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Gamified App-based Well-being Interventions for Children and Young People: A Systematic Literature Review

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Abstract

This study examines gamified app-based well-being interventions (GABWI) for children and adolescents. It aims to guide app developers and policymakers in designing human-led and peer-supporting well-being interventions at a comprehensive school. The study explores these interventions' features: goals; background theories; and gamification strategies. PRISMA systematic literature review guidelines were applied, and sixteen studies from 2017–2022 were analyzed.

The results underline that interactivity is essential for engaging children and adolescents in well-being apps, but offline connections in interventions are also necessary. Moreover, the study emphasizes the holistic approach including the combination of physical and mental aims in GABWI, and a strong theoretical background of interventions. The study showed that Self-determination Theory is prevalent in GABWI. However, Social Cognitive Theory may enhance tailored support, particularly for students with special needs. The study is situated in the context of Finland, considering the specific curriculum and health needs. Despite Finnish young people's high overall fitness level, about 40 percent of pupils have low physical capacity, and a third of girls and a fifth of boys at the end of comprehensive school perceive their health as average or poor.

Keywords: well-being, app-based intervention, children and adolescents, gamification

Introduction

This study examines gamified app-based well-being interventions (GABWI) for children and young people. The study provides guidance to app developers and policymakers who are designing human-led and peer-supporting interventions with the aid of an application for comprehensive school students. In this study, human-led means that artificial intelligence (AI) only supports the intervention's leaders, teachers, or coaches, or GABWI do not include AI. According to Dritsa (2024), there are remarkable challenges and risks when AI is connected with designing well-being, such as ensuring that AI-generated feedback is remarkable for individuals.

In particular, the paper explores the features of GABWI, including their goals, background theories, and motivation strategies. In this study, gamified app-based well-being intervention refers to a measure—a period that aims to influence the well-being of the target group using a certain gamified application. The literature review covers interventions with many kinds of target groups, from children with diabetes to adolescents with drug problems. The article supports the idea that these interventions are based mainly on the Self-determination Theory and Social Cognitive Theory. Nevertheless, the behavior change theory, nudging theory, and COM-B model also exist in GABWI. The searchers were made through LUC-FINNA international e-material, and sixteen articles were finally approved for analysis, applying PRISMA methods. The study focuses on gamified app-based interventions. Gamification, transferring motivating game elements to another context (Deterding, 2015), is a behavior change technique considered vital in health apps (Maturo & Moretti, 2018). Moreover, this research explores apps linked to goal-oriented academic interventions because well-being apps have rarely been evidence-based or created by academics (Thornton & Kay-Lambkin, 2018).

Well-being has been defined as a synonym for well-living (Helseth et al., 2014), and it is divided into the hedonic and eudaimonic aspects of well-being. Hedonistic well-being pursues life satisfaction with a positive mood (Diener et al., 2009). Eudaimonic well-being emphasizes the theoretical background of well-being, underlining elements of self-actualization (Ryff, 2017). The concept of "five ways to well-being" is a common way to promote health (Aked, 2008), including the following content: "Connection to others," "Activity," "Take notice," "Learning," and "Giving" (Tolks et al., 2019; Hone et al., 2015). This content is closely linked to the most common features among well-being apps, such as activity (collecting points by doing different acts), connection to others, taking notice, and giving (giving and receiving feedback and encouraging friends through social tools in the app), and learning (learning with info tool according to the aim of the app) (Thornton & Kay-Lambkin, 2018). Generally, wellness is more than a physical combination: It encompasses the integration of physical, mental, and spiritual health, energizing the body, stimulating the mind, and nourishing the soul (Stoewen, 2017). In this research, supporting holistic well-being means that well-being has been approached from at least two perspectives. Lane et al. (2011) were forerunners of holistic wellness app developers, emphasizing the significance of physical activity, diet, sleep, and social connections. For example, using applications in interventions has improved health literacy (Lin & Lou, 2020), meaning people can obtain information, resources, and services to sustain and enhance their health (Shape America, 2024), including physical or cognitive person-centered qualities which are essential in a physically active lifestyle (Carl et al., 2023). Moreover, GABWI have

significantly aided diabetes management (Liang et al., 2010). As Shabir et al. (2022) suggest, lifestyle apps can alleviate the healthcare burden.

This research is from the context of Finland, although the literature review includes papers worldwide. Finland is among the top five countries in Europe for 6–18-year-olds' aerobic fitness and physical strength (Ortega et al., 2023), yet around 40 percent of Finnish students' physical capacity is at a level that is potentially harmful to their health and well-being (Finnish National Agency for Education, 2023C). Finland aims to be the top developer and user of sustainable digitalization in education, teaching, and training in the world by 2027 (Publications of Ministry and Culture, 2023). In this vision, digital tools and environments not only support learners'' individual needs but also promote the equality and accessibility of education. The Finnish school curriculum encourages the use of well-being apps in teaching. The health education curriculum emphasizes interactions, communities, and digital environments, which support the use of interactive well-being applications in teaching (Finnish National Agency for Education, 2023A).

Finnish physical education (PE) promotes well-being, supporting physical, social, and mental fitness and body positivity. Well-being apps align with PE goals, supported by a curriculum emphasizing technology use and functional capacity in grades 7–9 (Finnish National Agency for Education, 2023B). The Move!—Monitoring System for Physical Functional Capacity (MSPFC) (Jaakkola et al., 2012) measures 5th and 8th grade pupils' physical capacity nationally in Finland. In the Move! System, physical functional capacity (PFC) is measured according to Rissanen (1999) as coping with a task that requires physical effort and its goals. Move! is a nationally remarkable tool in physical education that helps understand current situations of functional capacity at the individual, school, municipality, and national levels (Finnish Agency for Education, 2023D). In Finland, the Move! system is a natural context for developing GABWI to enhance children's and young people''s holistic well-being because it covers the whole age group at a time. A current government program also mentions the Move! system as a tool for increasing young people's physical activity (Finnish Olympic Committee, 2023).

The Research question

This systematic literature review examines the features of interventions made through gamified well-being and fitness applications, concentrating on children's and young people's holistic well-being and functional capacity. The gamified app-based well-being interventions from 2017 to 2022 were researched to address the following research question:

1. What are the main features of gamified app-based well-being interventions targeted at children and young people?

Theoretical background

The theoretical framework of this research is built on two well-known theories: Self-determination Theory (SDT) and Social Cognitive Theory (SCT). SDT explains movement motivation (Standage et al.,

2010), has been empirically tested for decades, and has received much support (Fortier et al., 2009). Moreover, SDT is behind the Motivation, Engagement, and Thriving in User Experience (METUX) model (Peters et al., 2018), which helps understand how technology can improve well-being by supporting basic psychological needs. According to SDT, to understand the human motivation to change health behavior, one must also understand being autonomous, competent, and related (Deci & Ryan, 2000). Applying the theory with SDT-supportive applications, users have active roles and possibilities for personal choices, working at their level, and user fellowship. In line with SCT, people learn from their experiences and by observing other people's reactions to them (Bezner & Held Bradford, 2020), and it is widely accepted as an explanation for behavior change (Clark & Janevic, 2014). SCT-based interventions commonly support users' self-efficacy, strengthening their belief in their ability to handle their duties and tasks, providing feedback, and offering safe and close areas for peer support and social interaction. Pupils can also view successful performance negatively at school if other pupils look down on it. SCT therefore gets support using digital well-being tools with shy and bullied pupils. In a well-being application, a pupil can choose with whom to share their well-being or physical activity and can do exercises alone. These two theories have been applied in this paper by searching for especially useful features of these theories in app-based interventions. Using the SDT and SCT aligns with previous research (Johnsson, 2016; Schunk & DiBenedetto, 2020) to build successful GABWI in the school context in the future.

Behavior Change Theory (BCT), Nudging Theory (NT), and the COM-B model are other theories linked to this research. BCT is based on multiple models explaining triggers causing behavior change. One of the most famous BCT models is the Theory of Planned Behavior (Ajzen, 1991), which includes three key factors. Those are attitudes toward behavior, others' expectations, and perceived behavioral control, which all determine behavior. NT is seen as a practical theory that causes changes in health behavior, especially in eating habits. For example, a nudge shows healthy eating options more visibly than unhealthy ones. Studies have shown that nudges can affect children's and adolescents' instant dietary behaviors such as eating more vegetables or smaller unhealthy portions (Lycett et al., 2017). The COM-B model states that three factors, capability(C), opportunity (O), and motivation (M), must occur to make any behavior change (B) possible. The model emphasizes that change is a dynamic process, and these factors constantly interact—the desired behavior happens when someone has the ability and opportunity to do it and is more motivated than others (West & Michie, 2020).

Behavior change techniques (BCT) are linked to how people commit to using well-being applications. In theory, more BCT leads to more effective interventions (Webb et al., 2010). In this research, the essential BCT is gamification, but strong visual design, goal-setting, self-monitoring, or action plans were also relevant BCTs, for example. Deterding et al. (2011) measured gamification as using game design elements in non-game contexts, but it can also be seen as improving services by incorporating motivational elements to create gameful experiences and further desired behavioral outcomes (Hamari et al., 2014; Huotari & Hamari, 2012). Gamified features can positively increase engagement (Looyestyn, 2017) because they offer similar psychological experiences to games (Huotari & Hamari, 2012). The most accurate game elements are rewards and feedback (Sardi et al., 2017). Johnsson et al. (2016) stated that the effects of gamification are primarily positive in health and well-being studies. Gamified features such as self-tracking have been transferred successfully

for many mobile-based well-being interventions such as the promotion of physical activity among young girls on weekends (Seah & Koh, 2020) or supporting active aging (Castro et al., 2020). Nevertheless, some studies report mixed or neutral effects (Johnsson, 2016). In the context of behavioral impacts, the positive effects of gamification are more evident. Gamification has been a convenient feature in applications where the target is increasing physical activity or engaging users to self-monitor themselves for different fitness levels. The fuel of gamification in playing is fulfilling the satisfaction needs or that players think it is fun (Deterding, 2015).

Engagement with using gamified applications is closely linked to motivation, which is divided into intrinsic and extrinsic motivation (Ryan & Deci, 2000). Developing intrinsic instead of extrinsic motivation is essential in health behavior change (Fortier et al., 2012). When humans are intrinsically motivated, the action itself engages them in participation more sustainably than extrinsic motivation. Extrinsic motivation always has external factors, such as rewards that motivate a person (Fortier et al., 2012). However, more study is required to clarify the effects of rewards or incentives on engagement (Rowland et al., 2020). Previous research has shown that competition and cooperation influence exercise performance, motivation, and enjoyment (Peng et al., 2013; Staiano et al., 2013). Competition and cooperation are essential for enjoying games and influencing players' choice of games (Vorderer et al., 2003), and affect physical activity and motivation (Marker & Staiano, 2015). Despite the positive effects of gamification, a few researchers have also highlighted its dark side. Andrade et al. (2016) noted that gamification implementation techniques were not yet well established, and this was the reason for creating a framework for gamification elements to avoid addiction, for example. According to Toda et al. (2018), a wrong game design can lead to performance loss and other harmful effects such as a lack of intrinsic motivation. An example of a destructive substance is leaderboards, which can have negative impacts (Toda et al., 2018). Moreover, app users can feel a lack of motivation if the learning environment is too competitive (Turan et al., 2016). Tailoring app-based intervention features to different user types is therefore essential.

METHOD

Search Strategy

The searches were conducted through the LUC-Finna international e-material search, which covers the following databases: Academic Search Elite (Ebsco); Multidisciplinary SPORTDiscus (Ebsco); ERIC—Education Collection (ProQuest); ACM Digital Library; APA PsycArticles (Ebsco); Emerald Journals; JJSTOR I & IV; OUP Journals; SAGE Journals; ScienceDirect (Elsevier); SpringerLink Journals; Taylor & Francis Online; and Wiley Online Library. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines, widely used in evaluating interventions' effects (Page et al., 2021), were applied in this research.

The data provide a comprehensive picture of the features of GABWI, including aims, theoretical framework, and strategies to support participants' motivations to engage in intervention. The procedure is presented in Figure 1. The primary criteria for choosing the studies were that they should be peer-reviewed journal articles with a full text, be in English, and published between 2017

and 2022. They should also research gamified mobile interventions with behavior change techniques, concentrating on functional capacity, fitness, well-being, or mental health. At least in theory, they could target children or young people in a school context, or they could be combined with Finland's health information curriculum (Finnish National Agency for Education, 2023A). For example, a drug prevention GABWI was approved because substance abuse problems usually develop between the ages of 14 and 15 in Finland (Finnish Institute for Health and Welfare, 2023A). According to the SCT, GABWI targeted at students with drug problems could support individual learning, and according to the curriculum, the student's development as an acquirer and user of information related to health and illness and to promote the ability to act appropriately in situations related to health, safety, and illness (Finnish National Agency for Education, 2023A). In contrast, the author did not see a point of contact with the school and omitted GABWI, which aims to improve pre-exposure prophylaxis adherence among young men having sex with men in Bangkok (Songtaweesin et al., 2021). The final search used the following search string:

(gamification OR "gamified learning") AND (adolescents OR teenagers OR "young people" OR pupils) AND (applications OR apps OR digit*) AND (mobile* OR smartphone*) AND (well-being OR wellbeing OR wellness OR "holistic well-being") AND ("intrinsic motivation") AND (intervention*) AND (theory OR theor*) AND (mental OR functional OR physical) AND ("behavior change") AND (school* OR classroom OR "physical education") AND (tailored OR "user-centered") (1.1.2023).

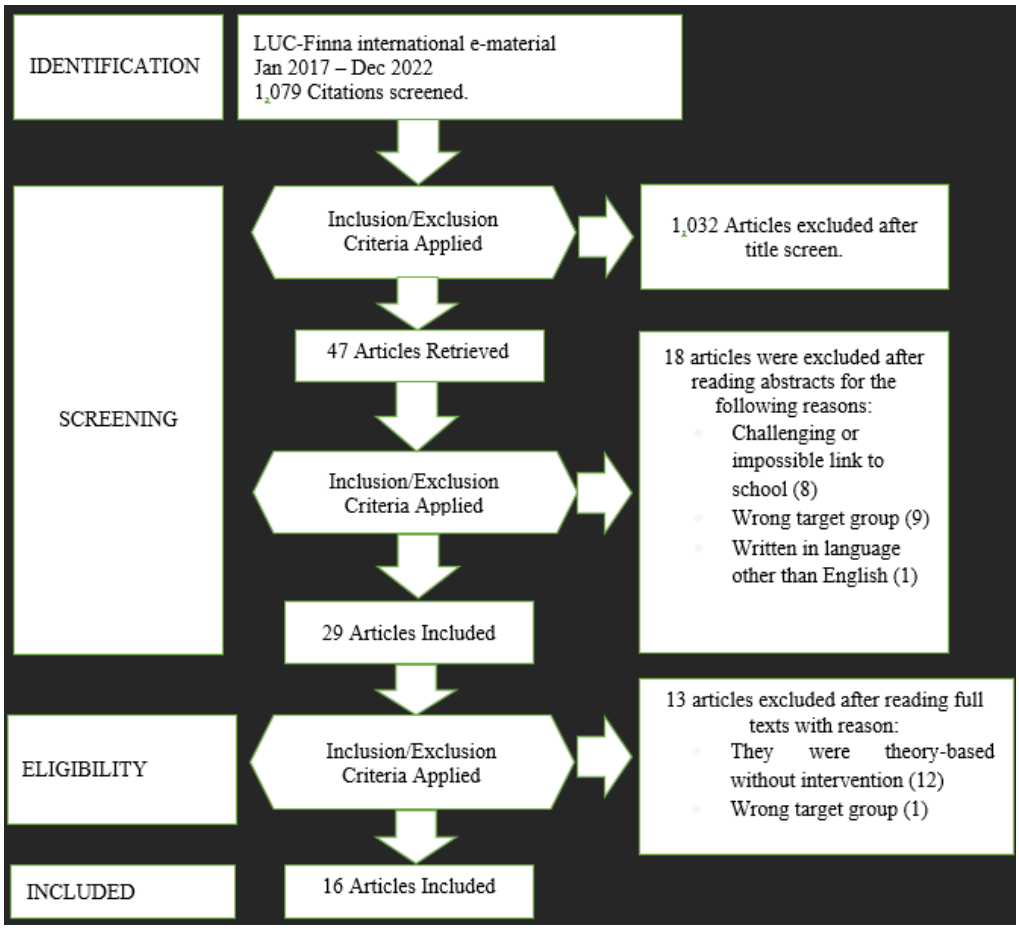

Figure 1:
Searching process

Study Selection: Inclusion and exclusion criteria

The author decided on the inclusion and exclusion criteria during the review process. The author worked independently, and to assess the risk of bias, each article was read and screened without using automated tools.

Table 1

Inclusion and exclusion criteria

Inclusion	Exclusion
The aim was possible to link with school circumstances	The aim was impossible to link with school circumstances
Includes gamified app-based intervention (or option to participate via mobile phone)	Does not include app-based intervention with gamified features. Participation by mobile phone is impossible
The target group was children, adolescents, young adults, or children and parents together	The target group was unclear or older than young adults
The full article was written in English	The article was written in a language other than English

Search Results

According to the criteria in Table 1, eighteen articles were excluded based on the abstract for the following reasons: The substance of the study could be more challenging or impossible to link to school circumstances (8); the target group was other than school-age children, adolescents, or young adults (9); the article was written in another language (1).

After reading full texts, twelve theory-based articles and one with the wrong target group were excluded. Sixteen empirical studies were approved for synthesis.

Data synthesis and analysis

This study's author designed coding schemes to extract data from 16 articles. The data were screened and classified in the analysis, applying PRISMA guidelines (Page et al., 2021). -The classifications of GABWI's features developed during the research process and were formed in accordance with the research question. The coding includes a theoretical background of GABWI sharing the theories on primary and secondary theories (Figure 3). Primary theory exists when the supportive theory is openly mentioned. Secondary theory means in this coding that the research has some features of another theory, even though it is not said. The method was chosen because the aim was to determine which theories the interventions supported, including latently. The research also clarifies the aims of GABWI (Figure 2). The gamified features of GABWI were analyzed using thematic analysis and were divided into four classes: sociality; motivation; knowledge and skills; and user experience (Figure 4).

RESULTS

This study examines GABWI's features by approaching them from goals, background theories, and gamification perspectives. This research proves (Figure 2) that most GABWI aim to develop the applications. The aims of the sixteen interventions in this literature review have been classified into fourteen groups. The most common aim was application development (for example, Kapitány-Fövény et al., 2018; Kim et al., 2021; Rohde et al., 2019). Other popular aims were promoting participants' mental health (Povey et al., 2022; Tark et al., 2019; McCallum et al., 2022, whose research on cognitive therapy and mindfulness can also be seen as supporting mental health), reducing obesity (Mâsse et al., 2020; Rohde et al., 2019; Martin et al., 2020), promoting a healthy lifestyle (Puigdomench et al., 2019; Rohde et al, 2019; Martin et al., 2020), and promoting physical activity (Van Dyck et al., 2019; Mâsse et al., 2020; Brons et al., 2022).

Other aims were supporting young diabetes patients (Klaassen et al., 2018; Holtz et al., 2017), asthma management (Brons et al., 2022; Kim et al., 2021), drug prevention (Kapitány-Fövény et al., 2018), the self-management of daytime urinary incontinence (Whale et al., 2021), analyzing digital tools or social media in interventions (Van Dyck et al., 2019), identifying barriers to and enablers of engagement (Gorny et al., 2022), and promoting social participation (Brons et al., 2022).

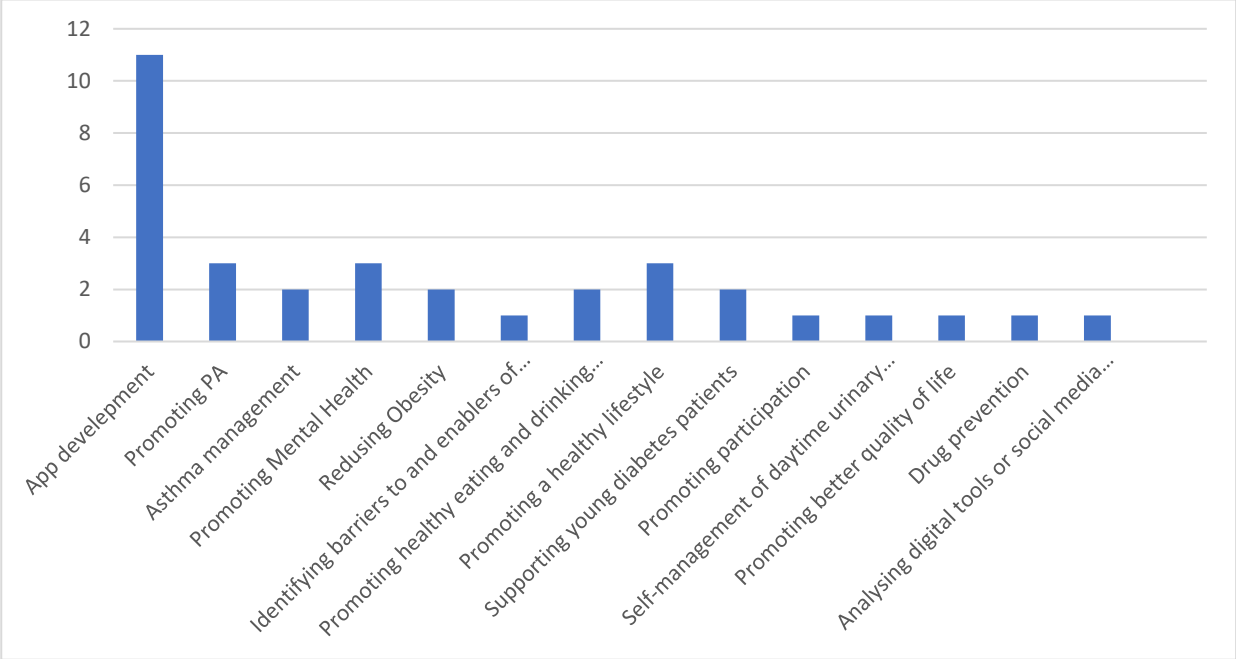

Figure 2:

Aims of gamified app-based well-being interventions

The findings indicate that a holistic approach is quite rare in the application market because only three application platforms used in research papers, Aim2Be, PEGASO F2F, and PERGAMON, seem to be based on a holistic approach. Mâsse et al. (2020) aim to test the efficacy of the gamified application Aim2Be to improve the weight outcomes and lifestyle behaviors by increasing physical activity and improving the dietary quality among 10–17-year-old overweight children. Puigdomench et al. (2019) and Martin et al. (2020) tested the PEGASO F4F (Fit for Future) platform in three

European countries to improve adolescents' health behavior through smartphone technology. The approach is based on an iterative co-design process. Klaassen et al. (2018) can be said to have holistic features because in its PERGAMON framework, users can add physical activity to a multi-thematic goal of the day among diet and therapy management.

It should be noted that some of the interventions in this study targeted children and parents, and these studies aimed to reduce obesity (Mâsse et al., 2020) and support young diabetes patients (Holtz et al., 2017). As Mâsse et al. (2020) point out, in-person family-based interventions can be expensive and may not reach all those who could benefit from them. App-based interventions could therefore offer alternatives to in-person family-based interventions. Nevertheless, more research is needed to evaluate the results of such interventions.

The analysis interpreted the theoretical framework as a primary or secondary theory. Figure 3 shows that the well-being app-based interventions in this literature review mainly supported the following theories: Self-determination Theory (SDT), Social Cognitive Theory (SCT), Behavior Change Theory (BCT), Nudging Theory, and the Capability, Opportunity, Motivation, Behavior (COM-B) Model. Some studies supported more than one theory, and other studies' theoretical framework was unclear.

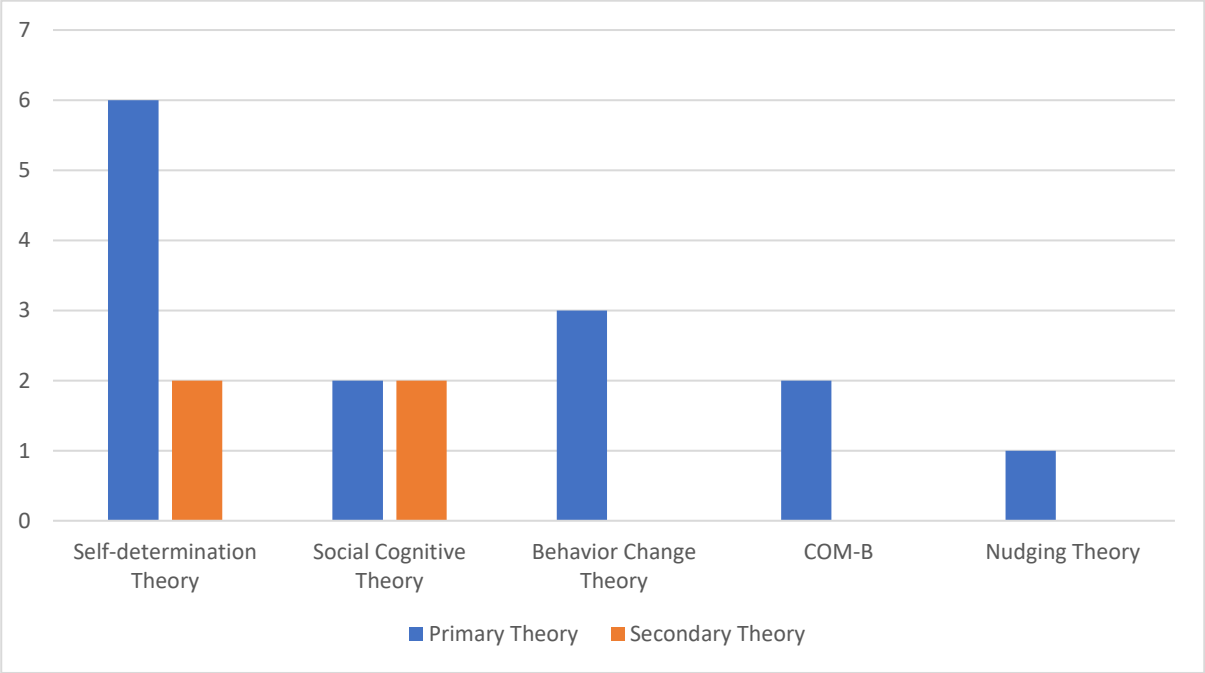

Figure 3:

Theoretical frameworks supported by gamified app-based well-being interventions.

Self-determination Theory includes ideas of being autonomous, competent, and related to one's fellows. SDT was a primary theory in six studies (Johnson et al., 2022; Martin et al., 2020; Tark et al., 2019; Klaassen et al., 2018), including two papers (Mâsse et al., 2020; Tark et al., 2019), in which the Player Experience and Satisfaction Model (PESM) and the Need Satisfaction Model

(NSM) were leader approaches (PESM and NSM are applied in SDT). As a secondary theory, SDT existed in two studies:

> Furthermore, adolescents stressed the importance of having autonomy (e.g., to determine their personal activity goals, to self-monitor their behaviour) and of being active together with friends. (Van Dyck et al., 2019, 654).

> One of the key features of this app was to show parents that their children have tested their blood glucose, but not to show the number immediately. This is designed to increase trust, self-efficacy, and autonomy to help the transition process. (Holtz et al., 2017, 6).

Three studies (Mâsse et al., 2020; Rohde et al., 2019; Puigdomench et al., 2019) directly supported Behavior Change Theory. Social Cognitive Theory (SCT) was two studies' (Brons et al., 2022; Mâsse et al., 2020) primary and two studies' (Whale et al., 2021; Johnson et al., 2022) secondary theory. The results of these studies showed that the theory has high potential and applies to different aims and circumstances. Brons et al. (2022), who promote physical activity and social participation among children with asthma, support the results of previous studies of SCT: children with physical disabilities feel left out of the group. According to SCT, they measure themselves by reacting to peers' feedback, and children should therefore also have the opportunity to be physically active alone.

> Integration in everyday life is therefore important from 2 perspectives. On the one hand, we have to prevent that using the intervention creates a special situation as this might reinforce children's feeling of being different and excluded. On the other hand, PA is often intertwined with social life. By focusing on PA in everyday life situations instead of sports specifically, children might experience better social participation…However, participating children should not see PA behavior of other children to prevent them from comparing themselves with each other (Brons et al., 2022,6).

The features of SCT also came up in an SDT-based study (Johnson et al., 2022) targeted at children with disabilities. In designing the gamification, parents pointed out that a digital pet was better than an animated child avatar because children with disabilities might have self-concept issues. The reason was that the children might not fully identify with an avatar of a child who looked too well, or avatars with visual signs of disability might not satisfy children with mild disabilities. It seems that children must measure themselves through their parents' eyes. Behavior Change Theory emerged because part of the term "BEHAVIOR CHANGE" was included in the research sentence. Nudging Theory was one of the theories behind Martin et al.'s (2020) intervention in reducing adolescent obesity.

This literature review shows that the need for user-centrism is widely evident in applications, from interfaces to features and tutorials. Social features, clear targets, and competence must also be developed so that users will engage in using apps. Personal coaching delivers feedback and asset goal-setting, both recognized as success factors in behavior change (Brons et al., 2022). Feedback can be seen as an essential feature of GABWI because every intervention in this literature review

included feedback elements. Gamified features in well-being app-based interventions can be classified in four main aims (Figure 4). *Sociality* includes the idea of interactivity with participants and a trainer, for example. Competitions, roleplay, and so on can also have social aspects. Rewards, points and levels, and other marks of progression support *motivation*, including features personifying user experience. *Knowledge and skills* include features such as feedback, information, and tools supporting self-tracking and goalsetting. *A user experience* class's features make using the app easier and more enjoyable, customizing onboarding or making the interface more familiar, for example. Some features can be classified for multiple aims, such as interactivity with friends which can support sociality, motivation, knowledge, and skills. All these aims support a user-centered approach.

Personalization, a key element in gamified pediatric interventions, empowers patients by allowing them to choose game modules that resonate with them. The ability of young users to customize the app and make it their own is not just a feature but a tool for psychological support (Whale et al., 2021). Tark et al. (2019) pointed out that participants benefited from using components they liked, indicating that psychological support for GABWI should be personalized. Moreover, it seems that clear graphics of the activity and encouraging feedback are an effective combination in GABWI (Brons et al., 2022). The app should offer systematic monitoring. Early detection of psychological challenges such as treatment intensity and health changes can positively impact psychological well-being. There are also differences between genders: Boys suffer more from a lack of motivation and attitudes than girls, so they probably need more support to gain health outcomes (Tark et al., 2019). Nevertheless, among coaching features, self-monitoring was an essential enabler of engagement (Gorny et al., 2022).

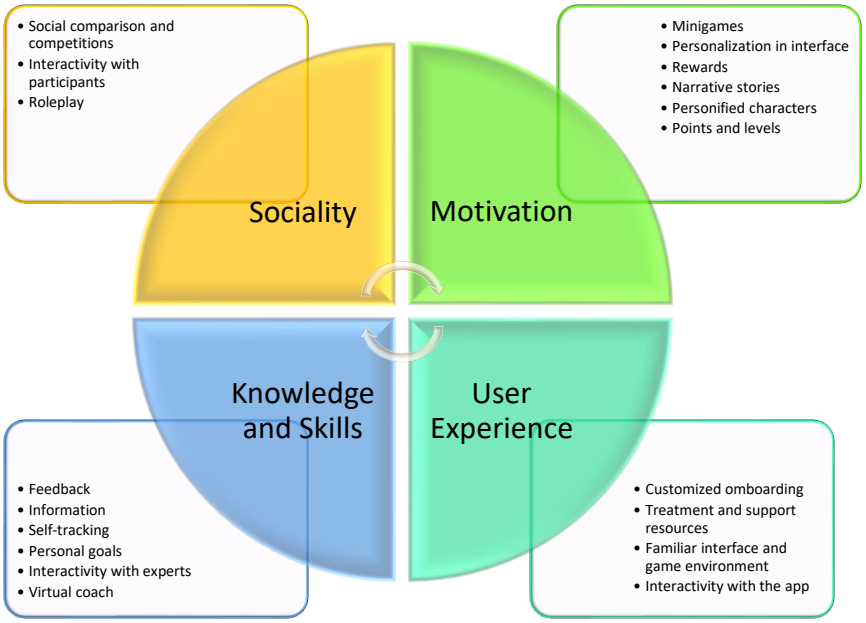

Figure 4:

Classification of gamified features by aims.

In-person meetings were also important in mobile intervention. As Brons et al. (2022) stated, interventions should include blended technology, combining in-person interaction with digital

technology and optimizing digital technologies with personal coaching functions. The importance of blended technology is also shown in online work. In the Facebook-based intervention (Van Dyck et al., 2019), users considered it essential that there were only participants with whom they also had offline connections. Virtual coach features should include encouragement, rewards, reminders, guidance, and game elements. Similarity and social roles are expressed in the game when the participant tries to relate to the main character and uses the same character as the virtual coach (Klaassen et al., 2018).

In the application design process, tailoring to the individual user and their social and intellectual capabilities was necessary (Klaassen et al., 2018). Components such as goal-setting, planning, and education should be adaptive and personal, supporting children to adapt to specific situations (Brons et al., 2022). For example, in an intervention for people with type-1 diabetes, the users desired to customize the app to allow them to add their favorite foods, restaurants, messages, glucose ranges, and nutritional information (Holtz et al., 2017). Based on the findings, personalization should cover a wide range of aspects of the app when aiming for long-term health behavior changes. Personalization should shield technical support (Gorny et al., 2022). The instructions and content should be age-appropriate, and researchers must test and assess the language's suitability with the likely user (Martin et al., 2020). Significantly, health applications targeted at young people should permit the personalization of the app interface (Whale et al., 2021). One study considered two critical aspects of the user-centered design in a child-friendly approach: First, there must be a balance between brevity and expressivity; second, the longitudinal effects of gamification needed more research (Kim et al., 2021).

Rewards are essential to keep users engaged in gamified mobile intervention and motivate them to the required behavior (Holtz et al., 2017). Tangible rewards boost positive feelings, especially in the PA context (Brons et al., 2022), and the reward system must be self-explanatory and appealing (Martin et al., 2020). In UrApp, aiming to reduce daytime urinary incontinence, young users found the stars and trophies encouraged them to use the app and kept them motivated (Whale et al., 2021). Nevertheless, virtual points should lead to tangible benefits as in the MyT1DHero, a self-management mobile app for young people with diabetes (Holtz et al., 2017). That study stated that engaging narrative connected to gamified and sociality-supporting features was compelling. Users earned points in teams, and with the points, users could acquire "powers" or tools to defend their villages and farms, for example. Holtz et al. (2017) emphasized the role of social interaction—joining a team was a key reason for using the MyT1DHero app.

Holtz et al. (2017) asserted that interactivity results in motivation, and young people wanted to interact meaningfully with the app and other users, respecting being a team member. However, individual targets were also essential, and users liked collecting points to get virtual accessories for their avatars, such as clothing, sunglasses, tools, or powers. Virtual points therefore increased their social competence in the app, offering opportunities for self-expression or lifting their position as valuable warriors. MyT1DHero app users suggested that earned points could be used as money in Apple iStore, Google Marketplace, or Amazon. In addition, Gorny et al. (2022) argued that health-promoting financial incentive supported extrinsic motivation among adolescents. The idea has been

criticized: It is suspected that there is no lasting effect on behavior change. Nevertheless, it has been shown that once the circle of behavior change has started, the targeted behavior such as increased PA will continue even after the reward is finished.

Social features are necessary for effective gamified intervention, especially when the study follows Self-determination Theory. Interactivity is the second important reason for using applications after fun (Holtz et al., 2017). The obesity-related study emphasized that connectivity with peers in competitive activities through technology positively impacted motivation (Martin et al., 2020). Traditionally, intrinsic motivation is considered stronger than extrinsic motivation from a behavior change perspective. However, physical activity-orientated intervention with children with asthma by Brons et al. (2022) proposed that an extrinsically motivated application user could experience positive emotions, joy, and competence, which were factors in becoming intrinsically motivated and were valuable for improving well-being.

Discussion

This literature review offered new information to help us understand the field of gamified app-based well-being interventions. This research underpins the holistic approach and strong theoretical background of interventions for application developers and policymakers considering organizing such interventions in schools. It also emphasizes that parents play an essential role in children's and adolescents' well-being. According to this study, the most common aim of gamified well-being app-based interventions was developing the app, although those studies also offered tools for different challenges. The result may suggest that app-based well-being interventions represent a young science sector. These studies reach relatively narrow aims and target groups—the literature included only three holistic application platforms in the intervention (PERGAMON, PEGASO F4F, and Aim2Be). However, holistic applications are needed (Lane et al., 2011; Mâsse et al., 2020). It seems that the leading position of SDT is problematic from a holistic perspective. Mental and physical goals together are scarce in well-being interventions. This paper therefore states that clarifying the relationship between mental health, well-being, and physical capacity is essential. Two interventions in this literature review targeted children and parents (Brons et al., 2022; Holtz et al., 2017). We must also consider how relevant it is to affect pupils' functional capacity through interventions without targeting support at parents, who do all that they can for their children's well-being.

The study shows that Self-determination Theory is a leading theory in gamified mobile well-being interventions, which supports previous research. The critical aspects of SDT, competence, relatedness, and autonomy were shown in how studies supported users' motivation and engagement through a user-centered approach and personalized features. Social Cognitive Theory is also suitable for gamified mobile intervention at school by helping pupils with special needs to be physically active (Brons et al., 2022; Whale et al., 2021). Holtz et al. (2017) clarified the critical motivations for using health-tracking applications: Customization, interactivity, and tangible rewards were essential to developing a motivating app. The most motivating factor in gamified mobile interventions is the user's active role in the design process and in using the app. Gamification in successful well-being applications includes participation ideas—the user can

choose the level of information and activity or pick up suitable avatars, costumes, or personal interfaces. Along with autonomy, interactivity is an essential feature of well-being applications. However, this study highlights the value of the hybrid model in interventions—in-person interactions with a trainer or fellows reinforce the virtual interactivity and make the intervention more effective, especially if users know the trainer from offline situations. These real-life connections encourage users to share information and cooperate on a digital platform (Brons et al., 2022; Van Dyck et al., 2019).

This literature review offers perspectives on the relationship between intrinsic and extrinsic motivation, and in gamified well-being app-based interventions, the intrinsic and extrinsic motivations are in the interplay. The findings support the assumption that extrinsic motivation may also sustain a mobile intervention's long-term effects by increasing joy and competence, which result in long-lasting behavior change (Brons et al., 2022). However, determining the potential long-term effects of incentives on sustainability in behavior change needs more research. Tangible rewards can be something other than economic support, as the following example shows. First, the user can choose tailored rewards for the avatar, which simultaneously offers an opportunity for self-expression, like getting accessories from a pet shop (Johnsson et al., 2022) or customizing the avatar with clothes (Mâsse et al., 2020). Engaging with the avatar can also involve role-play, allowing users to bring out their playful side and creative imagination (Sun et al., 2023). Second, the user can use the rewards to support their virtual community. For example, they can defend the community from external attackers, providing meaningful experiences.

Implications for future research

Designing the application with a narrow target group makes it relatively easy to notice user-centrism such as the critical elements of SDT, autonomy, relatedness, and competence. With holistic applications, app designers must consider users' needs. When building interventions that support holistic well-being, the critical question is: How can I support different aspects of the user and build a structural but adaptive application in the future? The answer may be AI, which helps the teacher or intervention coach to support numerous students simultaneously. Thus far, AI-based feedback must be checked (Dritsa et al., 2024). Moreover, there is a need for further research on the long-term effects of incentives on behavior change. Indeed, the reward types must be varied as a young user gets older.

Lin et al. (2018) offered other perspectives on behavior change. The study, which researched the effectiveness of mobile cognitive therapy for smoking cessation, stated that eliciting strong inspiration did not support the app user as effectively as perceived psychological empowerment and enhanced hedonic well-being. MyT1DHero app users suggested that earned points could be used as money in Apple iStore, Google Marketplace, or Amazon. In addition, Gorny et al. (2022) argued that health-promoting financial incentives supported extrinsic motivation among adolescents. The idea has been criticized and it is suspected that there is no lasting effect on behavior change. According to Gorny et al. (2022), it has been shown that once the circle of behavior change has started, the targeted behavior such as increased PA will continue even after the reward is finished. Given the worldwide cost of low PA for citizens, the mentioned perspective

addresses the need for new research to investigate whether children and adolescents with low PA should be offered more tangible incentives to start a physically active lifestyle.

Visions such as Policies for the digitalization of education and training until 2027 (Ministry of Education and Culture, 2023) and national annual reports like the Move! measurement results (Finnish National Agency of Education, 2023C) and School health promotion studies (Finnish Institute for Health and Welfare, 2023B) provide a framework for future research in GABWI in the context of health and physical education in Finland. GABWI offer opportunities to study, share information, and develop tools to support young people's holistic well-being nationally. At the individual level, those apps give pupils opportunities to learn, have fun with a social network, and coach privately in new ways but in connection with their teachers and fellows.

Limitations

The literature was read, and the data were analyzed carefully, but researcher triangulation could have made this study stronger (Abdalla et al., 2018; Cornelissen & Kaandorp, 2022). This literature review offers a narrow picture of gamified mobile interventions. The search string limited results for interventions that included user-centered and person-based features, and a broader research perspective could have provided more essential interventions. However, in line with the previous literature (Peters et al., 2017; Yardley et al., 2015), the author considered the user-centered and person-based elements necessary in app development. The research period, after Covid-19, was exceptional from the perspective of app development because the coronavirus strongly increased the use of well-being and fitness applications (Alexopoulos et al., 2020; Mutz et al., 2021; Wang et al., 2023), and the use of AI in well-being applications has increased powerfully in recent years (García-Madurga et al., 2024). The limited search period after or before Covid-19 might have made the data more coherent.

Moreover, the requirements for the platform may have affected coherence. This study included only mobile interventions, but it does not speculate on the interventions' platforms or the use of AI. Some interventions did not have their own application, and they used Facebook as a platform, for example. One limitation of this study is that it includes only the literature in English.

References

Abdalla, M. M., Oliveira, L. G. L., Azevedo, C. E. F., & Conzalez, R. K. (2018). Quality in qualitative organizational research: Types of triangulation as a methodological alternative. *Administração: Ensino E Pesquisa*, *19*(1), 66–98. https://doi.org/10.13058/raep.2018.v19n1.578

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Aked, J., Marks, N., Cordon, C., & Thompson, S. (2008). Five ways to well-being: A report presented to the Foresight Project on communicating the evidence base for improving people's well-

being. *Centre for Well-being, NEF*. https://neweconomics.org/uploads/files/five-ways-to-wellbeing-1.pdf

Alexopoulos, A.R., Hudson, J.G., & Otenigbagbe, O. (2020). The use of digital applications and COVID-19. *Community Mental Health Journal,* 56, 1202–1203. https://doi.org/10.1007/s10597-020-00689-2

Andrade, F. R. H., Mizoguchi, R., & Isotani, S. (2016). The bright and dark sides of gamification. In A. Micarelli, J. Stamper, & K. Panourgia (Eds.), *Intelligent Tutoring Systems. ITS 2016* (pp. 176-186). Springer. https://doi.org/10.1007/978-3-319-39583-8_17

Bezner, J. R. & Held Bratford, E. C. (2020). Integrating health promotion and wellness into neurorehabilitation. In R. T. Lazaro, S. G. Reina-Guerra, & M. U. Quiben (Eds.), *Social Cognitive Theory: Umphrey's Neurological Rehabilitation* (7th ed., p. 943). Elsevier.

Brons, A., Braam, K., Broekema, A., Timmerman, A., Millenaar, K., Engelbert, R., Kröse, B., & Visser, B. (2022). Translating promoting factors and behavior change principles into a blended and technology-supported intervention to stimulate physical activity in children with asthma (Foxfit): design study. *JMIR formative research*, *6*(7), e34121. https://doi.org/10.2196/34121

Carl, J., Bryant, A. S., Edwards, L. C., Bartle, G., Birch, J. E., Christodoulides, E., Emeljanovas, A., Fröberg, A., Gandrieau, J., Gilic, B., van Hilvoorde, I., Holler, P., Iconomescu, T. M., Jaunig, J., Laudanska-Krzeminska, I., Lundvall, S., De Martelaer, K., Martins, J., Mieziene, B. (…) Elsborg, P. (2023). Physical literacy in Europe: The current state of implementation in research, practice, and policy. *Journal of Exercise Science & Fitness*, 21(1), 165–176. https://doi.org/10.1016/j.jesf.2022.12.003.

Castro, P. C., Romano, L. B., Frohlich, D., Lorenzi, L. J., Campos, L. B., Paixão, A., Bet, P., Deutekom, M., Krose, B., & Dourado, V. Z. (2020). Tailoring digital apps to support active ageing in a low income community. PLOS ONE, 15(12), e0242192. https://doi.org/10.1371/journal.pone.0242192

Clark, N. M. & Janevic, M. R. (2014). Individual theories. In K. A. Riekert, J. K. Ockene, & L. Pbert (Eds.), *The Handbook of Behavior Change* (4th ed., pp. 4–7). Springer.

Cornelissen, J. & Kaandorp, M. (2022). Towards stronger causal claims in management research: Causal triangulation instead of causal identification. *Journal of Management Studies*, 60(4). https://doi.org/10.1111/joms.12897

Deci, E. L. & Ryan, R. M. (2000). *The "What" and "Why" of goal pursuits: Human needs and the self-determination of behavior. Psychological Inquiry*, 11(4), 227–268. https://selfdeterminationtheory.org/SDT/documents/2000_DeciRyan_PIWhatWhy.pdf

Deterding, S., Khaled, R., Nacke, L. E., & Dixon, D. (2011, May 7–12). Gamification: Toward a definition. In *CHI 2011 Gamification Workshop Proceedings,* 12, 1–79. Vancouver, BC,

Canada. http://gamification-research.org/wp-content/uploads/2011/04/02-Deterding-Khaled-Nacke-Dixon.pdf

Deterding, S. (2015*).* The lens of intrinsic skill atoms: A method for gameful design. *Human-Computer Interaction*, 30(3–4), 294–335. https://doi.org/10.1080/07370024.2014.993471

Diener, E., Lucas, R. E., Scollon, C.N. (2009). Beyond the hedonic treadmill: Revising the adaptation theory of well-being. In E. Diener (Ed.) *The science of well-being. Social Indicators Research Series, 37.* Springer. https://doi.org/10.1007/978-90-481-2350-6_5

Dritsa, D., van Renswouw, L., Colombo, S., Väänänen, K., Bogers, S., Martinez, A., Holbrook, J., & Brombacher, A. (2024). Designing (with) AI for wellbeing. In *Extended abstracts of the 2024 CHI Conference on Human Factors in Computing Systems* (CHI EA '24) (Article 465, 1–7). Association for Computing Machinery. https://doi.org/10.1145/3613905.3636282

Finnish Institute for Health and Welfare (2023A). *Nuorten päihteiden käyttö ja käytöshäiriöt [Substance use and behavioural disorders among young people]*. https://thl.fi/fi/web/mielenterveys/mielenterveyshairiot/nuorten-mielenterveyshairiot/nuorten-paihteiden-kaytto-ja-kaytoshairiot

Finnish Institute for Health and Welfare (2023B). *Well-being of children and young people: School Health Promotion Study 2023.* https://thl.fi/en/web/thlfi-en/statistics-and-data/statistics-by-topic/social-services-children-adolescents-and-families/well-being-of-children-and-young-people-school-health-promotion-study

Finnish National Agency for Education (2023A). *Perusopetuksen opetussuunnitelman perusteet 2014: Terveystieto. [Finnish National Core Curriculum for Basic Education 2014: Health Education].* https://eperusteet.opintopolku.fi/#/fi/perusopetus/419550/oppiaineet/478973

Finnish National Agency for Education (2023B). *Perusopetuksen opetussuunnitelman perusteet 2014: Liikunta. [Finnish National Core Curriculum for Basic Education 2014: Physical Education].* https://eperusteet.opintopolku.fi/#/fi/perusopetus/419550/oppiaineet/530525

Finnish National Agency for Education (2023C). *Lasten ja Nuorten fyysisen toimintakyvyn lasku on tasaantunut. [The decline in physical activity among children and young people has leveled off].* https://www.oph.fi/fi/uutiset/2023/lasten-ja-nuorten-fyysisen-toimintakyvyn-lasku-tasaantunut

Finnish National Agency for Education (2023D). *Move! Monitoring system for physical functional capacity*. https://www.oph.fi/en/education-and-qualifications/move-monitoring-system-physical-functional-capacity

Finnish Olympic Committee (2023). *Move!-mittausten tulokset 2023: Lasten ja nuorten fyysisen toimintakyvyn lasku on tasaantunut [The results of the Move! measurements 2023: The decline in children's and young people's physical activity capacity has leveled off]*

https://www.olympiakomitea.fi/ajankohtaista/uutiset/move-mittausten-tulokset-2023-lasten-ja-nuorten-fyysisen-toimintakyvyn-lasku-on-tasaantunut/

Fortier, M. S., Williams, G. C., Sweet, S. N., & Patrick, H. (2009). Self-determination theory: Process models for health behavior change. In R. J. DiClemente, R. A. Crosby, & C. Kegler (Eds.), *Emerging theories in health promotion practice and research: Strategies for improving public health* (2nd ed, pp. 157–183). John Wiley & Sons.

Fortier, M. S., Duda, J. L., Guerin, E., & Teixeira, P. J. (2012). Promoting physical activity: development and testing of self-determination theory-based interventions. *International Journal of Behavioral Nutrition and Physical Activity, 9*(20). https://doi.org/10.1186/1479-5868-9-20

García-Madurga, M., Gil-Lacruz, A., Saz-Gil, I., & Gil-Lacruz, M. (2024). The role of artificial intelligence in improving workplace well-being: A systematic review. *Businesses,* 4(3), 389–410. https://doi.org/10.3390/businesses4030024

Gorny, A. W., Chee, W. C. D., & Müller-Riemenschneider, F. (2022). Active use and engagement in an mHealth initiative among young men with obesity: Mixed methods study. *JMIR formative research, 6(1)*, e33798. https://doi.org/10.2196/33798

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. 47th Hawaii International Conference on System Sciences, 3025–3034. Waikoloa, HI, USA, 2014. https://doi.org/10.1109/hicss.2014.377

Helseth, S. & Haraldstad, K. (2014). *Child Well-Being*. In: Michalos, A.C. (Eds.) *Encyclopedia of Quality of Life and Well-Being Research.* Springer, Dordrecht. https://doi.org/10.1007/978-94-007-0753-5_339

Holtz, B.E., Murray, K.M., Hershey, D.D., Dunneback, J.K., Cotton, S.R., Holmstrom, A.J., Vyas, A., Kaiser, M.K., & Wood, M.A. (2017). Developing a *Patient-Centered mHealth App: A Tool for Adolescents With Type 1 Diabetes and Their Parents. JMIR Mhealth Uhealth.* 2017 Apr 19, Volume 5, Issue 4:e53. https://pubmed.ncbi.nlm.nih.gov/28428167

Hone, L.C., Jarden, A., Duncan, S., & Schofield, G.M. (2015). Flourishing in New Zealand workers: Associations with lifestyle behaviors, physical health, psychosocial, and work-related indicators. *J. Occup. Environ. Med.* 2015, Volume 57, 973–983. https://pubmed.ncbi.nlm.nih.gov/26340286

Huotari, K. & Hamari, J. (2012). *Defining Gamification: A Service Marketing Perspective*. ACM J. https://doi.org/10.1145/2393132.2393137 https://www.researchgate.net/publication/259841647_Defining_Gamification_-_A_Service_Marketing_Perspective

Jaakkola, T., Sääkslahti, A., Liukkonen, J., & Iivonen, S. (2012). *Peruskoululaisten fyysisen suorituskyvyn seurantajärjestelmä*. *[Physical performance monitoring system for primary*

school pupils]. University of Jyväskylä. Faculty of Sport and Health Science. https://docplayer.fi/9114785-Peruskoululaisten-fyysisen-toimintakyvyn-seurantajarjestelma.html

Johnson, D. Deterding, S., Kuhn, K.-A. Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: A systematic review of the literature. *Internet Interv. 2016 Nov 2*, Volume 6:89–106. https://pubmed.ncbi.nlm.nih.gov/30135818

Kapitány-Fövény, M., Vagdalt, E., Ruttkay, Z., Urbán, R., Richman, M.J., & Demetrovics, Z. (2018). Potential of an Interactive Drug Prevention Mobile Phone App (Once Upon a High): Questionnaire Study Among Students. *JMIR Serious Games*. 2018 Dec 4, Volume 6, Issue 4:e19. https://pubmed.ncbi.nlm.nih.gov/30514697

Kim, S., Park, Y., & Ackerman, M.K. (2021). Designing an Indoor Air Quality Monitoring App for Asthma Management in Children: User-Centered Design Approach. *JMIR Form Res.* 2021 Sep 22, Volume 5, Issue 9:e27447. https://pubmed.ncbi.nlm.nih.gov/34550080

Klaassen, R., Bul, K.C.M., Op den Akker, R., van der Burg, G.J., Kato, P.M., & Di Bitonto, P. (2018). Design and Evaluation of a Pervasive Coaching and Gamification Platform for Young Diabetes Patients. *Sensors (Basel).* 2018 Jan 30, Volume 18, Issue 2:402. https://pubmed.ncbi.nlm.nih.gov/29385750

Lane, N.-D., Mohammod, M., Lin, M. Yang, X., Lu, H., Ali, S., Doryab, A., Berge, E., Choudhury, T., & Campbell, A.T. (2011). BeWell: A Smartphone Application to Monitor, Model and Promote Wellbeing. Proceedings of the 5th International ICST Conference on Pervasive Computing Technologies for Healthcare. https://www.researchgate.net/publication/267847444_BeWell_A_Smartphone_Application_to_Monitor_Model_and_Promote_Wellbeing

Liang, X., Wang, Q., Yang, X., Cao J., Chen, J., Mo, X., Huang, J., Wang, L., & Gu, D. (2010). Effect of mobile phone intervention for diabetes on glycaemic control: A meta-analysis. *Diabetic Medicine*. https://doi.org/10.1111/j.1464-5491.2010.03180.x

Lin, Y. & Lou, M. (2020). Effects of mHealth-based interventions on health literacy and related factors: A systematic review. *Journal of Nursing Mangagement*. 2020, Volume 29, 385–394. https://doi.org/10.1111/jonm.13175

Lin, Y., Tudor-Sfetea, C., Siddiqui, S., Sherwani, Y., Ahmed, M., & Eisingerich, A.B. (2018). *Effective Behavioral Changes through a Digital mHealth App: Exploring the Impact of Hedonic Well-Being, Psychological Empowerment and Inspiration*. JMIR Mhealth Uhealth 2018; Volume 6, Issue 6:e10024. https://mhealth.jmir.org/2018/6/e10024

Looyestyn, J. Kernot, J., Boshoff, K., Ryan, J. Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PLOS One.* https://doi.org/10.1371/journal.pone.0173403

Lycett, K., Miller, A., Knox, A., Dunn, S., Kerr, J.A., Sung, V., & Wake, M (2017). ´Nudge´ interventions for improving children´s dietary behaviors in the home: A systematic review. *Obesity Medicine,* Volume 7, 2017, pp. 21–33, ISSN 2451-8476, https://doi.org/10.1016/j.obmed.2017.06.001.

Marker, A.-M. & Staiano, A.-E. (2015). Better Together: Outcomes of Cooperation Versus Competition in Social Exergaming. *Games Health J*. 2015 Feb, Volume 4, Issue 1:25–30. https://doi.org/10.1089/g4h.2014.0066

Martin, A., Caon, M., Adorni, F., Andreoni, G., Ascolese, A., Atkinson, S., Bul, K., Carrion, C., Castell, C., Ciociola, V., Condon, L., Espallargues, M., Hanley, J., Jesuthasan, N., Lafortuna, C.L., Lang, A., Prinelli, F., Puidomenech, E., Puig, E., Tabozzi, S.A., & McKinstry, B. (2020). A Mobile Phone Intervention to Improve Obesity-Related Health Behaviors of Adolescents Across Europe: Iterative Co-Design and Feasibility Study. *JMIR Mhealth Uhealth.* 2020 Mar 2, Volume 8, Issue 3:e14118. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7076410

Mâsse, L.C., Vlaar, J., Macdonald, J., Bradbury, J., Warshawski, T., Buckler, E.J., Hamilton, J., Ho, J., Buchholz, A., Morrison, K.M., & Ball, G.D.C. (2020) Aim2Be mHealth intervention for children with overweight and obesity: study protocol for a randomized controlled trial. Trials. 2020 Feb 3, Volume 21, Issue 1:132. https://pubmed.ncbi.nlm.nih.gov/32014057

McCallum, M., Ho, A.S., Mitchell, E.S., May, C.N., Behr, H., Ritschel, L., Mochrie, K., & Michaelides, A. (2022). Feasibility, Acceptability, and Preliminary Outcomes of a Cognitive Behavioral Therapy-Based Mobile Mental Well-being Program (Noom Mood): Single-Arm Prospective Cohort Study. JMIR Form Res. 2022 Apr 15, Volume 6, Issue 4:e36794. https://pubmed.ncbi.nlm.nih.gov/35436218

Maturo, A.F. & Moretti, V. (2018). *Digital Health and Gamification of Life: How Apps Promote a Positive Medicalization*. University of Bologna.10–12, 17–18, 25. ISBN:978-1-78754-365-2. https://www.researchgate.net/publication/328030322_Digital_Health_and_the_Gamification_of_Life_How_Apps_Can_Promote_a_Positive_Medicalization

Ministry of Education and Culture (2023). *Policies of Digitalisation and Training until 2027. Publications of Ministry of Education and Culture: 2023:48*. https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/165248/OKM_2023_48.pdf?sequence=1&isAllowed=y

Mutz, M., Müller, J., & Reimers, A.-K. (2021). Use of Digital Media for Home-Based Sports Activities during the COVID-19 Pandemic: Results from the German SPOVID Survey. *International Journal of Environmental Research and Public Health*, Volume 18, Issue 9: 4409. https://doi.org/10.3390/ijerph18094409

Ortega, F.B., Leskošek, B., & Blagus, R. (2023). The FitBack, HELENA and IDEFICS consortia, et al., 2023. European fitness landscape for children and adolescents: updated reference values, fitness maps and country rankings based on nearly 8 million test results from 34 countries

gathered by the FitBack network. *British Journal of Sports Medicine* 2023, Volume 57, 299–310. https://bjsm.bmj.com/content/57/5/299.info

Page, M.J., McKenzie, J.E., Bossuyt, P., Boutron, I., Hoffman, T.C., Mulrow, C.D., Shamseer, L., & Moher, D. (2021). The PRISMA 2020. Statement: An updated guideline for reporting systematic reviews. *Systematic Reviews* Volume 10, Article number 89. https://doi.org/10.1136/bmj.n71

Peng W, Crouse JC, & Lin J-H. (2013). Using Active Video Games for Physical Activity Promotion: A Systematic Review of the Current State of Research. *Health Education & Behavior.* 2013, Volume 40, Issue 2:171–192. 10.1177/1090198112444956

Peters, D., Calvo, R.A., & Ryan R.M. (2018). Designing for Motivation, Engagement and Wellbeing in Digital Experience. *Frontiers in Psychology* 2018, Volume 9. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2018.00797

Peters, D., Davis, S., Calvo, R.A., Sawyer, S.M., Smith, L., & Foster, J.M. (2017). Young People's Preferences for an Asthma Self-Management App Highlight Psychological Needs: A Participatory Study. Journal of Medical Internet Research 2017, Volume 19, Issue 4:e113. https://doi.org/10.2196/jmir.6994

Povey, J., Sweet, M., Nagel, T., Lowell, A., Shand, F., Vigona, J., & Dingwall, K.M. (2022). Determining Priorities in the Aboriginal and Islander Mental Health Initiative for Youth App Second Phase Participatory Design Project: Qualitative Study and Narrative Literature Review. *JMIR Formative Research,* 2022 Feb 18, Volume 6, Issue 2:e28342. https://doi.org/10.2196/28342

Puigdomenech, E., Martin, A., Lang, A., Adorni, F., Gomes, S. F., McKinstry, B. Prinelli, F., Condon, L., Rashid, R., Caon, M., Atkinson, S., Lafortuna, C. L., Ciociola, V., Hanley J., McCloughan, L., Castell, C., & Espallargues, M. (2019). Promoting healthy teenage behaviour across three European countries through the use of a novel smartphone technology platform, PEGASO fit for future: study protocol of a quasi-experimental, controlled, multi-Centre trial. *BMC Medical Informatics and Decision Making,* Volume 19, 278 (2019). https://doi.org/10.1186/s12911-019-0958-x

Rohde, A., Duensing, A., Dawczynski, C., Godemann, J., Lorkowski, S., & Brombach, C. (2019). An App to Improve Eating Habits of Adolescents and Young Adults (Challenge to Go): Systematic Development of a Theory-Based and Target Group-Adapted Mobile App Intervention. *JMIR Mhealth and Uhealth.* 2019 Aug 12, Volume 7, Issue 8:e11575. https://doi.org/10.2196/11575

Ryan, R.M. & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, Volume 25, 54–67 (2000) https://doi.org/10.1006/ceps.1999.1020

Ryff, C.D. (2017). Eudaimonic well-being, inequality, and health: Recent findings and future directions. *International Review of Economics*, Volume 64, Issue 2:159–178. https://doi.org/10.1007/s12232-017-0277-4

Rissanen, L. (1999). *Vanhenevien ihmisten kotona selviytyminen*. *[Coping with ageing at home].* University of Oulu. http://jultika.oulu.fi/files/isbn9514254414.pdf

Rowland, S.P., Fitzgerald, J.E., Holme, T., Powell, J., & McGregor, A. (2020). What is the clinical value of mHealth for patients? *NPJ Digital Medicine 2020 3*(4). https://doi.org/10.1038/s41746-019-0206-x

Sardi, L., Idri, A. & Fernández-Alemán, J.L. (2017). A systematic review of gamification in e-Health. *Journal of Biomedical Informatics*, Volume 71, pp. 31–48. ISSN 1532-0464, https://doi.org/10.1016/j.jbi.2017.05.011

Seah, M.L.C. & Koh, K.T. (2020). The efficacy of using mobile applications in changing adolescent girls' physical activity behaviour during weekends. *Eurepean Physical Education Review.* 2020, Volume 27, 113–131. https://doi.org/10.1177/1356336X20930741

Shabir, H., D'Costa, M., Mohiaddin, Z., Moti, Z., Rashid, H., Sadowska, D., Alam, B., & Cox, B. (2022). The barriers and facilitators to the use of lifestyle apps: A systematic review of qualitative studies. *European Journal of Investigation in Health, Psychology and Education,* 2022,Volume *12*, Issue 2:144–165. https://doi.org/10.3390/ejihpe12020012

Shape America—Society of Health and Physical Educators (2024). *Literacy in PE + HE.* *https://www.shapeamerica.org/MemberPortal/events/healthandphysicalliteracy.aspx*

Schunk, D.H. & DiBenedetto, M.K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, Volume 60, 101832. https://doi.org/10.1016/j.cedpsych.2019.101832

Songtaweesin, W.P., LeGrand, S., Bandara S., Piccone, C., Wongharn, P., Moonwong, J., Jupimai T., Saisaengjan, C., Theerawit, T., Muessig, K., Hightow-Weidman, L., Puthanakit, T., Phanuphak, N., & Tangmunkongvorakul, A. (2021). Adaptation of a Theory-Based Social Networking and Gamified App-Based Intervention to Improve Pre-Exposure Prophylaxis Adherence Among Young Men Who Have Sex With Men in Bangkok, Thailand: Qualitative Study. *Journal of Medical Internet Research*, Volume 23, Issue 11:e23852. https://doi.org/10.2196/23852

Staiano, A.-E., Abraham, A. A., & Calvert, S. L. (2013). Adolescent exergame play for weight loss and psychosocial improvement: a controlled physical activity intervention. *Obesity (Silver Spring, Md.)*, Volume 21, Issue 3:598–601. https://doi.org/10.1002/oby.20282

Standage, M., Duda, J.L., & Ntoumanis, N. (2010). A test of self-determination theory in school physical education. *British Journal of Educational Psychology* (2005), Volume 75, 411–433. https://doi.org/10.1348/000709904X22359

Stoewen D. L. (2017). Dimensions of wellness: Change your habits, change your life.*The Canadian Veterinary Journal = La revue veterinaire canadienne*, Volume 58, Issue 8:861–862. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5508938/

Sun, L., Kangas, M., & Ruokamo, H. (2023). Game-based features in intelligent game-based learning environments: A systematic literature review. *Interactive Learning Environments.* *https://doi.org/10.1080/10494820.2023.2179638*

Tark, R., Metelitsa, M., Akkermann, K., Saks, K., Mikkel, S., & Haljas, K. (2019). Usability, Acceptability, Feasibility, and Effectiveness of a Gamified Mobile Health Intervention (Triumf) for Pediatric Patients: Qualitative Study. *JMIR Serious Games.* 2019 Sep 30 Volume 7, Issue 3:e13776. https://doi.org/10.2196/13776

Thornton, L.-K. & Kay-Lambkin, F.-J. (2018). Specific features of current and emerging mobile health apps: user views among people with and without mental health problems. *mHealth*, Volume 4, Issue 56. https://doi.org/10.21037/mhealth.2018.11.04

Toda, A.-M., Valle, P. H. D., & Isotani, S. (2018). *The Dark Side of Gamification: An Overview of Negative Effects of gamification in Education*. https://doi.org/10.1007/978-3-319-97934-2_9

Tolks, D., Sailer, M., Dadaczynski, K., Lampert, C., Huberty, J., Paulus, P., & Horstman, D. (2019). ONYA—The Wellbeing Game: How to Use Gamification to Promote Wellbeing. *Information* 2019, Volume 10, Issue 2:58; https://doi.org/10.3390/info10020058

Turan, Z., Avinç, Z., Kara, K., & Goktas, Y. (2016). Gamification and Education: Achievements, Cognitive Loads, and Views of Students. *International Journal of Emerging Technologies in Learning 11*(7) *(iJET).* https://doi.org/10.3991/ijet.v11i07.5455

Van Dyck, D., D´Haese, S., Plaete, J., De Bourdeaudhuij, I., Deforche, B., & Cardon, G. (2019) Opinions towards physical activity interventions using Facebook or text messaging: Focus group interviews with vocational school-aged adolescents. *Health Soc Care Community*. 2019 May, Volume 27, Issue 3:654–664. https://doi.org/10.1111/hsc.12679

Vorderer, P., Hartmann, T., & Klimmt, C. (2003). *Explaining the enjoyment of playing video games: The role of competition.* Proceedings of the Second International Conference on Entertainment Computing. https://www.researchgate.net/publication/220851167_Explaining_the_enjoyment_of_playing_video_games_The_role_of_competition

Wang, X., Markert, C., & Sasangohar, F. (2023). Investigating Popular Mental Health Mobile Application Downloads and Activity During the COVID-19 Pandemic. *Human Factors,* Volume 65, Issue 1:50–61. https://doi.org/10.1177/0018720821998110

Webb, T., Joseph, J., Yardley, L. & Michie, S. (2010). Using the Internet to Promote Health Behavior Change: A Systematic Review and Meta-analysis of the Impact of Theoretical Basis, Use of

Behavior Change Techniques, and Mode of Delivery on Efficacy. *Journal of Medical Internet Research,* 2010, Volume 12, Issue 1:e4. https://doi.org/10.2196/jmir.1376

West, R. & Michie, S. (2020). A brief introduction to the COM-B Model of behavior and the PRIME Theory of motivation. Qeios, CC-BY 4.0 Article, April 7, 2020. https://discovery.ucl.ac.uk/id/eprint/10095640/1/WW04E6.pdfW

Whale, K., Beasant, L., Wright, A.J., Yardley, L., Wallace, L.M., Moody, L., & Joinson, C.A (2021). Smartphone App for Supporting the Self-management of Daytime Urinary Incontinence in Adolescents: Development and Formative Evaluation Study of URApp. *JMIR Pediatrics and Parenting.* 2021 Nov 15, Volume 4, Issue 4:e26212. https://doi.org/10.2196/26212

Yardley, L., Morrison, L., Bradbury, K., & Muller, I. (2015). The person-based approach to intervention development: application to digital health-related behavior change interventions. *Journal of Medical Internet Research.* 2015 Jan 30, Volume 17, Issue 1:e30. https://doi.org/10.2196/jmir.4055

Appendix A

List of Articles

Study no.	Author details	Year	Title	Publication title
1	Johnson, White, Gucciardi, Gibson, and Williams	2022	Intervention Mapping of a Gamified Therapy: Prescription App for Children with Disabilities: User-Centered Design Approach	JMIR Pediatrics and Parenting. 9;5(3):e34588. https://pubmed.ncbi.nlm.nih.gov/35943782/
2	Brons, Braam, Broekema, Timmerman, Millenaar, Engelbert, Kröse, and Visser	2022	Translating Promoting Factors and Behavior Change Principles into a Blended and Technology-Supported Intervention to Stimulate Physical Activity in Children with Asthma (Foxfit): Design Study	JMIR Formative Research, 6(7), e34121. https://doi.org/10.2196/34121
3	Whale, Beasant, Wright, Yardley, Wallace, Louise, Moody, and Joinson	2021	A Smartphone App for Supporting the Self-management of Daytime Urinary Incontinence in Adolescents: Development and Formative Evaluation Study of URApp	JMIR Pediatrics and Parenting, 4(4), e26212. https://doi.org/10.2196/26212
4	Kim, Park, and Ackerman	2021	Designing an Indoor Air Quality Monitoring App for Asthma Management in Children: User-	JMIR Formative Research, 5(9), e27447. https://doi.org/10.2196/27447

Study no.	Author details	Year	Title	Publication title
			Centered Design Approach	
5	Povey, Sweet, Nagel, Lowell, Shand and Vigona, and Dingwall	2022	Determining Priorities in the Aboriginal and Islander Mental Health Initiative for Youth App Second Phase Participatory Design Project: Qualitative Study and Narrative Literature Review	JMIR Formative Research, 6(2), e28342. https://doi.org/10.2196/28342
6	McCallum, Ho, Mitchell, May, Behr, Ritchel, Mochrie, and Michaelides	2022	Feasibility, Acceptability, and Preliminary Outcomes of a Cognitive Behavioral Therapy-Based Mobile Mental Wellbeing Program: Single-Arm Prospective Cohort Study	JMIR Formative Research, 6(4), e36794. https://doi.org/10.2196/36794
7	Gorny, Chee, and Müller-Riemenschneider	2022	Active Use and Engagement in an mHealth Initiative Among Young Men With Obesity: Mixed Methods Study	JMIR Formative Research, 6(1), e33798. https://doi.org/10.2196/33798
8	Martin, Caon, Adorni, Andreoni, Ascolese, Atkinson, Bul, Carrion, Castell, Ciociola, Condon, Espallargues, Hanley,	2020	A Mobile Phone Intervention to Improve Obesity-Related Health Behaviors of Adolescents Across Europe: Iterative Co-Design and Feasibility Study	JMIR mHealth and uHealth, 8(3), e14118. https://doi.org/10.2196/14118

Study no.	Author details	Year	Title	Publication title
	Jesuthasan, Lafortuna, Lang, Prinelli, Puidomenech, Tabozzi, and McKinstry			
9	Mâsse, Vlaar, Macdonald, Bradbury, Warshawski, Buckler, Hamilton, Ho, Buchholz, Morrison, and Ball	2020	Aim2Be mHealth intervention for children with overweight and obesity: Study protocol for a randomized controlled trial	Trials 21, 132 (2020). https://doi.org/10.1186/s13063-020-4080-2
10	Rohde, Duensing, Dawczynski, Godemann, Lorkowski, and Brombach	2019	An App to Improve Eating Habits of Adolescents and Young Adults (Challenge to Go): Systematic Development of a Theory-Based and Target Group Adapted Mobile App Intervention	JMIR mHealth and uHealth, 7(8), e11575. https://doi.org/10.2196/11575
11	Puidomenech, Martin, Lang, Adorni, Gomez, McKinstry, Prinelli, Condon, Rashid, Caon, Atkinson, Lafortuna, Ciociola, Hanley, McCloughan, Castell, and	2019	Promoting healthy teenage behaviour across three European countries through the use of a nove smartphone technology platform, PEGASO fit for future: Sstudy protocol of a quasi-experimental, controlled multi-	BMC Medical Informatics and Decision Making, 19(1), 278. https://doi.org/10.1186/s12911-019-0958-x

Study no.	Author details	Year	Title	Publication title
	Espallargues		Centre trial	
12	Tark, Metelitsa, Akkermann, Saks, Mikkel, and Haljas	2019	Usability, Acceptability, Feasibility and Effectiveness of a Gamified Mobile Health Intervention (Triumf) for pediatric Patients: Qualitative Study	JMIR Serious Games, 7(3), e13776. https://doi.org/10.2196/13776
13	Van Dyck, D'Haese, Plaete, De Bourdeaudhuij, Deforche, and Cardon	2019	Opinions towards physical activity interventions using Facebook or text messaging: Focus group interviews with vocational school-aged adolescents	Health and Social Care in the community, 27(3), 654–664. https://doi.org/10.1111/hsc.12679
14	Kapitány-Fövény, Vagdalt, Ruttkay, Urbán, Richman, and Demetrovics	2018	Potential of an Interactive Drug Prevention Mobile Phone App (Once Upon a High): Questionnaire Study Among Students	JMIR Serious Games, 6(4), e19. https://doi.org/10.2196/games.9944
15	Klaassen, Bul, op den Akker, van der Burg, Kato, and Di Bitonto	2018	Design and Evaluation of a Pervasive Coaching and Gamification Platform for Young Diabetes Patients	Sensors, 18(2), 402. https://www.mdpi.com/1424-8220/18/2/402
16	Holtz, Murray, Hershey, Dunneback, Cotten, Holmstrom, Vyas, Kaiser, and	2017	Developing a Patient-Centered mHealth App: A Tool for Adolescents With Type 1 Diabetes and Their Parents	JMIR mHealth and uHealth, 5(4), e53. https://doi.org/10.2196/mhealth.6654

Study no.	Author details	Year	Title	Publication title
	Wood			