Chapter 1

Using Gamification to Reduce Stress and Anxiety in Children: Innovative Approaches

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Abstract

Gamification has been proposed as a novel methodology for reducing stress, anxiety and negative emotions experienced by children. Gamification-based applications are implemented through various digital tools, including web and mobile applications, virtual reality technologies, digital storytelling and wearable devices. These tools have the potential to enhance children's hospital experiences by increasing their cooperation, especially during interventional procedures.. The utilisation of gamification-based applications has been demonstrated to be an effective method of mitigating anxiety and stress in children undergoing highly stressful medical procedures. However, the unregulated use of these technologies may lead to several risks, including screen addiction, social isolation, and a sedentary lifestyle. Consequently, it is imperative to simultaneously develop strategies to mitigate potential adverse effects while designing gamification applications. Pediatric nurses play an important role in improving the quality of care by closely following technological developments in this field, ensuring that gamification-based interventions are implemented in an effective, ethical and safe mannerIn this chapter, anxiety and stress in children are examined in relation to the concept of gamification. Innovative interventions based on gamification and focused on reducing anxiety and stress were discussed.

1. Anxiety and Stress

Anxiety is an emotion, tension, or feeling of worry that is accompanied by physiological changes and associated concerns or fears. Actually, anxiety is a normal response to stressors. Moderate levels of anxiety constitute a universal response that alerts individuals to potential dangers in their environment and prompts them to take action. If anxiety occurs excessively

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or inappropriately and significantly impairs an individual's functioning, it may be classified as an anxiety disorder. Anxiety disorders are among the most prevalent psychopathologies in children and adolescents (*National Institute of Mental Health, 2025)*; American Psychiatric Association, 2015); Vallance & Garralda, 2008). Anxiety and stress cause similar symptoms, including irritability, anger, fatigue, muscle pain, digestive problems, and difficulty sleeping (American Psychological Association, 2022)

Anxiety is emerging as an increasingly significant public health concern. It is estimated that 4.05% of the global population currently suffers from an anxiety disorder. This corresponds to approximately 301 million people, which is nearly equivalent to the population of the United States, the third most populous country in the world after China and India (Javaid et al., 2023).

Individuals may experience anxiety disorders at any point in their lives for a variety of reasons. According to data from the National Institute of Mental Health, an estimated 31% of adults in the United States will experience an anxiety disorder at some point in their lives. Similarly, among adolescents aged 13 to 18, the prevalence is estimated at 31.9%, with 8.3% experiencing severe impairment (National Institute of Mental Health, 2025).

Anxiety is common in children, as it is in the general population. The incidence of anxiety in children increases significantly from the age of 10. It peaks twice—between the ages of 10 and 14 and 35 and 39—but remains at elevated levels within these age ranges. The incidence of anxiety reportedly begins to decline only after the age of 65 (Javaid et al., 2023). The American Psychiatric Association reports that generalized anxiety disorder is observed in 0.9% of adolescents, separation anxiety disorder in 4% of children and 1.6% of adolescents. Females are also reported to be at greater risk of developing anxiety disorders than males (American Psychiatric Association, 2015).

1.1. Anxiety and Stress in Children

The factors causing stress and anxiety in children vary depending on the child's developmental stage. While separation from the mother causes anxiety in 1-year-old children, social anxieties such as speaking in front of a group or attending parties are more prominent among adolescents, as their ability to think abstractly and comprehend abstract threats develops (Vallance & Garralda, 2008).

Children may experience anxiety in examination and treatment environments such as blood draws, injections, physical examinations, and

operating rooms. Children, especially at a young age, are vulnerable to this and lack sufficient coping mechanisms to manage stressful situations. This can lead to undesirable outcomes such as treatment avoidance, non-cooperation, eating and sleeping disorders, and increased stress symptoms (Ghaddaripouri et al., 2022).

1.2 Traditional Approach to Anxiety

Pharmacological interventions may be used in the treatment of anxiety disorders. Selective Serotonin Reuptake Inhibitors (SSRIs) are the primary treatment option. In addition to SSRIs, which inhibit serotonin reuptake and increase serotonin levels in the synaptic cleft, Serotonin-Norepinephrine Reuptake Inhibitors (SNRIs) are also utilized. Benzodiazepines were frequently used as anxiolytics in the past; however, due to issues such as dependence, withdrawal, cognitive, and coordination disorders associated with long-term use, their use has declined. In addition, antiepileptics, tricyclic antidepressants, and atypical neuroleptic agents are pharmacological options for treating anxiety. Non-pharmacological methods are also employed in the treatment of anxiety disorders (Bystritsky et al., 2013).

Cognitive-behavioral therapy (CBT) is at the forefront of these methods. CBT aims to help individuals recognize and challenge dysfunctional thoughts and subsequently develop realistic alternatives. The success of CBT is directly related to the patient's active participation and adherence to therapy. In treatment-resistant anxiety disorders, some experimental and invasive treatment options are also being considered alongside traditional methods. Methods such as deep brain stimulation (DBS), psychosurgery, vagus nerve stimulation (VNS), and repetitive transcranial magnetic stimulation (rTMS) are used, particularly in treatment-resistant obsessive-compulsive disorder (OCD). The effectiveness of these methods remains unproven, and research on this topic is ongoing (Bystritsky et al., 2013).

Traditional distraction techniques can help reduce anxiety in children experiencing anxiety in hospital settings who tend to avoid cooperation due to increased stress symptoms. In this context, audiovisual distraction (AVD) techniques positively affect children by diverting their attention away from anxiety-inducing stimuli. Music therapy is another effective approach used with children, particularly during medical procedures. A study conducted in a hospital setting found that live music therapy reduced children's anxiety levels and increased their sense of safety (Whitehead-Pleaux et al., 2006).

2. Gamification

Gamification is a method that aims to make interventions more enjoyable, motivating, and engaging by using game elements in non-game contexts (Deterding et al., 2011; Hoffmann et al., 2017). The definition of gamification remains unclear due to overlapping terminology. Deterding et al. classified these terms according to their usage methods and scope (Deterding et al., 2011):

- **Gameful design (gamification):** The purpose of the software is to serve a non-gaming function, but it contains game-like elements.
- **Serious games:** It is created entirely with game elements; if it has a purpose other than entertainment, it is defined as a serious game.
- **Playful design:** Although it contains entertaining elements, it mainly refers to systems that have a real function.
- **Toys:** Designed solely for gaming and entertainment purposes, it has no other function.

When viewed in a broader context, gamification refers to the integration of game components into real life. As a broader definition, gamification is the adaptation of real-world environments using game components. The focus is on education and behavioral change rather than entertainment (Krath et al., 2021).

With technological advancements and easier access to technology, the use of gamification has become increasingly widespread in recent years. In gamification, game elements such as points, badges, levels, and leaderboards are used to maintain individuals' interest, increase their engagement, and ensure that desired behaviors are sustained (Semartiana et al., 2022). It can be used as a motivational tool to regulate individuals' habits. For example, game systems where children earn points or badges are often used to help them develop habits such as brushing their teeth or using the toilet. In the field of education, especially with the growth of online learning, gamification is increasingly used to enhance student motivation and, consequently, learning outcomes (Kasurinen & Knutas, 2018). In the health field, gamification methods have been developed to promote weight loss, increase physical activity, and improve stress management (Hoffmann et al., 2017). In addition, gamification techniques are used in areas such as monitoring chronic diseases, regulating medication adherence, and supporting therapy processes. These applications increase individuals' compliance with treatment and encourage the continuation of positive behaviors. As a result, gamification has become an effective tool for shaping

daily habits and creating sustainable change in critical areas such as education and health (Huang et al., 2023).

Gamification is used by children of all ages to enhance the learning process. Especially during the pandemic, it has been a widely used method for young people to learn about health protocols and socialize. The use of gamification in children's education is based on increasing motivation, making the learning process enjoyable, encouraging participation, and improving academic performance. The most commonly used game elements are points, levels, and leaderboards. Regarding technological tools, previous research shows that mobile applications are the most prominent (Semartiana et al., 2022).

2.1 Fundamental Principles of Gamification

Gamification, which integrates game elements into real-world processes to enhance user motivation and engagement, is based on certain working principles. The table-1 summarizes the fundamental principles and theories that explain how gamification is effective at behavioral, individual, and social levels (Krath et al., 2021).

Tablo 1. Fundamental Principles of Gamification

Principles guiding the intended behavioral outcomes	
Clear and relevant objectives	Gamification can transparently demonstrate goals and their relevance.
Instant feedback	Gamification can provide users with direct feedback on their actions.
Positive reinforcement	Gamification can reward users for their performance and communicate the relevance of their achievements.
Guided paths	Gamification can guide users to take the necessary actions to achieve goals.
Simplified user experience	Gamification systems are generally easy to use and their content can be simplified.
Principles that encourage individual fitness	
Individual goals	Gamification can enable users to set their own goals.
Adaptive content	Gamification can adapt tasks and complexity to the user's abilities and knowledge.
Multiple options	Gamification can allow users to choose among multiple options to achieve a specific goal.
Principles that facilitate social interaction and foster positive social outcomes	
Social comparisons	Gamification can enable users to view the performance of their peers.
Social norming	Gamification can bring users together to support each other and collaborate towards a common goal.

3. Innovative Gamification-Based Applications in Anxiety and Stress Management

In addition to traditional methods for reducing stress and anxiety, innovative and effective approaches have emerged in recent years. These include mindfulness-based meditation, yoga, virtual reality (VR), digital games, gamification, storytelling, digital storytelling, smartphone sensors, mobile android applications, gamified digital therapy engaging visual, auditory, and tactile senses, and exergames incorporating active physical movement (Andrade et al., 2019; Hoffmann et al., 2017; Huang et al., 2023; Nicolaidou et al., 2022; Wang et al., 2025). Significant evidence shows that methods such as storytelling, digital storytelling, digital games, digital therapy, mobile applications, various tools, and gamification strategies reduce anxiety and stress in children, especially before they face stressors (Andrade et al., 2019; Hoffmann et al., 2017; Mete İzci & Çetinkaya, 2024; Montaner-Marco, 2019; Nicolaidou et al., 2022; Wang et al., 2025).

3.1 Virtual Reality Applications

Virtual reality (VR) headsets are often used as a gamification method to reduce stress and anxiety in children. VR has been identified as the most effective method for reducing pain and anxiety during blood collection and intravenous catheterization, which are among the most common causes of anxiety in children. Anxiety scores and symptoms were lower in experimental groups using VR headsets compared to other groups (kaleidoscope and distraction cards). Virtual reality headsets have been reported as the most effective method for reducing anxiety (Ates Besirik & Canbulat Sahiner, 2024).

The process of intravenous catheter insertion is one of the most stressful medical procedures for children. Virtual reality headsets can be effective during intravenous catheter insertion due to their distraction capability. In another study examining the effect of virtual reality headsets, the impact of their use during intravenous catheter insertion in the pediatric emergency department on children's emotional responses was investigated. Children who used virtual reality headsets exhibited fewer negative emotional behaviors during the invasive procedure (Şen & Çetinkaya, 2024).

Children are often fearful and anxious about dental treatment. Distraction techniques are effective in reducing anxiety during dental treatment. Another study investigating the effect of virtual reality headsets on anxiety included children aged 7–10 who visited a dental health center for tooth extraction and pulp treatment. Children in the intervention group who used virtual reality

headsets during dental treatments reported lower anxiety scores than those in the control group. It was noted that virtual reality headsets can be used as a distraction method during dental treatments (Demir Kösem et al., 2024). Another study investigated whether the use of virtual reality headsets during dental treatment reduced anxiety in children. The study included children aged 6–8 who required dental treatment. The same children participated in the study on two separate occasions. During the first treatment, VR headsets were used, while they were not used during the subsequent treatment. The results of the study indicated that children's anxiety levels were lower during treatments where VR was used (Bahrololoomi et al., 2024).

Another study investigated the effect of virtual reality on reducing anxiety in children during invasive procedures such as blood collection or intravenous catheter insertion. The study reported that the VR application reduced anxiety. A notable finding in the study was that children who were sensitive to anxiety experienced a greater reduction in anxiety when they focused deeply during the VR application (Gold et al., 2024).

A study investigating whether virtual reality can be used instead of anesthesia in minor medical procedures requiring sedation and general anesthesia in children reported that all procedures were performed without the need for additional sedation and anesthesia using virtual reality. Thanks to virtual reality, children focused their attention on the virtual environment and distanced themselves from the real environment that caused anxiety (Salimi-Jazi et al., 2024).

A systematic review investigating the effects of VR applications on reducing anxiety associated with surgical procedures reported that immersive VR can significantly reduce anxiety. VR applications were found to be effective as a distraction technique. Notably, VR appeared to be more effective in younger children, which was attributed to their higher levels of focus and immersion in the virtual environment (Sánchez-Caballero et al., 2024).

In a meta-analysis examining the impact of VR during intravenous catheter insertion procedures in children, ten randomized controlled trials were evaluated. The results indicated that VR was effective in alleviating anxiety. It functioned by diverting children's attention and shielding them from negative environmental stimuli. This distraction facilitated both physical and psychological relaxation, thereby mitigating anxiety (Wei et al., 2024).

The surgical process is considered one of the most challenging experiences for both children and their families. Preoperative anxiety is commonly observed in pediatric patients (Mete İzci & Çetinkaya, 2024; Santiago et al., 2025; Turgut et al., 2024). Studies have reported that VR tours—which visually introduce the operating room and provide information about the perioperative period—significantly reduce anxiety in children in the VR group compared to those in the control group (Turgut et al., 2024).

Vaccination, a key component of herd immunity, begins in infancy and continues through childhood. Fear and anxiety about vaccinations are common among school children. It has been reported that using VR headsets to distract children during vaccinations is effective in reducing anxiety (Kirbas & Kahriman, 2024).

3.2 Mobile Applications

Mobile applications are increasingly utilized as a form of gamification within digital health solutions. In particular, mobile health applications have been developed to enhance individuals' awareness of their health data, promote adherence to treatment, and facilitate communication with healthcare providers. Studies involving the pediatric population have shown that mobile applications enhance children's engagement in treatment and reduce both anxiety and pain. Additionally, these applications have been found to improve parental satisfaction. By incorporating gamification techniques, these applications enhance children's motivation and improve their healthcare experiences through age- and developmentally-appropriate content. Moreover, applications designed to educate parents and foster their active involvement support comprehensive treatment management. In this context, mobile applications are emerging as effective and accessible tools for gamification in pediatric healthcare (Rantala et al., 2022; Wang et al., 2025).

Cognitive behavioural therapy (CBT) is commonly administered to children with anxiety disorders. The impact of mHealth technologies and gamification on anxiety has been investigated to enhance the effectiveness and out-of-session application of CBT. Researchers developed a gamified mobile application for child anxiety, known as Gamified SmartCAT. The app encourages children to engage more consistently in therapeutic exercises aimed at managing anxiety. The application has been reported to effectively support children in coping with anxiety and reducing their anxiety symptoms (Pramana et al., 2018).

Stress management apps available on Android platforms were analyzed with respect to gamification strategies, stress management methods, and behaviour change techniques. The analysis revealed that gamification strategies were extensively employed across these applications. However, it was reported that application designers implemented gamification without a specific intent to influence user behaviour or emotional responses. Integrating gamification techniques with behaviour change theories is essential for effectively influencing users and promoting desired behavioural outcomes (Hoffmann et al., 2017).

Gamified educational games have been reported to effectively reduce social anxiety in preschool-aged children. It has been emphasized that multidisciplinary educational games significantly contribute to the development of personal skills, such as helping behaviours and self-confidence, in preschool-aged children (Maria & Sumantri, 2025).

A study applied a gamified digital therapy intervention integrating visual, auditory, and tactile stimuli to reduce children's preoperative anxiety. Children in the gamified digital therapy group exhibited a 42% reduction in anxiety compared to the control group (Wang et al., 2025).

3.3 Digital Storytelling

Interventions aimed at reducing preoperative anxiety in children include storytelling and video games. A study comparing the effects of storytelling and video games on anxiety found that both served as effective distraction techniques for children (H. M. Ali et al., 2023). A meta-analysis reported that storytelling effectively reduced anxiety and fear among children in hospital settings (Ku et al., 2025). Storytelling facilitates children's ability to recognize and manage negative emotions. Digital storytelling refers to a short film of 3-5 minutes duration, created using web-based programs that integrate visual and auditory elements such as narrative text, images, animations, and music. Storytelling using computer-based applications (Robin & McNeil, 2019). Another definition describes digital storytelling as the art of narrating stories through computer-based applications (Stanley, 2018). Digital storytelling can be categorized into personal, educational/informative, and historical story types (Robin, 2008). Personal and informative stories are particularly noted for their positive impact on anxiety reduction (Macdonald et al., 2024; Mete İzci & Çetinkaya, 2024).

A study investigated the effects of digital storytelling on children experiencing anxiety. Participants attended workshops to acquire skills including storyboard creation, visual element design, voice-over production,

and software use during the digital story preparation process, enabling them to transform their anxieties into personal digital narratives. This process offered children an opportunity to express their emotions through storytelling. Digital storytelling empowers children to narrate difficult or stressful experiences and has been found enjoyable for those experiencing anxiety, as it helps them realize they are not alone, facilitates sharing of stories, and fosters peer support. Digital storytelling has been reported to enhance children's ability to express their anxiety, thereby improving understanding of their mental health and aiding in anxiety coping mechanisms (Macdonald et al., 2024).

Another study investigating the therapeutic effects of digital storytelling in pediatric day surgery employed the informative type of digital storytelling. Children in the intervention group were prepared for surgery through digital storytelling. No intervention was administered to children in the control group. Anxiety levels in the digital storytelling group were reported to be significantly lower than those in the control group both on the day of surgery and two weeks postoperatively. Digital storytelling was found to be effective in reducing anxiety and negative emotional behaviours in children (Mete İzci & Çetinkaya, 2024).

4. The Risks of Gamification on Children

As previously discussed, gamification offers numerous benefits for children. Digital gamification provides physical, social, and cognitive benefits to children. Although digital gamification applications offer these benefits, they also pose certain risks. These applications pose risks related to increased screen time, addiction, and mental health concerns. It is essential for gamification developers to implement strategies aimed at mitigating these risks. Children's use of these applications should be carefully monitored, and physical activity should be integrated into application design. Designing content that promotes children's healthy behaviours and raising awareness among gamification designers regarding this issue are crucial. This process can be effectively managed with the support of a multidisciplinary team including parents, peers, and educators (R. F. Ali et al., 2024).

5. Conclusion

Gamification interventions represent an innovative approach that reduces the negative experiences children face during hospitalization, thereby decreasing stress and anxiety. Gamification can effectively improve children's health by enhancing their sense of self-worth. Innovative tools including web-based platforms, mobile apps, virtual reality, digital

storytelling, and wearable technologies, can effectively increase cooperation during challenging surgical procedures, reduce anxiety, and promote more positive experiences for children in hospital settings. To maximize the benefits of gamification applications, potential risks such as screen addiction and sedentary behavior should not be overlooked. Concurrent initiatives to mitigate these risks should be implemented. Pediatric nurses can enhance their caregiving capabilities by staying abreast of technological advances and advocating for the widespread adoption of such gamification interventions.

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