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USER INTERFACE DESIGN FOR CHILDREN AND YOUTH: WEBSITES AND APPLICATIONS TO PROMOTE MENTAL HEALTH AND WELLBEING

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ABSTRACT

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This master's thesis focuses on the design of digital mental health and wellbeing websites and applications for children and youth. First, a literature review was carried out to identify the most important theories and recent research efforts within this field. The subject was inspected from the perspective of child and youth user interface (UI) design. According to the reviewed literature, digital mental health and wellbeing resources generally lack research evidence to support their effectiveness. In terms of UI design, the resources should be more carefully designed in order to be more suitable to child and youth users. For example, efforts to make websites, applications and games to support the intrinsic motivation of children and youth could enhance the achievement of the underlying mental health and wellbeing outcomes. As a result, a framework for assessing the suitability of mental health and wellbeing resources for children and youth was created. In the second phase of the thesis, a heuristic evaluation was carried out to assess how well the existing digital mental health and wellbeing resources (n=49) follow the principles presented in the framework. The main findings include how most of the mental health and wellbeing resources assessed have difficulties with content, social interaction, user engagement, co-design and information privacy. The providers of child and youth mental health and wellbeing websites and applications should pay more attention to adequately narrowing down their intended target group, while providing wider possibilities for social interaction. In addition, user engagement should be better promoted by increasing the provision of narrative, gamification and interactive elements. Finally, co-design processes used should be made more specific and visible to the user. The quality of data privacy statements should also be improved by more clearly stating the information processing practices relating to both personal and non-personal data. In conclusion, the existing digital mental health and wellbeing websites, as well as applications do not meet most of the design principles set for children and youth to an adequate standard.

Keywords: user interface design, children, youth, mental health, mental wellbeing

TIIVISTELMÄ

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Käyttöliittymäsuunnittelu lapsille ja nuorille: sivustot ja sovellukset mielenterveyden ja mielen hyvinvoinnin edistäjinä
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Tämä pro gradu -tutkielma keskittyy mielenterveyden ja mielen hyvinvoinnin sivustojen ja sovellusten suunnitteluun lapsille ja nuorille. Tutkielman ensimmäinen vaihe toteutettiin kirjallisuuskatsauksena, jossa keskityttiin aiheeseen liittyvien olennaisimpien teorioiden sekä viimeisimpien tutkimustulosten esittelyyn. Aihetta käsiteltiin lapsille ja nuorille suunnittelun periaatteiden näkökulmasta, painopisteen ollessa erityisesti käyttäjälähtöisessä käyttöliittymäsuunnittelussa. Kirjallisuuskatsauksen perusteella voidaan todeta, että digitaalisten mielenterveyden ja mielen hyvinvoinnin resurssien tehokkuuden toteaminen vaatii lisää tutkimusta. Käyttöliittymät tulisi myös suunnitella paremmin nimenomaan lapsille ja nuorille sopiviksi. Resurssit voisivat hyötyä suunnittelusta, joka tukee lasten ja nuorten sisäistä motivaatiota, sillä tämä voi edesauttaa mielenterveyteen ja mielen hyvinvointiin liittyvien tavoitteiden saavuttamista. Kirjallisuuskatsauksen tulosten avulla luotiin viitekehys lapsille ja nuorille suunnattujen mielenterveyden ja mielen hyvinvoinnin resurssien arviointiin. Tutkielman toisessa vaiheessa suoritettiin heuristinen arviointi, jonka tavoitteena oli selvittää kuinka hyvin olemassa olevat lapsille ja nuorille suunnatut mielenterveyden ja mielen hyvinvoinnin resurssit (n=49) noudattavat viitekehyksessä esitettyjä suunnitteluperiaatteita. Tuloksista selviää, että suurella osalla arvioiduista mielenterveyden ja mielen hyvinvoinnin resursseista on ongelmia sisältöön, sosiaaliseen vuorovaikutukseen, käyttäjän sitoutumiseen, yhteiskehittelyyn ja tietosuojaan liittyen. Lapsille ja nuorille suunnattujen resurssien tarjoajien tulisi kiinnittää enemmän huomiota kohderyhmän rajaamiseen iän puolesta ja monipuolisempien sosiaalisen vuorovaikutuksen tapojen tarjoamiseen. Lisäksi käyttäjän sitoutumista tulisi edistää lisäämällä vuorovaikutuksellisuutta, tarinallisuutta ja pelillisyyttä eri elementtien avulla. Käytetyt yhteiskehittelymenetelmät tulisi ilmaista tarkemmin ja tehdä näihin liittyvä tieto käyttäjälle näkyvämmäksi. Myös tietosuojaselosteiden laatua tulisi parantaa ilmaisemalla selkeämmin tunnistettavan ja ei-tunnistettavan tiedon prosessointiin liittyvät käytänteet. Tutkielman johtopäätöksenä voidaan todeta, että olemassa olevat lapsille ja nuorille suunnatut mielenterveyden ja mielen hyvinvoinnin sivustot ja sovellukset eivät riittävissä määrin noudata suurinta osaa niille asetetuista suunnitteluperiaatteista.

Asiasanat: käyttöliittymäsuunnittelu, lapset, nuoret, mielenterveys, mielen hyvinvointi

FIGURES

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CONTENT

1 INTRODUCTION

The quality of digital mental health and wellbeing resources for children and youth is an essential topic in information systems (IS) research, since health behavior models formed in youth play a likely role in the formation of life-long wellbeing (McDaid, 2016). In addition, children and youth utilize digital environments (e.g. applications, games and websites) Even more frequently in their everyday life, and a growing amount of health services targeted to these age groups are provided online. Relating to this, it has been noticed that online mental health and wellbeing interventions can be effective in promoting the mental health of children and youth (e.g. Lau, Smit, Fleming & Riper, 2017; Huen et al., 2016; Li, Chau, Wong, Lai & Yip, 2013). However, the current digital mental health resources might not necessarily meet the expectations of youth (Wetterlin, Neilson, Werker & Krausz, 2014). When resources targeted to children and youth are designed by carefully following the principles of age group specific design, there is an increased likelihood that using digital mental health and wellbeing resources becomes more natural and intuitive.

The most relevant terms in this thesis are mental health, mental wellbeing, digital literacy, health literacy and (user-centric) user interface design (UI design). The term mental health is used to portray the psychosocial wellbeing of children and youth in general. Mental wellbeing, in turn, has been distinguished from the term mental health to highlight the goal of promoting wellbeing, while the term mental health is often associated with mental disorder prevention and intervention. The usage of both terms ensures that the positive as well as the negative sides of mental health are covered in the process.

The user competence side of this thesis discusses especially digital literacy and health literacy as well as their derivatives. However, there are many variations of different literacies and their definitions depending on the context (e.g. McDaid, 2016; Sørensen et al., 2012; Gray, Klein, Noyce, Sesselberg & Cantrill, 2005). Thus, the main focus of this thesis is on digital mental health literacy of children and youth. Nevertheless, the emphasis of this thesis is on the technological aspects of mental health and wellbeing resource use and thus, the point of interest does not reside in the competence of the children or youth using the

resources. However, it is not reasonable to inspect the features of technology as a separate entity since the human-technology interaction (HTI) does not occur in a vacuum. In addition, the introduction to the logic of user competence research facilitates the understanding of terminology used in the thesis (e.g. the connectedness of the terms digital mental health literacy and digital mental health resources).

Digital literacy refers to a person's ability to cope in digital environments by being able to efficiently process provided information (Eshet-Alkalai, 2004). In turn, health literacy focuses on the ability to access health related information, as well as being able to understand and use this information in a meaningful manner (WHO, 1998). User interface design refers to the actions that are carried out to make UIs more suitable to certain purpose. Over the years, numerous UI design principles have been developed depending on the specific approach and technology at hand (e.g. Shneiderman & Plaisant, 2005; Nielsen, 1993). In this thesis, the focus is on the principles of designing for children and youth, especially from the point of view of user-centric UI design. In this approach, UIs are designed by acknowledging the qualities, needs and limitations of the actual end-user.

The research question in this thesis interrogates how well the existing digital mental health and wellbeing websites and applications follow the guidelines of designing for children and youth. The topic is covered from the UI design point of view, focusing especially on what is required from children and youth to use technology, as well as the principles of UI design. In the first phase of this thesis, a literature review was conducted to cover the most relevant theories and recent research about designing UIs for children and youth. This includes child and youth mental health and wellbeing topics specifically from a technological point of view. Google Scholar search engine as well as Scopus and JYKDOK databases were used as main channels to find relevant literature, and these were searched for with different word combinations that relate to mental health, mental wellbeing and digitality (e.g. "mental wellbeing" AND "youth" AND "internet"). The alternative spellings of each essential topic was also used in the search strings (e.g. mental wellbeing, positive mental health; mental disorder, mental health problem). The JUFO ranking produced by Publication Forum was utilized to assess the quality of reviewed publications. Based on the results of the literature review, a framework was constructed to create a set of principles for designing digital mental health and wellbeing websites and applications for children and youth.

In the second phase of this thesis, heuristic evaluation (Shneiderman & Plaisant, 2005) was used as a method to assess how well the existing digital mental health and wellbeing websites and applications for children and youth follow the principles presented in the framework. The set of websites and applications assessed (n=49) was received from a systematic review of existing digital mental health and wellbeing applications (n=181). The set of 49 resources was achieved by excluding resources that 1) did not include signs about being targeted to children or youth 2) included content that was, for the most part, targeted to adults 3) did not include enough digital mental health or wellbeing

content for children or youth 4) could not be reached at the time of the analysis or 5) were created for promotional purposes. The underlying review of existing digital mental health and wellbeing resources (n=181), as well as this thesis, are a part of the Awareness, Prevention and Early Intervention (APEX) research project that is carried out as a joint venture between the University of Turku (Coordinator), the University of Eastern Finland, the University of Jyväskylä, Dalhousie University and IWK Health Centre. The research project is funded by the Academy of Finland Strategic Research Council (SA303582). Both the review of existing resources as well as this thesis are carried out as a part of the research activities of the APEX Digital Mental Wellbeing Literacy subproject in the University of Jyväskylä.

The relevancy of this thesis is especially visible in the aim of the research, which is to create new information of a rather sparsely researched area. For example, there are not many online interventions that have been specifically designed with the goal of promoting resilience and wellbeing in the youth population (Baños et al., 2017). Digital environments are an ever-greater part of our everyday life, and with this growth there is also an increasing need to study the use potential of digital resources in different life areas (e.g. health, wellbeing, learning and quality of life). The framework provided can be utilized to create standards for the creation and development processes of digital mental health and wellbeing resources targeted to children and youth, as well as to support the development of individual resources. The assessment of existing digital mental health and wellbeing resources, in turn, provides valuable insights regarding the quality of resources that are available to children and youth online. All in all, this thesis provides unique information about child and youth mental health and wellbeing website and application design from human-centered technology point of view.

In the second chapter of this thesis (following the introduction), user interface design for children and youth is discussed. The third chapter, in turn, discusses how technology can be utilized in mental health and wellbeing promotion among children and youth. In the fourth chapter, factors affecting the design of mental health and wellbeing resources for children and youth are discussed. In addition, a framework for designing digital mental health and wellbeing resources for children and youth is constructed. In the fifth chapter, the data collection and analysis processes utilized in the heuristic evaluation of existing digital mental health and wellbeing resources are discussed. In chapter six, the results of the evaluation are presented and discussed in comparison to earlier research covered in chapters two through four. Finally, in chapter seven, the results of the thesis as well as the significance of the results are discussed with implications to future research.

2 DESIGNING USER INTERFACES FOR CHILDREN AND YOUTH

Considering the special characteristics of the intended user group is an essential step in any technology development process. One should not overlook the complex nature of modern users, since they can be viewed as social actors who perform in different roles depending on the context (Lamb & Kling, 2003). According to Shneiderman and Plaisant (2005), for example cognitive abilities, cultural background and age of the user cause variance in recommended design actions. However, when UIs are designed and developed carefully in an iterative manner, there is a greater chance that they become more suitable to the end user (Nielsen, 1993), which facilitates the operations performed by the user.

It is essential to ensure that the fundamental design heuristics and established principles are considered before adjusting the interface for children and youth. In the history of web and mobile design, numerous UI design alternatives have been experimented with, and there is a reason why certain designs maintain their popularity over others. For example, according to Velasco-Santos, Laureano-Cruces, Mora-Torres and Sánchez-Guerrero (2008) UI design can be divided into two main elements: 1) visual design and 2) functional design. The first element, visual design, relates to the implementation of graphic elements that guide the intuitive use of the interface and ensure the aesthetics. Functional design on the other hand relates to the arrangement of the screen elements, which should ensure the ease of navigation (Velasco-Santos et al., 2008). Examining UI elements in smaller entities makes it easier to form a picture of the interplay between visual and functional design and how this can be improved through means of design.

There is no universal design that pleases everyone, but the basic use of an interface can be facilitated by considering what makes child and youth target groups unique compared to adult users. Children growing up with technology have the opportunity to deepen their understanding of different technologies and become teenagers who are fluent in using technology. The may also support their parents and older relatives in technology use. However, this may require easy access to technology, as well as an environment that supports tech-

nology use, including enough money to purchase technology and enable functional use (Shneiderman & Plaisant, 2005).

When technologies are designed for younger children, there are several aspects of their technology use that need to be taken into account. For example, the difficulties of children to operate with touch panels have been covered in past research (Chang, Tsai, Chang & Chang, 2014; Quinn, Bederson, Bonsignore & Druin, 2009). According to Shneiderman and Plaisant (2005), the manual dexterity of children is still evolving, and thus, reaching small targets and double-clicking is not always possible. In turn, the evolving literacy skills of children may make the displayed instructions and error messages rather ineffective. In addition, the researchers acknowledge that it might be hard for children to understand complex sentences, since their capacity for abstraction is low. Other challenges include short attention span as well as not being able to efficiently work with multiple concepts at the same time (Shneiderman & Plaisant, 2005). However, since modern technologies are different, they also demand various actions from children and youth. Thus, it is essential to inspect technologies as their own entities to be able to form a realistic view of what they require from different user groups.

2.1 Web Design

Because of their long history, websites are generally associated with user interface design. In fact, using the search term "website design" in Google Scholar returns about 40 400 search results (search conducted in 01/21/18). Thus, it can be argued that website design is undoubtedly an area of comprehensive research. In their study, Rosen and Purinton (2004) state that web content is one of the main factors affecting the continuity of user visits. According to the researchers, this makes the picture, graphic, layout and sound decisions critical for the effectiveness of web design. However, content design is not only about selecting the right elements for a certain audience, but it also includes the placement of those elements in a way that increases the ease of use (Rosen & Purinton, 2004). Thus, with proper and thorough web design, the possibility of designing appropriate content to the appropriate audience can be increased.

According to Martens (2012), there are two aspects that need to be considered once digital resources are developed for children: 1) translating physical environments to online environments and 2) translating search terms into a language that is natural to children. In this sense, it is essential to keep in mind that children are still growing. This means that their motor, linguistic and abstract thinking abilities and skills are not at the same stage as adults and youth, which makes it difficult for children to find information (Martens, 2012). Thus, as children are increasingly being exposed to computer technologies, they need to be designed with the abilities, interests and developmental needs of children in mind (Hourcade, 2008). Research on the experiences of children with digital

resources is not only advantageous for children, but it can also provide insights into designing for other groups with developmental limitations (Martens, 2012).

In a study conducted by Livingstone (2007), a group of youth examined an example website that was intended for youth. One of the observations made by the group was that the target audience of the site (13–19) was too broad. If the website was viewed as it was made for a younger audience, the content felt patronizing to the participants, while content created for an older audience seemed boring (Livingstone, 2007). In fact, an analysis of data collected from 923 users of a leading virtual world for teenagers (HabboHotel) shows that intrinsic motivation, interpersonal influence and self-efficacy are important factors affecting the decision for teenagers to stay in virtual worlds (Mäntymäki et al., 2014). These research results could imply that youth have a strong sense of what a website for their age group should look like and that they are motivated to use virtual environments that are specifically designed for them. Thus, trying to design for multiple age groups may be problematic and more attention should be paid towards the characteristics of youth within a certain age group.

Naidu (2008) examined how well 7–11-year-old children were able to carry out tasks on educational websites targeted to children. Perhaps the most interesting observation made by the researcher was that while children preferred websites that included interactive elements, having too many frames caused them confusion. In addition to this, tables with too many details as well as links that were not correctly organized added to their cognitive load, especially in the case of the younger children. Other problematic areas included the use of metaphoric icons, excessive animation and plug-ins required by the site (Naidu, 2008). Thus, web design needs to acknowledge the developmental limitations of children, but also the desire of both children and youth for environments that are meaningful, engaging, and to which they may identify.

2.2 Mobile Design

Mobile design has not been around as long as website design and it has traditionally borrowed ideas from other media (Fling, 2009). Thus, the practices are not as researched, established and unique as in the case of web design. However, mobile design has come a long way from its early years, and the mobile design of today can be seen as a world of its own. Since designing mobile games and applications can be viewed as a trending topic, there is still a lot of debate surrounding how to choose best design practices for different operating systems. Thus, trying to make sense of a field that is still going through rapid changes is a challenge that mobile designers need to keep in mind while trying to find the right content for their intended audience.

Mobile technologies bring many advances and new possibilities to child and youth education compared to traditional computers. Whereas computers provide perhaps their best utility when children remain indoors in a stationary position, mobile devices can be utilized in more diverse circumstances and even

combined with physical activities (Druin, 2009), for example with the use of augmented reality (AR) and virtual reality (VR) technologies. Even though mobile and web design are two completely different fields, in both cases good design goes a long way. Working mobile navigation is mostly invisible, in the sense that completing tasks seems simple regardless of the type of task at hand (Neil, 2014). In addition, simplicity is highly appreciated in mobile design practices, especially because simple UIs with larger fonts work better on small devices (when compared for example with trying to scroll traditional websites on small screens). Thus, in mobile applications, it would be preferable to use forms that do not require much input from the user (Neil, 2014). However, every designer should remember, that simple can be both clear (simple enough) and confusing (too simple).

Skiada, Soroniati, Gardeli and Zissis (2014) explored the possibility of using a mobile application to enhance learning for children with learning difficulties. The researchers conducted an evaluation with a group of children, who all preferred mobile devices over paper when completing the tests. In addition, the researchers were able to observe progress in the game performance of children over a short period of time (Skiada et al., 2014). Even though conclusions cannot be made due to the preliminary phase of the study (Skiada et al., 2014), the results indicate that mobile applications are indeed an option that children favor in learning, which might also facilitate engagement in these environments. Masood and Thigambaram, in turn, studied the usability of educational applications operated on tablets in 4–5-year-old children (2015). The results of the study indicate that mobile applications are designed according to adult or developer mental models, which affects their usability to younger children. This calls for mobile UI design that better takes into consideration the developmental stage of the user. As a result, the researchers propose guidelines for child UI design, which consists of four dimensions: navigation, presentation, content and interaction (Masood & Thigambaram, 2015). These dimensions are presented in Table 1 with example guidelines.

TABLE 1 Guidelines for Child User Interface Design (adjusted from Masood & Thigambaram, 2015)

Dimension	Example Guidelines
Navigation	Navigation should help users stay oriented; alternative navigation can be provided; navigation should match the mental model of the user
Presentation	The visuals used should be clear; colors should be used consistently; graphics should be relevant to the layout or learning objective; text should consist of simple and easy to understand language
Content	Content should be comprehendible in text and audio for children who are unable to read; audio instructions can be used for younger children
Interaction	User interface controls should be provided; error handling and feedback need to be understandable to children

Chang et al. (2014) studied the ability of children, youth and the elderly to use different sized touch panels (dragging, rotating and scaling). They discovered that both the touch panel size and age affected the operating performance of users. According to the results, children and elderly subjects had a lot more difficulties to operate touch panels when compared to young adults. However, the hand movements used by the three age groups were not very different from each other. The researchers suggest that the performance of children with 4.3-inch touch panels could be improved by allowing them to drag items by first selecting the item to be dragged and then tapping the desired location to move the item there (Chang et al., 2014). Similar results were recorded by Quinn et al. (2009), who suggested that using one finger to lock input focus on an item and using another one to resize the item might be a better way for elderly and children to perform this action. In addition, an on-screen rotatable button should be included in 23 and 42-inch touch panels to decrease the load of rotating the device (Chang et al., 2014). Thus, the stage of motor-cognitive processes as well as mental models of the age group need to be considered to make mobile interfaces more suitable to children and youth.

2.3 Game Design

According to Dede (2009), immersion in a digital environment can be utilized to enhance education. This is possible because immersive environments allow the occurrence of situated learning, transfer and multiple perspectives (Dede, 2009). The benefits of immersion are especially relevant to digital games, since these allow children and youth to feel like they have their own role to play in the story of the game. In fact, Amory, Naicker, Vincent and Adams (1999) inspected game types and game elements in four commercial computer games. Their study included 20 biology students who were requested to rate the entertaining and educational aspects of these games. According to the results, the students preferred adventure and strategy games because of the stimulation they provided. In addition, storyline, graphics and sound were identified as important aspects. The authors conclude that adventure games could be the most suitable type for educational games and they could also support the occurrence of intrinsic motivation (Amory et al., 1999). Similar results were recorded by Dondlinger (2007), who conducted a literature review focusing on research publications that analyzed educational game design. The results indicate that game design elements such as narrative context, goals, rewards and interactivity seem to be advantageous in reaching the desired learning objectives (Dondlinger, 2007). Thus, games including stories and different levels to progress on have the potential to promote engagement as well as the achievement of educational outcomes.

Since game elements seem to enhance learning, the use of these elements in non-game contexts has gained interest in the last few years (Deterding, Dixon, Khaled & Nacke, 2011). In a recent study, Sailer, Hense, Mayr and Mandl (2017)

inspected different game design elements within the self-determination theory framework, since they had noticed that previous studies had viewed gamification as a rather generic construct that supports human motivation and performance. Thus, the authors were interested in knowing how the fulfilment of basic psychological needs can be observed on the level of individual game design elements. According to the results, badges, leaderboards and performance graphs have a positive effect on competence need satisfaction and perceived task meaningfulness. In addition, avatars, meaningful stories and teammates have an effect on the experience of social relatedness. Thus, the researchers conclude that gamification as a general construct does not have specific psychological effects, but these effects can be perceived in the level of individual design elements (Sailer et al., 2017). However, the classification of technological resources into games or gamified applications can be challenging, since this cannot be done without considering the intention of the developer or the user experience (Deterding et al., 2011).

Merikivi, Nquyen and Tuunainen (2016) examined the role of perceived enjoyment in continued mobile gaming. The researchers noticed that enjoyment directly affects intentions for continued use. In addition, three variables originating from the gaming experience (design aesthetics, perceived ease of use and novelty) seem to affect enjoyment in this context (Merikivi et al., 2016). Thus, the interplay between design and enjoyment should be considered already in the developmental stage of new games. In addition, it would be interesting to study how enjoyment could be added to games with educational outcomes.

Koivula and Mustola (2015) conducted a study on the digital play of preschool aged children (6 years old). The results indicate that children use ideas from games quite flexibly in their play (e.g. game characters) and thus, the researchers conclude that digital games are not a threat to traditional play. In fact, combining technology with traditional play might enable the formation of new and interesting types of play for children (Koivula & Mustola, 2015). It has been established that video games can elicit positive experiences through multidimensional and dynamic emotional experience chains (Triberti, 2016) and thus, the potential of video games in positive child and youth development should be considered in future research efforts.

2.4 User Interface Design for Children and Youth

According to the reviewed literature, it seems that user interface design can benefit greatly from considering the opinions of children and youth as well as taking into account the unique properties of these target groups. In addition, essential to keep in mind is the fact that child and youth UI design is not only about adjusting interfaces to create a better user experience. Instead, functional UIs allow children to perform tasks that are interesting to them, e.g. to produce and share their own creations which, in turn, can be advantageous to their personal and social development (Shneiderman & Plaisant, 2005). Even though

established heuristics cannot be overlooked, there is a need to realize that these are usually constructed with adult mental models and thus, are natural and logical above all to adult users. Considering web and mobile UI design heuristics from child and youth perspectives can also make understanding the logic underlying these principles somewhat easier.

The guidelines established by Masood and Thigambaram (2015) provide a good starting point for child UI design. However, these need to be situated into each context uniquely. The continuously developing motor, cognitive and social skills should be an essential starting point for any heuristics that are created to facilitate child UI design. In the case of youth, websites and mobile applications should be designed for their age group in the sense that the visual design is pleasing to them and follows the trends of newest technologies, while the content remains understandable and natural to young users. Language that is too basic should be avoided since this might feel patronizing (Livingstone, 2007), but using too complex language might make the content, and respectively, the entire resource obsolete to these age groups. Thus, it is crucial to realize that children, youth and adults all require content that is specifically created for their age group, through technology that functions intuitively and naturally to them.

When reviewing the literature, the fact that child UI design heuristics could benefit the elderly users as well could not be overlooked. This might be true in the cognitive sense due to the fact that some effects of cognitive development and decline are rather similar in normatively maturing humans. For example, the effect of right ear advantage (subjects in a dichotic hearing tasks are better at correctly identifying the timing of stimuli with their right ear) is quite similar in groups of 5–7- and 59–79-year-old subjects. This is due to the fact that both groups have difficulties in correctly identifying the timing of stimuli coming to their left ear regardless of their focus level (Hämäläinen & Takio, 2010). Thus, even though the needs and preferences of child and elderly users are not similar in every area, it could be beneficial for child UI design to learn from the already established and quite researched principles of design for older adults (see e.g. Farage, Miller, Ajayi & Hutchins, 2012; Hart, Chaparro & Halcomb, 2008; Chadwick-Dias, McNulty & Tullis, 2003; Holt & Morrell, 2002; Zajicek, 2001).

3 MENTAL HEALTH AND WELLBEING IN THE DIGITAL AGE

The emergence and development of digital technologies has brought new possibilities to the application of mental health related information. This has led to a situation, where new skills are required from consumers for them to be able to benefit from the non-traditional information forms and sources. Literacy types such as critical literacy (e.g. Shor, 1999), digital literacy (e.g. Eshet-Alkalai, 2004) and computer literacy (e.g. Simonson, Maurer, Montag-Torardi & Whitaker, 1987) have evolved with new technologies, and need to be combined with skills in health literacy (e.g. Bröder et al., 2017; McDaid, 2016; Sørensen et al., 2012) as well as mental health literacy (e.g. Jorm, 2012; Jorm, 2000), to enable efficient use of online mental health resources. The resulting multidimensional literacy skill sets are a necessity in today's technology-oriented world. However, there are various factors affecting this competence that need to be accounted for to form a realistic view on the interaction between consumers and digital mental health resources.

In a study conducted in 2002, Eysenbach and Köhler observed health information retrieval skills of 21 internet users. According to the results, consumers evaluated the credibility of a website by assessing the ease of use, language used, source in general and how official, professional or scientific the website seems. In addition, the users only explored the first search result links when looking for health information. The researchers also noticed that the users did not generally attempt to verify the credibility of the source by for example checking the about us section on the website (Eysenbach & Köhler, 2002). Even though the internet and its users have evolved from the time of the study, it is essential to pay attention to the tendencies of users to look for easy and fast information, especially when the trustworthiness of information and its source is overlooked in the process.

3.1 Child and Youth Mental Health

Even though children have their unique ways to interact with digital technologies as well as process mental health related information, they cannot be examined separately from their surroundings. The role of parents, teachers and relatives as guides, as well as educators, is essential to child development (e.g. Cochran & Brassard, 1979). In addition, the competence of these adults in digital technologies as well as health and mental health related topics affects their ability to assist children within this field. Of course, the need for parental support decreases as children grow older, but sufficient support in the early years facilitates the ability of a child to independently increase competence in these areas later in life. Thus, children should always be viewed in their social-developmental context.

According to Fok and Wong (2002), the understanding that younger children have of health is at a rather superficial level and thus, they might not possess the skills to maintain health and become healthy adults. This highlights the role of teachers and caregivers as educators in this field and the effects of their competence to the development of health literacy in children. In a recent study, Baker et al. (2017) inspected the effectiveness of an online parenting intervention for parents of children with conduct problems. Even though these kinds of interventions are still quite new, the researchers found out that a brief online intervention targeting child conduct problems can be effective in improving dysfunctional parenting, parental confidence and child behavior (Baker et al., 2017). In turn, a follow-up study on the preventative effects of a parenting intervention targeting preschool aged children reveals that an intervention aimed towards parents can be especially beneficial in the case of girls at risk of internalizing (Rapee, 2013). Thus, child mental health can be efficiently enhanced by providing support to caregivers.

Elford et al. (2014) conducted a study on delivering psychiatry services over a videoconferencing system. All the children and parents participating in the study liked the system, and up to 56% of the children expressed that they preferred the ‘teledoctor’ over a physical doctor (Elford et al., 2001). Thus, delivering mental health services to children over the internet shows promise in the terms of acceptability among both the patients and their caregivers. Based on the reviewed literature, children do not possess sufficient skills to promote their own health. However, good results can be achieved by tackling the mental health skills of caregivers. In addition, providing mental health interventions over the internet might even be preferred by children and caregivers, which provides interesting opportunities for child and parent mental health interventions in the future.

While youth still require support, the role of teachers and parents has clearly decreased within this population while the role of peers has increased. Thus, there is a need to make mental health related topics understandable to youth to enable self-help as well as the possibility to provide support to a friend

in need. However, school-based programs to increase knowledge of mental health can be efficient in this population (e.g. Milin et al., 2016). Thus, one of the important aspects is to empower youth to take control of their own mental health and encourage them to become aware of the effects that their actions and beliefs have (Jorm, 2012).

Boydell et al. (2014) conducted a literature review on delivering mental health services to children and youth. The researchers noticed that internet and other technologies may be advantageous in delivering mental health information and mental health services to these age groups in a more cost-effective and efficient manner. However, the researchers acknowledge the privacy of data delivered through technology as an important aspect to be considered in the provision of mental health services over the internet. Nevertheless, it seems that youth even prefer treatments that are offered to them via technology (Boydell et al., 2014). As a result, online interventions can be viewed as a viable option for youth mental health, as long as the privacy of the data in different information systems is ensured.

Hansen et al. (2003) inspected the health information search patterns of youth (12–17 years old). Out of all participants in the study, the older youth (16–17 years old) were successful in finding correct answers to health-related questions 87% of the time, with this number being 68% in the case of the younger youth (12–15 years old). However, youth seemed to be in general very confident in searching online health information regardless of their age. They had a clear strategy for formulating strings (terms and symbols used to conduct searches) and choosing the website they wanted to explore (usually trial-and-error approach). However, they also had difficulties in finding the right answers even in cases where the information was visible on the site they were currently inspecting (Hansen et al., 2003). Similar results were also found by Gray et al. (2005), since they observed deficiencies in the functional, critical and interactive skills of 11–19 years old youth relating to online health literacy. Thus, mental health websites aimed towards youth could benefit from the provision of information in a light form that is easy to find, at least in the case of questions that youth tend to ask about mental health.

Gulliver, Griffiths and Christensen (2010) reviewed studies on mental health help-seeking among youth, focusing on the perceived barriers and facilitators. They noticed that stigma, embarrassment, problems with recognizing symptoms and self-reliance were the biggest barriers for help-seeking. In turn, positive past experiences, social support and encouragement were perceived as facilitators. The researchers conclude, that future efforts to improve help-seeking among youth should focus on attempting to reduce stigma, enhance mental health literacy and acknowledge the youth's desire to be self-reliant (Gulliver et al., 2010). Thus, mental health resources provided to youth over the internet could facilitate help-seeking, as long as collected data is secured, and the information provided is easy to find and understand.

3.2 Child and Youth Mental Wellbeing

Mental wellbeing can be viewed as an emerging topic in the field of mental health, especially due to the fact that mental health has traditionally been viewed as the absence of mental illness (e.g. Keyes, 2005). In general, research surrounding mental health seems to focus on the negative aspects, for example in terms of mental health literacy that was first defined as the knowledge of mental disorders (Jorm, 2000). This is, however, rather a simplistic view to have on a multidimensional construct. Thus, recent research efforts have included the aspects of attaining and maintaining positive mental health to the definition of mental health literacy (e.g. Kutcher, Wei & Coniglio, 2016). Mental wellbeing as a term highlights the aspect of concentrating on the strengths of individuals or groups in maintaining and promoting good mental health. In addition, mental wellbeing allows keeping in mind that mental health can be strengthened regardless of a co-occurring mental health problem.

There is quite a lot of different terminology that relates to the field of mental wellbeing. For example, Bjørnsen, Espnes, Eilertsen, Ringdal and Moksnes (2017) have studied positive aspects of mental health literacy (positive mental health literacy, PMeHL) as well as mental wellbeing in youth population. According to the study, there is an association between positive mental health literacy (PMeHL) and mental wellbeing in youth. Even though female respondents reported lower mental wellbeing compared to males, the current study indicates that gender differences associated with mental health literacy are small. However, the education and financial wealth of parents as well as the age and gender of a young person do affect their mental wellbeing, and these effects cannot be overlooked (Bjørnsen et al., 2017).

Hall, McKinstry and Hyett (2016) examined the perceptions that youth using mental health services had of positive mental health. According to the results, personal, occupational and environmental factors are important in how positive mental health is viewed. In addition, the researchers stress the importance of engaging youth in building definitions, as well as increasing knowledge of the developmental needs of youth among mental health service providers (Hall et al., 2016). Thus, it is essential that positive mental health is encouraged among youth living with existing mental health problems as well, since promoting positive mental health is useful to any child or young person regardless of their mental health status.

Even though digital resources bring new opportunities for the enhancement of mental wellbeing, the potential negative effects of digital-screen use need to be acknowledged once mental wellbeing of children and youth is being discussed. In a recent study, Przybylski and Weinstein (2017) studied the negative effects that screen use has on the mental wellbeing of youth. One of their main findings was that moderate use of technology is not harmful itself, and in turn, moderate use might be even useful to youth in today's connected world. However, the researchers point out that digital screen use should be moderated

to some degree by the caregivers. Nevertheless, perhaps even more important to the mental wellbeing of youth is whether the technologically-based activities are shared between youth and their caregivers, since this allows the emergence of shared experiences (Przybylski & Weinstein, 2017)

Rose et al. (2017) reviewed instruments developed to measure mental wellbeing among youth. In their study, they emphasize that adult-developed mental wellbeing measures should be more widely validated among youth. In addition, the cultural and conceptual relevance of these instruments in the youth population should be confirmed (Rose et al., 2017). In addition, it is important to recognize that youth might view mental wellbeing differently than adults. For example, a study on the views of youth girls living in Northern Finland shows that the adolescents taking part to the study viewed good mental health as a state that enables psychological wellbeing with the absence of mental illness (Wiens, Kyngäs & Pölkki, 2014). Thus, there is a need to be able to define what mental wellbeing actually means to children and youth and how this can be appropriately quantified in studies. There might also be a need to educate these groups about the relationship between mental wellbeing and mental health problems, since these are not exclusive constructs (see e.g. Kutcher et al., 2016).

3.3 Mental Health and Wellbeing – How to Engage Children and Youth

Even though children and youth are all individuals with different interests and preferences, certain recommendations considering the discussion of mental health and wellbeing topics in child and youth populations can be made based on the reviewed literature. For example, youth should be included in decisions that affect their life. In the context of online mental health and wellbeing, this means that youth should be engaged by making them co-developers of new mental health resources and diminishing the role of adults as leaders of these projects (King et al., 2015). Children and youth have a much better view on what is trending in terms of technology in their age groups and thus, they also have a better take on how to approach different topics in an engaging manner. That being said, digital mental health and wellbeing resources should be developed with children and youth instead of simply trying to design for them.

Even though in ideal situations mental health resources and technologies would be readily functional to children and youth, we cannot design these without assessing the competence of these age groups. For example, in terms of health literacy, we need to acknowledge that children and youth have very different skills in acquiring, assessing and applying health information when compared to adults (Bröder et al., 2017). Thus, the mental health and wellbeing content provided to them must be in a form that can be understood by them without excessive effort. By combining the right design elements with apposite

mental health or mental wellbeing content to each age group, there is a much better chance to create resources that are not only easy to use to children and youth, but also preferred over other digital resources.

4 DESIGNING DIGITAL MENTAL HEALTH AND WELLBEING RESOURCES FOR CHILDREN AND YOUTH

Based on the previous chapters, it can be argued that there are two fundamental aspects that need to be considered when designing digital mental health and wellbeing resources for children and youth: competence and support. On the one hand, children and youth are always at a certain competence level when interacting with mental health resources, which has to be acknowledged when assessing their ability to complete tasks. On the other hand, we cannot assume that children and youth are as competent as adults in accessing, evaluating and applying mental health and wellbeing information. In addition, parents, teachers and peers themselves have their own competence levels, which influence their ability to provide adequate support. Thus, we can view the ability of children and youth to efficiently use mental health and wellbeing technologies as interplay between competence and support (Figure 1).

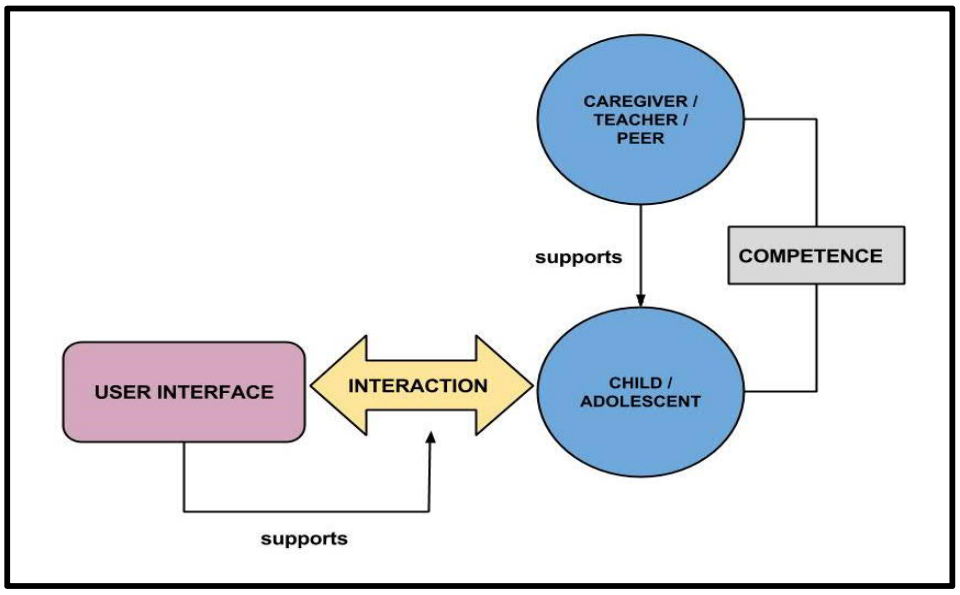

FIGURE 1 Child and Youth Technology Use Environment

As established in Figure 1, people are not the only source of support for children and youth, since any digital resource can be designed to support and guide the user. However, this support is not always present, especially when the interface is not designed for the right audience. Even though mental health resources are sensitive in terms of their topic, with adequate privacy functions, child and youth UI design principles can be utilized just as much with mental health and wellbeing as with any other topic. Design, however, needs to be adjusted to the content, and the formation of context specific heuristics begins by observing recent efforts in the field. Luckily, the views of children and youth regarding mental health and wellbeing technologies have been thoroughly reviewed (e.g. King et al., 2015; Wetterlin et al., 2014; Rasmussen-Pennington, Richardson, Garinger & Contursi, 2013).

Baumel and Muench (2016) conducted a literature review to create heuristics for eHealth interventions (Table 2). These include usability, aesthetics, safety, content, engagement, persuasive design, research evidence and the owner's credibility. According to the established heuristics, it is important that eHealth interventions and technologies are carefully designed to suit their intended target groups without compromising the user's privacy or the desired outcomes of the intervention. The researchers especially highlight the importance of finding a balance between proper usability and research evidence on the intervention efficiency. After all, any product can be usable without therapeutic potential, but therapeutic potential occurs only when products are usable (Baumel & Muench, 2016).

TABLE 2 Heuristics for eHealth Interventions (adjusted from Baumel & Muench, 2016)

Heuristic Dimension	Example Heuristics
Usability	Consistency and standards are used; burden and effort are reduced
Aesthetics	Design is aesthetically appealing; design is appropriate for the target audience
Safety	User privacy is protected; data security is ensured
Content	Clearness, logicalness and correctness of content is ensured; content is comprehensive but concise
Engagement	The resource is interactive; the resource is entertaining
Persuasive Design	The resource sufficiently motivates and triggers desired behaviors; the users are educated about the relation between user actions and desired outcomes
Research Evidence	Data exists for example from randomized controlled trials; the organization that has administered the research regarding the eHealth intervention is credible
Owner's Credibility	The source is legitimate; there is clinical-thought leader input from an advisory board

According to Kayser et al. (2015), the usability and effectiveness of eHealth products and systems can be improved by involving end users in the design process. To do this, the researchers have introduced a five-step process on how to consider the needs and competences of the users in the design of ICT technologies for health care (Table 3). The researchers emphasize the importance of actively involving both professional developers and typical end users in the process to enable the creation of a system that corresponds to actual user requirements (Kayser et al., 2015). Thus, the framework proposed by the researchers follows the principles of co-design.

TABLE 3 A Five-Step Process for Requirements Specification in eHealth ICTs (adjusted from Kayser et al., 2015)

Phase	Description
Step 1: Brainstorm groups	Recruitment of developers and a user panel consisting of typical end users
Step 2: User and task characteristics	Specifying the characteristics that the users of the system would have and the tasks that they would need to carry out
Step 3: Initial user-task-context matrix	Formalizing the ideas from the previous step by creating the first draft of a user-task-context matrix (key characteristics in each area)
Step 4: Feedback	The structure of the initial matrix is discussed and inspected more closely
Step 5: Refinement of the initial matrix	The initial matrix is adjusted based on the feedback

Both of the above mentioned studies bring the needs, characteristics and required operations of the end user to the center of the development process. Thus, when designing systems that are intended to be used by children and youth, the developmental phase of the age group as well as the technological environment they have grown up with need to be considered as traits that strongly relate to them as well as their ability and willingness to use the system at hand. However, this needs to be done without compromising the possible psychological advances gained from the mental health or wellbeing purpose that the technology is used for. Nevertheless, the technology cannot only be viewed as a tool to provide access to mental health or wellbeing contents. Yet, its full potential and value should be utilized to enable immersive and interactive experiences in educational or therapeutic context. Thus, there is a need to view mental health and wellbeing technologies not only as utilitarian means to achieve better mental health or wellbeing, but also as hedonic experiences where value is created through fluent and enjoyable technology use.

4.1 Mental Health and Wellbeing Websites

As noted in the previous chapter, there are many ways to facilitate the use of a website by means of design. It is safe to say that the most suitable design for a website depends on the content provided to the users as well as the intended use cases. Websites differ greatly in terms of functionality, and thus there is no universal design that works in every context every time. However, some common design principles should be considered when mental health and wellbeing websites are discussed.

Many mental health websites focus on providing the user with information relating to mental health. Thus, various studies have focused on what youth expect from online youth mental health resources (e.g. Wetterlin et al., 2014; Rasmussen-Pennington et al., 2013). According to Rasmussen-Pennington et al. (2013), youth aged 12–18 experience social media as a problematic source for mental health information. In addition, they state that interactive elements as well as mental health information generated especially for their age-group would be engaging to them (Rasmussen-Pennington et al., 2013). These findings stress the importance of designing youth mental health websites with the specific age group in mind. Wetterlin et al. (2014), in turn, explored the experiences that youth (aged 17–24) had of mental health resources (online / offline) and the expectations they had regarding mental health websites. In coherence with Rasmussen-Pennington et al. (2013), the findings of the study indicate that youth are rather reluctant to use social media websites for mental health information or help-seeking purposes. However, most participants indicated that they would use an information-based website to help them at a difficult time. Thus, the researchers conclude that information about mental health problems and resources, as well as social support, are necessities in web-based platforms. In addition, the design actions assuring the privacy of the user should be more carefully considered (Wetterlin et al., 2014).

Even though readability of online mental health materials is essential for any user group, this need is especially highlighted in the case of children and youth. King, Winton and Adkins (2003) conducted a study on the readability of child and youth mental health internet brochures. According to the study, the content of the seven examined brochures was noticeably above the recommended 8th grade reading level. In addition, the presentation and explanation of new words did not support readability and the font sizes were too small (King et al., 2003). Thus, by considering the reading levels of the intended user group, there is a better chance to provide information that is efficient or at least possible for them to use.

While a lot of research on mental health resources has been carried out within the Canadian population (e.g. King et al., 2015; Wetterlin et al., 2014; Rasmussen-Pennington et al., 2013), Drost, Krieke, Iedema den Boer, Sytema and Schippers (2017) have investigated the role of social support in online chat sessions among Dutch youth. The studied website was developed for youth

who had a family member living with a mental illness. According to the results, there was a positive correlation between sent disclosures and social support received. The chatroom was used to exchange a notable amount of social support and the participants used this channel to discuss the problems with their home situation in both peer and professional-lead conversations. The researchers conclude that chatroom sessions have the potential to help build a peer support network among youth who are not easily reached by professionals (Drost et al., 2017). Thus, mental health websites can be helpful within populations that do not correspond to traditional mental health interventions.

Following the increasing interest to foster the mental wellbeing of children and youth, websites focusing on promoting mental wellbeing have emerged online. The effect that these websites have on wellbeing has been studied, but with somewhat mixed results. For example, in the case of a web-based positive psychology program called BiteBack, the researchers noticed that youth using the website for 30 minutes or more every week experienced a significant decrease in stress and depression and improvements in wellbeing (Manicavasagar et al., 2014). However, similar results did not occur when participants used the website in a school context as a structured online positive psychology program (Burckhardt et al., 2015). Thus, it could be argued that voluntariness and inner motivation play a great role in the effectiveness of online mental wellbeing programs.

Baños et al. (2017) conducted a review of existing interventions designed to promote positive mental health in youth. The researchers noticed that many online positive interventions have been developed, and these are mainly executed through websites. However, the interventions should be designed by considering the characteristics of the intended target users. Another observation made by the researchers was that in terms of engagement, the suitability of the contents as well as the design elements to youth is very important (Baños et al., 2017). Based on the reviewed literature, mental wellbeing websites should be offered to youth as an option, not as a structured intervention. In addition, design elements and content should be tailored to youth to foster engagement and intrinsic motivation

4.2 Mental Health and Wellbeing Applications

The mobile application design of today can be viewed as a trending topic when contrasted with the history of UI design. Thus, the standards relating to it may not be as established as in other fields (e.g. website design). This, in turn, can be both a blessing and a nuisance for both the users and developers. On the one hand, there is a lot of freedom to create a user interface that could serve the objective of the application but on the other hand, a unique and context specific user interface might not be intuitive and easy-to-use for intended end users. In addition, once all of this is executed in the field of mental health and wellbeing,

there is no shortage of important questions to be asked and hard decisions to be made.

Mental health applications (MhApps) are an emerging topic in mobile application design. Recently, various reviews on the prevalence of these applications have been carried out (e.g. Grist, Porter & Stallard, 2017; Radovic et al., 2016), which indicate that there is a growing interest in both developing mental health mobile applications as well as in studying their efficiency. According to Radovic et al. (2016), it seems that many MhApps found in the Apple iTunes and Google Play stores focus on relieving certain mental health related symptoms or generally educating about mental health. However, many of the applications lack information that would verify their stated effectiveness. Thus, if clinicians wish to use MhApps with mental health patients, it is advisable that they provide the patients with guidance on how to use the application as well as make sure that the patients have the possibility to assess the application utility (Radovic et al., 2016).

In turn, Grist et al. (2017) reviewed the research evidence on the efficacy and acceptability of MhApps among children and youth. They were able to find up to 24 publications describing 15 different applications. Even though feasibility outcomes suggested good acceptance and moderate usage, the researchers conclude that the current research evidence is insufficient to support the effectiveness of these apps (Grist et al., 2017). In fact, similar results about mental health applications were already received by Donker et al. (2013). Thus, more research is required to verify that MhApps are efficient, especially when their goal is to support children and youth living with mental health problems.

Even though there have not been many positive interventions that have been developed to operate on smartphones, these offer many possibilities for mental wellbeing programs because of their role as a channel of communication, socialization and entertainment for youth (Baños et al., 2017). Mental wellbeing applications are quite similar to applications focusing on mental health problems, except that their focus is on fostering mental wellbeing instead of increasing knowledge on mental disorders or attempting to work as an intervention to an existing mental health problem. It is not unlikely that some applications attempt to cover both of these topics and thus, it is sometimes challenging to situate an app in only one of these categories. However, some research attempts emphasize that their focus is in fact on mental wellbeing and positive mental health (e.g. Kenny, Dooley & Fitzgerald, 2016).

In 2014, a group of researchers examined the views that youth have on positive mental health applications (Kenny et al., 2016). The researchers asked youth (15–16 years old) questions about using mobile apps to promote positive mental health and what they thought of a MhApp prototype presented. The participants stated that safety, engagement, functionality, social interaction, awareness, accessibility, gender and youth being in control are important factors for MhApps designed for youth. Out of these eight factors, safety, engagement and functionality seemed to be the most prevalent concerns (Kenny, et al., 2016). The findings of the study support the view that paying careful attention

to the functionality of a mobile application UI as well as its engagement to the user increases the chance for it to be acceptable among the intended target group.

4.3 Mental Health and Wellbeing Games

As established in the previous chapter, games are a great channel to reach children and youth, since a lot of social interaction and networking in these age groups happens through online games. Thus, for these age groups, environments that encourage social interaction can be seen as natural to them. In addition, games and gamification facilitate the prevalence of flow while using a technological device, which could be the key for making educational and otherwise advantageous content more engaging. However, there is a need to consider how educational material can better be combined with gaming elements in an intuitive way, without making the educational purpose too obvious or over-powering. These questions are also relevant in games that include mental health or mental wellbeing related content, regardless of their objective. With an ever-growing interest in gamification, mental health games have become an area of great interest to researchers who are attempting to create approachable and enjoyable interventions for children and youth (see e.g. Lau et al., 2017; Li et al., 2013). This might sound reasonable at a theoretical level, since playing digital games is prevalent among these age groups. Thus, it would make sense to go into the environment where the intended focus group prefers to spend their time. However, the field of mental health games is perhaps not as simple as could be hoped.

Lau et al. (2017) conducted a systematic review on the effectiveness of mental health games in reducing disorder-related symptoms. They reviewed and analyzed randomized controlled trials targeting 7–80-year-old subjects. Based on the analysis, the authors came to the conclusion that serious gaming interventions may be effective for this purpose. However, the number of meta-analysis comparisons in the study was quite small and the authors acknowledge that there is a need to increase knowledge of the efficacy in the case of specific mental disorders, as well as to inspect the long-term effects of serious mental health games (Lau et al., 2017). Li et al. (2013), in turn, studied the effects of a web-based game designed to improve the mental health literacy of youth (17–25 years old). The game was implemented through a social networking site. According to the study, the game was effective in enhancing users' mental health literacy (Li et al., 2013). This is interesting, especially since several studies have implied that social networking sites are not a preferable source of mental health information for youth (Wetterlin et al., 2014; Rasmussen-Pennington et al., 2013). Thus, there might be a need to discriminate between content to improve mental health literacy and general mental health information to be able to design suitable digital environments for youth.

Games focusing on mental wellbeing are perhaps the newest trend in the field of digital mental health and wellbeing technologies. Consequently, there are not as many studies conducted on the subject as there are for example in the case of mental health games. However, the increasing global interest on the matter has already set in motion a few research initiatives that are attempting to cover the possibilities of mental wellbeing games (see e.g. Huen et al., 2016).

Huen et al. (2016) conducted a study on how a digital game-based learning program can be used to enhance the mental health of secondary school students (mean age 12.6 years). The enhancement of mental health was measured by observing changes in psychological wellbeing. According to the study, engagement in the program enabled higher attainment of the learning constructs, which in turn, enhanced the psychological wellbeing of the students (Huen et al., 2016). The results of this study emphasize the importance of using gamification elements to increase user engagement in games focusing on mental wellbeing. Thus, mental wellbeing games should support the intrinsic motivation of the user, for example through voluntariness of participating to game activities.

4.4 A Framework for Designing Digital Mental Health and Wellbeing Resources for Children and Youth

The design processes of websites, applications and games are intrinsically quite complicated. When the context for these is mental health or mental wellbeing and the target group consists of children or youth, there are even more factors that need to be accounted for. As a result, it is hard to create universal heuristics that would work in any situation, even in the case of certain types of digital mental health resources. However, by increasing the abstraction level certain recommendations can be made.

Even though suggestions for reasonable design can be made based on the age of the user, some recommended design heuristics are quite general. Because of this, careful implementation of related design actions can benefit multiple target groups. Thus, design that supports engagement, co-design, verifying the source of the information as well as the efficiency of the resource use and privacy of data can be beneficial to any group that is using digital mental health resources. However, in the case of children and youth, it is especially important that the visual design, the functional design and the content provided are appropriately implemented to fulfill the goal of the resource. This is because adults tend to design resources that make sense from their own perspective. In addition, the role of the social support needed to use the resource is highlighted among child and youth population. Since children and youth are increasingly developing, the source, quality and degree of social support required changes over time as well. These heuristic dimensions, specific heuristics for children and youth as well as related references are presented in Table 4.

TABLE 4 A Framework for Designing Mental Health and Wellbeing Websites and Applications for Children and Youth

Heuristic Dimension	Heuristics for Children	Heuristics for Youth	References
1. The visual design of the resource is appropriate for its purpose	Interactive elements are used; tables and links are simple; animation is used with moderation; colors are used consistently	Visual elements that are relevant and interesting are used	Baumel & Muench, 2016; Masood & Thigambaram, 2015; Shneiderman & Plaisant, 2005; Livingstone, 2007; Martens, 2012; Hourcade, 2008; Naidu, 2005; Chang et al., 2014; Baños et al., 2017
2. The content of the resource is appropriate for its purpose	Natural language and simple sentences are used; content is comprehendible in text and audio	Critical information is presented in light form; content is tailored to one age group per time	Baños et al., 2017; King et al., 2003; Rasmussen-Pennington et al., 2013; Baumel & Muench, 2016; Shneiderman & Plaisant, 2005; Martens, 2012; Masood & Thigambaram, 2015
3. The functionality of the resource is appropriate for its purpose	Targets are big enough; double-clicking is avoided; interaction with objects on touch panels is divided into simple steps; alternative navigation is provided	Relevant information is made easy to find	Kenny et al., 2016; Baumel & Muench, 2016; Shneiderman & Plaisant, 2005; Masood & Thigambaram, 2015; Hansen et al., 2003
4. The role of social support and networks is acknowledged	The role of caregivers and teachers as supporters of resource use is defined, as well as the degree of this support	The role of peers and socially acceptable behavior is acknowledged; social media as a channel for mental health information is used with caution, but other channels for social interaction are provided	Mäntymäki et al., 2014; Kenny et al., 2016; Drost et al., 2017; Wetterlin et al., 2014; Rasmussen-Pennington et al., 2013; Gulliver et al., 2010; Fok & Wong, 2002

(continues)

TABLE 4 (continues)

5. The design of the resource promotes engagement	The content is interactive and narrative; efforts are made to support self-efficacy and intrinsic motivation	Skiada et al., 2014; Dondlinger, 2007; Amory et al., 1999; Naidu, 2005; Masood & Thigambaram, 2015; Hourcade, 2008; Huen et al., 2016; Kenny et al., 2016; Rasmussen-Pennington et al., 2013; Baumel & Muench, 2016
6. Co-design is utilized in the resource development process	The opinions and preferences of children and youth are taken into account; children and youth are included in the design processes	Kenny et al., 2016; Kayser et al., 2015; King et al., 2015; Hall et al., 2016
7. The reliability of the resource and its contents can be verified	Valid research evidence exists on the effectiveness of interventions; the resource provider / developer is trustworthy; the source for the information provided is legitimate; mental wellbeing programs support voluntariness; intervention and prevention programs are implemented carefully and with attention to the coherence of the therapeutic process	Grist et al., 2017; Radovic et al., 2016; Baumel & Muench, 2016; Manicavasagar et al., 2014; Burckhardt et al., 2015
8. The system data is secured	The privacy of user information and user interactions with the system is confirmed	Kenny et al., 2016; Wetterlin et al., 2014; Baumel & Muench, 2016

In light of the design heuristics presented in Table 4, it can be established that designing digital mental health resources requires careful attention from both the designers as well as the intended end users for the developed resource to be efficient in achieving its goals. In addition, the concerns of the users need to be considered even after the publication of the resource, with special attention being paid on how the user data is secured throughout the product life-cycle. Also, the importance of professional mental health input from researchers or mental health professionals should never be under-estimated, since the goal of any mental health resource should be in increasing life quality. This can be ensured only by inspecting the efficiency of mental health and wellbeing programs as well as following the principles for designing therapeutic processes (see e.g. Table 2). Thus, current mental health and wellbeing resources should be assessed to confirm their suitability for the promotion of mental health and wellbeing.

5 DATA COLLECTION AND ANALYSIS

This chapter has been divided into two subchapters, with the goal of discussing different aspects of the data collection and analysis processes separately, but side by side. The data collection subchapter discusses the generation of specific questions for each heuristic dimension to facilitate the assessment of the mental health and wellbeing resources. In addition, the section includes a description of the research methods used as well as reliability and validity assessment. In the analysis subchapter, the process of dividing questions relating to different heuristic dimensions into variables is introduced and the representativeness of the data is discussed based on the basic information recorded from each resource

5.1 Data Collection

The initial research question of this thesis is: How well do existing digital mental health and wellbeing websites and applications follow the guidelines of designing for children and youth? As a part of the APEX Digital Mental Wellbeing Literacy project in the University of Jyväskylä, a systematic review was carried out to identify existing digital mental health and wellbeing resources. After systemically including and excluding material provided by Google search engine, altogether 181 mental health and wellbeing resources meeting the selection criteria were identified. This set of mental health and wellbeing resources was used as a starting point in this thesis for the assessment of existing digital mental health and wellbeing resources for children and youth.

As a second step, guidelines for designing mental health and wellbeing resources were created by reviewing literature and identifying heuristics that continuously emerge in different papers. These heuristics were collected in Table 4 (previous chapter) to create a set of guidelines for designing mental health and wellbeing websites and applications for children and youth. The third step of the assessment was to decide how to use the established guidelines in assessing

existing digital mental health and wellbeing resources. As a result, heuristics were selected from each heuristic dimension to form a set of questions that would best capture the essence of each dimension. These questions were then divided into sub-questions to be able to collect the most relevant information regardless of the target group at hand. The heuristic dimensions and related questions as well as potential sub-questions used in the data collection are described in Table 5. In the analysis phase, the answers were further divided into separate variables to be better able to quantify the results.

TABLE 5 Heuristic Dimensions and Related Questions and Sub-Questions Used in the Data Collection

Heuristic Dimension	Main Questions	Sub-Questions
1 Visual Design	1.1 What is the visual design like?	1.1.1 Is the visual design consistent? 1.1.2 Are vibrant colors and pictures used?
2 Content	2.1 Is the content aimed towards a target group that is clearly described and adequately scoped? 2.2 Is the content presented in a suitable form to the target group?	2.2.1 Are simple sentences used? 2.2.2 Is critical information presented in light form?
3 Functional Design	3.1 Is navigation made easy to the target group?	3.1.1 What kind of elements easing navigation are present? 3.1.2 How is relevant information made easy to find?
4 Social Interaction	4.1 What is the role of social interaction?	4.1.1 How is the degree of required adult support defined? 4.1.2 What kind of possibilities are there to interact with peers?
5 Engagement	5.1 How is engagement promoted?	5.1.1 What kind of narrative elements are present? 5.1.2 What kind of interactive elements are present? 5.1.3 What kind of gamification elements are present?
6 Co-Design	6.1 How is co-design utilized?	6.1.1 Is there a mention that the target group has been included in the development process?
7 Reliability	7.1 How can the trustworthiness of the resource be verified?	7.1.1 Is the information source clearly stated? 7.1.2 Is the owner trustworthy?
8 Information Privacy	8.1 How can the privacy of user information be verified?	8.1.1 Does the resource include a thorough privacy policy?

Finally, the set of 181 mental health and wellbeing resources was systematically reviewed for eligibility based on how well the established questions can be utilized to gain meaningful information about the resource. As a result, 132 resources were excluded from the assessment. The exclusion criteria are presented in Table 6.

TABLE 6 Exclusion Criteria for Resources Not Suitable for Closer Analysis

Reason for Exclusion	Amount of Resources Excluded Based on Set Criteria
Does not include signs about being targeted to children or youth	48
Most of the content targeted to adults	41
Not enough digital mental health or wellbeing content for children or youth	30
Cannot be reached at the time of the analysis	10
Created for promotional purposes and thus, the target audience is too wide	3
Total	132

The majority of the excluded resources were left out of the analysis because they did not include signs about being targeted to children or youth, most of the content they provided was targeted to adults or they did not have enough digital mental health or wellbeing content for children or youth (90%). All of these areas are problematic in the light of the established framework, since it cannot be assumed that these resources should follow the heuristics of designing for children and youth. In addition, to assess certain heuristic dimensions, it is essential that there is enough digital mental health or wellbeing content targeted towards children or youth (e.g. navigation requires the assessment of hierarchical structures). The reasons for excluding the remaining resources (10%) include that the resource was not available at the time of the analysis (e.g. under maintenance or no longer exists) or that the resource was created for promotional purposes. The latter was problematic due to the fact that these resources were targeted towards a wide target group and thus, assumptions about preferable design could not be made.

After excluding the 132 resources not suitable for assessment, a set of 49 resources eligible for assessment were extracted. Expert review was chosen as an assessment method, since an expert review is not dependent on the design phase of the resource (Shneiderman & Plaisant, 2005). Other reasons for selecting this method for assessment include the great amount of existing literature that focuses on the experiences and preferences of children and youth (presented in chapter 4). Additionally, the object of this thesis is to examine child and youth mental health and wellbeing resources specifically from the human-technology interaction point of view.

Usually, an expert review consists of multiple reviews of one resource conducted by different experts. However, in this case one evaluator (the thesis author) evaluated all 49 websites and applications to gain an understanding of how well the existing digital mental health and wellbeing resources follow the principles of designing for children and youth. More precisely, heuristic evaluation was used in combination with the creation of heuristics based on research literature. During heuristic evaluation, an interface is reviewed by an expert by contrasting the current design with a selected set of design heuristics (Shneiderman & Plaisant, 2005). The reliability of this method was increased by using systematic observation, which was enabled by creating specific points of observation for each heuristic dimension examined. In other words, the reliability was increased by diminishing the possibility that the results are evaluator-dependent (see e.g. Carmines & Zeller, 1979). However, the limitations of this study include that both the framework creation and the evaluation are carried out by the same researcher, allowing some degree of bias to the results.

Before starting the data collection phase, the suitability of the assessment questions was confirmed by first recording data of only two resources. This liminal stage was carried out to increase the validity of the results, since it enabled the contemplation of how well the received results represent the studied phenomenon before conducting the entire data collection (see e.g. Carmines & Zeller, 1979). As a result, the questions were acknowledged to be fitting for this purpose and the data collection phase could begin. The data was collected in an Excel document to appointed columns to ensure that the information was available in one place and to facilitate the division of the collected data into different variables (separate columns) in the analysis phase. The data collection was carried out by examining one website or application at a time and recording data about all the heuristic dimensions. This ensured that each resource was examined as an entity. This was important, for example, in the light of navigation, since the navigation issues might better be visible when other information is sought from within the website or application.

5.2 Data Analysis

In the analysis phase, the answers recorded based on the questions presented in Table 5, were further divided into variables to facilitate the assessment of different aspects within the heuristic dimensions. As a result, every heuristic dimension was assessed by observing 1–3 individual factors that create a descriptive image of the dimension at hand. The resulting variables, their underlying assessment methods and heuristic dimensions are presented in Table 7. The rather specific data relating to each variable was further generalized across the resources to gain more descriptive information out of the entire data set. In fact, it has been argued that efforts to increase generalizability are important for the external validity of the research results (see e.g. Huberman & Miles, 2002). Thus,

the generalization of the data was a necessary step to convert the information about individual resources to a form that is compatible with other resources and functional when the resources are examined as an entity. Finally, the resulting data was illustrated by utilizing pivot table operations in Excel.

TABLE 7 Variables Identified Presented with the Relating Assessment Method and Heuristic Dimension

Heuristic Dimension	Variable	Assessment Method
1 Visual Design	1.1 Design consistency 1.2 Use of pictures or animations	1.1.1 Observing deficiencies in design consistency 1.2.1 Observing use of pictures and animations
2 Content	2.1 Target group age range 2.2 Content type	2.1.1 Defining the intended target group age range 2.2.1 Observing the lightness of the content provided
3 Functional Design	3.1 Navigation	3.1.1 Observing problems with navigation
4 Social Interaction	4.1 Type of social interaction 4.2 Social interaction experience	4.1.1 Observing existing means for social interaction 4.2.1 Observing existing means for experience of social interaction
5 Engagement	5.1 Narrative 5.2 Gamification 5.3 Interactivity	5.1.1 Observing the presence of narrative elements 5.2.1 Observing the presence of gamification element 5.3.1 Observing existing means for interactivity between user and user interface
6 Co-Design	6.1 Target group involvement	6.1.1 Observing references for the inclusion of the target group to the development process or content creation
7 Reliability	7.1 Owner 7.2 Content	7.1.1 Searching information about owner trustworthiness 7.2.1 Observing sources presented for the content provided
8 Information Privacy	8.1 Privacy policy	8.1.1 Observing the presence and thoroughness of privacy policies

In addition to the variables presented in Table 7, some basic information about the websites and applications was also recorded. These include the name, the type (e.g. web-based game, web-based program or informational website), the mental health focus (e.g. mental health problems or mental wellbeing), the primary language used and the country of origin. A summary of this information (excluding the names) is presented in Table 8. For more specific information about the assessed mental health and wellbeing resources, see Appendix 1 at the end of this thesis.

TABLE 8 Basic Information about the Websites and Applications Analyzed

Country of Origin	Primary Language Used	Target Group	Type by Main Activity	Mental Health Emphasis
Finland: 19 Canada: 10 Australia: 9 UK: 7 New Zealand: 2 Ireland: 1 USA: 1	English: 31 Finnish: 18	Children: 6 Youth: 36 Children and Youth: 7	Informational Website or Application: 32 Web-Based Game or Game Application: 9 Website or Application for Recording Activity or Answering a Questionnaire: 4 Web-Based Program: 3 Peer Experience Website: 1	Mental Health Problems: 26 Mental Health Problems and Mental Wellbeing: 17 Mental Wellbeing: 6

By observing Table 8, it is possible to conclude that the data set includes mental health and wellbeing websites and applications from different countries. However, Finnish resources are most likely over-represented, since both Finnish and English search-word combinations were used in parallel in the systematic review phase. In addition, the number of websites and applications targeted to youth is quite high compared to the resources targeted to children, while the amount of resources focusing solely on mental wellbeing related topics is quite low. However, it was noticed in the literature review phase that research on the area focuses mostly on youth. Moreover, mental wellbeing oriented resources are a newer trend in the field of digital mental health resources, which can explain the poor amount of mental wellbeing websites and applications in the data set.

6 RESULTS AND DISCUSSION

As stated in the previous chapters, this thesis focuses on the analysis of variables portraying heuristic dimensions that together create a framework for assessing existing digital mental health and wellbeing resources for children and youth. In this chapter, the variables relating to each dimension are separately discussed with findings relating to that dimension. The discussed heuristic dimensions are (in order of appearance): 1) Visual Design 2) Content 3) Functional Design 5) Social Interaction 6) Co-Design 7) Reliability and 8) Information Privacy. Once the results have been covered, the main findings are discussed and contrasted with results from earlier studies.

6.1 Visual Design

The visual design of the websites and applications was assessed by observing the consistency of design as well as prevalence of colorful pictures, graphics, animations and icons (Figure 2). Design consistency was evaluated by observing how well the pages or sections within the website or application fit together and whether a certain style is consistently followed between the different areas. By concentrating on the design consistency and prevalence of images, it was possible to get a comprehensive but not too specific view of the overall visual design.

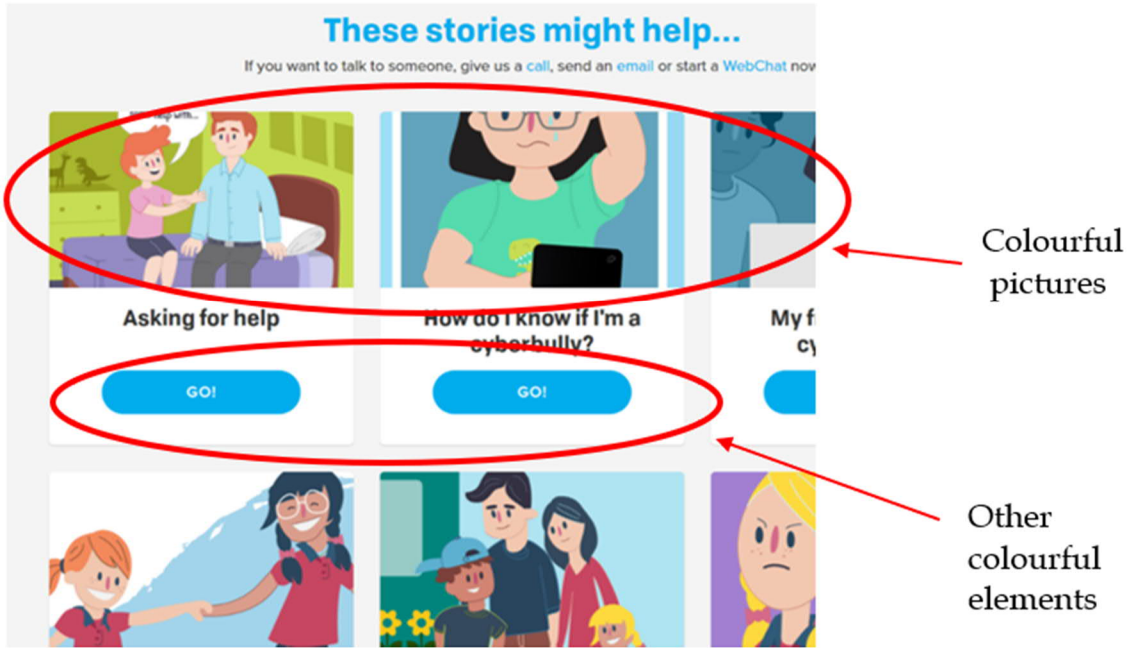

FIGURE 2 The Kids Helpline Website

In the case of 90% (44/49) of the websites and applications, there were no identifiable problems with the design consistency. However, the remaining 10% (5/49) included minor problems, such as slight variation in fonts or colors used or in the overall layout (Figure 3). All in all, the evaluated websites and applications did not have major problems with design consistency. When prevalence of images was assessed, it was perceived that most of the websites and applications (66%, 32/49) included colorful pictures or animations. However, up to 12% (6/49) included pictures only primarily on top of every page. In addition, in the case of 6% (3/49) of the resources the illustration provided consisted primarily of colorful icons. Finally, 8% (4/49) of the websites and applications only included pictures and icons with dark colors. Similarly, 8% (4/49) did not include many pictures, animations or icons in general. Thus, up to 34% (17/49) of the resources could benefit from widening the scope of their picture or animation use practices to enable better use of illustrations to support the message of the content provided.

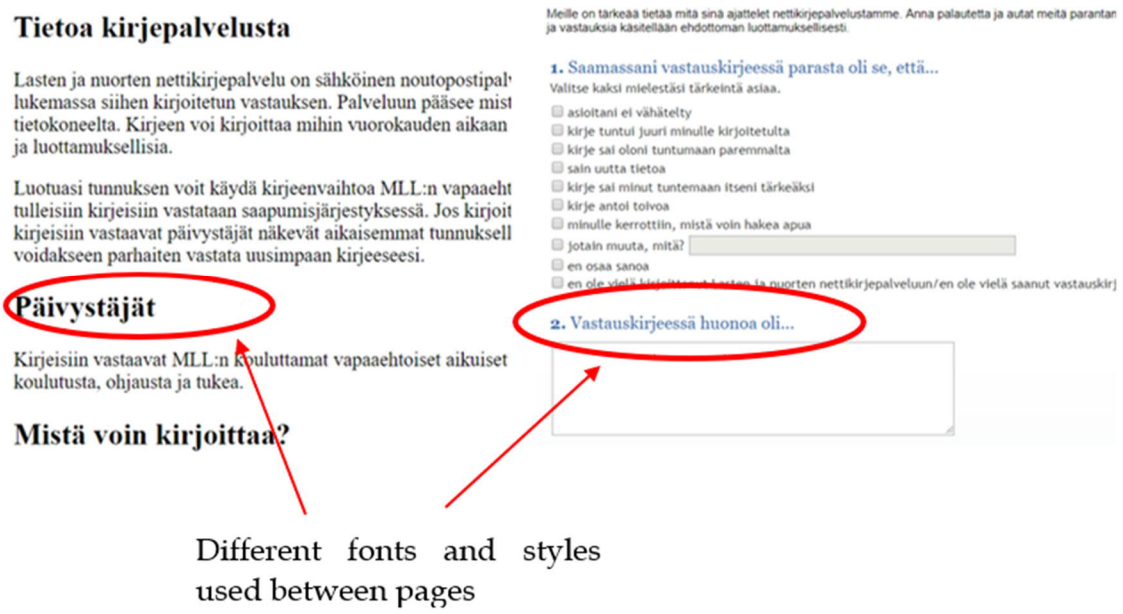

FIGURE 3 The Nuortennetti (Youth Net) Website

In conclusion, the visual design of the websites and applications assessed was quite good in the terms of design consistency. Further, colorful images or animations were present in most cases. Nevertheless, some websites and applications have room for improvement. Yet, fortunately, the changes required might not be excessively burdensome, since the identified problems did not have wide effects on the resource use.

6.2 Content

The suitability of the content was assessed by observing the target group age range stated by the owner as well as the overall lightness of the content present. These two aspects were concentrated on to get a clear view of the wideness of the target group the resource owner is attempting to reach, and if the content in fact seems to be created with this target group in mind.

Most of the websites and applications (51%, 25/49) did not include a clear description of the specific age group that the owner was attempting to reach. Instead, these resources were merely targeted to youth, young people or children or a combination of these. Unfortunately, these definitions tell little about the actual target group, since the age ranges associated with the age groups vary. Once the resources clearly stating their intended target group were examined more closely, it was noticed that 54% (13/24) of these resources included an age range greater than or equal to seven years (Figure 4). In addition, there was one

website that included separate sections for children and youth. The section for children had an age range greater than or equal to seven years, while the youth section had an age range smaller than seven. Finally, 42% (10/24) of these resources had an age range smaller than seven years. Thus, most of the resources analyzed (82%, 38/49 resources) were targeted to children or youth without clearly stating the intended age group or to a group of children or youth with a greater or equal age range to seven years. Thus, the websites and application analyzed might have problems with targeting their content to an adequately scoped group of children and youth.

Mention of target group age range on the website frontpage (10-28-year old youth and young adults)

FIGURE 4 The e-Talo (eHouse) Website

Once the weight of the content provided was analyzed, it was perceived that 90% (44/49) of the resources included content in a form that could be characterized as light. In this context, light content means that no overly complicated sentences or too long paragraphs are used, and the overall layout seems light (Figure 5). In turn, 4% (2/49) of the resources included content that could be characterized as quite light. These websites and applications included some overly long articles and critical information (help now sections) could be made easier to access. Finally, 6% (3/49) of the resources included content that was not in a light form. These resources had problems in multiple areas, such as having information in a heavy article format without lighter alternatives, not presenting critical information in light or easy to access form, completely lacking a section for immediate help or providing information that could be more suitable to another age group.

Amount of text on the frontpage is controlled

The sentences used are simple and larger fonts are used to ease reading. Not all text is visible at once

Figure 5 The Lasten Sivut (Children's Pages) Website

Overall, the content provided by the websites and applications was in most cases either light or quite light (94%). Thus, the ability to provide light and easy to access information does not seem to be a great problem among mental health and wellbeing resources targeted to children and youth. However, the inability to target content at a clearly narrowed down age group could be problematic. Thus, it would be essential that mental health and wellbeing resource developers would be able to decide what audience they are aiming to reach.

6.3 Functional Design

Functional design was assessed by observing possible problems with the website or application navigation. This was chosen as a suitable examination point to ensure the visibility and inclusion of a very essential element of UI design in the data analysis. In addition, navigation problems are something that can affect the use of a website or an application in a quite comprehensive manner, since navigation has an influence on all the other operations performed.

Out of the websites and applications, up to 73% (36/49) did not have any identifiable issues with navigation. This indicates that most of the developers of mental health and wellbeing resources realize the importance of functional design. However, 27% (13/49) had minor issues with navigation. These included: having a help now section that is not effortlessly visible or available; slight difficulties with navigating through certain pages effortlessly; not always knowing your location within the website or application; a single page is not working or does not include any content (Figure 6); within site links lead the user to sections that are meant for other user groups; categories are not as logical as they could be; site structure is slightly too deep and navigation could be facilitated more. However, the websites and applications did not have issues in many different areas, and a problem with navigation within a website or an application was more an exception than a rule.

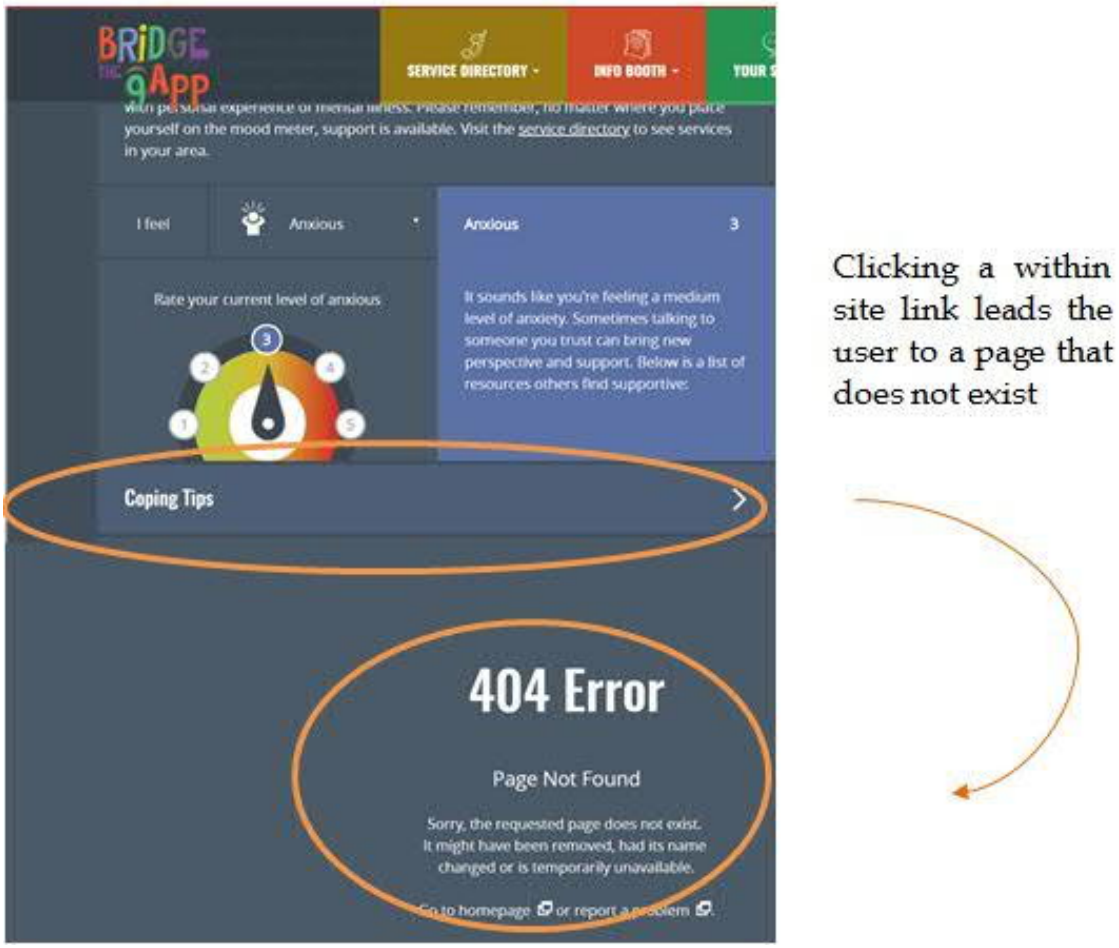

FIGURE 6 The Bridge the Gapp for Youth Website

In conclusion, most of the mental health and wellbeing websites and applications assessed did not have any identifiable problems with the functional design. Once there were problems, these were not comprehensive and disrupted only certain website or application use cases. Thus, with moderate alterations, even the resources with navigation problems could improve their user experience. in sum, the importance of functional design seems to be a well understood topic among the website and application developers as well as the owners of these resources.

6.4 Social Interaction

Social interaction was assessed by observing the type of social interaction together with the type of social interaction experience provided by the website or application (Figure 7). The type of social interaction was chosen as an examination point to represent the direct interaction provided by the resource. However, the type of social interaction experience was included to better capture the mul-

tidimensional nature of social interaction, since social interaction is not always direct. In this context, social interaction experience means interaction with peers, caregivers, teachers or professionals that cannot be categorized as social interaction per se but is still present within the resource.

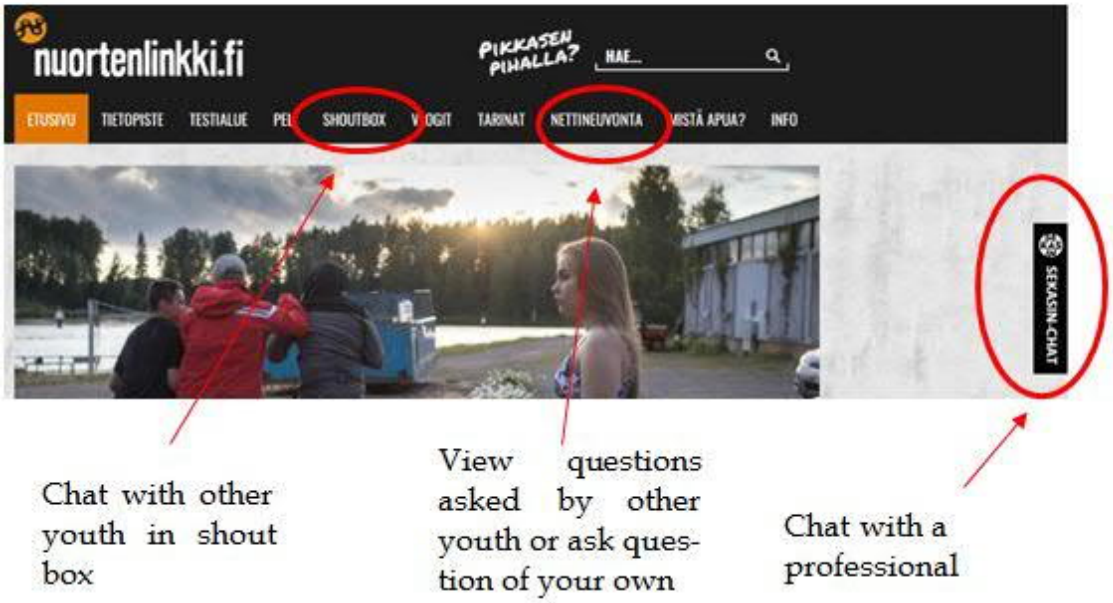

FIGURE 7 The Nuortenlinkki (Youth Link) Website

Up to 65% (32/49) of the websites and applications did not include social interaction. Thus, merely 35% (17/49) of the resources included some form of social interaction. However, when a resource included social interaction, it was mostly discussion with other resource users or professionals (94%, 16/17). The remaining one resource (6%) included social interaction in the form of playing a game together with someone else (two-player game).

Since not all social interaction presented in the resources was direct, activity relating to the experience of social interaction was also recorded. Eighty percent (39/49) of the resources did not provide any additional social interaction experience. Eight percent (4/49) allowed the user to view questions send by peers and answers provided by the professionals. Eight percent (4/49, two of which included the ability to submit own art as well), similarly, allowed the user to view artwork created by peers. One resource included the possibility to send an anonymous message to a professional (without the possibility to receive an answer), and one allowed the caregiver or teacher to see what the user records to the system.

Overall, the social interaction dimension was not very comprehensively accounted for in the websites and applications analyzed. Up to 55% (27/49) of the resources did not include social interaction or any activities that relate to social interaction experience. In addition, the realization that the social interaction provided to the user was mainly discussion with other resource users, or

professionals, allows the questioning of whether the possibilities provided by online environments are fully understood and utilized among the mental health and wellbeing resource developers. However, the need for peer support and professional guidance seems to be well understood among the resource developers who have included social interaction or social interaction experience activities on their website or application.

6.5 User Engagement

User engagement was assessed by observing the presence of narrative, gamification and interactivity elements. Narrative elements refer to different components of the website that discuss topics in a story-telling manner. Gamification elements, in turn, are game-like components that are added to the resource such as achievements earned upon progress (Figure 8). Finally, interactivity elements are the non-social activity components that promote the interaction between user and user interface.

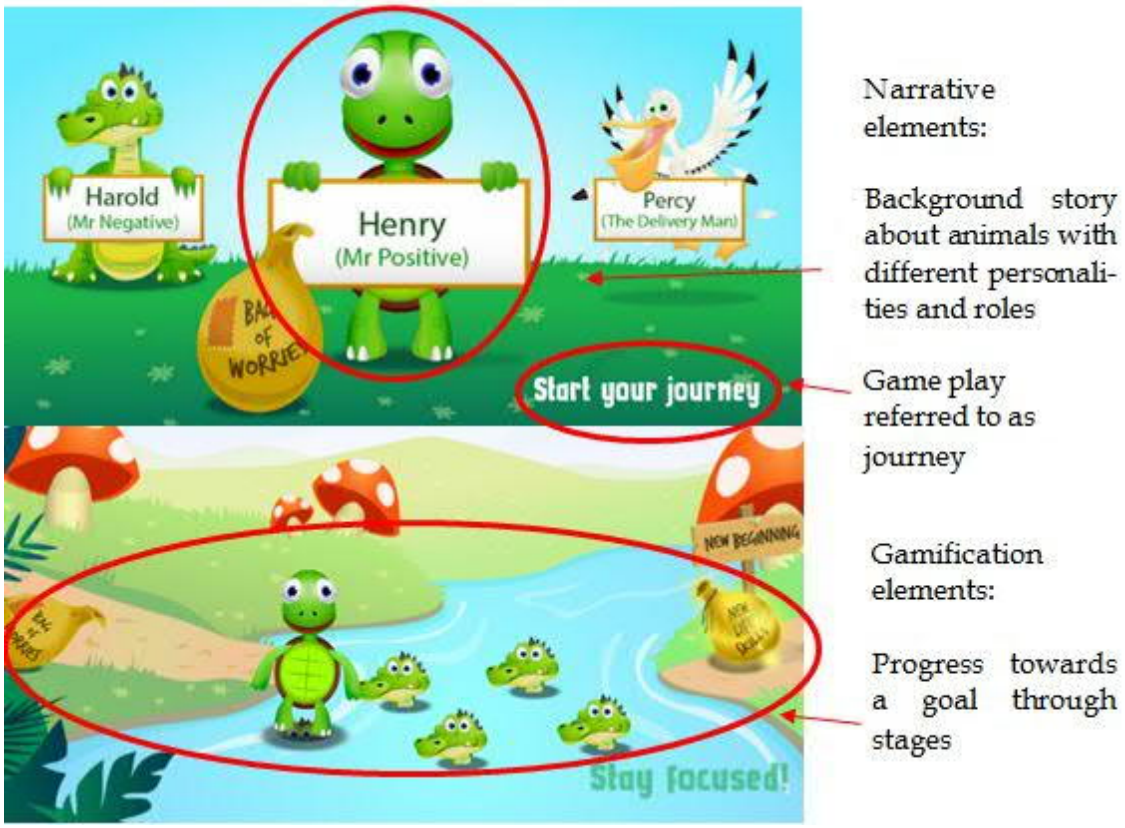

FIGURE 8 The Life Skills for Kids Game Application

Most of the resources (76%, 37 / 49) included narrative elements, for example, in the form of blog posts that included a story about personal experiences. However, 70% of these (26 / 37) were merely moderately narrative due to the fact that narratives were only visible on some parts of the resource. In turn, 30% of these (11 / 37) included elements that could be characterized as highly narrative. The highly narrative resources were mainly games where the user takes part in the story. Highly narrative resources can be characterized as including high immersion with the narrative as an essential part of the main activities. Finally, 24% (12 / 49) of the resources did not include narrative elements.

Once the presence of gamification elements was observed, it was noted that up to 67% (33 / 49) of the resources did not include any gamification elements. However, 6% (3 / 49) included moderate gamification elements, such as a game deep within a website that does not play a main role. Finally, 27% (13 / 49) included various gamification elements. These comprised resources that were categorized as games as well as resources that utilized gamification in the resource main activities. Thus, up to 73% of the resources did not include gamification elements or the resource was merely moderately gamified.

In terms of interactivity, 38% (19 / 49) of the websites and applications did not include noticeably interactive elements. This group of resources consisted of websites and applications where interaction provided was mostly navigation. However, 31% (15 / 49) included moderately interactive elements such as being able to choose the right alternative from different options. Similarly, 31% (15 / 49) included elements that could be characterized as highly interactive. The progression in the main activities of these resources (such as playing a game) required the user to constantly interact with the user interface as well as have an influence on the outcome (Figure 9). Thus, up to 69% of the websites and applications included either moderately interactive elements, or did not include interactive elements at all.

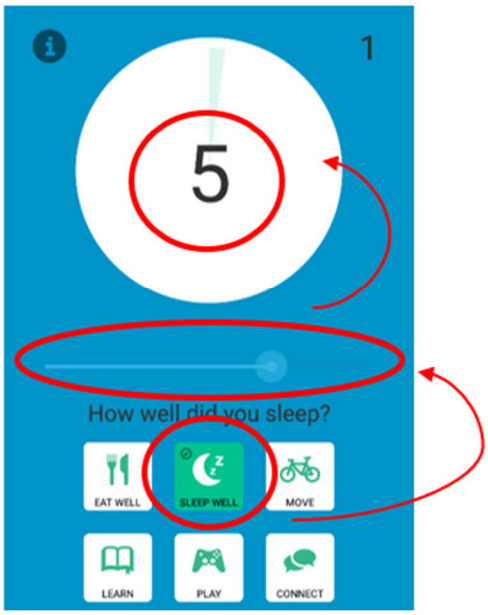

FIGURE 9 The Miyo Application

The websites and applications analyzed were only moderately able to contribute to the user engagement dimension. This is due to the fact that most of the resources did not include or included only moderately narrative, gamification or interactive elements. However, almost a third of the resources included highly interactive elements, but the ability to use gamification, narrative and interactive elements varies quite widely across resources. Once the aspects of user engagement were observed as an entity, it could be noticed that merely 20% (10/49) of the resources included highly interactive, narrative and gamification elements. In conclusion, most of the resources analyzed have room for improvement in at least one of these three categories.

6.6 Co-Design

Co-design was assessed by observing if there is a mention on the website or application that the target group has been included in the development process or content creation (Figure 10). This was chosen as a point of examination because youth want to be active in the creation of a resources aimed towards them (see e.g. Kenny et al., 2016). Thus, it seems that it would be beneficial for a resource creator to announce that the target group has been active in the website or application development process, or content creation.

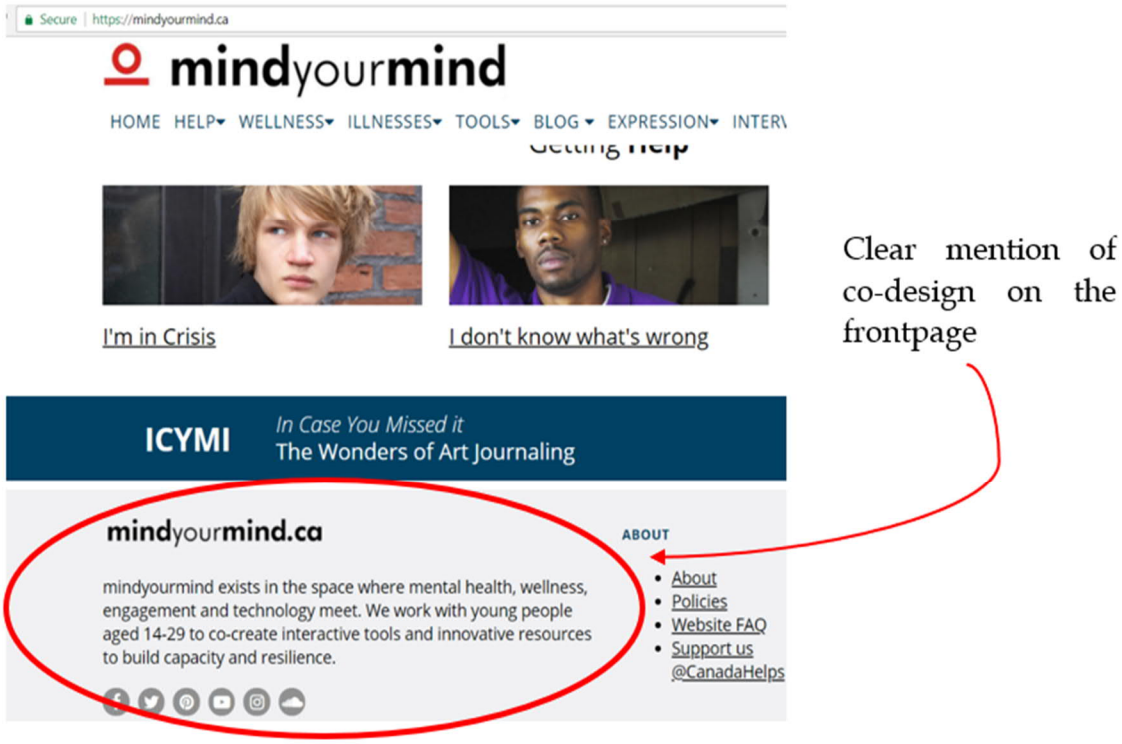

FIGURE 10 The Mindyourmind Website

Despite of the benefits of announcing the input provided by the target group, up to 59% (29/49) of the websites and applications did not include a mention of utilizing co-design. However, in the case of 25% (12/49) of the resources, co-design was implied for example in the description of organization operation policy. Finally, merely 16% (8/49) of the websites and applications included a clear description that co-design was utilized in the design process or in content creation. In conclusion, as much as 84% of the resources had difficulties with stating the role of the target group in the development process or content creation activities. Naturally, this does not mean that co-design has not been utilized, but the user might not find the resource to be identifiable without knowing the role that their peers have had in the development process. Thus, most of the websites and applications assessed could benefit from at least including a mention of co-design processes used. If the resources have not used co-design, they could naturally benefit from adding co-design to their operations policy.

6.7 Reliability

For the reliability dimension, information source trustworthiness and owner trustworthiness were selected as suitable examination points (Figure 11). These were landed on due to their ability to capture the trustworthiness of a website or an application more comprehensively, since this is not assessed merely on

the basis of the reputation of an organization or the sources cited. In addition, the ability to make the organization operations visible communicates to the user about the organization transparency.

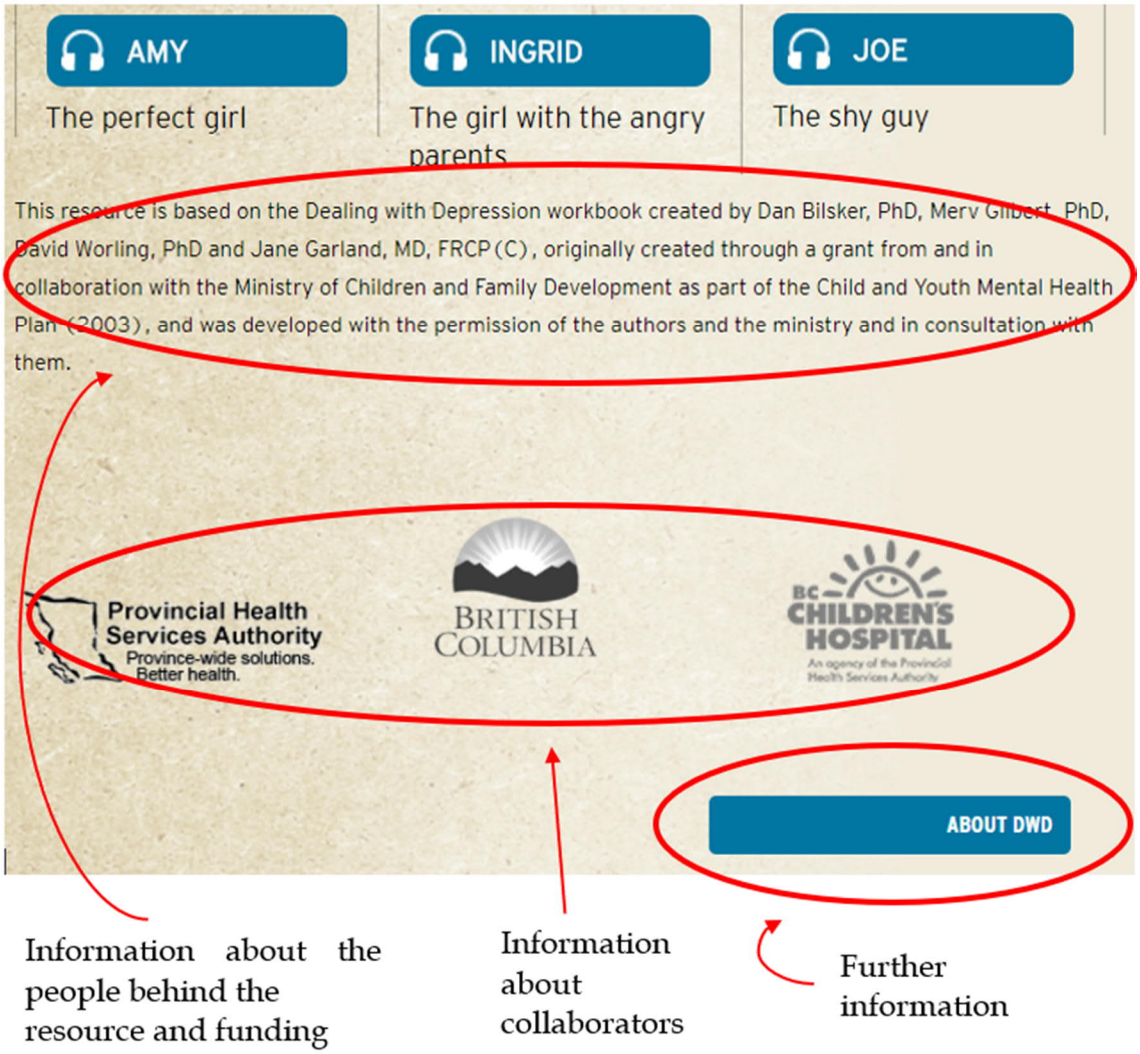

FIGURE 11 The Dealing with Depression Website

Only 23% of the websites and applications (11/49) did not have any issues with information sources. Most of the resources had problems with citing their sources, since 71% (35/49) did not include clear statements of sources for the information provided. Many, for example, mentioned that the information was based on professional or researched information but failed to express who the professionals are or what the researched information is. In addition, two resources (4%) did not always cite their sources and one resource (2%) included references but the source cited was another youth website that, in turn, did not cite its sources. Thus, up to 77% of the resources had problems with stating the sources for the information provided.

Up to 90% of the websites and applications (44/49) did not have any identifiable issues with owner trustworthiness. The organizations behind the resources were open about their operations and information was available to assess their trustworthiness based on their history or status within the field they operate. However, one of the resources was developed by higher education students, and even though there was mention that professionals had been consulted, the developer group consisted solely of students from the game field and there was no mention at which stage of studies the students were at. Another resource included only the name of the developer, but no other information was available. Three resources did not include clear information about the people behind the organization and one of the three did not mention the source of the funding received either. Thus, the remaining websites and applications included some problems that allow the questioning of owner trustworthiness. However, the problems identified here do not automatically indicate that the owner is not trustworthy; merely the lack of information provided which, in turn makes it hard for the user to be ensured that the owner is indeed trustworthy.

Finally, when the data about owner credibility and information sources was combined, it was evident that most of the resources not citing their sources did not have problems with owner trustworthiness. In fact, up to 77% (32/44) of the resources that did not have identifiable problems with owner credibility did not cite their sources. In addition, only 8% (4/49) of the resources had problems with both owner trustworthiness and information sources. Thus, in the case of up to 92% (45/49) of the resources either the sources were adequately cited, or the owner could be deemed trustworthy.

In sum, most of the websites managed to provide enough information for the user to become ensured about the provider or information trustworthiness. However, both the information about the owner and information about the content provided should be present, eliminating the need for the user to solely rely on the reputation of the organization or spend too much time ensuring the trustworthiness of the sources.

6.8 Information Privacy

Information privacy was assessed by examining the privacy policies or statements found or not found on the website or application (Figure 12). This was chosen as an examination point to gain a good understanding of how much value the owner gives on information privacy and how much time the owner is willing to spend to guarantee the privacy of the operations performed by the user within the website or application.

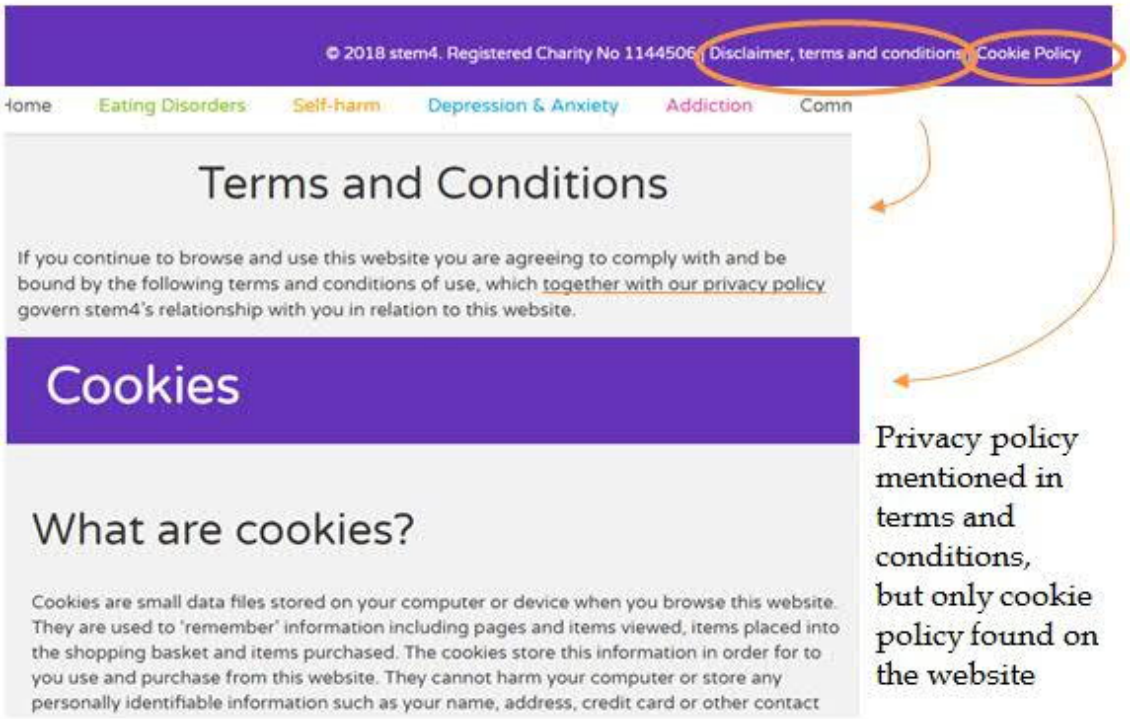

FIGURE 12 The Stem4 Website

Out of all the websites and applications, only 33% (16/49) did not have major issues with the privacy statements presented. In the case of 45% (22/49) of the resources, there was not a thorough privacy policy present. Either the privacy policy was missing altogether or there were notable deficits with the privacy information provided. Furthermore, 12% (6/49) of the resources included a privacy policy, however, more or less generic (e.g. same privacy policy for all the company websites) or did not specifically address the resource at hand. In addition, 10% (5/49) of the resources included a privacy policy with individual deficiencies, such as not clearly mentioning user rights or how non-personal information is collected.

In total, up to 67% of the resources had different problems with the privacy information provided. This seems alarming, since organizations developing and maintaining mental health and wellbeing websites and applications should be aware that they may be handling very sensitive information. Thus, the information processing chains should be very secure and apparent to the user before they provide such information using the resource. In addition, the website and application providers should have a responsibility to announce it clearly to the user if they are not collecting information, since the user cannot conclude that no information is collected if there is no mention of it on the resource. In conclusion, the website and application providers should pay more attention to how well they are currently able to provide the user with accurate and reliable information about their practices to process personal and non-personal information.

6.9 Discussion

In conclusion, the mental health and wellbeing websites and applications targeted towards children and youth assessed in this thesis vary in terms of visual design, content, functional design, social interaction, user engagement, co-design, reliability and information privacy. Table 9 summarizes the main findings of the analysis categorized by heuristic dimension.

TABLE 9 The Qualities of Existing Digital Mental Health and Wellbeing Resources Categorized by Heuristic Dimension

Heuristic Dimension	Qualities of Assessed Websites and Applications (n=49)
1 Visual Design	Only a minority (10%) of the assessed websites and applications had slight problems with design consistency. Nearly half of the resources (44%) could provide more colorful pictures and animations.
2 Content	Most of the resources (82%) did not include a clear description of the target group age range or the range was greater than or equal to seven years. In most of the resources (90%), the content provided could be characterized as light.
3 Functional Design	Most of the resources (73%) did not have identifiable issues with navigation. Navigation issues identified were not comprehensive and disrupted only certain use cases.
4 Social Interaction	Over half of the resources (55%) did not include social interaction or social interaction experience elements. When social interaction was present, it was mostly communication with peers or professionals (94%).
5 User Engagement	Most of the resources did not include or included merely moderate narrative (68%), gamification (73%) or interactive elements (69%) elements. Only a fifth of the resources included highly narrative, interactive and gamification elements.
6 Co-Design	The majority of the resources (84%) had problems with stating the role of the target group representatives within the resource development process or content creation.
7 Reliability	More than three out of four resources (77%) had difficulties with stating a source for the content provided. Nine out of ten resources (90%) did not have issues with owner trustworthiness. The majority of the resources (92%) either included a trustworthy owner or cited sources adequately.
8 Information Privacy	Most of the websites and applications (67%) had problems with privacy information provided. Problems with information privacy included missing privacy policy, notable deficits in the privacy policy provided and providing only a general privacy policy to all the resources provided by the organization without clear references to the resource at hand.

The mental health and wellbeing websites and applications analyzed in this thesis do not meet most of the principles of designing for children and youth. This is especially visible in content, social interaction, user engagement, co-design and information privacy dimensions. In terms of content, perhaps the biggest issue is the inability of most resources to orientate their content towards a clearly narrowed down target group. This could be problematic, for instance, in light of the observations made by Livingstone (2007), since it was argued that a website with an age range from 13 to 19 could be seen as too broad by the youth assessing the website. If the websites were viewed as being made for a younger audience, it was viewed as condescending, while a website seemingly created for an older audience was evaluated boring (Livingstone, 2007). Thus, once the content is targeted to multiple target groups, there is a possibility that it is in fact only usable to a certain subgroup and identifiable to none.

The social interaction dimension in some resources seems to follow the observations made by previous research that youth prefer the possibility to talk with peers when engaging with a mental health resource (Kenny et al., 2016). This is especially important due to the fact that chatroom sessions can help youth that are not traditionally reached by professionals to build a peer support network (Drost et al., 2017). However, not many resources provide the users this possibility. In addition, the means for social interaction could further be enhanced by providing more chances to discuss with peers or professionals and widen the scope of social interaction. Online environments provide many possibilities for cooperation and thus, mental health and wellbeing resource developers should be able to understand social interaction as a more multidimensional structure than merely the possibility to discuss with others.

Similarly, user engagement could be promoted by increasing narrative, gamification and interaction elements within the resource. These elements can be utilized in various forms but still, mainly resources that can be characterized as games are currently nearly the only ones using gamification elements as parts of the main activity provided by the resource. This is unfortunate, since including these features to the resources has the potential to promote the achievement of relating mental health goals (e.g. Huen et al., 2016). For example, in mobile gaming, user enjoyment is an essential part of assuring the continuance of resource use (Merikivi et al., 2016).

It is well established in the previous research that children and youth should be involved in the design process of resources that are targeted to them (e.g. Hall et al., 2016 Kenny et al., 2016; Kayser et al., 2015; King et al., 2015). The problems with co-design identified in this thesis could be solved by providing more visible information about the co-creation processes utilized with the intended target group representatives. Once the users within the target group cannot see the influence of their peers, they might not or no longer identify with the resource. By utilizing co-design processes and making the processes visible to the target group, there is a better chance that the users within the target group feel that the resource is made especially for them. This, in turn, has the

potential to increase engagement among the users within the intended target group (e.g. Rasmussen-Pennington et al., 2013).

Finally, the information privacy dimension was perhaps the most problematic of all the dimensions, since many of the resources did not have a privacy policy at all, or the privacy policy provided included various deficits. In addition, quite a few of the analyzed websites and applications did not mention what their policies were regarding the processing of non-personal information or included merely a statement of (personal) information processing practices as a privacy policy as well. The information privacy dimension is essential to ensure that user rights are followed, and more importantly, because youth rate this dimension as one of the most relevant areas of web-based mental health resource design (e.g. Wetterlin et al., 2014). Thus, many of the mental health and wellbeing websites and applications targeted towards children and youth could benefit from attaching a privacy policy to their resource. This privacy policy would clearly state the practices for processing both personal and non-personal information, clearly mentioning the user rights and, all in all, emphasize what kind of information is collected and what is not collected from the user.

Even though the websites and applications had clear difficulties with most of the heuristic dimensions, they also had strengths within some of them. For example, the functional design was good in most of the resources and when navigation problems occurred, these were minor and affected only certain resource use cases (e.g. an individual page did not work or did not include any content). Similarly, only a small part of the websites and applications had problems with design consistency and the identified problems in this area were quite small (e.g. slight variation with fonts or colors used). The reliability dimension was problematic because many resources did not cite their sources, but only a small amount of the websites and applications assessed did not include a trustworthy owner or cite their sources. Thus, in most cases, there was at least one element present that could ensure the user that the resource is trustworthy

7 CONCLUSION

Based on the reviewed literature, it can be concluded that there are a lot of unanswered questions surrounding the ideal design of digital mental health and wellbeing resources for children and youth. Moreover, the research conducted to date has hardly made it easier to understand this phenomenon and notice the connections between functional design and effective promotion of mental health and wellbeing. Nevertheless, there is a need to discriminate between technological resources that include programs intervening with existing mental health problems and those that attempt to promote mental wellbeing of individuals. For example, interventions that are meant to decrease the prevalence of symptoms relating to depression in a certain population are carefully designed to suit the needs of people of a certain age that live with a certain type and stage of depression. These interventions or parts of them can be executed for example through a website or a mobile application. However, the therapeutic process must remain coherent and concise in a way that the effects of the intervention stay visible and suitable for the intended group. However, freedom to choose seems to be an essential part of the efficiency of mental wellbeing programs, which emphasizes the importance of facilitating the prevalence of inner motivation. In addition, since mental wellbeing programs may be useful to anyone regardless of their current mental health status, these can be offered to wider populations with more opportunities regarding the technological execution. Thus, games and gamification elements could be especially useful for mental wellbeing programs due to the connections between inner motivation and the formation of flow.

Even though the developmental phase of a child or a young person cannot be overlooked in the process of developing usable and enjoyable UIs, there is a need to realize that child and youth users are individuals just like adults. Thus, they also have individual preferences and tendencies. Children and youth are accustomed to certain technological environments and they expect UIs to behave in a certain way. Just like in the case of adults, a lot from this is learned from earlier encounters with technology. Thus, it should be ensured that the mental health or wellbeing resources designed for children and youth follow

the logic of the technologies that they typically use. This means that there is a need to establish standards regarding both the use of digital environments as well as mental health and wellbeing information, including their suitable forms. This requires the usage of existing web and mobile design heuristics but with adaptations to the context of child and youth mental health and wellbeing. There is no need to re-invent UI design, but it would be foolish to overlook the effects of growing up with certain technology and the nature of the information that is meant to be covered.

The design of mental health and wellbeing websites and applications has an important role to play in supporting the interaction between children and youth and the interface they are using. With suitable content, visual and functional design as well as by acknowledging the role of social support required by the target group, there is a greater chance for improving the design of digital resources to better suit the needs of the intended users. However, more general heuristic dimensions should be considered as well, such as promoting engagement, securing system data, following the principles of co-design and verifying the source of the content. Additionally, the legitimacy of the resource developer or provider should be ensured. Nevertheless, these aspects always need to be considered individually for every situation.

The results of this thesis indicate problems in the dimensions of content, social interaction, user engagement, co-design and information privacy. Content should be more carefully tailored to a more refined user group and the means of social interaction could better utilize the possibilities provided by online environments. Once the user group is adequately narrowed down, there is a better chance that the information is relevant for the age group at hand. User engagement, in turn, can be promoted by increasing the use of narrative, interactive and gamification elements in relation to the main activities provided by the resource. Perhaps the biggest problem with user engagement occurs due to misuse of related elements, since for example, a story or a game found on a website that is not relevant or predominant in the light of the main purpose of the website does not increase the engagement of the user in an advantageous way. Finally, the co-design process descriptions should be more specific and visible to the user and the data privacy statements could benefit from including more precise information about the information processing practices in relation to both personal and non-personal data. Adequate amounts of co-design combined with a clear target group has the possibility to increase the engagement of the users within the intended target group especially when combined with precise co-design information that is also visible and understandable to the user. The importance of comprehensive privacy policies should not be overlooked either, since some mental health and wellbeing resources might process sensitive information, and even if they would not, it is important that the user is aware that personal information is not collected. At the end of the day, it is the responsibility of the provider to give the user enough information about their operations so that the user would not come to false conclusions.

In this thesis, a framework was constructed for designing digital mental health and wellbeing resources to children and youth. The framework can be used in future research efforts to assess mental health and wellbeing resources from the technological perspective. In addition, the framework can be used in designing mental health and wellbeing resources to increase the likelihood of developing resources that follow the principles set for children and youth. The heuristic evaluation conducted in this thesis, in turn, provides unique information about the state of existing mental health and wellbeing resources that are designed for children and youth. Thus, the results of this research provide distinct, significant insights into designing digital mental health and wellbeing resources for children and youth. However, more research is needed to discover if the heuristics for designing child and youth mental health and wellbeing resources constructed in this thesis are compatible with the heuristics from the therapeutic process design perspective. This thesis was carried out from the human-technology interaction point of view and thus, the assessment method does not provide accurate information about the therapeutic relevance of the resources analyzed. Once this has been established, more precise recommendations can be made about the crucial aspects of designing digital mental health and wellbeing resources for children and youth.

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APPENDIX 1 BASIC INFORMATION ABOUT THE WEBSITES AND APPLICATIONS EVALUATED

Number	Name of the Resource	Primary Language Used	Country of Origin	Type by Main Activity	Target Group	The Emphasis of Mental Health Content
1	Allison	Finnish	Finland	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
2	Autism Games / Whizkid-games	English	Australia	Web-Based Game	Children	Mental Health Problems
3	Aye Mind	English	UK	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
4	BiteBack	English	Australia	Informational Website	Youth	Mental Wellbeing
5	Booster-Buddy	English	Canada	Application for Recording Activity	Youth	Mental Health Problems and Mental Wellbeing
6	Breathing Room	English	Canada	Web-Based Program	Youth	Mental Health Problems
7	Bridge the Gapp for Youth	English	Canada	Peer Experience Website	Youth	Mental Health Problems
8	Dealing with Depression	English	Canada	Informational Website	Youth	Mental Health Problems
9	E-Talo	Finnish	Finland	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
10	Game of My Life	Finnish	Finland	Web-Based Game	Youth	Mental Health Problems

11	Headspace	English	Australia	Informational Website	Youth	Mental Health Problems
12	HealthyMinds	English	Canada	Informational Application	Youth	Mental Health Problems and Mental Wellbeing
13	Help.some	Finnish	Finland	Informational Application	Children and Youth	Mental Health Problems
14	HONEY-MOON	English	USA	Web-Based Game	Youth	Mental Health Problems
15	Kelty Mental Health	English	Canada	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
16	Kids Help Phone	English	Canada	Informational Website	Children and Youth	Mental Health Problems
17	Kids Helpline	English	Australia	Informational Website	Children and Youth	Mental Health Problems and Mental Wellbeing
18	Lasten ja nuorten netti	Finnish	Finland	Informational Website	Children and Youth	Mental Health Problems
19	Lasten mielenterveystalo	Finnish	Finland	Informational Website	Children	Mental Health Problems
20	Lasten sivut	Finnish	Finland	Informational Website	Children	Mental Health Problems and Mental Wellbeing
21	Life Skills for Kids	English	Australia	Game Application	Children	Mental Health Problems
22	Mielen saaret	Finnish	Finland	Web-Based Game	Children and Youth	Mental Wellbeing
23	MindShift	English	Canada	Informational Website	Youth	Mental Health Problems
24	Mind-Strength	English	Australia	Web-Based Program	Youth	Mental Wellbeing
25	mindyourmind	English	Canada	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
26	MiYo	English	Ireland	Application for Recording Activity	Youth	Mental Wellbeing
27	Mun Mieli	Finnish	Finland	Application for Answering a Questionnaire	Children and Youth	Mental Health Problems and Mental Wellbeing
28	NettiNappi	Finnish	Finland	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
29	No Bullying	English	UK	Informational Website	Youth	Mental Health Problems

30	Nuorten mielenter-veystalo	Finnish	Finland	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
31	Nuorten netti	Finnish	Finland	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
32	Nuorten Elämä	Finnish	Finland	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
33	Nuortenlinkki	Finnish	Finland	Informational Website	Youth	Mental Health Problems
34	Pelipäiväkirja	Finnish	Finland	Web Service for Recording Activity	Children and Youth	Mental Health Problems
35	ReachOut Orb	English	Australia	Game Application	Youth	Mental Wellbeing
36	Regional Youth Bus	English	Australia	Informational Website	Youth	Mental Health Problems
37	Reimari	Finnish	Finland	Informational Website	Youth	Mental Health Problems
38	Sisunmaan Sankarit	Finnish	Finland	Web-Based Game	Children	Mental Health Problems and Mental Wellbeing
39	Stem4	English	UK	Informational Website	Youth	Mental Health Problems
40	Students Against Depression	English	UK	Informational Website	Youth	Mental Health Problems
41	Teenmen-talhealth	English	Canada	Informational Website	Youth	Mental Health Problems
42	The Kid and I	English	UK	Web-Based Game	Youth	Mental Health Problems
43	the Low-down	English	New Zea-land	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
44	The Mix	English	UK	Informational Website	Youth	Mental Health Problems and Mental Wellbeing
45	Toivo	Finnish	Finland	Web-Based Program	Youth	Mental Health Problems
46	Tunne-etsivät	Finnish	Finland	Web-Based Game	Children	Mental Wellbeing
47	Young-Minds	English	UK	Informational Website	Youth	Mental Health Problems
48	Youthbe-yondblue	English	Australia	Informational Website	Youth	Mental Health Problems
49	Youthline	English	New Zea-land	Informational Website	Youth	Mental Health Problems