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Abstract

Gamified health interventions can offer child-centered and tailored health-promoting strategies. Evidence suggests that its various mechanics foster engagement that can be utilized to promote health and well-being as well as influence health behavior. At present, psychosocial challenges among school-aged children are becoming a global predicament. We conducted a scoping review to explore the range and nature of evidence on gamified interventions for promoting the psychosocial well-being of school-aged children from the general population. We followed the Arksey and O'Malley framework and extracted sources of evidence from five databases. Our review findings were summarized with basic numerical analysis and provided with narrative accounts based on a gamification taxonomy and the Template for Intervention Description and Replication (TIDieR). We identified 12 gamified interventions and included 23 records that reported their development and evaluation. Theories on emotions, behaviors, social skills, and mental health were commonly applied frameworks. Narrative was found as the most commonly used gamification mechanic (11/12, 91.7%), followed by avatar and tasks (10/12, 83.3%), feedback system and level progression (9/12, 75%), points (7/12, 58.3%), badges (5/12, 41.7%), progress bar (4/12, 33.3%), virtual goods, reminders, and time pressure (2/12, 16.7%). The included sources of evidence reported significant improvements in some of the measured psychosocial outcomes; however, studies on this domain for this particular target group are still considerably limited. Further research is needed to determine how the applied theories and gamification mechanics brought about the change in psychosocial outcomes, bridging the gap in current evidence.

Keywords: gamified intervention, health games, psychosocial well-being, prevention, children, scoping review

Introduction

Digital interventions for promoting health and well-being are growing in popularity. The World Health Organization (WHO) recognized how this approach showcased great potential in enhancing various health outcomes[1] and continues to strengthen evidence-based digital health interventions.[2] In promoting children's health and well-being, gamification gained recognition as an innovative approach offering child-friendly health-promoting strategies.[3] It is defined as the application of game design and its mechanics in a non-game context other than for entertainment purposes.[4] Evidence suggests that gamified interventions have positive effects on children's health and well-being,[5] their health behaviors,[6] and their perspectives toward health.[7] These interventions fill in the shortcomings of their conventional counterparts (non-gamified interventions) such as intrinsic motivation, accessibility through technological devices such as tablets and smartphones, appeal to wider population, applicability to various health domains, cost-benefit efficiency particularly in intervention scalability, ease of fitting the intervention with other daily life activities and generating positive and fun experiences.[5] Gamification can foster intervention engagement and convenience.[3,5]

Psychosocial well-being is one of the many dimensions of mental health[8] which focuses on the psychological and social levels of human functioning.[9] There are varying definitions and interpretations to date. Generally, the term psychosocial refers to the correlation of the mind, body, and social environment in the contexts of a person's experience, behavior, and social dynamics.[10,11] It impacts one's quality of life[12] extending to personal growth, values, purposeful activity, and self-perceived life satisfaction.[13,14] Challenges in these areas may escalate to various health risks.[12-14]

The high prevalence of psychosocial challenges among school-aged children is a growing global predicament.[15] It has become a significant barrier even for children with no underlying health deficiency. Children's psychosocial well-being is affected by their health behavior, relationships with family, peers, and society in general.[16] Recognizing their psychological resources, for example, their self-esteem and emotional resilience, as well as their social environment is crucial.[17,18] Studies have shown that the effect of these resources is highly significant to children's health risks such as obesity, lack of physical activity, early smoking, and alcohol use.[19] Furthermore, the continuous effect of the changes in social norms brought about by the Coronavirus disease 2019 (COVID-19) pandemic aggravated negative psychosocial outcomes, especially in children.[20] In light of this escalating predicament, child-centered interventions that address the psychosocial well-being of children are needed. As

research and development on gamified health interventions are continuously growing,[5-7] it is of our interest to explore the extent of evidence on its application to promote the psychosocial well-being of children from the general population.

Methods

Given the broad and complex nature of our topic, we conducted a scoping review to explore and provide an overview of the range and nature of evidence on using gamification for promoting the psychosocial well-being of school-aged children. A scoping review is useful to rapidly map evidence across a wide range of sources, identify areas where research warrants further investigation, and assess if a more in-depth type of review is feasible,[21,22] which are in line with our objectives. We adhered to the five-stage Arksey & O'Malley framework for scoping reviews.[23] This framework offers a straightforward process while encouraging flexibility and consideration of key elements of our review questions as our familiarity with literature develops. The review protocol was preregistered under the Open Science Framework (https://osf.io/7df2a).

Stage 1: Identifying the research questions

This review was conducted with the following questions: 1) What are the available gamified interventions for promoting the psychosocial well-being of children from the general population? 2) What theoretical frameworks and gamification mechanics were used to support their psychosocial outcomes? 3) What psychosocial outcomes and changes were observed after playing the gamified interventions?

Stage 2: Identifying relevant studies

We conducted our initial search in April 2022 and performed updated searches in December 2022 and February 2024 to identify additional evidence published until the end of 2023 ensuring our review is up to date. The eligibility criteria were pre-determined prior to our review. We included sources of evidence without published date restrictions on gamified digital interventions, health games, serious games or mobile health apps, for the promotion of psychosocial well-being or its resources, and for children aged 6-12 years old. We excluded reviews and meta-analyses, focused on children with underlying physical or mental health disorders, and sources not available in English.

We identified the studies from PubMed, Cumulated Index to Nursing and Allied Health Literature (CINAHL), PsycInfo, and Scopus using keywords generated based on synonymity and as identified from preliminary search of literature. The construction of search phrases was

based on identified keywords from population, concepts, contexts as well as Medical Subject Headings (MeSH) terms and subject headings as applicable. Each were tailored accordingly as per database. We also referred to the information retrieval strategies by Salvador-Oliván[24] to avoid misappropriation of keywords as search phrases and to ensure that applied search suffixes comply with each database search syntax. For example in PubMed, we used the search string ("Child"[Mesh] OR child*[tw] OR "school aged child*"[tw] OR "school-aged child*"[tw]) AND ("Gamification"[Mesh] OR "Mobile Applications"[Mesh] OR gamif*[tw] OR "health game*"[tw] OR "serious game*"[tw] OR ”health app*”[tw] OR "mobile app*"[tw] OR mhealth[tw] OR m-health[tw] OR ehealth[tw] OR e-health[tw] OR "digital intervention*"[tw]) AND ("Mental Health"[Mesh] OR "psychosocial health*"[tw] OR "mental health*"[tw]). At this stage, grey literatures were explored through Google Scholar. Reviewers have agreed that the first 100 hits from the search engine will be extracted for screening prior to search. Sci-hub was also used to map literature as found necessary. Bibliographic references were inspected for further study inclusion.

Stage 3: Study selection

The criteria were applied at every screening stage (title, abstract, full text) by two independent reviewers (KK, JA). In any case ambiguity occurred during the screening process, we retained the source of evidence for further examination. Our screening decisions were discussed at every stage and concluded prior to the commencement of the following stage. Study authors and game developers were contacted as necessary, to ensure that relevant study reports were obtained. Primarily, we were looking for gamified interventions intended for children ages from 6-12 years old. We decided not to exclude sources that also catered to children beyond the age criteria as long as the target users include those from 6-12 years old. Else, we will be missing on sources of evidence for this review’s particular population. We used Rayyan screening management tool[25] in our screening process.

Stage 4: Charting the data

Data were charted from the selected sources of evidence using an Excel spreadsheet designed for the purpose of this review (KK). The charting was cross-checked by two independent reviewers (KJ, AP) for consistency. We grouped the sources based on gamified interventions and extracted information on their general characteristics. To have a structured way of describing the identified gamified interventions, we (KK, FA) recorded information based on the Template for Intervention Description and Replication (TIDieR). Its primary use is to enhance the reporting of interventions and address challenges that can hinder the

replication, implementation, and synthesis of evidence.[26] We used the Schöbel & Janson's gamification taxonomy[27] to have a consistent approach in identifying the reported gamification mechanics applied in the intervention such as collection system (i.e. points, badges, and virtual goods), leaderboard, level, progress bar, feedback, representing avatar, tasks, narratives, reminder, and time pressure. The taxonomy provides explanations, meanings, and characteristics of game design elements that can guide a cohesive gamification process. Therefore, we can avoid the misrepresentation of overlapping terminologies used in different studies.

Stage 5: Collating, summarizing, and reporting the results

We collated the charted information and summarized our results with basic numerical analysis. The gamification taxonomy we used and adapted items from TIDieR guided our thematic construction in presenting narrative accounts of our findings. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)[28] guided our reporting procedure.

Results

Our search yielded a total of 2132 potential records. During the first search, there were 1420 records identified with which 504 records were removed after deduplication. After the updated search, we found 311 additional records with 85 duplicates. From our latest updated search, we found 401 additional records with 92 duplicates. Of the 1451 total records, 36 met our eligibility criteria and screened for full text. Six were excluded due to not being actual gamified interventions nor serious games, but rather incorporated mini-games. Five were for the wrong target group such as interventions intended for diagnosed children with underlying health conditions. Four records were not for promoting psychosocial well-being, and four were reviews. We depicted our evidence identification process using the PRISMA flow diagram[29] as shown in Figure 1.

(insert Figure 1)

We found a total of 23 records[30–52] of different studies of gamified interventions for promoting the psychosocial well-being of school-aged children (Table 1). The earliest was published in 2017 and the latest in 2023. The studies were conducted in 10 different countries. There were seven randomized controlled trials (RCT), with two studies employing waitlist control groups, four business-as-usual groups, and one with educational sessions by a school psychologist. There were 12 evaluation studies that did not use RCT design, three protocols,

and one descriptive qualitative study. There were 22 records published in peer-reviewed journals and one conference paper.

(insert Table 1)

Gamified interventions

We identified 12 gamified interventions aimed to promote the psychosocial well-being of children and presented their descriptions in Table 2. Eleven (91.6%) gamified interventions were designed to target the psychological and social well-being of children, while one (8.3%) was aimed to promote the overall psychosocial well-being of children together with increasing their physical activity levels. The age range of the target groups widely differed for each of the identified gamified interventions. In the context of school-aged children (6-12 years old), majority were catered for 11-year-olds (10/12, 83.3%), followed by those for 10- and 12-year-olds (9/12, 75%), 8- and 9-year-olds (6/12, 50%), 7-year-olds (3/12, 25%), and for 6-year-olds (2/12, 16.7%).

(insert Table 2)

Theoretical frameworks

Various theoretical frameworks on emotions, behaviors, social skills and mental health were applied in the game development to support the psychosocial outcomes of the interventions. Two gamified interventions (16.7%) were based on the assumptions of Social Emotional Learning and also two (16.7%) applied the Social Cognitive Theory. There was a substantial heterogeneity in the applied theoretical frameworks as with the characteristics of the gamified interventions, we therefore presented each separately in Table 3.

(insert Table 3)

Gamification mechanics

The narrative or the story of the game was the most applied gamification mechanic (11/12, 91.7%), followed by avatar or virtual characters and tasks (10/12, 83.3%), feedback system and level progression (9/12, 75%), points (7/12, 58.3%), badges (5/12, 41.7%), progress bar (4/12, 33.3%), and virtual goods, reminders and time pressure (2/12, 16.7%) to support the psychosocial outcomes of the interventions.

Intervention delivery

The delivery of the gamified interventions varied from school settings (8/12, 66.7%), non-school settings (2/12, 16.7%), psychologist's clinic (1/12, 8.3%), and flexible setting (1/12, 8.3%) with which users can play the game on their chosen time and place. Although

EmoTIC and Moving Stories are school-based programs, both gamified interventions had combinations of game tasks that needed to be completed at school and at home.[36,36,38–40] Moreover, Li et al. reported that in their recent evaluation study of the Adventures Aboard the S.S. GRIN, they delivered the intervention as part of the school's distance learning due to COVID-19 restrictions when all elementary schools were closed.[42]

The doses of interventions differedper gamification approach. Nine (75%) gamified interventions were delivered per session with which the maximum time was less than 60 minutes, while the least was 10 minutes. Two (16.7%) were played freely by target users with no time constraints or level progressions that can indicate the end of the game, while one (8.3%) was based on level progressions with short in-game challenges. The length of the overall gameplay ranges from a one-time session, one school week, one month, two months, three months to 6 months.

Intervention findings

Various study designs and instruments were used to measure the gamified interventions' outcomes. Children's self-reported instruments were used in nine (75%) gamified interventions, one (8.3%) used both self-reported and teacher-reported, while one (8.3%) used parent proxy-reported instruments. One (8.3%) gamified intervention explored the study outcomes through interviews of child participants. One (8.3%) also explored the perspectives of teachers to complement the instruments. We presented the intervention findings in the contexts of psychological and social levels.

Psychological level

Eleven (91.7%) gamified interventions showcased improvements in children's emotions towards self, related to their social functions. Three (25%) gamified interventions reported improvements in children's self-esteem after playing the game.[36,46,52] De la Barrera et al. further reported that their developed gamified intervention can also prevent the increase of children's emotional problems, although it was not clear in their findings if children's emotional intelligence improved.[36] One (8.3%) gamified intervention reported that children's cognitive and affective well-being improved but there were no statistically significant improvements in children's trait emotional intelligence.[30] There were improvements in children's emotion regulation in three (30%) gamified interventions.[42,45,47] Although according to Nicolaidou et al., there were only 7 out of 20 child participants who were able to identify or demonstrate the techniques learned from the gamified intervention.[47] One (8.3%) gamified intervention showcased moderate effects on improving children's emotional resilience in two

separate trials. In the first trial, children improved their emotional awareness (d = 0.64) and ability for emotion control (d = 0.69).[31] In the second trial, there was a decrease in children's emotional difficulties (d = 0.42), irrational beliefs (ABS d = 0.58, CASI d = 0.30), and negative thoughts (d = 0.41).[34] Statistically significant effect on children's emotions and attitudes towards empathy ($p < 0.01$) were observed in one (8.3%) gamified intervention but no effect was detected in their knowledge towards empathy.[50] Sotos-Martinez et al. observed increases in the values of children's autonomy ($Z = -5.306$; $p < 0.001$; ES = 0.336), competence ($Z = -7.145$; $p < 0.001$; ES = 0.452) and relatedness ($Z = -5.285$; $p < 0.001$; ES = 0.334).[51] Keinonen et al. did not observe effects on children's psychological flexibility nor in health-related quality of life. However, the gamified intervention was effective in alleviating self-rated loneliness.[41]

Improving mental health literacy and reducing children's stigma towards negative emotions such as depression were aimed in one (8.3%) gamified intervention.[38,40] However, Tuijnman et al. found no statistically significant differences in symptom recognition, first aid intentions, knowledge of first aid, first aid confidence, beliefs about help, and help-seeking intentions aside from short-term improvements in reducing depression stigma at 3-month follow-up ($p < 0.001$); but not at 6-month follow-up.[40]

Social level

Five (41.7%) gamified interventions addressed the children's social well-being. One (8.3%) showed statistically significant gains with good effect sizes between treatment and control groups in children's communication skills ($p = 0.005$, effect size = 0.39), social skills ($p = 0.033$, effect size = 0.29), and pro-social behavior ($p = 0.004$, effect size = 0.37).[42] One (10%) reported that based on the SDQ, the overall psychosocial problems of children declined at 6-month follow-up ($p = 0.005$), with great improvements in children's pro-social behavior score ($p = 0.003$) and hyperactivity/ inattention ($p = 0.002$).[52] In one (8.3%) gamified intervention, social awareness was addressed by letting the child participants virtually experience behavioral and peer relationship problems as well as hyperactivity through the game.[37] One (8.3%) showcased improvements in children's over-all empathic behavior ($p < 0.01$).[49] Increased motivation for cooperative attitude and teamwork were emphasized by children during post-intervention interview.[51] In one (8.3%) gamified intervention, there were no significant effects on children's social normative beliefs nor statistically significant differences with children's help-seeking behavior and intentions between groups on follow-ups.[40]

Discussion

The psychosocial distress of school-aged children increased exponentially at present times.[53,54] In the era of growing popularity of digital health interventions, we conducted the first scoping review providing an overview of the range and nature of evidence on gamified interventions for promoting the psychosocial well-being of school-aged children in the general population. The identified gamified interventions addressed various resources of children's psychosocial well-being. As psychosocial well-being is a complex construct that represents the psychological and social levels of human functioning,[10] there were varying outcomes. On a psychological level, emotions affecting the children's social behavior such as self-esteem, emotions towards self and others, as well as mental health literacy towards negative emotions were addressed. On a social level, children's communication skills, pro-social and empathic behaviors, hyperactivity/ inattention, and social awareness were the focus. There were three gamified interventions catered to all school-aged children ages 6-12 years old. The target groups were mostly pre-adolescents and fewer for younger children from ages 6-9 years old. It is worth noting that pre-adolescence is a critical stage when children develop long-term health behaviors as well as their inter- and intrapersonal skills.[55] This is also a stage when health-related interventions can achieve maximum effect.[56] However, as challenges to children's psychosocial well-being are becoming a global dilemma,[15] the need for promotive and preventive strategies for all school-aged children is adamant.

The theoretical frameworks applied in the gamified interventions varied widely to support the psychosocial outcomes. Common to these theories is shaping children's awareness on emotions towards self and others, which in turn help them develop pro-social skills. Narrative was not surprisingly the most commonly applied gamification mechanic (91.7%). As mentioned in earlier studies, it plays an important role in gamified interventions as it can set the context and flow of the intervention.[57] Narratives can provide more meaning to gamified interventions, they can help users understand the objectives and challenges of the game as well as instill knowledge.[58] All identified gamified interventions in this review used combinations of different gamification mechanics to support the psychosocial outcomes. This is consistent with previous studies that when certain gamification mechanics are combined, they can elevate user experience and foster engagement which can lead to maximum effectiveness.[58] For example, narrative with feedback to inform players of the efficacy of their game actions;[59] points, rewards system, and level progression to drive desire towards goal achievements, sense of empowerment[5], and as performance benchmark.[27] Gamification in health interventions

primarily enhances motivation and outcomes by engaging individuals actively in learning through practice, problem-solving, and reflection in a safe environment. It promotes retention and application of knowledge. In this paper, we did not seek to compare the efficiency of combining different gamification mechanics. Nevertheless, we would like to emphasize that it is crucial not to overlook the variety of game mechanics and their combinations for achieving diverse outcomes.[60] Although the delivery of a gamified intervention relies on its mechanics and objectives, we found that school setting was the most popular choice (66.7%). Based on the target groups we explored, this setting offered opportunities for sample saturation, school's role in fostering children's literacy, behavior, and development.[59,61] However, flexibility in implementation settings is essential, especially considering situations like the COVID-19 pandemic, where interventions may need to extend beyond classrooms. As in the case of Li et al., the gamified intervention was able to be delivered to children when school activities were either halted or shifted online.[42] Despite variations in gameplay frequency and duration, the identified studies showed promising effects in enhancing the psychosocial well-being of school-aged children. Yet, warranting further understanding of how the applied theories and gamification mechanics influence psychosocial outcomes. Gamification, with its playful and immersive nature, can enhance conventional interventions, such as school-based programs.[4,5] It is crucial to note that gamified interventions cannot fully substitute face-to-face interactions; thus, real interaction opportunities are indispensable.[62]

This scoping review included studies conducted in 10 countries which added cultural diversity and strengthened our undertaking. It is limited to studies published in English up to December 2023. Due to the heterogeneity of the characteristics of the identified evidence, we could not conduct a meta-analysis. There were no uniform psychosocial theories used in the intervention approaches. Future research and development on gamified interventions for promoting the psychosocial well-being of children still need to strengthen the theoretical framework of the intervention approach and its effectiveness in the general population.

Conclusion

Our findings indicated that gamification can be effective in promoting the non-physical aspect of health and well-being. However, gamified interventions for promoting the psychosocial well-being of school-aged children from the general population are still understudied. This paper provides relevant contribution to health and gamification literature, shedding light on the need to enrich evidence on using gamification for the promotion and risk prevention of children's psychosocial well-being.

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