

Recommendations for the Development of Video Games to Reduce Stress in Young People

1st José Aldana

Universidad Peruana de Ciencias Aplicadas
Prolongación Primavera 2390, Lima 15023, Perú
U201726329@upc.edu.pe

2nd Sebastian Trujillo

Universidad Peruana de Ciencias Aplicadas
Prolongación Primavera 2390, Lima 15023, Perú
U201914877@upc.edu.pe

3rd Eduardo Díaz

Universidad Peruana de Ciencias Aplicadas
Prolongación Primavera 2390, Lima 15023 - Perú
pesijord@upc.edu.pe

Abstract— Nowadays, stress in young people is a frequent problem that can affect their physical and mental well-being. This article aims to propose nine recommendations for the development of video games to reduce stress in young people. The recommendations were based on the analysis of 25 research works and 7 video games about of themes and contexts, video game design, aspects such as color selection for video games, creation of scenarios and gameplay. For a better understanding, an illustrative example was developed to show the use of the recommendations in the development of a video game to reduce stress. This work may be of interest to video game designers, psychologists and educators who need to develop video games to reduce stress in young people.

Keywords— *Stress, Video games, Recommendations, Video game design.*

I. INTRODUCTION

Stress is defined as a complex physiological, psychological, emotional, and behavioral response of the organism to situations perceived as challenging and threatening to a person's coping ability [1]. The year 2021 has been considered the most stressful year in history, with a record of 41% of young people and adults around the world suffering from stress [2]. Stress in young people is a frequent problem that can affect physical and mental well-being as well as academic performance. Young people are known to experience a great deal of pressure from academic, family, and other activities. Which can be overwhelming and stressful [3]. In this context, the search for effective solutions to combat stress in young people is becoming increasingly important. It is because of this that there are several strategies that can help prevent or reduce stress: physical exercise [4], adequate sleep [5] and leisure time [6]. In the last strategy of leisure time, video games are becoming increasingly popular as a stress-reducing tool. Video games can be used for serious purposes, such as health and education [7].

According to the study conducted by Russoniello et al. [8] mentions that many modern medical disorders are related to stress and because of this there is a great need for effective low-cost interventions that guarantee compliance. With the results obtained in their study they prove the potential of

casual video games to carry out all the requirements mentioned above. In addition, the article by Singh [9] mentions that stress and depression affect millions of people around the world [53] so alternative methods to treat symptoms are becoming increasingly popular. The journal JMIR Serious Games studies video games designed to combat depression. According to their report [22], which examines the effects of commercial video games on mental health problems such as depression and anxiety, playing them can be especially helpful for those who do not have access to traditional treatments due to cost or location barriers. In addition, video games can supply a sense of community, crucial for supporting good mental health, especially for those suffering from social isolation and loneliness. It is because of this, and the lack of articles focused on recommendations for developing video games focused on stress reduction in young people that we decided to conduct this research.

According to the American Psychological Association. Millennials (ages to 18 to 33) report the highest average stress level [54]. Therefore, recommendations were developed for people aged 18-25 years who play video games and possess certain characteristics, such as the ability to understand and enjoy the story of a video game, intellectual curiosity, and empathy.

The contribution of this work is to supply nine recommendations for the development of video games to reduce stress. These recommendations were based on 25 research articles that cover the fundamental elements that make up a video game, in addition to the analysis of 7 video games (Embrace [12], Paper Cranes [23], Dorameon Story of Seasons [14], Journey [22], Flower [11], Dungeon and Dragons [19], and Elder Scroll: Morrowind [19]). The nine recommendations proposed are distributed in three categories: (i) recommendations for the theme or context of the video game, containing concepts on the theme of the video game, (ii) recommendations for the development of the video game design, containing concepts on video game design patterns, colors that can be used in the video game, scenarios where they interact with the main character, and (iii) recommendations for the playability of the video game, containing concepts on levels of difficulty. In addition,

therapeutic approaches with proven results in the field of stress treatment are involved [10]. The article shows an illustrative example of the development of a video game using the proposed recommendations.

The article is structured as follows. Section 2 reviews the literature related to the development of video games and techniques to reduce stress. Section 3 shows the definition of the recommendations to develop a video game to reduce stress. Section 4 shows an illustrative example using the proposed recommendations and Section 5 presents conclusions and future work.

II. STATE OF ART

This section reviews earlier work in the literature related to video games to reduce stress in young people. We conducted a Targeted Literature Review (TLR), a non-systematic, in-depth, and informative literature review aimed at keeping only the significant references to maximize rigorosity while minimizing selection bias. For this purpose, the semantic question about the of video games to reduce stress is translated into the following syntactical query used as a search string on the Scopus digital library:

("video game" OR "computer game") AND "stress" OR "anxiety" AND "study." The articles were classified into two groups: (a) Development of stress-reducing video games, and (b) Studies on the impact of generating stress-reducing video games. Inclusion criteria are: (i) video games with stress-reducing features, (ii) stress-reducing therapies and technology. Exclusion criteria are: (i) a topic unrelated to stress-reducing therapies (ii) video games that do not include relaxing features. The first search showed 89 articles. After applying inclusion and exclusion criteria, the sample of 10 articles was considered. The articles accepted in the search are as follows:

A) Development of stress-reduction video games

Desai et al. [11] developed a study with the video game "Flower" to evaluate its effectiveness in reducing stress in young people in comparison with conventional meditation. The results showed that at the physiological level the effects were similar between both approaches, which places the video game as an alternative of relaxation. Zygotegou et al. [12] developed a video game named "Embrace" based on the Experiential Avoidance Model [13] that includes relaxing tasks to reduce stress and replace users' thoughts of self-injury with those of preserving their integrity. The findings of the experiment showed that users mostly experienced positive feelings after playing the video game, being noteworthy to mention the contribution of art therapy [14] to video games to enable them to be stress reducers. Agrawal et al. [15] analyzed art therapy and stress reducing factors of video games for the development of a video game that could combine these ideas called "Color me". Téllez et al. [48] conducted research to study stress in sports performance and explored the use of biofeedback [52] and virtual reality video games for stress management. Our findings suggest that virtual reality video games, such as Virtual Autonomic Nervous System (VANS), can effectively reduce stress in athletes, supplying a promising avenue for future stress management interventions.

As a conclusion on works considered in this group, we can state that some studies have focused on developing video games to alleviate stress, such as [11] and [12]. Another work explored the utilization of art therapy in the creation of video games [15], [48] explored its impact on sports performance. It is important to note that our proposal enables the development of a video game with tailored recommendations within specific contexts.

B) Studies to generate stress-reduction video games

Govender et al [49] analyzed the impact of therapeutic video games on the empowerment of pediatric patients with chronic diseases, such as cancer. The results highlighted the importance of video games and mobile health applications in the development of empowerment interventions to improve patients' quality of life. Villani et al [50] highlighted that video games supply promising opportunities for stress management. The findings suggest that video games may be a valuable tool in emotional regulation interventions. Future studies, especially with clinical populations, could further support their implementation in stress management. Bouchard et al [51] investigated the use of biofeedback in a three-dimensional video game for stress management. Results showed that practicing stress management skills within the game effectively reduced stress levels, suggesting that video games may be a promising tool for stress reduction in different contexts and populations.

As a conclusion on works considered in this group, we can state that some works analyzed the impact of video games to reduce stress [49], [50] and [51]. Therefore, our proposal analyzed research works in the development of video games where recommendations were extracted for an adequate development of a video game to reduce stress.

III. DEFINITION OF RECOMMENDATIONS FOR VIDEO GAME DEVELOPMENT

This section shows recommendations based on the literature review and research conducted for the design of a video game to reduce stress in youth. These recommendations are based on research articles and analysis of current video games with stress themes [17]. A set of 25 research articles collected from different bibliographic databases such as Scopus and Web of Science and 7 video games (Embrace [12], Paper Cranes [23], Dorameon Story of Seasons [14], Journey [22], Flower [11], Dungeon and Dragons [19], and Elder Scroll: Morrowind [19]) that were carefully selected and analyzed by previous studies demonstrating their effectiveness in reducing stress. These videogames were analyzed by us, based on the themes of the video game, video game design, aspects such as color selection video game interfaces, the creation of scenarios in the video game, interaction with other characters, and aspects of how the video game should be in concepts of difficulty to this is called playability [12]. The recommendations are mentioned with the prefix R with a number, for example, we have recommendation R1, R2, etc. Next, we describe the recommendations divided into three categories: (i) Recommendations for the theme or context of the video game; (ii) Recommendations for the development of the video game design, contains concepts about what colors should have the

graphic components, the scenarios where the video game characters interact, the use of design patterns, and others; (iii) Recommendations for the playability of the video game, shows levels of difficulty. Next, we describe the nine recommendations to develop video games that reduce stress:

A. Recommendations for the theme or context of the video game:

R1: Works of therapies for the themes or context of video games were analyzed as: (i) Narrative Therapy [18] is a therapeutic approach based on the premise that people construct their identity through stories they tell about their experiences, can be used in the development of Role Play video games such as Elder Scroll: Morrowind and Dungeon and Dragon to reduce stress [19]. In addition, as suggested by Polkinghorne et al. [20] in their study of the video game Dungeon and Dragons, characteristics of the mechanics of the game with a narrative generated by the participants were compared with those seen in narrative therapy. Narrative Therapy is used in video games because: (a) the construction and reconstruction of video game stories should contain a person's life, to help them redefine and re-signify their reality and experiences; (b) it holds that narratives are not simply stories told about a person's life, but are that person's own identity and problems; (c) narratives are a fundamental part of how people define themselves and how they experience and process the challenges and conflicts they face in their lives. (ii) Art Therapy [21] uses creative expression through art as a primary means of exploration and emotional release, allows to be used for the development of video games such as Dorameon Story of Seasons [14] and Journey [22] that possess this functionality to reduce stress as suggested by Kardemis E. [23] with his video game Paper Cranes, which was created as an accessible and easy means of therapy, implementing art therapy as the main idea. Art Therapy is used in video games because: (a) video games are a form of artistic and emotional expression, and art therapy provides an avenue for game designers and graphic artists to develop unique visual worlds (b) the use of video games can be considered as venues for complex artistic expressions based on interpretation in a virtual space [24]. Therefore, the use of Narrative or Art therapy in the development of video games is recommended.

R2: Works and video games about video game music were analyzed, it was identified that in the works of: (i) Witte et al. [25] analyzed that listening to music produces the reduction of heart rate and cortisol levels, this allows reducing stress-related symptoms, either in a clinical setting or in daily life. (ii) Li et al. [26] developed an experiment with fifty-six young people between the ages of 18 to 26 years with stress, sub-threshold, or mild depression. The individuals were randomly assigned into control and experimental groups, in which the experimental group underwent training with casual music-based video games for four weeks and the other group continued with their daily activities without any intervention. As a result, symptoms of depression and anxiety were significantly reduced in the participants of the experimental group. Proving that casual video game music reduces stress. Taking as examples of video games that implemented casual music: Flower [11] and Animal Crossing: New Horizons [27] and. Therefore, it is recommended that the use of casual music

(classical music) in the development of video games can reduce stress.

As a summary, the recommendations extracted for the themes or context of the video game, it turns out that Narrative therapy or Art therapy should be used, and casual music should be used in video games.

B. Recommendations for video game design development

R3: Works and video games about the colors of video games were analyzed, it was identified that in the works of (i) Lubos et al [28], developed an experiment that consisted of exposing people to colors such as blue and pink painted on a wall for twenty minutes. The results were that people who were exposed to these colors felt significantly more relaxed than before the experiment. (ii) Pine et al [29], conducted research with a group of 207 adolescents between the ages of thirteen and fifteen from seven different schools on their interest in a casual video game focused on mental health. The adolescents who were less stressed wore soft colors (light blue and white in pastel shades). In the Embrace video game [12] all graphical interfaces follow soft color patterns, such as the use of warm (carmine, coral, vermillion, and amber) and light colors with white tones, as they have been shown to help users relax [30]. Therefore, it is recommended that the use of colors in video games should be with soft and warm shades (such as blue, pink, carmine, coral, and others).

R4: Works on exposure to the environments where the video game character is located have been analyzed. In the work of: (i) Choe et al [31] analyzed that exposure to natural environments can influence people's mental health, investigated whether the effects of the wellness intervention, Mindfulness-Based Stress Reduction (MBSR) [32], are enhanced when combined with the benefits of exposure to a natural environment. There were ninety-nine participants randomly assigned to a weekly one-hour MBSR session in three different environments (natural outdoor, built outdoor, and indoor) for six weeks. The results show that the positive effects of MBSR are greater when conducted in a natural outdoor setting compared to indoor or built environments. (ii) Adevi & Mårtensson [33] conducted a study on the therapeutic role of nature in the form of a garden based on interviews conducted with a group of five volunteers from a rehabilitation program for people with stress disorders who described their experiences with garden therapy as essential to their recovery. Therefore, it is recommended that for the video game you can use nature settings or environments.

R5: Works on software development patterns have been analyzed: (i) State Pattern: this pattern allows an element or entity to change its behavior when its internal state changes [34]. In the context of video games to reduce stress, it can be applied to manage different emotional states of the player and adjust gameplay [35]. For example, in an adventure game, the player's state could change from "relaxed" to "stressed" according to game criteria, and the game behavior could be adapted to provide easier or harder challenges; (ii) Strategy pattern: this pattern focuses on encapsulating interchangeable algorithms and allowing them to be used flexibly [36]. In the context of stress-reducing video games, it can be applied to provide young players with different strategies or approaches

to deal with stressful in-game situations [35]. For example, in a puzzle game, multiple strategies could be provided to solve a challenge; (iii) Observer Pattern: sets up a one-to-many relationship between objects (entity), so that when an object changes state, all dependent objects are automatically notified and updated [37]. For the context of video games to reduce stress, this pattern can be applied to supply feedback and emotional support to the young player [35]. As an example, we have that a non-playable character could act as an observer and offer words of encouragement in stressful moments of the game, which could help reduce anxiety and improve the overall experience of the player; (iv) Factory pattern: it is used to create objects without specifying the specific class of the object to be created [26]. This pattern can be applied to dynamically generate game elements to have a relaxing effect on players [35]. An example of the factory pattern in a simulation game could create decorative elements, such as Zen gardens (meditation gardens) or fountains, which provide a calm and serene in-game environment. Therefore, the State, Strategy, Observer and Factory patterns are recommended for video game design as they are used in different video games [35].

R6: Works of the studies on screen dimensions were analyzed, in the work of (i) Hou et al. [38] where they suggest that the size of the device's screen can influence the user's experience when playing video games. The screen size is an important variable to consider as it directly affects the perception of visual information. (ii) Sanchez et al. [39] conducted two experiments where participants observed different objects on two smartphones with different screen sizes, confirming that the size of the phone screen can negatively influence users' visual perception. Therefore, it is recommended to consider the device's screen size when designing a video game to reduce stress in young people. Video games designed for mobile devices with small screens smaller than six inches can increase eye strain and tension, thereby reducing the effectiveness of the game as an anti-stress tool [40].

R7: Works of the studies on video game levels were analyzed, in the work of Khalifa et al. [41] analyzed thirty representative video games, including both old and new titles, video games from major companies and independent developers. Design patterns in video games were identified, considering their relevance, recurrence, and impact. These patterns are elements that are present in levels across multiple games, rather than being a recurring feature of just one game [42]. For example: (i) Level shapes are used in video games to guide players in specific directions, (ii) Collectibles are used to guide players towards what appears to be a dangerous path, and (iii) Video games use empty areas to relax and relieve players' tension. Therefore, it is recommended to use design patterns in video game levels, as designers use these tools of the trade to design levels and benefit from a perspective on level design and other technical approaches [41].

Figure 1 shows the video game Donkey Kong 2, where it depicts the characters and a group of bananas showing the path the characters should choose. This provides guidance for the characters to progress in the game.



Fig. 1: Collectibles (an object in a video game that can be collected by players).

As a summary, the extracted recommendations for video game design development indicate that soft and warm colors should be used in the video games, along with natural environment settings. Design patterns such as State, Strategy, Observer, and Factory should be employed. It is important to consider the target devices and their screen sizes when designing the game. Additionally, game levels should be developed by implementing patterns such as level shapes to guide players, and collectibles can be used to guide players towards dangerous paths.

C. Recommendations for gameplay in the video game

R8: Video games about of gamification techniques were analyzed as in the game Embrace [12], which was developed to reduce stress levels using a combination of psychotherapy and gamification techniques (techniques related to the use of rewards in video games). Gamification is the process of applying game elements and mechanics in non-gaming contexts with the aim of increasing interaction, engagement, and enjoyment of the video game [43]. In Embrace, certain game mechanics were explored, such as having the game consist of four levels with increasing difficulty, although the overall gameplay is quite simple. The main mechanic involves moving a ball across the screen to progress in the game. Part of the game's concept is for the player to interpret the ball as themselves and to experience relaxing moments throughout the four levels. (ii) Animal Crossing: New Horizons [27] became incredibly popular among people of all ages as they used it as a means of relaxation and stress reduction during the COVID-19 pandemic. The game provided a sense of satisfaction through achieving goals that were presented with various difficulties, helping players cope with the isolation associated with the pandemic [44]. Therefore, it is recommended to include various levels of difficulty in the game, such as Easy, Normal, and Hard, and utilize mechanics that can maintain the player's attention long enough to help reduce their stress levels.

R9: Works on the interaction with animals in video games were analyzed, in the work of: (i) Farmer [45] demonstrated through their research that interaction with trained animals served as a complementary therapy to cognitive-behavioral therapy [46] for treating stress in war veterans. (ii) Pendry et al. [47] founded that animal-assisted therapy positively influenced the improvement of students experiencing stress related to their studies. After increasing human-animal interaction, an improvement in the patients' moods and a

greater willingness to confront their academic problems were observed. Therefore, it is recommended to potentially include human-animal interaction in the video game to reduce stress.

As a summary, the recommendations extracted for the video game are to use levels of easy, normal, and difficult complexity, and to include interaction with animals.

Table 1 presents a summary of the nine recommendations for video game development.

Table 1 Summary of Recommendations

Category	Recommendation	Details
Recommendations for the theme or context of the video game	R1	Narrative Therapy Art Therapy
	R2	Casual Music: “Sweden” – Minecraft, “Life as a Flower” – Flower, “Nascence” – Journey
Recommendations for video game design development	R3	Color: Soft (light blue and White in pastel shades) y Warm (carmine, coral, vermilion and amber)
	R4	Exposure to natural environments
	R5	Software Development Patterns: State Pattern, Strategy Pattern, Observer Pattern and Factory Pattern
	R6	Consider the screen size of the device on which the videogame will be developed
	R7	Videogame level design patterns
Recommendations for gameplay in the video game	R8	Develop various levels of difficulty of the video game and include gamification techniques
	R9	Interaction with animals

IV. ILLUSTRATIVE EXAMPLE

This section presents an example of five recommendations for developing a stress-reducing video game. The aim of this section is to provide a guide on how these selected recommendations could be implemented in a stress-reducing video game. This example shows a video game about a girl who finds herself in her dreams, where she goes through various levels involving feeding and petting animals, puzzle games in a platform game design, and with each completed level, the player earns in-game coins that can be used to buy clothes for the girl. Each figure presented in this section has a different context of a video game.



Fig. 2: Video game character in nature feeding a rabbit.

Figure 2 shows the main character of the game in a level where she is in a natural environment feeding a rabbit. For this example, we are incorporating recommendation R4, which suggests using natural environments in the game where the character, the girl, is situated. Additionally, it aligns with recommendation R9, which involves interacting with animals, as depicted by the action of feeding a rabbit.

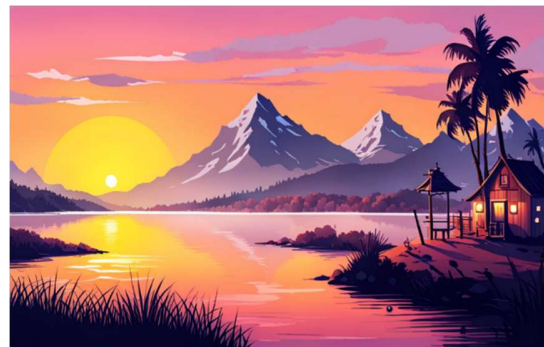


Fig. 3: Sunset in a location with mountains and a lake.

Figure 3 shows the starting location of the game. At the beginning, a cinematic will highlight where the girl's dreams begin, and the cabin serves as the starting point for her journey. The landscape features a sunset with a palette of soft and warm colors, creating an atmosphere of peace and tranquility for the player, aligning with recommendation R3. The use of blue and pink tones further enhances this effect. The aim is to evoke a sense of relaxation and reduce stress in the player.



Fig. 4: Platform video game level.

Figure 4 shows a level in a platform-style game where the shape of the level is used to guide the player in a specific direction thanks to the design of this level. For this example, we are using recommendation R7, which mentions the use of level design patterns in video games. The pattern used here is platform level design, as seen in various games such as Mario Bros, Dustforce, and Sonic.



Fig. 5: Video game character receiving coins as a reward.

Figure 5 shows the game character receiving coins as a reward after completing a level of the game. In this figure, a gamification technique is depicted, where the player is given coins for completing tasks within the game. This example aligns with recommendation R8, which suggests the use of gamification techniques to increase player engagement.

In summary, the illustrative example of this video game incorporates recommendations R3 (Colors), R4 (Exposure to natural environments), R7 (Video game level design patterns), R8 (Gamification techniques), and R9 (Interaction with animals) for game development. This illustrative example supplies a clearer understanding of how these recommendations should be implemented in a video game aimed at reducing stress in young players.

V. CONCLUSIONS AND FUTURE WORK

This article presents nine recommendations for the development of video games focused on reducing stress in young people. The analysis includes 25 research works studies and 7 video games, from which recommendations have been extracted. Recommendations R1 and R2 relate to the theme or context of the video game, suggesting the inclusion of

therapies such as Narrative Therapy and/or Art Therapy, as well as the type of music to be included. Recommendations R3 emphasize the use of soft and warm colors. Recommendation R4 focuses on the exposure to natural environments. Recommendation R5 pertains to the use of software development patterns. Recommendation R6 emphasizes considering the screen of the target device during game development, and finally. Recommendation R7 highlights the use of level design patterns in video games. Moving on to video game. Recommendations R8 and R9 suggest the development of different difficulty levels, incorporating gamification techniques, and including animal interactions, respectively.

The work presents an illustrative example of using recommendations R3, R4, R7, R8, and R9 to develop a video game. This illustrative example supplies a clearer understanding of how these recommendations should be implemented in a video game focused on reducing stress in young people.

As future works. First, we are developing a computer video game to reduce stress that incorporates all the recommendations presented in this study. Second, we plan an analysis with more related research works to obtain new recommendations for video game development. Third, we plan to develop a virtual reality video game that includes the new recommendations as part of the development process.

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