

# The Use of User-Centered Participatory Design in Serious Games for Anxiety and Depression

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## Abstract

There is increasing interest in using serious games to deliver or complement healthcare interventions for mental health, particularly for the most common mental health conditions such as anxiety and depression. Initial results seem promising, yet variations exist in the effectiveness of serious games, highlighting the importance of understanding optimal design features. It has been suggested that the involvement of end-users in the design and decision-making process could influence game effectiveness. In user-centered design (UCD) or participatory design (PD), users are involved in stages of the process, including planning, designing, implementing, and testing the serious game. To the authors' knowledge, no literature review to date has assessed the use of UCD/PD in games that are designed for mental health, specifically for anxiety or depression. The aim of this review is, therefore, to document the extent to which published studies of serious games that are designed to prevent or treat anxiety and depression have adopted a PD framework. A search of keywords in PubMed and PsychINFO databases through to December 2016 was conducted. We identified 20 serious games developed to prevent, treat or complement existing therapies for anxiety and/or depression. Half ( $N=10$ ; 50%) of these games were developed with input from the intended end-users, in either informant ( $N=7$ ; 70%) or full participatory co-design roles ( $N=3$ ; 30%). Less than half of games (45%) included users only in the testing phase.

**Keywords:** Participatory design, User-centered design, Serious games, Mental health, Anxiety, Depression, Therapy, Game research

## Introduction

ANXIETY AND DEPRESSIVE disorders are among the leading causes of burden of disease worldwide.<sup>1</sup> Although there is a wide variability of available treatments, many individuals either do not seek treatment or receive appropriate evidence-based care. Of those receiving treatment, dropout remains high and response rates are far from optimal.<sup>2</sup> Technology-based (e-health) interventions were developed to overcome some of the shortcomings of face-to-face therapy, by having the potential to reach a wide range of individuals, reducing long waiting lists, and making treatment available at any given time in people's daily lives.<sup>3,4</sup> Internet-based psychological therapy (particularly online therapy grounded in cognitive behavioral principles) has established a strong empirical base for clinical efficacy and patient acceptability. Countries such as Australia, Sweden, and the Netherlands provide good examples of how digital interventions provide alternative pathways to access care and

demonstrate how to successfully implement such interventions alongside traditional systems of mental healthcare.<sup>5</sup> However, despite increasing market penetration of e-health/digital interventions, patient engagement and adherence remains a challenge. Many patients fail to engage with the material or drop out before completion of a program.<sup>5</sup> This has led to other technology-based strategies that are designed to increase engagement. Among such digital interventions are "serious games": games that are designed to train skills or teach knowledge while actively engaging the user. Serious games share characteristics with "games" in that serious games have rules, elicit behaviors, get input from the player, and provide feedback. However, the primary purpose of serious games is education rather than entertainment.<sup>6</sup>

There is increasing interest in using serious games to deliver or complement healthcare interventions for mental health. For example, serious games have been developed to help treat obsessive-compulsive disorder (OCD),<sup>7</sup> anxiety and panic,<sup>8</sup> specific phobias,<sup>9</sup> depressive symptoms,<sup>10</sup> and post-traumatic

stress symptoms (PTSS).<sup>11</sup> A recent meta-analysis of randomized controlled trials (RCTs) ( $N=9$ ) of serious games for a range of mental health conditions reported a moderate effect ( $g=0.55$ ; 95% CI=0.28 to 0.83) on symptom improvement.<sup>12</sup> Although these results seem promising, variations exist in the effectiveness of serious games, highlighting the importance of understanding optimal design features.

It has been suggested that the involvement of end-users and/or the practitioners who oversee the care of intended end-users in the design and decision-making process could influence game effectiveness. There are different degrees to which end-users can be involved in the game design. In full user-centered design (UCD), users are typically involved at every stage of the process, including planning, designing, implementing, and testing the product/game.<sup>13</sup> Participatory design (PD) is a UCD approach in which users have the opportunity to actively influence and play a critical role in the design process, which is aimed at addressing users' needs. The user context (e.g., the healthcare sector) forms the fundamental starting point of the design process.<sup>14</sup> In PD, end-users can be involved either as informants (asked for input and feedback early in the design process) or as co-designers (partners in the design process and in charge of parts of the game development). For example, in the role of informant, end-users may be asked for feedback on design sketches or may be observed using other technology before product development. In the role of co-designer, the end-user is involved during the entire design process, and can influence the design process with their domain expertise.<sup>15</sup>

A recent meta-analysis on games for healthy lifestyle promotion indicates that games developed with certain types of PD could be more effective than others. That is, involving end-users as co-designers in creating the game world or characters relates to lower effectiveness (i.e., is counterproductive), whereas involving end-users (co-design or informant) in designing the game challenge or dynamics relates to higher effectiveness. Thus, the effectiveness of PD may depend on the design element, and involving end-users as informants may be more effective than involving end-users as co-designers. Although co-design is a newer and lengthier process than informant design, it might be the case that not all studies execute co-design properly (i.e., about half of the studies in the meta-analysis only involved users in one aspect of the design process, as opposed to continuous involvement), which may explain these results.<sup>16</sup> In addition, literature indicates potential benefits of collaborating with domain experts (e.g., clinicians) during the design process.<sup>17</sup> Expertise of clinicians could be invaluable not only to ensure that technology is intuitive and easy to use but also to ensure that it meets the standards outlined by the profession.<sup>18</sup>

Thus, although the use of certain types of PD involving end-users and/or experts could be beneficial, to the authors' knowledge, no literature review to date has assessed the use of PD in games that are designed for mental health, specifically for anxiety or depression. The aim of this brief article is, therefore, to document the extent to which published studies of serious games that are designed to prevent or treat anxiety and depression have adopted a PD framework. For the purposes of this review, we differentiate between input versus participation from both end-users (for whom the intervention was designed) and practitioners/experts (who may implement the intervention).<sup>16</sup>

## Method

### Search strategy

We searched the PubMed and PsychINFO databases through to December 2016. To identify relevant articles, we used a combination of keywords related to computers (i.e., computer, online, web, internet, internet-based, digital, electronic, tablet, tablets), serious games (i.e., game, video-game, games, gaming, gamifying, gamified, game-based, virtual play, avatar), and anxiety or depression (i.e., anxiety, obsessive compulsive, OCD, phobic, phobia, panic, GAD, mood, depressive, depression, dysthymic, dysthymia, affective, affect, post traumatic, post-traumatic). The reference lists of previous reviews on serious games for anxiety and depression were also searched manually to identify additional publications. One additional serious game was identified through author contact.

### Eligibility criteria and study selection

Studies were considered for inclusion if they: (1) described the usability, acceptability, likeability, engagement, effectiveness, efficacy, or prototype of a computerized serious game developed for anxiety or depression; (2) were published as an English brief report, case study, or full-text manuscript. Studies were excluded if the serious game was: (1) designed for assessment purposes, (2) designed for families or relatives, (3) designed to target only one symptom of depression or anxiety (e.g., cognitive functioning), and (4) focused on Virtual Reality (VR). We applied these exclusion criteria to restrict the focus to serious games designed specifically as an intervention for depression and/or anxiety symptoms experienced by the target user. Reviews or meta-analyses were also excluded from this review. The initial search resulted in 606 hits. After applying all inclusion and exclusion criteria mentioned earlier, 35 articles and 20 serious games were included in the review. Authors of the included studies were contacted to request more information on the use of a PD (i.e., whether end-users were involved as informants or co-designers, tested a concept, or finalized version of the game, whether clinical individuals or therapists were involved in the design/testing process). Game developers were also contacted. For 6 of the identified games, the contacted authors either did not respond or were unable to provide us with complete design details. For those games, available information on the use of a PD was retrieved from the associated article(s). We provide a brief summary of each of the games, categorized by the extent of user involvement.

## Results

### Serious games developed with end-users: informants or co-designers

We identified 10 serious games with input from end-users (Table 1):

- (1) "SPARX" (Smart, Positive, Active, Realistic, X-factor thoughts) is an online cognitive behavioral intervention game that is designed for adolescents with mild-to-moderate depressive symptoms, stress, or anxiety.<sup>19</sup> The game can be used as a stand-alone intervention, or as an adjunct to traditional face-to-face therapy. Fourteen young people (aged

TABLE 1. THE USE OF A PARTICIPATORY DESIGN IN SERIOUS GAMES FOR DEPRESSION AND ANXIETY

Associated publications	Game	Target symptoms	Information source	User involvement		
				PD: informant	PD: Co-designer	Testing (only)
Coyle et al. <sup>37</sup> ; Coyle and Doherty <sup>17</sup> ; Coyle et al. <sup>38</sup>	Personal investigator	Anxiety, depression, social skills problems	Article		Therapist	End-users
Brezinka <sup>7,39,40</sup>	Treasure hunt	Anxiety, depression, anger management	Author	Therapist		End-users
Shandley et al. <sup>36</sup>	ReachOut central	Anxiety, depression, stress, resilience	Author		End-users	
<a href="http://au.reachout.com/reachout-orb-game">http://au.reachout.com/reachout-orb-game</a>	ReachOut Orb	Anxiety, depression, stress, resilience	Author	End-users		
Merry et al. <sup>19</sup> ; Fleming et al. <sup>20</sup> ; Bobier et al. <sup>53</sup> ; Cheek et al. <sup>22</sup> ; Shepherd et al. <sup>23</sup> ; Poppelaars et al. <sup>21</sup>	SPARX	Depression	Author	End-users	Therapist/Researcher	
Lucassen et al. <sup>26</sup> ; Lucassen et al. <sup>25</sup>	Rainbow SPARX	Depression	Author	End-users	Therapist/Researcher	
Perry et al. <sup>24</sup>	SPARX-R*	Depression (prevention)	Author	End-users	Therapist/Researcher	
Stasiak et al. <sup>42</sup>	The Journey	Depression	Article			End-users
Carrasco (2016) <sup>47</sup>	Maya	Depression	Author	Therapist		End-users
Pinto et al. <sup>31,32</sup>	eSMART-MH	Depression	Author		End-users	
Roepke et al. <sup>33</sup>	SuperBetter	Depression	Author		End-users	
Pham et al. <sup>8,28</sup>	Flowy	Anxiety	Author	End-users		
Wijnhoven et al. <sup>35</sup> ; Schoneveld et al. <sup>34</sup>	Mindlight	Anxiety	Author	End-users	Therapist	
Coyle et al. <sup>43</sup>	gNats Island	Anxiety	Article			End-users
Dennis and O'Toole <sup>48</sup>	ABMT	Anxiety	Author	Therapist		End-users
Kreutzer and Bowers <sup>29,30</sup>	Walk in my shoes	PTSD	Author	End-users	Therapist/Researcher	
Marsac et al. <sup>11,44</sup>	Coping coach	PTSD	Article			End-users
Brezinka <sup>41</sup> ; Brezinka <sup>40</sup>	Ricky and the spider	OCD	Author	Therapist		End-users
Botella et al. <sup>9</sup>	Cockroach Game	Anxiety, phobia	Article	Therapist		End-users
Scholten et al. <sup>50</sup>	DOJO	Anxiety (prevention)	Article	?	?	?

“?” indicates insufficient information derived from the published article or response from the authors.

\*We based this information on correspondence that indicated that SPARX-R was based on SPARX.

PTSD, post-traumatic stress disorder; OCD, obsessive-compulsive disorder.

approximately 12–19) seeking support via school health counseling or health services (some with anxiety or depressive symptoms, though clinical diagnosis was not a requirement) were involved in the design process of “SPARX” as informants. In an interactive workshop, they advised on the format of the game, the story line, and some of the mini-games that are part of “SPARX.” Results of several RCTs showed that “SPARX” is more effective in reducing depressive symptoms than a waitlist control condition<sup>20</sup> and equally effective as treatment as usual<sup>19</sup> or an active monitoring control condition.<sup>21</sup> Importantly, “SPARX” was more effective compared with treatment as usual for those with more depressive symptoms.<sup>19</sup> In addition, young people rated “SPARX” as both engaging and appealing.<sup>22,23</sup>

- (2) “SPARX-R,” a revised version of “SPARX,” was modified as a preventive intervention for depression rather than an acute treatment. A cluster RCT comparing SPARX-R with an attention control condition is currently being conducted in secondary school students in Australia.<sup>24</sup>
- (3) “Rainbow SPARX,” an additional revised version of “SPARX,” was adapted for lesbian, gay and bisexual (LGB) adolescents with depressive symptoms. “Rainbow SPARX” was developed in collaboration with LGB youth (eight out of nine suffered from feeling down for more than a few days in a row, aged 16–27). During three focus groups, nine participants provided suggestions on how the characteristics, design, and scenarios of “SPARX” could be adapted to LGB youth. Based on outcomes of the focus groups,

- adjustments to “SPARX” were made. Several studies showed that “Rainbow SPARX” is a promising, feasible, and acceptable intervention.<sup>25–27</sup>
- (4) “Flowy” was developed for anxiety management by delivering breathing retraining exercises. Adults suffering from panic attacks or generalized anxiety disorder provided input and feedback on a series of test media, to assess the desired themes, mechanics, and esthetics of the game. Subsequently, prototypes were developed and feedback was provided on usability by several groups of participants. Results from a pilot RCT showed that “Flowy” is experienced as an acceptable and engaging intervention, and it may increase quality of life. However, the game did not significantly decrease anxiety, panic, or hyperventilation symptoms as compared with a waitlist control condition, indicating that further studies are needed to show clinical efficacy.<sup>28</sup>
  - (5) “Walk in My Shoes” was developed for post-traumatic stress disorder (PTSD), focusing on coping strategies and cognitive restructuring. Veterans who experienced symptoms of PTSD were involved in the design process of the game as informants. In addition, therapists were involved in the design of the game. Several studies using “Walk in My Shoes” suggest that user expectations toward the intervention may play an important role in reactions toward the game (e.g., perceived usefulness, ease of use, intention to use, and enjoyment).<sup>29,30</sup>
  - (6) “Electronic Self-Management Resource Training for Mental Health” (eSMART-MH)<sup>31</sup> is an avatar-based intervention that is developed to reduce depressive symptoms and to stimulate individuals toward effective communication with the virtual healthcare provider. The game was developed in collaboration with community-dwelling individuals with chronic health conditions. In addition, medical professionals with expertise in mental health were involved in the design process. Research demonstrated initial efficacy of the game; individuals (aged 18–25) showed a significant reduction in depressive symptoms over three months as compared with an attention control group.<sup>31</sup> Research showed preliminary support for the efficacy of the game; compared with an attention-control condition, individuals showed a reduction in depressive symptoms over a period of three months.<sup>31</sup> In addition, a recent RCT with young adults (aged 18–25) showed that eSMART-MH has greater feasibility compared with usual care, and it has been found to be a safe, acceptable intervention.<sup>32</sup>
  - (7) “SuperBetter” (SB) is an Internet- and smartphone-based game that is developed to enhance the user’s drive to pursue certain goals and to build social support (also called “General SB”). Recently, a version of SB has been designed to specifically target depressive symptoms (“CBT-PTT SB”), adopting principles from CBT and positive psychotherapy (PPT). This game was developed in collaboration with individuals with depression. Results from an RCT showed that both General SB and CBT-PTT SB are more effective in reducing depressive symptoms compared with a waitlist control condition.<sup>33</sup>
  - (8) “MindLight” is a serious game that is designed to tackle anxiety in children. Children suffering from anxiety were asked for input and feedback during an early stage of the design process. In addition, therapists were involved as both informants and testers of the game. Recent results from an RCT have shown a significant reduction in anxiety symptoms in children aged 7–13. However, the improvements of anxiety did not differ from a control game condition.<sup>34</sup> An RCT that is currently still ongoing (including children aged 8–16) may provide more results on the effectiveness of “MindLight.”<sup>35</sup>
  - (9) “ReachOut Central” (ROC) is a web-based game that depicts characters in real-life situations and uses gamified role-play to encourage the player to find solutions to common problems and then apply these acquired skills to their own life. Based on information collected from the current ReachOut Project Manager, young individuals were involved in the early ideation and design phase of the game. An uncontrolled trial of ROC in 266 adolescents demonstrated improvements in all outcome measures for women, but a worsening effect on some measures for men (e.g., avoidance and resilience).<sup>36</sup> As the authors note, in the absence of a control condition, the results should be interpreted with caution.
  - (10) “ReachOut Orb” (an extension of ReachOut Central) is a serious game that is designed around the Australian Year 9 and 10 curriculum to promote resilience and well-being. Students interact with a range of characters in an attempt to return color and positivity to the virtual world that has become devoid of color. Based on information collected from the current ReachOut Project Manager, young individuals were involved as informants during the development process, but they were not as extensively involved in the design phases compared with the original ReachOut game. We did not identify any academic paper reporting program evaluation.

#### *Serious games developed with end-users: users as testers only*

Nine serious games were identified that did not include direct user input at the design phase, but that included end-users at the test phase where feedback on usability and/or acceptability was provided (Table 1). Although involving users only in the testing phase is not considered a form of PD, this process can, nonetheless, provide important information regarding usability/acceptability.

- (1) “Personal Investigator” (PI)<sup>37</sup> is a computer game based on Solution Focused Therapy (SFT) that is designed to help treat adolescents with mental health problems, such as anxiety, depression, or social skills problems, and to help build a client-therapist relationship. During the design process of the game, a multi-disciplinary team of both mental healthcare professionals and technical professionals was involved.<sup>38</sup> Twenty-two adolescents (aged 10–16) with mental health problems (e.g., depression, suicidal ideation, low self-esteem, problems with anger management) tested

the game. Initial evaluations showed that PI has the potential to increase client engagement during face-to-face therapy sessions and help build an effective client-therapist relationship.<sup>37</sup>

- (2) “Treasure Hunt”<sup>39</sup> was developed to support cognitive behavioral treatment for children with a broad range of mental health problems (e.g., anxiety, depression, anger management). Children play the game under guidance of a therapist, to maximize its potential. During the development of the game, end-users were not actively involved. However, clinical experience of the developer did greatly influence the design. Children between 9 and 13 years of age with externalizing or internalizing problems tested the game and provided suggestions for improvement. Therapists who played the game with children during treatment reported that the game was helpful, reinforcing, and strengthened the therapeutic relationship.<sup>40</sup>
- (3) “Ricky and the Spider”<sup>41</sup> was designed to enhance the treatment of children with OCD. Similar to “Treasure Hunt,” this game should be played under supervision of a therapist. During the development of “Ricky and the Spider,” end-users were not actively involved. However, therapists were involved as informants during the design process. In addition, children with a diagnosis of OCD (aged 6–12) were included at the test phase of the game. Initial evaluations showed that “Ricky and the Spider” is well accepted by young children suffering from OCD and is perceived as a helpful tool by therapists.<sup>41</sup>
- (4) “The Journey”<sup>42</sup> is a computerized CBT program with gaming features developed for adolescents with depression. During the development of the game, end-users were not involved. However, 34 adolescents (aged 13–18) who referred to school counselors for low mood tested the game. Results of a pilot RCT indicated that “The Journey” was significantly more effective in reducing depressive symptoms than a computerized attention placebo condition (with psycho-education), and it was rated as an acceptable intervention by adolescents.<sup>42</sup>
- (5) “gNats Island”<sup>43</sup> was developed to support interventions for adolescents experiencing mental health problems, such as anxiety and depression. The computer game implements various components of CBT and is played under guidance of a clinician. “gNats Island” has been developed without user input. However, six adolescents (aged 11–16) with anxiety symptoms evaluated the game, and they found the game likeable and useful. In addition, the game has been perceived as both useful and acceptable by therapists.<sup>43</sup>
- (6) “Coping Coach”<sup>44,45</sup> is a web-based intervention with a gamified component that is designed to prevent or reduce post-traumatic stress symptoms (PTSS) for children who experience acute (potentially) traumatic events. The game was developed with feedback from children. Results of a pilot RCT of 72 children (aged 8–12) who completed Coping Coach versus Wait-list Control after an acute medical event indicated a medium effect size reduction in PTSS symptoms at 6-week follow-up. However, no differential effects were reported for trauma-related cognitive appraisals, coping, or social support seeking.<sup>46</sup>

- (7) “Maya”<sup>47</sup> was developed as a psychotherapeutic complementary tool for adolescents in treatment for depressive symptoms. Both interpersonal psychotherapy and cognitive behavioral models guided the design of the intervention. End-users with clinical symptoms of depression were not involved in the design process. However, therapists collaborated in the game design (as informants) and provided feedback on the story and game elements. The game was tested by 15 adolescent patients (aged 12–18) with depressive symptoms or a diagnosis of mild-to-moderate depression. Results showed that most patients find the game helpful and acceptable as part of psychotherapeutic treatment.<sup>47</sup>
- (8) “Cockroach Game”<sup>9</sup> is a phone-based serious game that is developed for cockroach phobia. End-users did not influence the game design process. However, therapists collaborated with engineers when designing the program (e.g., developing the concept, writing the clinical specifications). Patients suffering from small animal phobias tested the “Cockroach Game.” A case study (female, aged 25) showed that the use of the game was perceived as helpful, and it could reduce fear before an Augmented Reality treatment.<sup>9</sup>
- (9) A mobile gamified “Attention-Bias Modification Training” (ABMT)<sup>48</sup> was developed for highly trait-anxious adults. During the design of the game, end-users were not involved. However, therapists influenced the game design by providing input and feedback. Individuals with low to moderately elevated anxiety symptoms (aged 21–35) tested the game. Results of an RCT (78 highly trait-anxious individuals; score  $\geq 49$  on the State-Trait Anxiety Inventory) showed that “ABMT” might reduce anxiety and stress reactivity.<sup>48</sup>

#### *Serious games: user involvement unknown*

We could not determine end-user involvement in either the designing or testers phase for the serious game “Dojo,” a heart rate variability biofeedback game that incorporates emotion-regulation strategies to prevent anxiety among adolescents (Table 1). Dojo was developed by Gamedesk and evaluated in a pilot study of 8 adolescents with externalizing and anxiety problems<sup>49</sup> and an RCT of 138 adolescents with sub-clinical anxiety symptoms (where no significant differences in anxiety score reductions were reported relative to an active game comparator).<sup>50</sup>

#### **Discussion**

In this review, we have identified 20 serious games developed to prevent, treat or complement existing therapies for anxiety and/or depression. Half (50%) of these games were developed with input from the intended end-users, in either informant (70%) or full co-design roles (30%). Less than half of games (45%) included users only in the testing phase. Thus, most games did not involve users in the complete design process.

According to Fleming et al.,<sup>51</sup> it is important to create an understanding of current behavior, preferences, and needs of users by involving them during the development stage of the intervention. By combining scientific research with a user-

centered design, uptake and adherence of the intervention might be enhanced. However, as noted by DeSmet et al.,<sup>16</sup> full PD may not be required in all instances. From a clinical perspective, end-users (i.e., patients or clients) do not necessarily possess the knowledge about the strategies that will assist them in alleviating distress and coping with psychological difficulties. Clinicians frequently ask patients to engage in tasks that they are initially hesitant about or unwilling to engage in (e.g., exposure therapy wherein patients are asked to activate high levels of anxiety by putting themselves in the situations they avoid). Therefore, it is also important to more extensively consider clinician input during the design and testing phases.

Some limitations of this review must be considered. We limited our search to English publications; therefore, some potentially relevant serious games may have gone unnoticed. Second, not all authors responded to our request for additional information about the use of a PD. Further, as we did not limit our search to RCTs (comparing serious games with another intervention or waitlist), we did not conduct a meta-analysis of the impact of PD on the efficacy of serious games for outcome measures of depression and/or anxiety.

We recommend that authors routinely publish information on the design process (including more detailed information on the role of informants [e.g., clinicians] and end-users, such as the age and number of informants/end-users, the format [e.g., focus groups], the instructions provided, the level of user design experience, the stage of game development, the design elements in which informants/end-users are involved etc.) to enable a more comprehensive review and evaluation of the role of PD in effectiveness of serious games. Further, as noted by Eichenberg et al.,<sup>52</sup> greater consistency in the nomenclature used to describe serious games for mental health would facilitate comparisons across studies. This information could then be used by game developers and researchers to inform evidence-based decisions regarding design elements and the clinical value of PD.

### Acknowledgment

Funding for preparation of this article was received from the Utrecht University Serious Game Seed Fund.

### Author Disclosure Statement

The authors declare no conflicts of interest.

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