritsch, 2017).

Cognitive development: risks and benefits

Excessive or unsupervised screen use can impair attention span, critical thinking, and executive functions (Takeuchi et al., 2018; Ricci et al., 2021). Early screen time correlates with poorer inhibition skills (McHarg et al., 2020) and lower microstructural integrity of brain areas associated with language and literacy (Hutton et al., 2020). However, structured learning apps and interactive digital tools can improve working memory, literacy, and impulse control (Huber et al., 2018; Hill et al., 2016). Shared viewing with caregivers further supports positive outcomes by promoting engagement, guidance and understanding (Muppalla et al., 2023). A balance between screen use, hands-on play and face-to-face interaction is important to optimise the cognitive benefits while minimising the risks.

Digital media and sleep: understanding the disruption

Evening screen use disrupts melatonin production, delays sleep onset and reduces sleep quality (LeBourgeois et al., 2017). Studies link higher screen use before bedtime to shorter total sleep time and more frequent sleep disturbances in young children (Garrison and Christakis, 2012; Staples et al., 2020). Poor sleep can exacerbate cognitive and emotional difficulties, emphasising the need for screen-free routines. Time-shifting, psychological stimulation and blue light contribute to these disorders (LeBourgeois et al., 2017), and observational data confirm that screen use before bedtime correlates with delayed sleep and shortened duration of sleep (Staples et al., 2020). Caregivers can promote healthy sleep by limiting screen use before bedtime, establishing screen-free zones, and maintaining consistent routines for bedtime (Hale et al., 2018).

Connections: physical activity, nutrition, sleep, and mental health

Physical activity, nutrition, sleep, and mental health are intricately linked. For example, regular physical activity not only improves sleep quality, but also reduces anxiety and depression (Kredlow et al., 2015). Healthy eating habits support cognitive and emotional stability and promote consistent sleep patterns and energy for active play (Folkvord et al., 2017). Conversely, insufficient sleep can exacerbate poor eating habits, reduce physical activity levels, and increase mental health risks (Mindell et al., 2015; Staples et al., 2020). Stable mental health also promotes adherence to healthy habits (Hoge et al., 2017). Given this level of interdependence, comprehensive interventions — such as promoting outdoor activities, shared family meals and consistent bedtimes — can effectively promote all aspects of children's well-being from an early age.

The importance of forming healthy habits in early childhood

Healthy routines introduced early on support lifelong physical, cognitive, and emotional health. Rapid digitalisation offers opportunities but also threatens these routines and makes timely action on exercise, diet, screen use, and sleep essential (Baladaniya and Korat, 2024).

Creating a solid foundation: The role of physical activity

Regular exercise, starting at pre-school age, predicts an active adulthood, sharper motor skills, and better cardiovascular profiles (Kredlow et al., 2015; WHO, 2019). Outdoor play is particularly effective as it leads to spontaneous movement and fitness gains (Ricci et al., 2021). Early motor competence correlates with greater activity in adolescents and immediate benefits such as denser bones, improved mood, and better cardiorespiratory fitness (Loprinzi et al., 2012; Loprinzi et al., 2015). Competence also lowers future risk of chronic disease (Garcia et al., 2002) and is associated with better blood pressure and aerobic capacity in longitudinal cohorts (Proudfoot et al., 2019). Global guidelines therefore strongly recommend playing a fun, developmentally appropriate game every day (Willumsen and Bull, 2020).

Nutrition in early childhood: shaping lifelong health

Early eating habits strongly influence later preferences. Children who are offered balanced meals and guided by informed caregivers are less attracted to extremely processed foods (Folkvord et al., 2017), while the role modelling of parents — especially mothers — strongly influences food intake (Hill et al., 2016; Scaglioni et al., 2008). Hands-on meal preparation and learning where food comes from deepen understanding and acceptance of healthy choices (Metcalfe and Fiese, 2018). Recommended plates emphasise vegetables, fruits, whole grains, and lean proteins, while limiting high-energy, nutrient-poor foods (Melanson, 2008). However, excessive parental control can backfire and lead to overeating; positive modelling is safer (Scaglioni et al., 2008).

Digital literacy: preparing children for the digital age

Responsible use of technology must be taught alongside traditional play. Programmes that combine balanced screen habits, critical thinking, and source evaluation help children to navigate online spaces safely (Takeuchi et al., 2018). Collaborative efforts between parents and educators are most effective (Slater et al., 2016). The targeted integration of touchscreens into learning — accompanied by

adult guidance — encourages active rather than passive use (Donohue, 2014; Straker et al., 2018). Nevertheless, firm limits must be placed on screen time to protect physical and cognitive growth. Comprehensive approaches that combine media literacy, parental involvement and clear guidelines are key (Straker et al., 2018; Di Putra and Irwansyah, 2024). In addition, attention must be given to the hidden influence of recommendation systems and so-called information bubbles. Mihelač (2024) shows that most parents lack a deep understanding of how algorithms shape children's exposure to content, which can limit diversity of experiences and hinder critical development.

Introduce sleep routines

Consistent bedtimes support growth, cognition, and emotional regulation. Regular schedules and fewer screens before bedtime improve sleep quality by limiting the suppression of melatonin by blue light (LeBourgeois et al., 2017; Garrison and Christakis, 2012). Predictable routines are associated with better language, better executive function, and more consistent mood (Mindell et al., 2015; Kitsaras et al., 2018). Longitudinal data shows that habits established in childhood lead to healthier sleep years later (Fiese et al., 2021). Combining screen-free time with calming bedtime rituals is therefore a cornerstone of children's holistic development.

Using digital tools to promote a healthier lifestyle in children

In today's increasingly digital world, information, and communication technology (ICT) plays a crucial role in shaping children's habits and lifestyle choices. Educators are in a unique position to harness the potential of ICT tools to promote health awareness and positive behaviours in children. By integrating ICT into pedagogical practise, educators can promote digital literacy and ensure that children use technology critically and safely (Reid Chassiakos et al., 2016; Takeuchi et al., 2018).
ICT tools such as health monitoring apps, online collaboration platforms and educational games offer a variety of ways to promote well-being. These tools can do the following:

- Encourage physical activity through pedometers and fun fitness challenges (Ricci et al., 2021).
- Teach mindful screen use and create a balance between digital engagement and offline activities (Ponti et al., 2017).
- Support nutrition education with interactive tools that demonstrate healthy food choices and meal planning (Hill et al., 2016).

Educators can integrate these technologies into their lesson plans and emphasise their role not only in promoting healthy habits, but also in developing critical thinking and digital literacy skills. Training programmes for educators should focus on equipping them with the knowledge they need to use ICT purposefully and model responsible use of technology in their classrooms. For example, educators could lead projects where students use apps to track and reflect on their daily activity levels and link these results to broader discussions about physical health and well-being (Morrison et al., 2021).

Understanding the connections between human health and biodiversity is a critical component of holistic education. By familiarising students with topics such as ecosystems, sustainability, and the impact of biodiversity on human well-being, educators can instil a sense of environmental responsibility while promoting physical and mental health (Mantilla and Edwards, 2019; Larouche et al., 2017).

Outdoor learning experiences offer a double benefit: They foster an appreciation for biodiversity and encourage physical activity. Activities such as biodiversity mapping, nature walks or hands-on gardening projects allow students to combine theoretical knowledge with practical application. These activities promote physical health by reducing sedentary behaviour and encouraging movement, while also promoting cognitive development and emotional resilience through interaction with nature (Willumsen and Bull, 2020; Hutton et al., 2020).

Educators can link biodiversity education to healthy lifestyle habits by emphasising the role of ecosystems in food security and nutrition. For example, teaching about pollination and local agriculture can lead to discussions about fresh, nutrient-rich foods. Such interdisciplinary approaches reinforce the importance of biodiversity not only for environmental health, but also for personal well-being (Folkvord et al., 2017; Robinson et al., 2017).

Project framework for the integration of healthy lifestyles (ZŽS)

The ZŽS project aims to promote a sustainable approach to lifelong learning and well-being by encouraging multiple target groups to recognise the wider importance of healthy lifestyles. The project emphasises not only physical activity, healthy eating and sleeping habits, but also a holistic view of well-being that encompasses social inclusion, co-creation, acceptance, and trust within society. The key areas of focus are as follows:

- Health and well-being: Promoting physical activity, endurance and encouraging healthy eating and sleeping habits.

- Interdisciplinary integration: linking different areas such as sport, psychology, nutrition, science, art, sociology, and education.
- Creative learning approaches: Using different environments and experimental, exploratory learning to encourage creativity and collaboration.
- Fostering individual potential: encouraging non-competitive activities, creative expression, and sensory awareness, tailored to different age groups (Hill et al., 2016).
- Fostering collaboration: emphasising values such as equality, respect and active engagement while promoting cooperation and mutual understanding through shared activities (Baladaniya and Korat, 2024).

This holistic framework fits seamlessly with the themes discussed in this article and provides educators with actionable strategies to implement interdisciplinary approaches that promote comprehensive health and well-being. By integrating elements of the ZŽS project, educators can further enrich their curricula and ensure that students develop not only healthy habits, but also a deeper sense of community and environmental responsibility.

By combining insights from ICT and science education with the principles of the ZŽS project, educators can create a unified framework that addresses the multiple challenges of promoting healthy lifestyles in the digital age. Training programmes should do the following:

- Provide educators with the tools to balance screen time with active play and outdoor learning (Hale et al., 2018).
- Provide strategies to integrate digital literacy into physical and mental health lessons (Garrison and Christakis, 2012).
- Equip educators with interdisciplinary teaching approaches that link health, technology, and environmental sustainability (Reid Chassiakos et al., 2016).

Conclusion

Educators are at the forefront of creating healthy, balanced lifestyles for the next generation. By carefully integrating ICT tools, science education and the holistic principles of the ZŽS project into their lessons, they can promote digital literacy, encourage physical activity, and instil a great appreciation for biodiversity.

Research repeatedly emphasises the importance of these approaches:

- Integrating biodiversity into learning promotes cognitive and emotional resilience, as demonstrated by the role of outdoor learning in promoting mental and physical well-being (Larouche et al., 2017; Willumsen and Bull, 2020).

- Digital tools such as apps and games can improve critical thinking and promote active lifestyles, as found in studies on the impact of technology on health and learning (Takeuchi et al., 2018; Hill et al., 2016).
- Collaborative, interdisciplinary approaches, such as those emphasised in the ZŽS project, promote creativity, collaboration, and community engagement
- as seen in frameworks for holistic education (Baladaniya and Korat, 2024; Donohue, 2014).

These efforts will not only prepare children to navigate the complex digital world but also empower them to make informed choices that promote their overall well-being. By combining pedagogy with interdisciplinary principles, educators can cultivate lifelong habits that benefit both the individual and the community. This dynamic platform of technology, science and holistic education is key to addressing individual and societal challenges in promoting health and sustainability.

Implications and Future Directions

Building on our findings, future research should investigate the long-term effects of digital technology use on children's physical, cognitive, and emotional development. In particular, longitudinal studies could help to identify how controlled use of digital technologies, balanced with active offline use, affects developmental outcomes over time. Pilot intervention programmes incorporating elements from the ZŽS framework could provide valuable insights into practical strategies for educators and caregivers. Such interventions could include structured digital literacy training and outdoor experiential learning activities that promote healthier behaviours. Ultimately, these research initiatives could help policy makers develop evidence-based guidelines that promote a balanced and sustainable approach to children's use of digital technologies.

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