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Integrating Health Topics into Primary Education: A Review of Multidisciplinary Approaches Using Technology.

**دمج الموضوعات الصحية في التعليم الأساسي: مراجعة للمقاربات متعددة التخصصات
باستخدام التكنولوجيا**

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Abstract:

Promoting healthy lifestyles and reducing preventable diseases requires integrating health education into elementary schools. This review explores how technology can strengthen such efforts through interdisciplinary pedagogy, particularly in low-resource settings where school-based programs often face challenges. It highlights the importance of early interventions in nutrition, hygiene, mental health, and emotional well-being, while showing how digital tools—such as games, simulations, and mobile applications—encourage engagement, inclusivity, and positive behavior change. Drawing on the TPACK framework and four pedagogical models—constructivist, project- and inquiry-based, narrative learning, simulation and coping-skills training, and gamified pedagogy—the review synthesizes global evidence on effective strategies. It critically examines barriers including cultural sensitivity, curriculum misalignment, teacher preparedness, and infrastructure gaps. Practical insights are offered through a stepwise integration model and international case studies from Finland, South Korea, Australia, and Jordan. Findings emphasize that successful digital health education depends on system-wide cooperation, aligned curricula, inclusive pedagogy, and continuous support from educators, professionals, and policymakers.

Keywords: Digital health education, Primary schools, Pedagogical models, Technology integration, Preventive health.

المخلص:

ترويج أنماط الحياة الصحية والحد من الأمراض الممكن تجنبها يتطلب دمج التثقيف الصحي في المدارس الابتدائية. تستعرض هذه المراجعة كيف يمكن للتكنولوجيا أن تعزز هذه الجهود عبر مناهج تربوية متعددة التخصصات، خصوصًا في البيئات محدودة الموارد حيث تواجه البرامج المدرسية تحديات كبيرة. تؤكد المراجعة على أهمية التدخلات المبكرة في مجالات التغذية والنظافة والصحة النفسية والرفاه العاطفي، مع إبراز دور الأدوات الرقمية مثل الألعاب والمحاكاة والتطبيقات في تعزيز التفاعل والشمولية وتغيير السلوك. وبالاستناد إلى إطار TPACK وأربعة نماذج تربوية هي: التعلم البنائي، التعلم بالمشاريع والاستقصاء، التعلم بالسرد والقصص، والتعلم القائم على المحاكاة والمهارات، إضافة إلى التعليم المُمنهج بالألعاب، تُقدّم المراجعة أدلة عالمية حول الاستراتيجيات الفاعلة. كما تناقش العقبات التطبيقية مثل الحساسية الثقافية، عدم توافق المناهج، ضعف جاهزية المعلمين، ونقص البنية التحتية. وتعرض نموذجًا تدريجيًا للتطبيق مدعومًا بدراسات حالة من فنلندا وكوريا الجنوبية وأستراليا والأردن، لتؤكد أن نجاح التعليم الصحي الرقمي يستلزم تعاونًا مؤسسيًا شاملاً، مناهج متوافقة، وبيداغوجيا شاملة، ودعمًا مستمرًا.

الكلمات المفتاحية: التثقيف الصحي الرقمي، المدارس الابتدائية، النماذج البيداغوجية، دمج التكنولوجيا، الصحة الوقائية

1. INTRODUCTION

To reduce avoidable morbidity and mortality and shape lifelong health behaviors, health education in primary schools is essential (1). Primary school is a crucial environment for health promotion because children start developing habits related to social behaviour, physical activity, nutrition, and hygiene at a young age. It is becoming increasingly acknowledged that foundational education should include core subjects such as emotional well-

being, reproductive health, personal hygiene, and substance abuse prevention (2). These early interventions are associated with long-term health, employment, and quality of life outcomes (3–5), as well as improved cognitive, social, and academic development (6,7).

Despite their potential, many school-based health programs struggle to get off the ground due to issues such as age-inappropriate materials, cultural sensitivities, content gaps, and unclear delivery frameworks (8). There is a consistent

discrepancy between the way health education is taught in classrooms and the centrally planned curricula, according to research (2). In environments with limited resources and deficient professional development and infrastructure, these problems are especially severe (9).

Simultaneously, children are growing up in increasingly digital environments, and educational technology presents new ways to provide scalable, personalised, and engaging health education. AI-driven platforms, virtual simulations, mobile applications, and multimedia tools have demonstrated promise in improving engagement, motivation, and memory retention (10). There is evidence that gamified learning and interactive storytelling can help children better understand complex health concepts and improve behaviors such as hygiene, physical activity, and nutrition (11,12). However, there are drawbacks to digital integration as well, including the digital divide, teacher preparedness issues, and concerns about screen overuse and safety (13,14).

The COVID-19 pandemic has accelerated the digitization of education even further, underscoring the need to equip educators and schools with the necessary tools to integrate digital health literacy into regular classroom instruction (15). To overcome these obstacles and ensure that health education is inclusive, successful, and long-lasting, multidisciplinary, multi-stakeholder approaches that bring together educators, medical professionals, parents, and legislators are becoming increasingly important (16,17).

Few reviews have compiled these interventions from a multidisciplinary standpoint, despite the literature's support for the potential of combining technology and health education in elementary school settings. Research on the use of digital tools in health education, the pedagogical models that support them, and the implementation obstacles and enablers in various contexts is still necessary.

With an emphasis on the function of technology, this review attempts to synthesise interdisciplinary approaches to incorporating health topics into primary education. To inform future research, policy, and practice, this study will examine pedagogical frameworks, implementation challenges, and international case studies.

2. Technological Pedagogical Content Knowledge (TPACK)

More than just having access to digital tools is needed to incorporate health education into primary school curricula using technology; careful alignment of the content, pedagogy, and technology used for instruction is required. To create practical, technology-integrated lessons, Harris et al. (2009) developed the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the intersection of three key knowledge domains: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) (19).

TPACK has practical applications in lesson design, professional development, and the evaluation of teacher readiness (19). In primary education, it enables educators to craft developmentally appropriate, engaging, and digitally supported health lessons. For example, a lesson on hygiene for 6–9-year-olds might combine accurate content (e.g., when and how to wash hands), a child-centered pedagogy (e.g., storytelling or modeling), and interactive technology (e.g., gamified handwashing apps or animated explainer videos) (Figure 1).

Many primary educators find it challenging to integrate the three domains, despite their benefits. Gaps in technological fluency and the capacity to synthesize domains are common, even though teachers frequently exhibit strong content or pedagogical knowledge (20, 21). Lack of training, inadequate infrastructure, and contextual limitations, such as time constraints, school policies, and prevailing beliefs, are some of the obstacles (22,23).

TPACK has been incorporated into teacher education programs worldwide to address these issues. It has been demonstrated that TPACK-based curricula enhance instructional design, reflective thinking, and technology integration abilities in pre-service training (24). Teachers are also being assisted in critically assessing how technology supports particular subject matter by tools like the Technological Content Representation (T-CoRe) model (25).

Numerous academic fields, including mathematics, foreign languages, science, nursing, and health education, have utilized TPACK (26–29). Games, smartphone apps, and multimedia lessons are examples of TPACK-based digital

interventions that have been demonstrated to enhance student engagement, knowledge retention, and behaviour change in health-specific contexts (30).

Iterative, collaborative, and context-specific learning must be given top priority in professional development if TPACK is to be applied successfully in health education. Successful models have been found that incorporate digital pedagogy cycles, mentorship, and co-design (31,32).

3. Pedagogical Frameworks for Tech-Enhanced Health Education

Engagement, accessibility, interactivity, technology integration, and evidence level are the five main factors pertinent to digital health education in primary schools, which can be used to compare the pedagogical models described above. A visual summary of each framework's performance along these dimensions is provided in the following matrix (Figure 2), which also highlights the frameworks' relative advantages and potential applications.

Constructivist Learning Theory

Constructivist learning theory places a strong emphasis on how students actively construct their knowledge via investigation, teamwork, and introspection. Constructivism, with its roots in the work of Piaget and Vygotsky, has been widely applied in primary education across various subjects, including science, mathematics, and, more recently, health education (33). Constructivist principles, in particular, encourage meaningful engagement in health education by allowing children to explore and share their thoughts about real-life health situations. This enhances the practical application of knowledge, leading to more profound cognitive processing (34).

Constructivist health education uses context-based teaching to promote experiential learning. This idea is embodied in tactics such as the "child-to-child" approach, which equips children with the tools they need to apply what they learn in the classroom to healthy habits at home and in the community (35). These techniques have been proven effective in a variety of global settings, yielding favourable outcomes for critical thinking, behavioural modification, and knowledge acquisition (33). However, teacher preparation, supportive classroom environments, and curriculum alignment are necessary for successful implementation (36).

In constructivist health education, technology has proven to be a valuable tool. By enabling students to test theories, visualize procedures, and work together with peers in dynamic settings, web-based activities, simulations, and digital games promote learning (37, 38). Children's knowledge of nutrition, hygiene practices, and emotional comprehension, for example, has improved with the help of digital storytelling platforms and health-themed games (30,39). Serious games have even been successful in teaching illiterate children about healthcare and nutrition in developing nations (40).

Numerous studies support the effectiveness of constructivist digital interventions. Constructivist-based physical education programs in the United States helped primary school pupils improve their knowledge of fitness (33). Digital games and multimedia tools greatly enhanced dietary self-efficacy, behaviour, and nutritional knowledge in both Brazil and Europe (39,41). These techniques offer a fun and inclusive approach to discussing challenging topics such as emotional control and sustainable diets. Crucially, they also accommodate different learning needs and preferences, which is a crucial aspect of constructivist pedagogy.

Constructivist learning promotes more general developmental objectives in addition to content knowledge. Children participating in constructivist health programs exhibit improved decision-making, cooperative problem-solving, and self-regulation abilities (42). In line with 21st-century educational objectives, tools such as blogs, wikis, and social media further encourage student agency and voice (43,44). These digital tools support the transition from teacher-led to learner-centred instruction by encouraging interaction and reflection, which enhances the child's natural learning styles.

Project-Based and Inquiry-Based Learning

Inquiry-based learning (IBL) and project-based learning (PBL) are experiential pedagogical strategies that encourage students to investigate practical health issues in a student-centered manner. While IBL promotes critical thinking and curiosity-driven questioning, PBL involves students working together to solve real-world problems through extended, multidisciplinary projects. Both strategies support constructivist ideas by enabling students to take charge of their education and participate in health education in meaningful ways.

PBL has been used extensively in school-based health promotion, successfully improving students' behavioural skills, action competence, and knowledge. Projects that focus on physical activity, nutrition, and sexual health, for example, have shown improvements in health literacy and student engagement (45). According to a study by Carlsson and Simovska (2012), school-community partnerships in Denmark enabled students to investigate factors contributing to healthy growth, fostering a sense of shared accountability for health outcomes (46). However, PBL can help create long-lasting behaviour change and boost student motivation if it is backed by sufficient planning and resources (47).

In underprivileged communities, IBL has also been successfully applied. Participation in water and sanitation IBL activities by students in slum areas in India led to improved hygiene habits and a greater local impact (48). IBL's advantages in fostering curiosity, empathy, and responsibility make it an ideal approach for primary health education, despite potential challenges such as a lack of resources and inadequate teacher training (49).

By offering tools that promote cooperation, creativity, and access to a variety of resources, digital technologies improve both PBL and IBL. Multimedia tools, digital platforms, and mobile learning apps can boost learning efficacy and motivation (50). For instance, tools that enable data collection, visualisation, and presentation are beneficial to students engaged in STEM projects related to health (51).

Online simulations and geospatial hypermedia systems are two examples of technologies that enhance contextual and situated health education outside of the classroom (52). According to meta-analyses, the effects of technology-enhanced learning in primary education are moderate, and the subject domain and learning environment have an impact on the results (53). Therefore, incorporating suitable technology into health education that is inquiry- and project-based can enhance learning and develop critical 21st-century skills.

However, without ongoing support and reinforcement, long-term dietary and lifestyle changes might be more complex to maintain (54). To successfully integrate health content across disciplines and strike a balance between curriculum goals and student autonomy, teachers also require professional development (55).

Storytelling and Narrative-Based Learning

Numerous studies demonstrate how oral storytelling can effectively encourage children's health-related behaviours and knowledge. Dental hygiene (56–58), nutrition knowledge (59–61), and personal hygiene practices (62) have all improved as a result of storytelling interventions. In addition to improving children's focus and memory, the imaginative and participatory elements of storytelling help them internalize healthy habits (63). Children's knowledge, attitudes, and health-related practices have been shown to improve significantly as a result of story-based interventions (64).

The pedagogical value and reach of storytelling have increased with its evolution into digital formats. In various health contexts, including patient education, nursing education, and public health promotion, digital storytelling—brief, multimedia-based narratives that combine audio, video, and images—has shown promise (65). In addition to promoting peer learning and identity development, co-creating stories with patients or students increases engagement and reflection (66,67).

Additionally, narratives help students achieve academic and social-emotional goals. Children develop improved relational and self-regulation skills as a result of their assistance in understanding peer dynamics, making health decisions, and navigating emotional situations (68,69). Narrative pedagogy offers inclusive, recognizable formats that relate to students' lived experiences in classrooms with diverse cultural and linguistic backgrounds (70).

The use of narrative-based game interventions to enhance psychological determinants of health, such as motivation and self-efficacy, is supported by meta-analytic evidence (71). These results underscore the importance of incorporating narrative structures into educational and digital health games.

Children can learn in an immersive way through interactive storytelling, which combines narrative content with game elements or user-driven choices. This method has proven effective in teaching concepts related to hygiene, nutrition, and emotional control in both educational and medical contexts (72). By giving kids the opportunity to explore delicate subjects through storylines and avatars in secure, creative settings, interactive narratives can lessen the stigma associated with mental health (73).

In early education, emotional literacy and

social-emotional learning have also been promoted through the use of tangible storytelling kits and guided interactive storytelling (74). With the aid of these resources, students can practice coping mechanisms, express their feelings, and develop empathy. Dramatic tension, user agency, and emotional resonance are all balanced with educational goals in story-driven digital interventions (75). Storytelling has been used to teach university students reflective practice and emotional competence, even in dental education (57).

Simulation and Coping-Skills Training

Structured role-play and facilitated simulations are valuable tools for teaching communication, empathy, and emotional control in elementary school settings. Young students' self-control and behavioural problems have decreased in programs that employ coaching techniques, classroom role-playing, and adult modelling (76). By teaching children to identify emotions, practice appropriate reactions, and employ constructive coping mechanisms in social settings, these activities foster emotional literacy. Health lessons can be made more interactive and developmentally appropriate by teachers using scripted scenarios to address issues such as bullying, hygiene practices, or managing frustration.

Digital technologies increase the possibilities of simulation in the elementary school context. Children have been taught hygiene, asthma self-management, nutrition, and emotional regulation through age-appropriate serious games and computer-based simulations (26). With their gamified challenges, storytelling, and instant feedback, these resources encourage health behaviour change and are especially interesting for young students.

The development of coping strategies for stress, trauma, or disruptive situations has been the specific focus of some classroom-based programs. Children have been helped to develop emotional resilience and prepare for emergencies, such as natural disasters, through the use of digital storytelling, interactive animations, and web-based programs (77). These interventions utilize structured reflection and guided narratives to help make complex or frightening concepts more manageable.

Simple augmented reality experiences and virtual simulations have been introduced to teach health behaviors, such as preparing for a doctor's appointment or practicing hygiene. However,

they are still in their infancy in primary education. These resources offer engaging and unforgettable educational opportunities, demonstrating promise in improving comprehension, particularly for students with limited prior exposure to medical settings (78,79).

Careful curriculum integration and adequate teacher preparation are critical to the success of simulations and coping-skills training in primary health education. Research highlights the importance of pedagogical preparedness and digital literacy for teachers to utilize these tools effectively (80,81). Additionally, to reinforce skills outside of the classroom, simulations should be combined with reflection, discussion, and parental involvement.

Gamified Learning and Game-Based Pedagogy in Primary School Health Education

In primary school health education, gamified learning and game-based pedagogy are increasingly acknowledged as practical strategies to enhance student motivation, engagement, and behavioral outcomes. Teachers can make health topics more approachable, entertaining, and memorable for young students by incorporating game mechanics—such as points, badges, levels, and storylines—into instructional content.

Health education becomes an interactive experience through the use of gamification. Research has demonstrated that gamified methods can increase student engagement, motivation, and satisfaction in various health-related areas, including physical activity, diet, and hygiene (82, 83). Gamified interventions utilize visual rewards, such as leaderboards and badges, to track progress and transform routine tasks into challenges, which appeal to children's intrinsic and extrinsic motivators (84).

Numerous educational games, both physical and digital, have shown promise in promoting healthy habits and enhancing knowledge about health. For instance, the Alien Health Game enhanced children's understanding of nutrition and helped them make healthy food choices (59), while the e-Bug junior game has been used to teach hand hygiene and prevent the spread of germs (85). Board games that encourage good oral hygiene and the use of clean water have been used in classrooms in non-digital contexts, especially in settings with limited resources (86). Repetition, competition, and group learning are made possible by these formats, which strengthen behaviour modelling and retention.

General health topics are not the only topics covered by game-based learning (GBL). Oral hygiene, mental health awareness, and sexual health education have all benefited from its application (61,87,88). By fusing interactive components with narrative-based learning, GBL can be modified in the classroom to accommodate a range of developmental stages. Teachers can teach health concepts in an integrated and engaging way by using a storytelling game, for instance, to simulate a day in a child's life where decisions about food, hygiene, and physical activity impact the outcome.

The use of mobile health apps and games in educational settings has grown. These resources support differentiated instruction by enabling learners to repeat lessons as needed and facilitating individualised pacing. Research has shown the benefits of mobile games in managing chronic health conditions among young people and in fostering health literacy, particularly among underrepresented groups (87). However, careful curriculum alignment and consideration of screen time limits are necessary for successful implementation in classrooms.

Points, levels, or digital incentives are commonly used in gamification strategies to influence behaviour. These reward programs have been demonstrated to promote children's healthy lifestyle choices, medication adherence, and physical activity (89,90). These tools can aid in goal-setting, peer support, and progress tracking within classroom health programs. Although gamification often yields high levels of short-term engagement, it must be complemented with other pedagogical tools, such as reflective discussion and parental involvement, to sustain long-term behavioral change (91).

Issues of educational access and engagement among diverse learners can also be addressed by game-based pedagogy. According to research, gamified interventions can be especially inclusive, helping students with varying learning styles and skill levels and even advancing digital and ecological literacy in addition to health-related subjects (92).

More research is required to determine gamification's long-term effects on behaviour, transferability across contexts, and integration into more comprehensive school health curricula, despite the fact that its short-term educational benefits are widely known (93). In order to choose or create games that complement learning goals and developmental appropriateness,

educators also need assistance.

The following table provides a comparative synthesis of the pedagogical models discussed, highlighting their core features, ideal use cases in primary school health education, and how they integrate with educational technologies. It also outlines limitations, target age groups, and evidence strength based on current literature (Table 1).

4. Implementation Challenges in Technology-Enhanced Health Education in Primary Schools

Although there is a lot of potential for integrating digital tools and innovative pedagogy into primary health education, a number of institutional, systemic, and contextual issues frequently make it difficult to implement in various contexts. These obstacles affect the efficacy, sustainability, and equity of health education programs in addition to the adoption of technology.

Infrastructure and Digital Access

Lack of proper infrastructure is a major obstacle to teaching digital health in primary schools, especially in rural and low- and middle-income countries (LMICs). Schools might not have modern hardware, dependable internet access, or effective learning management systems (94). Even with the availability of digital tools, long-term usability is limited by intermittent electricity supplies and technological obsolescence. Additionally, marginalised students are disproportionately impacted by the digital divide, which restricts their access to digital learning at home and exacerbates pre-existing health disparities (95).

Teacher Readiness and Professional Development Gaps

Many educators lack the time, confidence, or training necessary to successfully incorporate digital tools into health curricula, particularly in underfunded educational systems. Research has indicated that although educators may possess strong pedagogical or content knowledge, their technological fluency and TPACK synthesis are frequently lacking (20). Teachers are also ill-prepared for implementation since pre-service training programs frequently neglect to cover interdisciplinary collaboration or digital health literacy (22,23). When provided, professional development is frequently disjointed, one-time, or out of step with actual classroom requirements (31).

Curriculum Misalignment and Rigid

Educational Structures

Structured guidelines on how to integrate digital methods or health topics in age-appropriate, pedagogically sound ways are lacking in many national curricula. The integration of health education into core subjects is limited because it frequently occurs as a cross-cutting theme without specific instructional time (2). Additionally, the pressures of standardised assessments may deter teachers from being creative or from deviating from textbook-based instruction. Inconsistent delivery and limited scalability result from unclear policies or frameworks that support technology-integrated health lessons (8).

Cultural Sensitivity and Social Norms

Sensitive subjects that may conflict with cultural, religious, or social norms include disease prevention, mental health, reproduction, and hygiene. Particularly in conservative or pluralistic societies, parents or school administrators may oppose digital interventions that are not culturally appropriate. To ensure acceptability and impact in these situations, storytelling, community involvement, and co-creation of materials are crucial.

Learner Diversity and Inclusion Barriers

Many technology-enhanced health education programs fall short of accommodating students with disabilities, language barriers, or mental health issues, despite the promise of Universal Design for Learning (UDL) (96). Many platforms are still inaccessible to children with visual, auditory, or cognitive impairments, and teachers might not have the resources or training to modify digital content to meet the needs of each individual student (97). Furthermore, if not properly designed, overstimulating digital environments may be problematic for neurodiverse learners or those with a history of trauma.

Concerns About Screen Time, Safety, and Data Privacy

Overuse of screens and the possible harm that digital exposure can do to young children's behaviour, attention, and physical health are frequent concerns expressed by parents and educator (13,98). Additionally, a lot of educational platforms gather data without obvious transparency or security measures, which raises moral questions about consent and privacy. Trustworthy, evidence-based, and age-appropriate digital tools are crucial for safe implementation because these issues are

particularly noticeable when working with minors (99).

Sustainability and Long-Term Engagement

It can be difficult to maintain behaviour change and digital engagement over time, even when pilot programs demonstrate immediate benefits. Although gamification and simulations may increase motivation at first, these benefits frequently wane in the absence of curriculum alignment, parental involvement, and teacher facilitation (93). Furthermore, a lot of programs are grant- or donor-funded, which causes them to end when funding runs out. Systemic planning, continuous evaluation, and conformity to national health and education objectives are necessary for sustainability (16).

A systematic, step-by-step framework can direct the incorporation of digital health education into primary school curricula in order to fully address these implementation challenges. The seven steps in this model are as follows: baseline assessment and stakeholder engagement come first, followed by curriculum alignment, teacher training, piloting, and data-informed feedback loops; policy inclusion and long-term training mechanisms come last. Localisation, lesson planning, support systems, behaviour tracking, and mixed-methods evaluation are important subcomponents of each step (Figure 3).

5. Global Case Studies to Inform Future Research, Policy, and Practice

Both innovation and inequality can be seen in the global landscape of primary school health education enhanced by technology. Countries have successfully and unsuccessfully implemented digital health interventions across a range of sociopolitical and educational systems, providing important information for forming future research agendas and policy frameworks. These case studies highlight the various requirements for successful integration, from infrastructure support and cultural sensitivity to curriculum design and teacher training, and they offer a path forward for scaling inclusive, sustainable, and evidence-based digital health programs (Table 2).

Since the early 2000s, health education has been a part of the national curriculum in Finland, a nation renowned for its equitable and student-centered educational system. Lessons on nutrition, exercise, and mental health have been bolstered by digital tools like interactive simulations, multimedia games, and tablet-integrated classroom activities. Finland's strong

policy alignment and investment in pre-service and in-service teacher education are key components of its success (96). In addition to their pedagogical and content knowledge, teachers possess digital fluency, which enables them to modify technology to meet the needs of their students while still being developmentally appropriate.

Government-sponsored e-health platforms in elementary schools, with a special emphasis on mental health, were first introduced in South Korea. These programs offer organised modules for developing empathy, controlling emotions, and preventing bullying. According to early assessments, students' coping and social skills have improved (100). However, nationwide scalability is limited by the differences in digital access between urban and rural schools. Furthermore, localised content adaptation is hampered by South Korea's centralised educational system.

At the state and school levels, innovation has been encouraged by Australia's decentralised educational system. Through collaborations with public health organisations, mobile applications that teach healthy eating habits, emotional control, and handwashing have been incorporated into elementary school classrooms. The continued need for co-designed, curriculum-aligned materials is highlighted by teachers' reports of difficulty matching some digital resources with current curriculum objectives (101). Similar trends can be seen in the UK, where programs like "Camp Cope-A-Lot" and "The Adventures of DoReMiFa" have been used to help kids develop their digital mental health literacy. These resources increased teacher confidence in presenting socioemotional content in addition to improving students' emotional self-regulation and behaviour (102). Despite their success, the need for teacher facilitation and variability in engagement across classrooms point to the importance of ongoing support and contextual adaptation.

App-based and gamified health interventions have become more and more popular in the US, particularly in schools that serve underserved communities. Engagement levels for interactive health games that encourage exercise, a healthy diet, and good hygiene have been encouraging (103). Even though these tools are good at increasing short-term knowledge, research indicates that long-term behavioural change necessitates reinforcement through

parental and teacher involvement as well as integration into more comprehensive school wellness policies. Another noteworthy example is Brazil, where school tablets and television-based platforms have been used to implement audiovisual-based hygiene and nutrition education programs, especially in rural areas. These interventions have proven effective in increasing health knowledge, particularly among lower-income populations, and are specifically designed to address geographic and resource-related barriers (104).

Moving on to the Middle East, Jordan makes a strong case for technology-enabled, contextualised school health interventions. Although it had no discernible effect on toothbrushing habits or plaque scores, a video-game-based oral health intervention in Jordanian primary schools enhanced children's dietary knowledge in one randomised controlled trial (105). This result is indicative of a larger trend in digital education: without corresponding support systems, acquiring knowledge does not always result in changing behaviour. The Children Immunisation App (CImA) was created in the Zaatari refugee camp to monitor vaccination records and provide caregivers—many of whom were illiterate—with basic health information. Although this intervention met a pressing need in a population that was at risk, its long-term efficacy has not yet been assessed (106).

Additionally, Jordan has seen school-based studies on the delivery of oral health (56), the evaluation of adolescent wellness (107), and digitally assisted early-grade literacy interventions (108). These studies repeatedly highlight a lack of a unified national strategy, low baseline health knowledge, and underdeveloped digital infrastructure in some areas. However, they also point out innovations that show promise. For example, it has been shown that mobile applications aimed at mothers and kids in rural Jordan can effectively enhance health education and immunisation management (109). Although Jordan's digital health infrastructure is developing, recent reviews by Alyahya et al. (2022) and Ashour et al. (2025) highlight that scalability is limited by the lack of adequate funding, policy, and interoperability (110,111).

WHO's EMRO office has supported mental health interventions in schools throughout the Eastern Mediterranean region by utilising digital platforms (100). These initiatives highlight the importance of regional cooperation

in monitoring, teacher preparation, and content creation. Digital interventions, however, face obstacles like low digital literacy, privacy concerns, and lax regulatory frameworks, as highlighted in a thorough review of fragile states in the MENA region (104). Three recurrent elements have been essential to the success of school health promotion in low- and middle-income nations more generally: integration with health services, alignment with national policy, and stakeholder engagement, including teachers and families (112).

6. CONCLUSION

All things considered, these international and local case studies demonstrate that the successful integration of digital tools in health education in schools involves more than just the availability of hardware or software. It entails balancing curriculum, pedagogy, cultural context, and structural support with technology. Long-term behavioural effects, cost-effectiveness, and implementation science frameworks that can guide context-sensitive scaling should all be investigated in future studies. Adopting system-wide approaches that connect the health and education ministries, encourage public-private partnerships, and enable educators and communities to collaborate on the creation of digital health content is recommended for policymakers. These international experiences provide a basis for innovation grounded in sustainability, equity, and evidence as Jordan and other countries hone their digital health education initiatives.

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Tables:

Framework	Key Features	Technology Applications	Limitations	Ideal Health Education Context	Target Age Range	Evidence Strength
Universal Design for Learning (UDL)	Inclusive, flexible teaching with multiple modes of engagement, expression, and content representation.	Multimedia lessons, assistive technologies, adaptive learning tools.	Requires training; inconsistent implementation; limited graduate-level data.	Teaching hygiene, nutrition, emotional health in diverse classrooms.	5–12 years	Moderate to strong
Project-Based / Inquiry-Based Learning (PBL/IBL)	Student-led exploration of real-world problems; promotes collaboration and critical thinking.	Tablets, geospatial tools, interactive science platforms, mobile health data apps.	Resource- and time-intensive; teachers may lack training or confidence.	School-wide nutrition campaigns, water/hygiene projects, mental health advocacy.	7–12 years	Strong
Storytelling & Narrative-Based Learning	Uses stories (real or fictional) to foster memory, empathy, and cultural relevance.	Animated stories, digital storytelling apps, narrative video tools.	Limited scalability; outcomes depend on quality of stories and facilitation.	Teaching emotions, personal hygiene, nutrition, and health protocols.	4–10 years	Strong in short-term gains; limited longitudinal data
Simulation & Coping-Skills Training	Practice-based emotional and decision-making skills through immersive scenarios.	Virtual reality, avatars, high-fidelity mannequins, game-based simulations.	Costly; teacher preparedness varies; infrastructure dependent.	Stress management, chronic disease self-care, social-emotional learning.	6–12 years	Moderate; growing evidence base
Gamified Learning & Game-Based Pedagogy	Uses game mechanics (points, rewards, feedback) to drive learning and behavior change.	Game apps for hygiene/nutrition, reward-based fitness trackers, leaderboard tools.	Short-term focus; mixed results on deep understanding and behavior transfer.	Daily hygiene routines, food choices, digital health habits.	5–11 years	Strong for motivation; mixed for long-term health behavior change

Table 1. Pedagogical Models in Primary School Digital Health Education.

Country/Region	Intervention Type	Technology Used	Target Health Domain	Key Outcome	Main Limitation
Finland	National digital health curriculum	Interactive games, classroom tablets	Nutrition, physical activity	Improved literacy in nutrition/fitness	Resource variation across schools
Hong Kong	“DoReMiFa,” “Camp Cope-A-Lot”	Web-based games	Mental wellbeing	↓ anxiety, ↑ coping skills	Requires trained facilitators
South Korea	e-Mental health in schools	Government e-platforms, VR simulations	Mental health	Improved emotion regulation in students	Regional access gaps
Australia	Health apps in curriculum	Mobile apps, teacher dashboards	Hygiene, nutrition	Increased short-term knowledge	Curriculum alignment issues

UK	Emotional learning through narrative games	“DoReMiFa”, “Camp Cope-A-Lot”	Mental health	Improved teacher confidence, coping skills	Student engagement variability
UK	E-Bug (antibiotic awareness game)	Board + digital game	Infection prevention	↑ hygiene knowledge	Curriculum alignment
USA	Gamified health literacy	Mobile games, fitness tracking apps	Physical activity, nutrition	High motivation, moderate behavior change	Reinforcement challenges
USA	“Re-Mission” (for cancer patients)	Game console, PC	Chronic disease management	↑ adherence, ↑ self-efficacy	Short engagement span
Brazil	Rural digital health outreach	Audiovisual-based interventions	Hygiene, nutrition	Improved rural health knowledge	Infrastructure deficits
Brazil	Water/hygiene conservation games	Interactive mobile games	Environmental health	↑ ecological awareness	Limited long-term follow-up
Jordan	Video game oral health RCT	Educational game	Oral hygiene, diet	Increased dietary knowledge	No behavioral change
Jordan (Zaatari Camp)	Refugee-focused mobile health app	Children Immunization App (CIaA)	Vaccination, child health	Increased documentation and health access	Literacy and hardware limitations
MENA Region	WHO EMRO mental health program	Digital training tools, educational modules	Mental health	Positive teacher/student outcomes	Need for long-term data
Egypt, Jordan	Early reading/literacy & health	Classroom apps + tablets	Literacy + indirect health ed.	↑ school attendance, ↑ literacy	Tech access varies
Palestine, Jordan	RMNCH digital initiatives	Health registries, e-tools	Maternal and child health	Advanced infrastructure; low data use	Limited data governance
Eastern Mediterranean	WHO EMRO mental health program	Scalable tech models	Mental health awareness	↑ teacher engagement	Under-evaluated outcomes
Sub-Saharan Africa	School health promotion campaigns	SMS reminders, interactive radio, apps	Water, hygiene, NCDs	Healthier habits, increased awareness	Variable policy support and funding

Table 2. Summary of Global Digital Health Education Case Studies in Primary Schools

Figures:

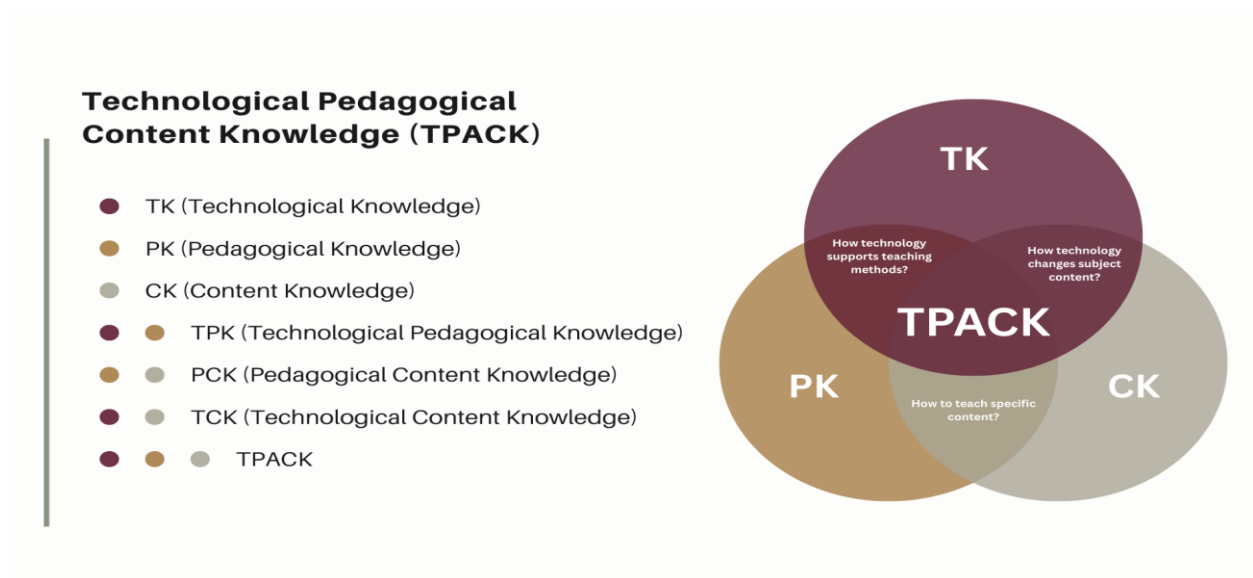


Figure 1. The TPACK Framework for Technology-Integrated Health Education

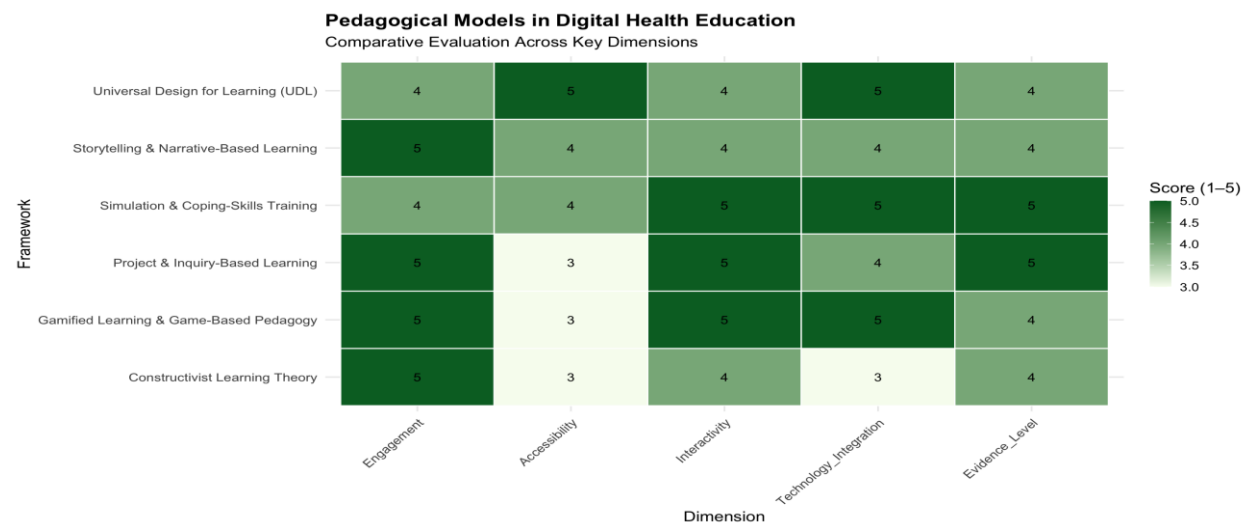
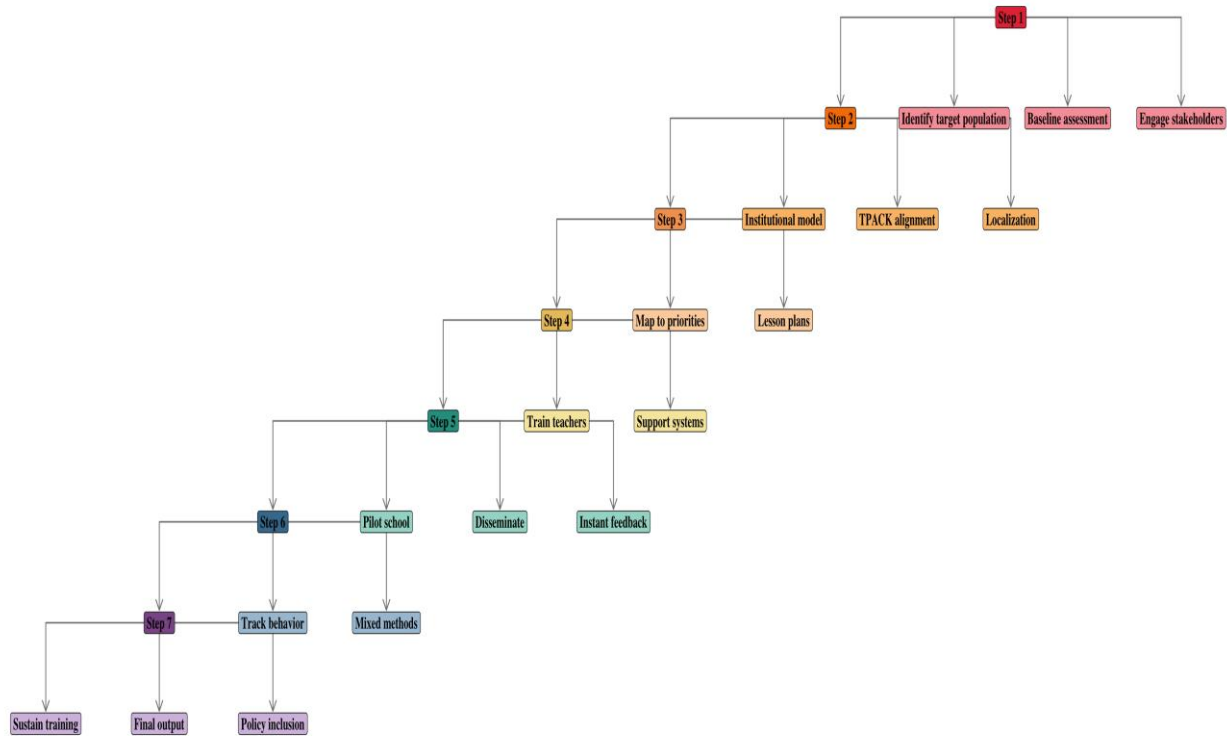


Figure 2. Comparative Matrix of Pedagogical Models in Digital Health Education for Primary School Learners



A structured implementation model presenting seven progressive stages for integrating digital health content into primary education. Each step includes subcomponents such as stakeholder engagement, institutional alignment, lesson planning, training and feedback mechanisms, piloting, behavior tracking, and sustainability planning.

Figure 3. Stepwise Framework for Implementing Technology-Enhanced Health Education in Primary Schools.