

Interactive Games as Tools for Health Education in Children: A Systematic Review

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ABSTRACT

Interactive games are increasingly used in early childhood health education for their ability to merge learning with play. This systematic review evaluated the effectiveness of interactive games in improving health literacy and behaviors among children aged 4–12 years. A systematic search was conducted in accordance with PRISMA 2020 guidelines. Of 312 records, 20 met inclusion criteria and were appraised using the Joanna Briggs Institute tool. Studies, originating from the US, Greece, Indonesia, Malaysia, and Brazil, examined digital games (n=12), board games (n=5), and role-play simulations (n=3) targeting personal hygiene, nutrition, physical activity, and emotional health. Seventy-five percent reported significant improvements in knowledge, and 60% documented positive behavioral changes at short-term follow-up. Common benefits included increased engagement (85% of studies) and enhanced socio-emotional skills. Study quality was mostly moderate; few included follow-up beyond six months. Interactive games show strong potential to enhance children's health education, but technological access and lack of long-term evaluation remain barriers. Future work should focus on high-quality, longitudinal studies and integration into school and community health programs.

Keywords: Interactive games, health education, school-age children, systematic review, PRISMA

INTRODUCTION

Children's health is fundamental to sustaining high-quality human development. Establishing healthy behaviors early in life is critical for preventing long-term health issues such as obesity, infectious diseases, and mental health disorders.¹ Promoting these behaviors is a shared responsibility involving not only the health sector but also the education system and families. However, traditional approaches such as lectures, printed leaflets, and instructional videos often fail to effectively engage children, as they tend to be passive and offer limited opportunities for interaction or experiential learning.^{2,3}

Over the past decade, technology-driven and interactive approaches have gained prominence in children's health education, with interactive games emerging as a particularly promising method. These games actively engage children through real-time feedback, dynamic storylines, and appealing reward systems, fostering sustained interest and motivation. Such features align well with the developmental needs of children aged 4–12 years, who, according to Piaget's theory, are in the concrete-operational

stage and benefit most from learning experiences that are tangible, visually rich, and emotionally engaging.^{4,5}

According to constructivist theory, children learn most effectively when actively engaged in direct, hands-on experiences. Games provide an enjoyable, safe, and stimulating environment that encourages exploration of health concepts through simulation and experimentation. Likewise, intrinsic motivation theory highlights autonomy, competence, and relatedness as core drivers of effective learning—all these elements can be effectively fostered through well-designed educational games.^{6,7}

Numerous studies have highlighted the benefits of interactive games in health education. For example, digital games focusing on personal hygiene improved handwashing and toothbrushing behaviors.^{8,9} Similarly, games addressing mental health enhanced children's emotional awareness and self-regulation.¹⁰ Educational board games developed collaboratively with educators and nutritionists have also improved children's understanding of healthy eating patterns.^{11,12}

However, the effectiveness of interactive games is not guaranteed. Success depends on factors such as design quality, age appropriateness, cultural relevance, and the extent to which games stimulate cognitive and emotional engagement.^{3,13} Key design elements—feedback systems, visual illustrations, relevant narratives, and competitive or cooperative features—play a pivotal role in promoting learning outcome.¹⁴ Beyond design considerations, disparities in technology access remain a significant barrier. Limited availability of devices, internet connectivity, and digital literacy among parents and teachers particularly hinder implementation in rural and low-income communities.¹⁵ Therefore, exploring non-digital but interactive game alternatives remains essential to ensure inclusivity.

Given these opportunities and constraints, a systematic review is warranted to comprehensively evaluate the application of interactive games in children's health education. Although many individual studies exist, few systematic reviews have synthesized this body of evidence within a structured evaluative framework.^{16,17} Such a review is essential to identify trends, strengths, limitations, and to generate evidence-based recommendations for researchers, educators, media developers, and policymakers.

Accordingly, this article presents a systematic review on the use of interactive

games in health education for children aged 4–12 years. Following the PRISMA 2020 guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), the review encompasses study identification, screening, quality assessment, and transparent reporting of findings.¹⁸ It aims to provide a comprehensive overview of the types of games used, the health topics addressed, the outcomes achieved, and the challenges and opportunities for implementation across diverse social and geographical contexts.

METHOD

This article presents a systematic literature review on the use of interactive games in health education for children aged 4–12 years, following the PRISMA 2020 guidelines to ensure transparency and reliability. Literature searches were conducted across PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar using combinations of keywords such as “interactive health games,” “gamification,” and “child health education.” The search was limited to English-language publications from 2015–2024. Search results were managed in Zotero to eliminate duplicates and streamline screening. After reviewing 312 articles, 20 studies met the inclusion criteria: a focus on children aged 4–12 years, integration of interactive games in health education, and reporting of measurable outcomes.

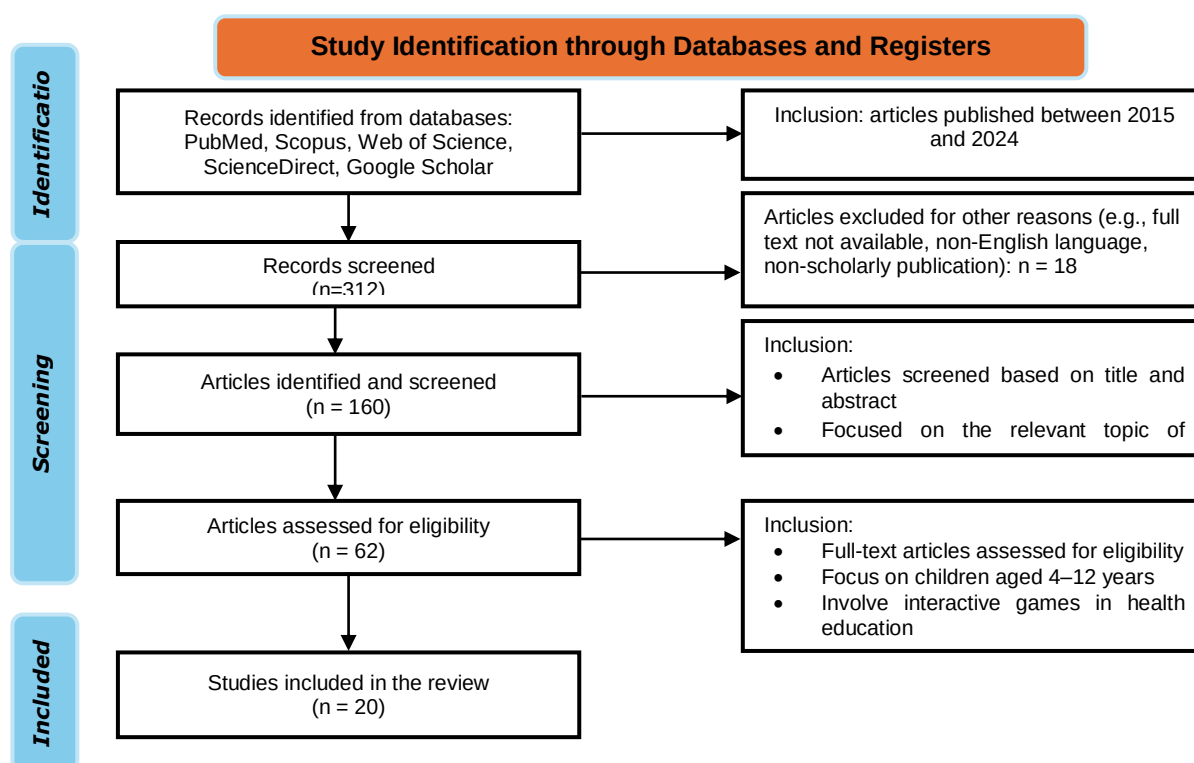


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

The selection process involved three screening stages—title, abstract, and full-text review—conducted independently by two researchers, with disagreements resolved through discussion or a third reviewer. Methodological quality was evaluated using the Joanna Briggs Institute (JBI) appraisal tools, and only studies rated as moderate to high quality (JBI $\geq 70\%$) were included. Key information such as author, year, location, game type, health focus, method, and main findings was extracted into a summary table. Given the heterogeneity of study designs and outcomes, a thematic narrative synthesis was applied to ensure scientific rigor, transparency, and replicability in the review process.

RESULT AND DISCUSSION

Characteristics of included studies

Following the processes of identification, screening, and selection according to the inclusion criteria, 20 studies were deemed eligible for analysis in this systematic review.

These studies originated from diverse countries, including the United States, Greece, Malaysia, Indonesia, and Brazil, reflecting wide social and geographical representation. Most were published between 2020 and 2024, underscoring a growing global interest in the application of interactive games in children's health education.^{5,13} The reviewed studies employed a wide range of game formats, including app-based digital games,⁹ educational board and card games,¹¹ and role-playing simulations designed to develop practical health-related skills.^{13,19} The health topics covered encompassed personal hygiene, oral health, balanced nutrition, basic reproductive health, physical activity, and children's mental and emotional well-being.¹⁰ The increasing diversity of intervention models suggests that interactive games are adaptable across cultural and educational contexts, reinforcing their potential scalability and relevance to different learning environments. Table 1 presents the detail of the matrix.

Table 1. Matrix of game types and health focus

Type of Game	Health Focus	Example Study
Digital application	Dental health	9
Board game	Balanced nutrition	11
Role-play simulation	Emotion regulation	13
Card game	Adolescent anemia	20
Interactive physical game	Physical activity & stress	5

Thematically, the study findings were analyzed into four main themes as presented in Table 2:

Table 2. Summary of themes and relevant studies

Theme	Relevant Studies
Engagement and motivation	5.21
Behavior change	9.11
Social and emotional aspects	10.13
Game design	3

Through the reviewed studies, interactive games consistently improved children's knowledge, engagement, and health behaviors. Positive changes included better hygiene practices and healthier food choices. Group-based games also developed social skills such as empathy and cooperation. Key design elements—rewards, progressive challenges, and engaging visuals—were identified as contributing factors to intervention effectiveness. For instance, Patil et al. (2024) reported significant

improvements in daily toothbrushing following a game-based program, while in Greece, Gkintoni et al. (2024) found that a gamified application integrating physical and cognitive components not only enhanced participation in physical activities but also helped reduce mild stress.^{5,9} Moreover, an analysis by Gaffar et al. (2022) validated that game design rooted in the Theory of Planned Behavior was more effective in promoting long-term healthy lifestyle behaviors, such as adequate sleep and regular exercise.²²

Similarly, a recent systematic review by Zikra et al. (2023) demonstrated that gamified interventions effectively increased health literacy and promoted sustained engagement across childhood and early adolescence.²³

Daud (2025) reported that the “Teddy Bear Pharmacy” module significantly improved children’s understanding of hygiene practices and appropriate medication use. Additional evidence from a meta-analysis by Alotaibi. (2024) confirms that game-based learning results in moderate to large improvements in children’s cognitive, emotional, and behavioral outcomes, particularly when embedded in structured educational contexts.⁴ In Indonesia, traditional educational games such as snakes and ladders and illustrated flashcards have likewise been effective in reinforcing children’s knowledge of clean and healthy living habits.^{20,22} These results highlight that effective interventions are not limited to digital formats; traditional, low-cost, and culturally familiar games can produce comparable learning outcomes, particularly in resource-limited settings.

Engagement and motivation in learning

A thematic analysis of the study findings identified four key themes. First, nearly all studies reported increased learning engagement and motivation, evidenced by children’s enthusiasm, longer attention spans, and active participation.^{21,23} Second, tangible improvements in health behaviors were observed, including better handwashing practices, healthier dietary choices, and increased physical activity following game-based interventions.²⁴ Third, many games positively influenced children’s social and emotional development, enhancing empathy, cooperation, and communication skills—particularly in collaborative or simulation-based formats.¹⁰ Finally, effective game design emerged as a critical factor for learning success, with real-time feedback, age-appropriate storytelling, relevant visualizations, and reward systems frequently cited as essential components.^{3,25}

Recent findings by Wong et al. (2024) emphasize that gamified interventions also improve sustained engagement among children in low-resource settings by utilizing hybrid formats that combine digital content with hands-on activities.²⁸ Similarly, Zikra et al. (2023) demonstrated that gamified health education interventions improve health literacy outcomes and maintain long-term participation rates compared with lecture-based instructional approaches.²³

However, several limitations were identified, including short intervention durations, small sample sizes, and the absence of long-

term evaluations to assess sustained behavioral change.¹⁷ Furthermore, limited access to digital devices and internet connectivity in certain regions created disparities in both implementation and outcomes.^{15,26}

Overall, evidence from the 20 reviewed studies suggests that interactive games—both digital and non-digital—are effective tools for enhancing children’s health education. Their impact extends beyond knowledge acquisition to shaping attitudes, influencing behaviors, and strengthening socio-emotional skills. Consequently, educational games should be recognized as viable health promotion strategies and considered for integration into school curricula and community-based health programs. However, their widespread adoption requires careful attention to game design quality, equitable access to resources, and rigorous long-term evaluation to ensure sustained impact.

Effects on health knowledge and behaviour change

The findings of this review reinforce that interactive games are an effective educational strategy for enhancing children’s health knowledge, engagement, and behavior. These results align with constructivist theory and intrinsic motivation theory, both of which highlight the role of direct experience, perceived competence, and emotional involvement in fostering meaningful learning. Evidence from studies such as Daud (2025) and Patil et al. (2024) demonstrates that children not only gain a cognitive understanding of health concepts but also translate this knowledge into consistent, positive behaviors in their daily lives.^{9,13}

An intervention study on serious games for nutrition education by Mattos (2023) supported the long-term cognitive impact, showing that children using the game had significantly higher knowledge retention about healthy food portions after three months compared to the control group.³⁰ Games also function as a vital bridge between formal education and contextual, real-world learning experiences. By simulating authentic scenarios, they enable children to internalize health values more effectively than one-way instructional methods such as lectures. For example, role-play activities like the “doll pharmacy” allow children to meaningfully grasp concepts of medication use and hygiene within a practical context. Game design is central to this process—features such as progressive challenges, reward systems, thematic narratives, and engaging visuals enhance motivation and sustain focus during learning activities. Gkintoni et al. (2024) further demonstrate that adaptive game design can significantly increase children’s engagement with educational content.⁵ These

findings underscore the need for close collaboration among game designers, educators, and health experts is essential for creating transformative and ethically responsible media.

Social and emotional development outcomes

In addition to enhancing cognitive outcomes, interactive games also contribute to children's social and emotional development. Group-based activities promote cooperation, communication, and empathy—core components of the affective dimension of learning. This aligns closely with the “Human Dimension” and “Caring” elements in Fink's Taxonomy of Significant Learning, which emphasize interpersonal growth and emotional engagement as essential to meaningful education. Support for these outcomes comes from a systematic review which concluded that serious game interventions are effective tools for enhancing emotional coping mechanisms and self-regulation skills in children dealing with mild anxiety and stress-related symptoms.³¹ Furthermore, other research indicated that simulation games requiring team negotiation significantly increased pro-social behavior and collaborative problem-solving skills in young children.³² Therefore, the role of interactive games extends beyond mere academic learning, making them an invaluable strategy for fostering emotional intelligence and social competence—foundations for children's holistic well-being

Nonetheless, implementation challenges persist. Access to digital devices and reliable internet remains uneven, particularly in low-income or rural areas, with Wei et al. (2024) identifying the digital divide as a significant barrier.¹⁵ Consequently, the continued development and integration of non-digital alternatives—such as educational board games, role-playing activities, and other physically interactive methods—are essential to ensure equitable access and impact.

Critical elements of effective game design

Several methodological limitations were identified, including short intervention durations and small sample sizes, which limit the ability to evaluate long-term effects. This implies that, while the evidence for short-term effectiveness is strong, there is an urgent need for studies with more robust designs that can validate sustained behavioral impact. To address these gaps, future research should incorporate longitudinal designs and large-scale trials to better assess the sustained impact of interactive games on children's health behaviors.

The findings of this review underscore several key implications. First, educational games should be integrated into elementary

school curricula, supported by teacher training on the effective use of interactive media. Second, policy frameworks need to encourage and sustain technology-based innovations in health education. Achieving this requires multisector collaboration to ensure that solutions are inclusive, effective, and sustainable. A notable strength of interactive games lies in their ability to bridge the gap between formal instruction and contextual learning. By simulating real-life situations, games enable children to connect health concepts—such as hygiene, healthy eating, and physical activity—to their daily experiences. Evidence from multiple studies shows that these concepts are not only understood at a theoretical level but also translated into practical behaviors after gameplay.^{9,13}

The effectiveness of interactive games is closely linked to the quality of their design. Key elements—such as reward systems, thematic narratives, progressive challenges, and age-appropriate visuals—have been shown to significantly enhance children's focus, engagement, and retention of learning. Gkintoni et al. (2024) emphasize that interactivity and adaptability are critical for sustaining motivation and strengthening the connection between gameplay and educational messages.⁵ Consequently, effective game design must integrate not only accurate health content but also psychological and developmental considerations to ensure that learning experiences are both engaging and developmentally appropriate. Close collaboration among game designers, educators, and health experts is *sine qua non* for creating media that are both transformative and ethically responsible.

Barriers and limitations

Moreover, many existing studies face methodological constraints, including small sample sizes, short intervention periods, and the absence of long-term follow-up, which limit the ability to fully evaluate the effectiveness of game-based interventions. The inherent enthusiasm for new technology must therefore be tempered with scientific rigor. Few have assessed the durability of behavioral changes over time, highlighting the need for more robust longitudinal and large-scale experimental research. Addressing these methodological gaps is paramount to moving the field from promising correlational evidence to validated, scalable intervention strategies.

Implications for practice and future research

These limitations carry important practical implications. First, schools and curriculum developers should integrate interactive games into children's health education as

complementary learning tools. This integration requires a shift in pedagogical approach, viewing games not as mere entertainment but as powerful instruments for applied learning. Second, close collaboration between game designers, educators, and health professionals is essential to ensure that games are not only visually engaging but also pedagogically sound and evidence based. Third, strong policy support is required, including teacher training initiatives, dedicated funding, and infrastructure investment to promote the sustainable use of interactive media in educational settings.

Considering these opportunities and challenges, interactive games hold significant potential to transform children's health education. When developed and implemented strategically, inclusively, and grounded in evidence, they can strengthen the foundation of healthy habits from an early age. The findings of this review provide a robust scientific basis for advancing program development, policy initiatives, and future research at local, national, and global levels, fostering more effective, engaging, and sustainable health education for children. Ultimately, maximizing the transformative potential of educational games depends on systematic, evidence-informed investment that ensures quality, accessibility, and long-term evaluation.

CONCLUSION

Interactive games have demonstrated substantial effectiveness as a medium for health education among children aged 4 to 12 years. Evidence from numerous studies shows that these approaches can significantly enhance children's knowledge, engagement, and adoption of healthy behaviors across key domains, including hygiene, nutrition, physical activity, and emotional well-being. Their success depends largely on appealing, age-appropriate design elements that sustain motivation and participation. Despite persistent challenges—such as unequal digital access and the scarcity of long-term impact assessments, interactive games remain a promising, enjoyable, and influential tool for learning.

Considering these opportunities and challenges, interactive games hold strong potential to transform children's health education if developed and implemented strategically, inclusively, and based on robust evidence. Embedding them within school curricula, alongside targeted teacher training, supportive policy frameworks, and multisector collaboration, offers a strategic pathway to maximizing their benefits. This approach can strengthen the foundation of children's health from an early age and foster lifelong healthy habits. The findings of

this review provide a scientific basis for advancing program development and research at local, national, and global levels.

Based on the findings of this systematic review, several recommendations are proposed to strengthen the effectiveness and sustainability of interactive games in children's health education: Interactive game-based learning should be systematically integrated into school health curricula at the primary level. Teachers need structured guidance, training modules, and standardized educational game resources to ensure alignment with learning objectives, age-appropriate competencies, and national health education standards. Collaboration between curriculum developers, health educators, and game designers is essential to produce evidence-based, engaging, and culturally relevant learning materials.

Future studies should adopt longitudinal research designs to assess the long-term impact of interactive games on children's knowledge retention, behavioural change, and health outcomes. Multi-site and large-sample studies are needed to produce more generalizable evidence. Additionally, periodic follow-up evaluations (6–12 months post-intervention) are recommended to measure the sustainability of behaviour change beyond the short-term effects commonly reported.

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