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Children's conceptions of mental well-being and ideas for its promotion through digital environments

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Children's conceptions of mental well-being and ideas for its promotion through digital environments

Abstract: The aim of this study is to further understanding of children's conceptions of mental well-being and their ideas for its digital promotion. The study is based on the need to provide children an opportunity to actively participate and share their understanding of mental well-being promotion with others in light of their understanding of what online environments and their design can afford for this promotion. The study was implemented as three subsequent workshops in primary school classrooms comprising four teachers and 79 children aged 9-11 years old. In the first two workshops, children reflected on mental well-being, digital environments they utilise and their possible connections to mental well-being. In the final workshop, children designed interaction designs and concepts for digital well-being promotion. Children broadly structured mental well-being through five main categories: individual factors, social interaction, healthy living, hobbies and creativity, and the absence of mental health problems. Children considered the effects of digital environments as factors that either promote or reduce mental well-being. The use of digital environments and various individual factors were experienced as contributing most to mental well-being. Whereas, children attributed the content of digital environments mainly as diminishing mental well-being. The children's designs for digital environments raised similar issues to their reflections on the effects of the digital environments. These could be contrasted with design dimensions proposed by earlier research. In addition, the design sessions led children to highlight new factors, reinforcing the importance of children's participatory interaction design. Children wanted to design environments that were safe in content and function and that did not include cyber-bullying. This study presents a combination of hands-on design research techniques through co-design and conceptual probing with children. It contributes an understanding of how children conceptualise and unite understandings of mental well-being to interaction design.

Keywords: mental health, mental well-being, child computer interaction, design, digital environments

1. Introduction

The enhancement of mental health is essential from an early age onwards, as it is the basis of children's positive growth, learning and integration into society [1]. Regarding children, the creation and development of positive mental health promotion activities are of utmost importance, as this period can set the foundation of cognitive and behavioral patterns for the rest of their lives [2]. It is important to promote children's mental health in all their meaningful everyday environments. In addition to formal health and social care services, schools and homes play an important role in the promotion of positive mental health [3]. Regardless of socio-economic circumstances, children are for the most part raised with the latest information and communication technology (ICT), making ICT an organic part of their everyday lives [4]. Thus, ICT environments can be viewed as potential channels for supporting the development of children's mental health [3,5-6].

In the child and computer interaction (CCI) community, computer use in health and special needs has been studied from a variety of perspectives. According to Hourcade's [7] review, the perspectives vary from promotion of healthy lifestyles through indoor and outdoor physical

activities as well as healthy habits to focus on diverse health conditions and to research on technologies aiding children with special needs. Especially autism spectrum disorder has gained wide interest in the CCI field [7,8,9]. A recent co-word analysis mapped it as one of the popular and growing topics in the field [10]. In Hourcade's [7] review, the promotion of mental health is situated as one type of special education need, alongside behavioral impairments. The existing CCI studies relating to health mental health interaction design seem to focus on the development of diverse technology-enhanced therapies and interventions [11-13].

In our study, the focus is on the promotion of positive mental health, and more precisely that of mental well-being of all children through computer interaction. This focus area is still scarcely studied in the CCI community [14]. Høiseth and Van Mechelen [15] conducted a review of children's well-being connected to issues concerning obesity. In the review, well-being and health promotion was one inclusion criteria. Well-being was defined according to WHO as, "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" [16]. In total, there were rather low numbers of papers dealing with the inclusion criteria (physical activity, well-being, healthy lifestyle, obesity and nutrition). Of these papers, most focus on promoting children's physical activity, and none of the papers deal with mental well-being. However, as Høiseth and Van Mechelen [15] emphasize, overall well-being consists of interlinked physical, mental and social issues, and thus, physical activity is also connected to mental well-being. A co-word analysis by Giannakos and associates [10] up until year 2018 did not result in research papers focusing on children's mental well-being, either.

In this study, our aim is to further understanding of children's conceptions of mental well-being and explore the ideas they harbor in terms of its promotion in relation to diverse digital environments, e.g., digital games, websites or social media. The study aims to construct child-driven information for interaction designers regarding the features of digital environments that may contribute to the promotion of children's mental well-being. The study was implemented in three subsequent workshops at Finnish primary schools. The workshops focused on the theme of health literacy in the context of mental well-being and digital mental well-being interaction design.

2 Related research

2.1 Conceptualising mental health and mental well-being

Mental health has traditionally been conceptualised through the terms mental health, mental well-being, mental illness and mental disorders. In the World Health Organisation's (WHO) [3, p. 6] action plan, for the years 2013-2020, mental health is defined as "a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community". Regarding children's mental health, WHO [3] emphasises developmental aspects, such as a positive sense of identity, the ability to manage thoughts, social relationships and an aptitude for learning.

Keyes [17] notes that mental well-being and mental health disorders are related concepts, but they are two separate dimensions of mental health. Thus, mental well-being can be promoted regardless of co-occurring mental health disorders [17]. Huppert [18] emphasises that the promotion of mental well-being provides the opportunity to increase well-being outcomes at the population level. Regarding adolescent populations, there are indications that mental health promotion is more effective than mental illness prevention [19,20]. In a study of adolescent girls' well-being, girls viewed positive mental health as an integral part of overall well-being [21]. However, girls seemed to think that having good mental health means having a comfortable state of mind without mental illness.

There are several categorisations of the factors and dimensions of mental health. This article considers factors from three main sources: 1) Mental Health Finland's mental health hand; 2) Aked and Thompson's five factor model; and 3) Lehtinen's four categories of mental health. In their school information packs, Mental Health Finland [22] – the leading mental health association in Finland – has modelled six factors of mental health in the shape of a 'mental health hand'. They include relationships and emotions, exercise and shared movement, hobbies and creativity, values and daily choices, sleep and resting and finally, nutrition and eating. Aked and Thompson's [23] five ways to well-being are to connect (social relationships), be active (physical activity), take notice (be aware), learn, and give (participation in social and community life, helping others). Lehtinen [24] divides factors related to mental health into four categories, these include: individual factors (e.g. emotions, identity); social interaction (e.g. family, school); community structures and resources (e.g. educational resources); and cultural values (e.g. rules, stigma). Similarly, in this study, we have utilized these conceptual factors of mental well-being within our own understanding and approach to examining children's relationships to digital mental well-being as a construct. Here we adopt the term 'mental well-being' as a synonym for positive mental health in the implementation of design study with children. The conceptualisation further reinforces understandings according to the current national Finnish primary school curriculum [25].

2.2 Towards digital promotion of children's mental health

WHO [3] calls for community-wide action in child mental health promotion. It is essential that schools embed mental health activities within their curricula [3,6]. For example, in Finland, the strengthening of mental well-being has already been actively accounted for in the national curricula from early childhood education to upper secondary education [25,26]. WHO's [3] action plan brings also forth digital and mobile technologies as key tools for self-care promotion. Even though problems still arise in digitisation, there are promising indications of economic and other benefits. These benefits include greater flexibility, novel ways for communication and interaction, active student participation, potentially reducing social and psychological discomfort and encouraging self-management, self-efficacy, information seeking behaviour and equity through access [27,28], that are evidenced in the implementation of digital services.

Taylor, Leslie and Boddie [6] emphasise that digital technology widens the opportunities for mental health promotion. They [6, p. 2] list key benefits or affordances of digital

technology as follows: customisation and personalisation to tailor content to the individual's needs and goals; interaction techniques to increase motivation to engage in health promoting activities; a more anonymous means of accessing content; widened access for 'hard-to-reach' groups; and easy access to content. While these benefits are attractive, there are still a myriad of challenges to overcome when embarking on the design of digital environments, to: a) promote, educate and foster mental health and well-being; and b) increase accessibility for groups such as children and youth. This is due to the fact that biases and short-comings (i.e., lack of knowledge, experience and know-how) held by design teams can easily be transferred into designs for children, in these contexts [29,30].

In the design of digital resources for mental health, it is essential to pay attention to future users' – children's and young people's – preferences on the general use of digital resources in order to design engaging resources. It has been noted that young people tend to prefer applications (Apps), games and websites as sources for mental health support [6]. A recent ICILS study [31] indicated that in Finland over 80% of young people utilize messaging services and social media. Additionally, digital games and streaming services were among the most popular digital resources in the leisure time of young people. Kaarakainen and Kaarakainen [32] found out that young peoples' use of digital environments focus on personal amusement and social interaction and these appear to be sources for learning, participation and well-being.

However, regardless of information technology having huge potential for mental health promotion and intervention, its promise as yet, has not been fully realised to its true potential [28]. The amount of digital resources for supporting youth mental well-being is limited [6] and the amount targeted towards young children (i.e., six to ten year olds) is likely to be even more restricted. One of the challenges might be that the existing resources do not respond to the level of attractiveness and interactivity to which children and youth are accustomed [28,33]. Moreover, it has been noticed that most digital mental health resources focus on mental ill-health, while maintenance of positive mental health still plays a minor role [6,34,35]. Additionally, the research focus seems to be on the efficiency of the intervention itself, placing little focus towards other design aspects of the digital tools and environments [28].

Through the Internet, children and youth have access to mental health resources that can greatly differ in quality. A framework was created [33,34] to understand digital mental health resources for children and youth from the view of user interface (UI) design. It consists of eight design dimensions that can be evaluated based on specific criteria to ensure that the design of a resource corresponds to the needs of children. The dimensions include visual design, content, functional design, social interaction, engagement, co-design, reliability, and information privacy. An assessment of existing digital mental health resources reveals that while visual and functional design are often well considered, greater attention needs to be placed on social interaction, engagement, co-design and information privacy [33,34]. For example, many resources do not mention co-design processes carried out with the target group in question, regardless of previous research emphasising the importance of age-group specific co-design [36,37]. Thus, there is a need to improve the design of digital technologies to be more responsive to these age groups.

2.3 Children's involvement in digital mental well-being promotion

Children are active social agents, and this agency should therefore be harnessed both in the conceptualisation of mental well-being and its promotion [34,38]. This is in accordance with contemporary strategic thinking about promoting children's rights for participation [39,40]. However, most non-adult health literacy models focus on adolescents. This contributes to a lack of research concerning children under the age of ten [38]. Additionally, perspectives of children have traditionally been influenced and synthesised by adults. In existing health definitions and models, children are often seen as dependent on the actions of their caregivers, and not as active social agents [38]. According to Bröder et al. [38], the special nature of children and their involvement in the definition of mental health promotion should be better recognised. Thus, there is a need for more genuine child-driven perceptions [41] when it comes to both conceptualising mental well-being and digital interaction design for its promotion. Above all, it is important to recognise the special characteristics of children and to provide them with opportunities to express these characteristics through their contributions to the promotion of healthy behaviour [38].

The need to expand the active participation opportunities of children has been recognized also in the CCI research [42-44]. This has meant a move from designing for children to designing with children and to the methods of participatory design with higher degrees of user involvement [43,45]. Druin [46] points out that designing with children may have benefits from the creative point-of-view, as children from age seven to ten are already skilled enough to express and explain their ideas. However, they are not old enough to possess strong preconceptions such as biases, and perhaps cannot fully participate in critical reflective design practice. While empowering children is important, it is not the only reason to involve them in design: children should be involved because they potentially possess many thoughts as well as cognitive and behavioural approaches that may be overlooked if they are excluded from the interaction design process [47]. Moreover, in cases in which children participate in the design process in a school environment, there are added benefits such as the acquisition of both subject-oriented and technical knowledge [48].

Also, children's diverse roles in the design process have been analysed and reconsidered. In Druin's [46] model, children's role in the design process varied from user to that of a tester, informant and design partner. In more recent research, there has been a shift towards even more participatory roles involving children at various stages of technology design, e.g., as process designer in which children assist in the definition of the design process and methods [44]. However, there is still a large variety regarding the extent that children participate in the design process, whether this means their involvement in one session or for a prolonged period of time [45]. Interestingly, Kinnula, Iivari, Isomursu and Kinnula [49] argue that children's roles are more varied than existing models suggest when looking closely at what roles children themselves adopt and create, e.g., the role of a socializer or achiever. They noticed that children also smoothly switch between different roles.

This study advocates the involvement of children in the co-design of digital environments, and argues that this is conducive for mental well-being promotion among younger people. By

doing this, children are afforded the possibility to indicate their views on mental well-being and its digital promotion, through incorporating children's ways of thinking and behaving in the interaction design process itself.

3. Research design

3.1 Aims of the study

The study was based on the need to provide children with an opportunity to actively participate and contribute their understanding of mental well-being promotion and to couple this with interaction design insight for child-centered digital tools, environments and other apps intended to promote mental well-being. The aims of the study were: 1) to further understanding of children's conceptions of mental well-being; 2) to examine children's views on factors in digital environments and interaction design that affect mental well-being, and 3) to explore child generated designs about digital environments that promote mental well-being.

3.2 Participants

The participants of the study were recruited through a regional school network, allowing the project to increase mental well-being awareness at a local level. The participants were in total 79 children; 33 girls and 46 boys from three Finnish primary schools. Third and fourth grade classes took part in the study. The age of the children varied from nine to eleven years of age. The children participated in co-design workshops that were implemented in the form of individual and group work. Groups typically consisted of three to five children and the total amount of the groups was 22. The teachers (altogether four) participated as co-facilitators in the planning and execution of the workshops. At least one school teacher and two researchers from the project group were present in all the sessions.

3.3 Method

This study had a combination of hands-on design research techniques through co-design, as well as conceptual probing techniques with children [50]. It contributes to an understanding of how children conceptualise and unite understandings of mental well-being with digital technology and interaction design. The study was conducted through three interlinked workshops (Figure 1). The structure and content of workshops were planned with the teachers. Each of the researcher-lead sessions lasted 90 minutes. At the beginning of the second and third workshops, children were asked to 'revisit' what was discussed and undertaken in previous workshop(s). Once the previous session(s) had been discussed, the present session was introduced.



Figure 1 Workshop content and structure

At workshop 1, the children were first asked to individually contemplate the concepts of mind and well-being in order to focus their thinking on the workshop theme. They were then assigned to groups of 3-4 children. Teachers arranged the working groups in advance to ensure that children were placed in groups of children with whom they were able to work collaboratively. To support group work and help make sure that individual childrens' voices were heard, teachers and researchers circulated the classroom. The goal of the group work was to create a joint description of the concept of mental well-being. The researchers had considered utilising the term 'positive mental health', yet decided to use 'mental well-being' due to its approachability and familiarity to the children.

Workshop 2, in turn, was implemented as a learning café, where the same small groups had approximately 15 minutes to work at a series of specifically themed stations. At each station, the groups were asked to answer questions related to digital environments and mental well-being, i.e., what websites or applications they use at school or home, as well as how and which digital environments they thought could affect mental well-being and in what ways. The concept of digital environment was not explained to the children. The idea was to gain insight into how they conceptualise and link these constructs themselves. For this reason, idea expression was emphasised in our data collection and co-design with the children. As, in order to understand how to design with and for children, we also need to understand how they understand these concepts through mental and linguistic representation.

Workshop 3 was implemented as an analogue hackathon session. Hackathons are events to which professionals are invited to solve specific problems [51]. These have also been described in education as 'hackathon-like activities' [52], whereby they are used as pedagogical techniques for framing applied learning tasks. The first two workshops provided the foundation to enable the final analogue hackathon session. It was assumed that the children might not yet possess the skills required for a real programming event. Thus, the 'analogue hackathon' was introduced to describe the children's non-digital approaches to solving digital and interaction design problems. The task for the groups was to create a design of a digital environment, tool

or App that would, in their opinion, foster mental well-being. Children were given drawing materials and tablet computers to help create their designs. At the end of the workshops each group presented their design to the class.

The role of the children in the workshops can be described as that of an informant. According to Tsvyatkova and Storni [43], this is more open than the role of user or tester. However, from the perspective of child involvement, the design process was still adult-led as it was planned by researchers together with the teachers, and not with the children [43]. It was noted that inside the work groups some children took more specific roles according to their relationship to the workshop themes [49]. This could be seen, for example, where children who possessed more experience in programming would guide their peers in the planning of a design. This included assistance with the ideation of game features. In other cases there were children with more knowledge about mental well-being who led their groups' discussions. There were also instances in which enthusiasts, such as (digital) gamers were eager to share their knowledge on games.

3.4 Data and data analysis

The data consists of children's outputs concerning concept designs for digital tools, Apps and environments that were generated during the workshops. All the group work content created in the workshops were added by children into Google Slides (GS) presentations and transferred to researchers' computers. The data gathered from workshop 1 consists of 20 textual GS presentations, workshop 2 of 21 textual GS presentations, and workshop 3 a total of 23 visual and textual designs for digital environments (Figure 1). The designs consisted of 22 game designs and one music streaming service. The data of children's design presentations consisted of children's drawings, textual descriptions about the promotion of mental well-being and video recordings of the presentation sessions.

Once the data collection from the schools was complete, all the textual material was transcribed. The transcriptions of the data were then coded and analysed using ATLAS.ti software. There were several subsequent coding cycles. In various phases of data analysis, three researchers participated in the iterative development and revision of the codes and categories. The analysis proceeded as iterative content-analysis as follows: One researcher did the first coding cycle and then two researchers re-coded the data based on existing mental health models. In each coding cycle the codes were carefully discussed in the research team in order to achieve consensus. We undertook iterative content-analysis, performed by multiple people in order to refine the coding of content-analysis findings [53,54]. Then, once agreement was made between the researchers, the final constructs were derived.

For the data from workshops 1 and 2, the first coding cycle was data-driven, resulting in general categories for mental well-being (workshop 1) and factors in digital environments increasing or decreasing mental well-being (workshop 2). Altogether 98 mentions of factors describing mental well-being were found from workshop 1 data, with this number being 180 in the case of workshop 2. The second coding cycle was directed by the existing models of mental health or well-being, especially the mental health hand [22], five ways to well-being [23], and

the categories in Lehtinen's study [24], which provided constructs for higher categories (Table 1).

Table 1 Example from the analysis process and categories from research sources

<i>Examples from data</i>	<i>Category</i>	<i>Research sources</i>
<i>Mental health means inner strength. [When] you are happy, the mind stays good.</i>	Individual factors (emotions, identity, thinking)	Lehtinen 2008, Mental Health Finland 2019
<i>It is nice to chat with friends on Whatsapp. It is good to connect with friends.</i>	Social interaction (to connect, family, school)	Aked & Thompson 2011; Lehtinen 2008; Mental Health Finland 2019
<i>Physical activity, resting, food</i>	Healthy living (sleep, resting, nutrition, eating)	Mental Health Finland 2019, Aked & Thompson 2011
<i>Playing an instrument, reading, drawing</i>	Hobbies and creativity	Mental Health Finland 2019
<i>Mental well-being means you are not mentally ill.</i>	Absence of mental disorders	Keyes 2002; Wiens et al., 2014

The analysis of workshop 3 data focused on the general characteristics of children's designs and on their ideas of mental well-being promotion via digital interaction design. The analysis focused on textual data of the designs. The textual data was coded according to the factors derived from the workshop 2 results. Children's drawings were analysed only in regard to general design characteristics, namely game types, characters and environments. In order to find a link between theory and practical recommendations [43], the results of children's designs were contrasted with a framework for designing digital mental well-being resources for children and youth [33, 34].

3.5 Ethics

In order to undertake this study involving minors (below 18 years of age), the research group applied for an ethics clearance that was subsequently approved by the University's Ethics Committee. Researchers specified that the children were not to come to any physical or psychological harm, and that permission to participate was requested from the children's parents. The study focused on the design of digital mental health environments and not on the mental health of the children themselves. In compliance with the Board of Ethics conditions, information material about the study was created and supplied to all parties involved in the study. All parties were also notified of their right to cancel participation at any time.

4. Results

The results section is divided into three parts according to workshop themes. First, children's conceptions of mental well-being are presented, followed by children's views on the factors affecting their mental well-being in digital environments. Third, children's designs of digital environments are explored in regard to children's ideas about mental well-being promotion.

4.1 Children's conceptions of mental well-being

Children expressed a wide and versatile understanding of mental well-being as compared to earlier research and categorizations (see Table 1). Children described mental well-being mostly (in 76% of mentions) with positive expressions as issues contributing to mental well-being. However, in altogether 24% of the mentions, mental well-being was viewed as the absence of negative situations or states, such as mental disorders or sad thoughts. The analysis indicated that there are five main categories through which children describe mental well-being, namely individual factors, social interaction, healthy living, absence of mental disorders, and hobbies and creativity (Figure 2).

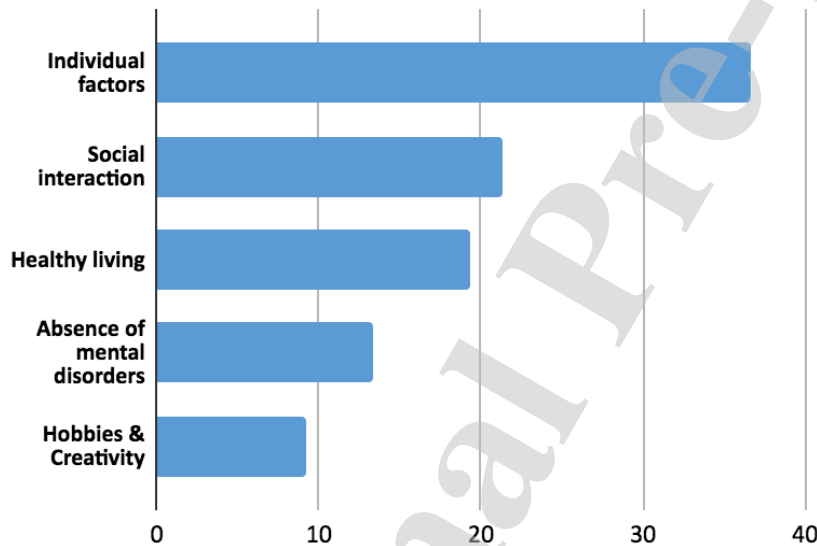


Figure 2 Distribution of mentions of mental well-being

In 37% of the overall mentions, children focused on describing diverse **individual cognitive-affective factors**, such as emotions and moods (affective) as well as thinking (cognitive processes) as indications of mental well-being. These are the processes that occur within the individual (mentally and physiologically), yet also exist in relation to the social and contextual whole. Children often utilised the word 'mood' instead of mental well-being. In Finnish language, the words "mood" and "mind" translate to one word, "mieli" which is also used in the concept of "mielen hyvinvointi", in English term "mental well-being". Positive emotions were considered from different dimensions, such as *happy thoughts, feeling good, good mood and funny things* but also as *feelings of happiness and joy caused especially by*

friends. There were several issues that created a good mood for children, e.g., receiving a new toy or a gift. One group drew a picture with various animals, explaining that *Animals contribute to good moods*. For many children good mood was seen as emotions resulting from the actions of others. Also, undertaking one's favourite activities was mentioned as a source of good mood. Children also mentioned happiness in general as a state of mind and good mood as a *key to a good life*. As opposed to positive expressions, some children also described mental well-being as the absence of negative emotions, e.g., sadness or anger.

Mental well-being means that .. [you're not] angry

Thinking was understood by some children at a basic level as *having good or happy thoughts*. However, there were also children who already had more profound ideas about thinking, and exhibited the ability for metacognition, for example, representing thought as a skill, and discussing this in relation to generating positive thoughts of others and oneself.

... you are able to think good of others.

You think positively about yourself.

You can think positively.

In one fifth of the mentions, children described **social interaction** and its linkage to good mood. Friends, family, and other people in general were mentioned: *Company of others brings me good mood*. Children described how other people influence good mood, for example through giving praise. In these mentions, children did not, however, yet emphasize their own role in evoking good mood for others. Instead, they explained how other people affect their mental well-being. Social interaction was seen mostly in a positive light but some mentions also focused on negative effects, or the absence of these effects such as, when *you are not being bullied and you have friends*.

Another fifth (19%) of the mentions focused on **healthy living**. For some children, physical exercise was seen as a way to increase mental well-being. Additionally, children brought forth issues covering nutrition and eating as well as sleep and rest.

Eating healthy food increases your mental well-being.

Mind has to rest and it's healthy to get bored sometimes.

In some (13%) descriptions, mental well-being was mainly determined as the **absence of mental disorder**, or just as a list of issues related to sickness and its caring. One group reflected on this as follows: *Mental well-being means that you do not [...] think self-destructive thoughts* and another group: *Mental health means that you are not mentally ill*. For others (9%), different **hobbies and creativity** were a source for mental well-being, such as the use of digital environments, reading, drawing or playing an instrument: *I feel good when I play piano*.

4.2 Factors affecting mental well-being in digital environments

Children were asked to think about the factors that affect – either increase or decrease – their mental well-being in the digital environments that they use. In the examination of all the factors, the percentage of each main factor was calculated. The factors are described mainly qualitatively and the calculations are utilized as preliminary indicators in describing the relations between the factors.

Children's answers included 180 mentions about factors affecting (increasing 51%, or decreasing 49%) their mental well-being from engaging in digital interaction. The majority of mentions (82%) included a reference or several references to a specific digital environment children were using. Most often children mentioned a digital game or game-playing, as this was found in 40% of the mentions (Figure 3). Other often referenced applications include Youtube videos and streaming services with 27% of mentions. Less than 10% of the mentions focused on digital environments enabling social interaction, music apps and diverse digital learning environments.

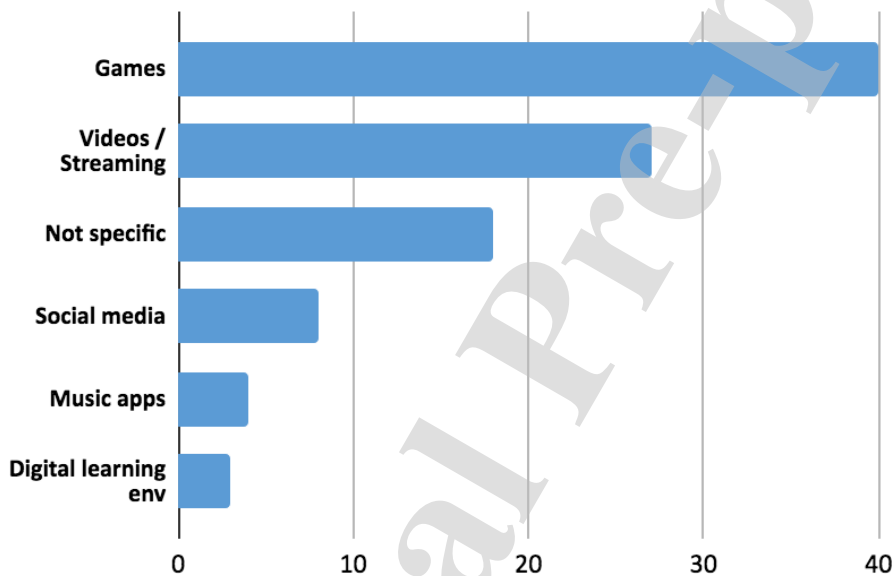


Figure 3 References to the digital environments in children's answers (% of mentions)

Children's views about factors affecting their mental well-being in digital environments were grouped into five main factors: the use of digital environments (33%), content (26%), individual factors (17%), social interaction (16%), and technical properties (8%). Children viewed all the factors both as increasing and decreasing mental well-being. However, there were some differences in the proportions of mentions (Figure 4). The use of digital environments and individual factors were mainly viewed as factors increasing mental well-being, whereas, content and technical properties were viewed as factors decreasing mental well-being. Herein lies a paradox as games and different online content (videos/streaming services) were two of the most often mentioned digital environments used by the children.

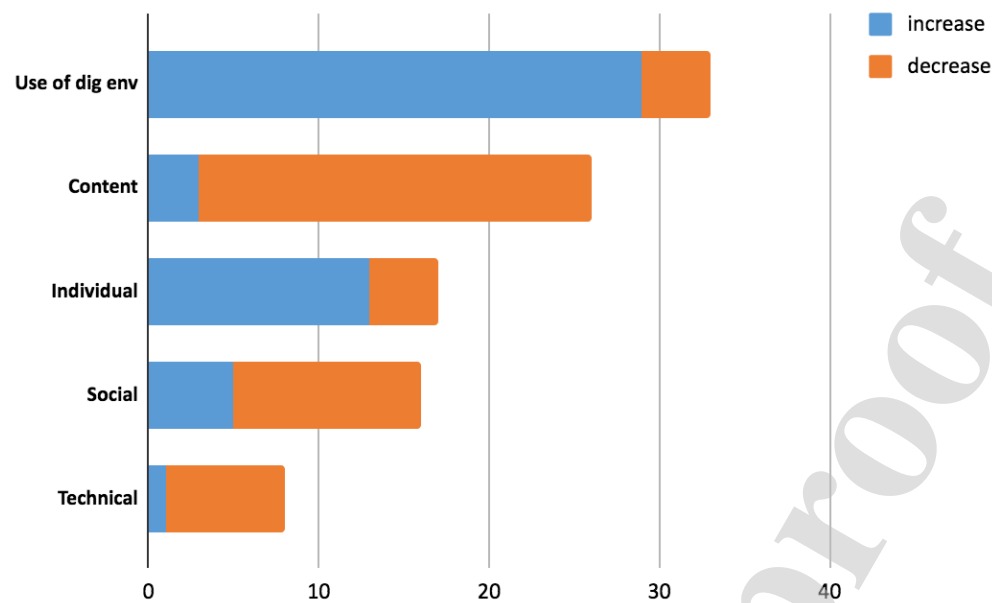


Figure 4 Children's conceptions of factors affecting their mental well-being in digital environments

The use of digital environments consists of mentions describing general and excessive use, as well as lists of diverse digital environments or certain content providers. General use, especially game-play and watching videos, was seen as a pleasurable activity and as increasing mental well-being. This can be seen as an age-related aspect with a focus on personal amusement. Only few children were able to perceive excessive use as decreasing mental well-being with issues such as irritation to head and eyes or harmful effects to sleep.

Blue light can make you tired.

Websites that we use and decrease mental well-being are: Netflix and YouTube. if you watch them too long you might have a headache or something similar.

With **content** children referred to engagement, desirability, fear, and appropriateness. Children often described the content factor with emotions. Only in some mentions children brought forth positive issues regarding digital content, e.g., humour and adventure in games, or relaxing music. Most often children depicted horror and inappropriateness in the digital content. Here, many mentions focused on videos, and their scary, horrific and distressing nature. Also, issues such as violence, adult content, unintentional encounters and age-inappropriateness were referred to. Thus, the children participating in this study demonstrated the ability to differentiate various issues causing distress. However, it is noteworthy that they were unable to fully avoid these situations or such contents, which caused distress in itself. This characteristic of exposure to Internet contents, additionally exhibits the impact and influence of the factor of control on mental well-being – when children experience moments in which they cannot control what they are exposed to, they lose the sense of well-being. Moreover, children

described unengaging or unwanted games and Youtube content such as advertisements and announcements that disrupted their ongoing activity.

Distressing videos e.g. tsunami and tornado.

Such videos that are not for under 10-years-old.

If you see inappropriate things on the Net.

Grandpa, there is a killer grandpa in the house and you are in that house. In the house, there are bodies and zombies + lots of blood.

On the other hand, **individual factors** appear mainly as increasing mental well-being. The factor consists of a sense of achievement and learning experiences. While a sense of achievement meant for some children to win or succeed in a game, for others this dimension had been experienced as losing and not succeeding. Children described that they learn new things especially through watching videos and from learning games. Agency, control, self-efficacy and achievement can be seen as aspects in game interaction that bring forth mental well-being. Children also listed some learning platforms they utilize at school. Again there were clear differences between children – while very few children could reflect in a more future oriented manner the benefits of game-playing, others saw it through immediate pleasure.

It is nice to play Kahoot with a class and guess questions.

You get in a good mood, if you win or complete something big.

I get ideas from games.

You can watch YouTube videos and learn and it is also otherwise fun.

In the mentions of **social interaction**, children brought forth more often factors that decreased rather than increased mental well-being. The detrimental side of interaction was cyberbullying in the form of nasty messages, false mobile calls and secretly recorded videos. In addition, unpleasant challenges and online scams caused negative feelings. The effects that increased mental well-being related to interaction with friends, in the form of having a good time playing games or watching videos together, as well as communicating using diverse communication applications.

If people write mean messages to another one.

If somebody teases you on the net.

It is nice to discuss with a friend on Whatsapp.

It is nice to watch videos with a friend and also the videos friends have made.

Technical properties or technical problems were described as factors decreasing mental well-being, except one group that depicted properties of a certain music application. Technical properties centered on problems with the Internet, running out of battery, faulty functionality of applications and especially in the lagging of a game.

In the second workshop two factors were repeated from the first workshop, namely

individual and social factors. Also new factors emerged, such as use of digital environments, content and technical factors.

4.3 Digital environment designs in the context of mental well-being

The following results section of children's designs focuses on qualitative descriptions of the design characteristics and examination of children's ideas on how their design could promote mental well-being. As the vast majority of the designs were games, we will first describe certain characteristics of game designs, namely game types, characters, play environments, and gameplay features. The designed games could be divided into four different game type categories: Adventure (11), Simulation (5), Puzzle (4), and Sports (2). An example of an adventure game level "Cross a bridge" is presented in Figure 5. Despite videos gaining most mentions after games in workshop 2 as an increasing factor for children's mental well-being, none of the designs had any video content or mimicked existing streaming services. Additionally, even though social media was mentioned as a factor contributing to positive well-being, it did not appear in the children's designs.



Figure 5 Illustration of an Adventure Game Level "Ylitä silta" (Cross a bridge)

Game designs had a rich variety of characters as altogether 15 different play characters could be identified. Three of the characters were human, i.e., school pupils. However, the vast majority of the characters (11) were imaginative, such as a snowman, zombies and monsters. One character, "Dragonslayer6969", could be said to derive directly from existing media culture, a Finnish tv-show. The represented characters are typical for games that children play. One of the key properties seemed to be that children could somehow affect the game, be it through customizable characters or choosing a suitable difficulty level. A play character (avatar) could be chosen in five of the games and the same amount of games provided the

possibility for character customization. Figure 6 presents an illustration of a game character created by one of the groups.



Figure 6 Illustration of a Robot Character

A total of 18 different environments with rich variation were featured in the designs. Especially adventure games included multiple levels and varying game environments. There were both imaginative and non-fictional environments, with the latter ones varying from more exotic environments (e.g. space, jungle) to children's everyday environments (e.g. home, school). In their designs, some of the children focused on building the game narrative, while others took their design to the level of user interface look and feel. For example, some of the drawings created by the children included menus and buttons for different functions.

The designs varied greatly in terms of how child groups had reflected on promoting mental well-being and whether these factors were visible in the designs. Eight designs included an explicit reference to the aims of promoting mental well-being. The other designs had more implicit references to mental well-being. In many cases, the groups designed a game environment according to their own preferences, and thus, it was the game's concept itself that generated a good mood for them. Some designs indicated similar emphasis on one's own pleasure as was evident in the responses to the workshops one and two. When a design did not include clear indications of mental well-being promotion, this relation was inquired from the group in the presentation situation. Still, there were five concept designs in which it was rather difficult to establish how they could promote mental well-being.

The designs portrayed partly similar factors to children's views on the effects of digital environments on mental well-being, as mentioned in the second workshop. Many of the designs

included factors from only one category. However, in some designs, more than one factor was evident. Through co-design, children also brought forth new issues (e.g. safety) that did not appear in workshop 2 results. The following quotation exemplifies a game design with multiple functions in regard to mental well-being promotion. They were absent of cyber-bullying and violence as well as motivational issues in the form of changes in the game fields and challenging game activities.

Well, because nobody can put you down inside the game. And your game character changes in each field, and that's exciting. And you get a good feeling as there are such places in which you need to search for. [...] And then there are things from which you might go gameover, it adds to the challenge. And you don't see blood or anything bad.

Again, the use of digital environments was seen as a source for mental well-being. Children designed games that increase mental well-being due to gaming itself being fun, and arousing positive feelings and joy. Children enjoyed explorative and exciting game activities.

In the game there are islands and places where it is fun to explore and fight.

We are in a house, in which you need to collect keys. The house is filmed from above. In the house there are guys who may not see when you collect keys. Each game level has three keys. You need to find them. The game increases mental well-being 'cause it is fun [to play it].

Even though the joy of gaming was evident in children's designs, they also had a good understanding of diverse issues related to game-playing. Especially issues of safety – safety of the content or feelings of safety – was mentioned in the designs. One group depicted explicitly that their game is *in terms of safety, a good game*. In some designs, safety was described through limiting violence or other negatively associated game properties to a certain degree, for example by making the death of a game character less graphic. One group designed separate games for girls and boys, the latter containing more violence. Additionally, some designs were characterized as bully-free environments.

And here are two parts, a girls' game and a boys' game. And in this first one it is not so violent, but it is more violent than girls', but it does not have blood.

So, if your character dies, maybe, at least in my game it does not show... if my character dies there, it just starts to blink and then it blows up, just a little.

In the designs emphasising social factors the focus was on the detrimental effects of digital environments but there were also mentions to positive aspects such as friendship. Most of these designs discussed bullying, with cyberbullying being brought up by the children already in the second workshop. Two designs aimed to prevent traditional bullying while one offered a cyberbully-free gaming environment: *No one can insult you and bring you down in the game*. One design stands out with its emphasis on embedding mental well-being for the whole

concept design. The aim of “Sun School game” is to decrease school harassment and home violence (Figure 7).



Figure 7 Drawing “Pelin kartta” (a game map) presenting the Sun School (Aurinkokoulu), home and other buildings

During the game, the player has to solve diverse tasks, with the aim to establish friendships with bullies (enemies) and help others. The player will have the whole school year in game time to do this. Moreover, after school days the player will return home and try to solve tasks to decrease home violence. The following excerpt describes two tasks that indicate diverse forms of kindness and ways of helping others:

Task 1: Could you please, fetch a jump-rope for me?

After performing the task: Thank you! Would you like to jump with me?

Task 2: Oh no. I left my backpack outside. Could you please, fetch it? It is hanging there on the net.

After performing the task: Thank you, you are a good friend!

Similarly, the game design “Good Friend” discusses decreasing harassment and helping others through various game tasks, with one of them focusing on finding friends.

Its name is ‘good friend’ and you help others in it. And you don’t harass in it. And it has one task in which you look for friends and get a point from that.

For many groups, certain game features produced mental well-being in various forms. This was evident in the designs as children described various in-game features such as game

character personalization, choosability of game activities and adjustable difficulty levels. The first two can be viewed as features that give the player the possibility to influence the game and the third as a feature enabling a suitable level of challenge. The designs contained diverse features creating desired levels of challenge, for example different actions leading to game over. Additionally, automatic changes, e.g., in the appearance of the character were seen as an important source for excitement.

It has well-being, as you can take [...] the difficulty level of the game or whether it is difficult, easy or suitable.”

Your character changes between each level and it makes it exciting and it makes you feel good as you search for [objects in the game].

You can do almost anything in the game.

Helping others is a theme that was apparent in four designs, manifesting as helping others in general, taking care of others' health or helping people who are being bullied. Some designs were directly related to health or healthy living. One was a game where you could work in different fields of healthcare and take care of patients. The other was a simulation in which the game character's well-being was affected by the quality of nutrition.

In the game you get sick if you eat unhealthy food.

For some, the visual design of the game was described as a source for well-being, while following the interests of the game designers. For some it was colors, for others inspiring game scenery such as apple rivers.

5. Discussion

This article contributes to both practical co-design applications and scientific understanding of children's conceptual relationship to the uniting of mental well-being and digital design concepts. It has combined design research techniques such as brainstorming and analogue hackathons, in a meaningful way to investigate and practically synthesise elements of two extremely complex fields – mental well-being (mental health) and digital environment design with children.

5.1 Children's conceptions of mental well-being

As Taylor, Leslie and Boddie [6] emphasise, it is important to consider young people's understanding of mental health in the design of mental health technologies. Designers need a platform upon which digital environments may be developed that is compatible with children's knowledge, vocabulary and expectations. Both the co-design process, and utilising designs that have been created on the basis of their own logic, can be an empowering experience for children [43, 45]. Co-design with children ensures that technologies are developed in relation to use habits, experience and accessibility. Additionally, through active involvement, children can bring up aspects that could have been otherwise disregarded in the design process [47].

In their views presented at the workshops, children often associated mental well-being with different feelings and states. Additionally, mental well-being was viewed as the absence of mental disorders, which is consistent with earlier research [21]. On the other hand, children brought forth versatile dimensions of mental well-being relating to individual factors, social interaction, healthy living and hobbies and creativity, linking mental well-being to overall well-being [16]. Thus, even though children tend to focus on expressing feelings and moods while describing mental well-being, they express versatile understanding and can bring forth diverse factors relating to the phenomenon that are consistent with existing mental health models [22-24.]

Most typically children felt that the use of digital environments as such was positively associated with their mental well-being, as they enjoyed playing games and watching videos. This is consistent with the results from the first workshop, where good mental well-being was viewed through positive feelings and moods, as well as the absence of negative feelings and states. In particular, emphasis on game play as a contributor to positive mental well-being, can be understood in regards to the positive psychological effects deriving from the increase of self-efficacy, control (e.g. customization of game characters) and reward as observed in prior research [55-57]. This however, additionally raises questions regarding the conceptual understandings and somewhat confusion between well-being and 'feel good'. Reward, control and immersion for instance, contribute to the experience of flow, which is often connected with positive psychology [58], and sensations of 'feel good', yet these also may contribute to negative mental effects such as game addiction and long-term mental and general health problems shown in previous studies [59]. At the same time, children were able to critically evaluate the pitfalls of digital contents. They raised issues of appropriateness and suitability for their age. As opposed to learning experiences and a sense of achievement, also problematic social factors, such as cyber-bullying and scamming, were brought up.

5.2 Children's digital designs for mental well-being

Diverse digital environments, especially games and videos, are children's natural everyday action environments [4,31]. This study points out the remarkable role of digital game environments and videos in children's ICT use, as game playing and video watching experiences were often used to describe the mental well-being outcomes [32]. Moreover, all except one of the children's designs were digital games, with features similar to modern video games. However, characteristics of social media or collaborative gaming (with friends) were not visible in the designs. While the majority of digital mental health and well-being resources targeted at children and youth are websites [34], there might be a need to design engaging game environments for children to gain their attention and in order to integrate aspects of children's own media culture [60]. Moreover, Youtube and other video streaming apps could be considered.

Children focused on designing digital game designs, in which differing characters, features and environments were present. The game designs were functional in nature and emphasized the user's active role in game-play. On the one hand, mental well-being themes were included in game narratives, but on the other hand, and in the case of most of the game designs, the

factor increasing mental well-being was actually game playing itself. In fact, where much attention has been placed on the study of excessive game play that in turn is connected to negative effects on mental health, there are signs that moderate ICT use has positive effects on mental well-being [61]. Thus, there might be a need to study game playing as an activity with potential positive effects on child mental health. In addition, the position of game playing as an enjoyable and worthwhile activity for children should be noted by both teachers and educators alike.

In some designs, it was noteworthy that violence was considered a natural part of the games and reducing or alleviating it increased mental well-being. Furthermore, in one design, degree of violence was mitigated by gender, as a game targeted to girls had less violence. In other designs, violence was moderated to be suitable for the target group, for example in the form of a less graphic death of a game character. Thus, children seem to be aware of the violent and gender-specific nature of computer gaming, and an interesting topic for further research would be to elucidate the background to this thinking. Some of the questions are: How much have children played games that are unsuitable for their age, and how much do games reflect their own experiences of game violence? How has the game violence been discussed at homes or school, and how much do children reflect adult opinions in their designs?

Ideas from existing games inspired some of the designs. Kuure, Halkola, Iivari, Kinnula and Molin-Juustila [62] stress the fact that children recycle ideas – imitate, adapt or modify them from several sources – and that should be understood and respected in research. Age seven to ten is expressed as an optimal age for children to participate in design since they can understand its idea and are not affected by bias caused by strong preconceptions [46]. However, it should be noted that the current generation of children are active users of diverse digital environments from a very early age onwards. This renders it possible for them to, in fact, hold strong preconceptions and structural understandings regarding computers and the design of digital environments [63].

5.3 Implications for CCI and design of digital mental well-being resources

In light of previous research in the field of CCI, this study makes contributions on the levels of: 1) topic – examination of CCI and co-design with children to understand the ontological understandings of mental well-being from children's perspectives in conjunction with the design of digital environments and Apps for its promotion; and 2) method – hackathons and analogue hackathons have been implemented in the past in various groups and contexts to address the design of digital technology with the absence of the need for programming skills, yet this approach appears to be somewhat scarce in relation to children and designing digital tools to boost mental well-being [43,64,65].

As opposed to previous CCI research focusing on mental health and special (education) groups [7], the children participating in this study represented whole classes from mainstream comprehensive education. Even though research focusing on specific groups such as children on the autism spectrum [7-9] has a remarkable societal role in taking different groups into consideration and making environments and conditions more inclusive, it is also important to discuss these topics in wider contexts. This is crucial for research in order to encourage the

move from problem and challenge-focused thinking into understanding mental health and mental well-being as topics that are relevant to all children regardless of their current health status.

There are several practical implications for designing digital mental well-being resources for children that are present within this study. As an attempt to find a link between theory and practical recommendations [42], these can be seen by contrasting results about children's designs with a framework for designing digital mental health resources for children and youth [33-34]. This comparison yields information on design qualities that children focus on and how their conceptions relate to earlier research. Figure 8 presents children's criteria together with the framework dimensions. The heuristic dimensions proposed by previous research [33-34] are presented with light blue color, while children's criteria and their categorizations are presented in light and dark green. Once the categorizations of children's designs are compared to the framework, it can be noticed that the mental well-being promoting factors in children's designs have relations to nearly all of the dimensions included in the model, excluding co-design. However, even though co-design is not particularly mentioned by the children, the criteria has been created as a result of a co-design hackathon. To portray this, the dimension of co-design is presented at the background of the figure, enabling the creation process.

The designs focus especially on the dimensions of engagement and content. However, many of the criteria can be placed in more than one of the dimensions, implying that children focus on broader entities extending the model. For example, functional design, visual design and engagement are all portrayed in the designs through mental well-being promotional in-game features. In the case of functional design and engagement, this can be seen e.g. in mentions to game type, while in-game features relating to visual design include game theme and colors used.

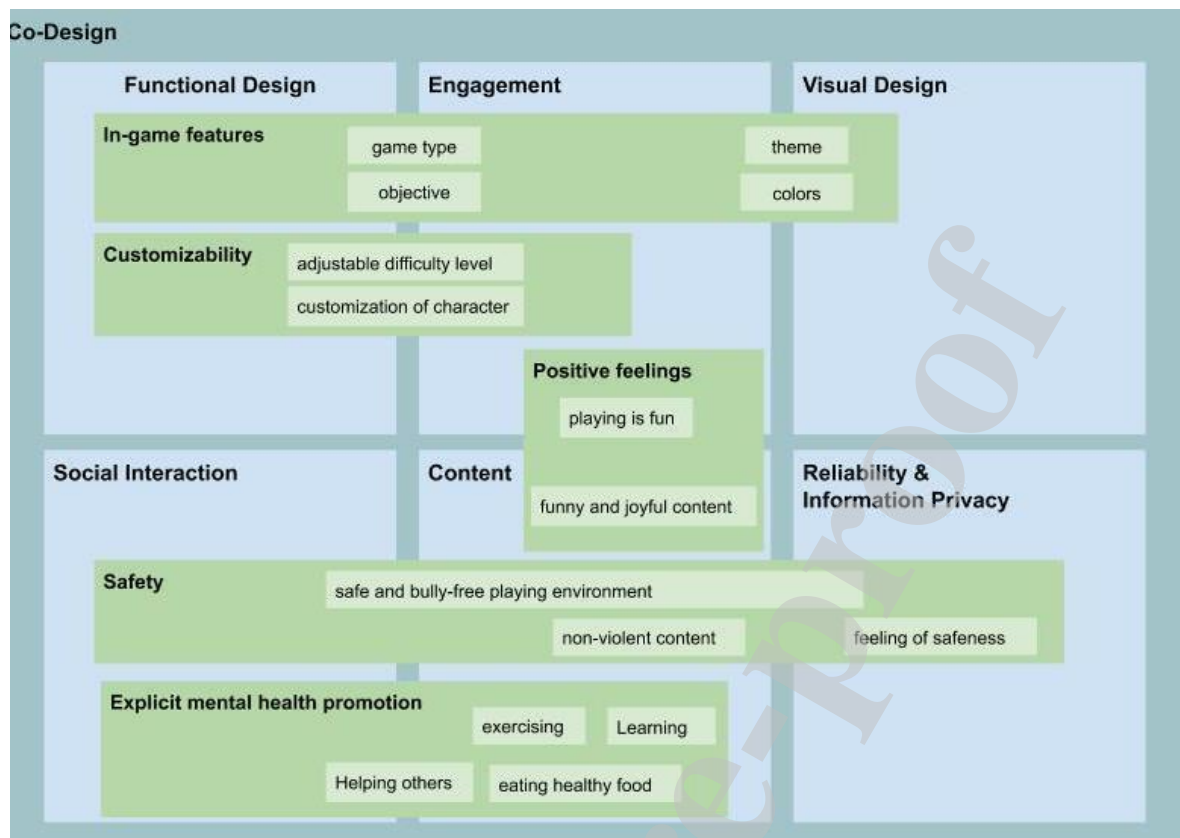


Figure 8 Children's conceptions of mental well-being promotional design properties contrasted with the framework for designing digital mental health resources for children and youth [33,34]

Children's focus on the engagement dimension is especially visible in the design types, since nearly all of the designed environments were games. Naturally, positive feelings were also associated with game play, and seen as a factor contributing to mental well-being. In their designs, the children consider well-known aspects for designing engaging digital solutions, such as specific in-game features and customizability, i.e. creating a gaming experience where the user can affect conditions or outcome of game play. Even though these design aspects might not intuitively connect to the theme of mental well-being, it is noteworthy to acknowledge that children viewed these aspects to specifically contribute to mental well-being promotion, within the scope of their understanding of the concept. Additionally, the children have the ability to consider diverse ways of incorporating explicit mental well-being promotional aspects into the environments, focusing e.g. on evoking positive feelings for the user (e.g. funny and joyful content), making the environment itself more safe and bully-free to use [60] and introducing specific themes, such as helping others and learning.

Figure 8 shows how children can focus on many different dimensions of UI design while working to create a design of digital solution for mental well-being promotion. It can be stated that children can approach the design process from different perspectives depending on their own interests. Even though many of the children's designs included specific mental well-being

goals, it is noteworthy to acknowledge that this was not the only way they approached the theme of mental well-being, as children also viewed more implicit factors (e.g. theme, game type) as meaningful contributors to mental well-being. Finally, Figure 8 can be used as a practical guide by software developers when they are designing new, or developing their existing resources for children. Moreover, researchers can use the model in further design initiatives, to clarify the connection between children's actual design processes and the different dimensions of user interface design discussed by research.

5.4 Limitations of the study

The study has some potential limitations. Although the design of the study was carefully designed to make children's views and voices heard at every workshop, more attention could have been paid in the group work to the equal participation of each child. As Heary and Hennessy [66] bring up, the benefit of individual work is that a wider range of ideas will likely emerge. Then again working in groups supports more elaborate outcomes than individual work. The choice between group and individual work shall ultimately be made based on the desired outcomes of the study [66]. In this study we aimed for as rich data as possible and group work supported that aim. In future studies more individual approaches should be taken to explore aspects of mental well-being in greater detail. Due to the intimate nature of the topic studied, an individual approach would need careful planning of the research setting to attend the vulnerability of the children.

Another limitation is related to children's designs. Five of the children's designs dealt with the mental well-being only superficially, and we could have guided or supported the children's work even more to bring about deeper reflection.

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Conflict of interest

No potential conflict of interest.

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