Creation and Implementation of a Serious Game to Detect Depression in Young People and Children

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Abstract. In medicine, according to the International Classification of Diseases (ICD-10), within the area of psychological diseases, there are 23 mental disorders of which neurodevelopment, psychotic, bipolar, obsessive-compulsive, stress disorders, anxiety stand out. and depressants, among others. At present, the creation of technological tools that facilitate the detection or diagnosis of diseases have revolutionized the way in which they are treated. In recent years, the design and creation of video games focused on educational purposes (Serious Games) has increased. The Serious Games are based on real scenarios, and their objective is to enhance the learning of higher order cognitive processes and skills in a specific context, which helps to improve behaviors and gather information. Within this area, simulations and video games designed to help the recovery of patients with chronic or terminal illnesses are included, as well as those designed to help with psychotherapy and overcome trauma, such as depression. The present work is based on the creation of a serious game based on the psychology of color of Max Luscher, the test of the human figure of Karen Machover, HTP by John Buck, with the aim of detecting depression in young people and children through of Criteria that can be analyzed according to their behavior and selective preferences during the game using an information gathering methodology in the analysis and design phase of the serious game, which allows to obtain a quality game, for its detection, fulfilling the specific purposes established.

Keywords: Serious games, color psychology, unity 3d, depression in young people and children, avatars 3d, information gathering methodology.

1   Introduction

Mental disorders are considered a public health problem worldwide. According to the ministry of health [1], it is estimated that around 15 million people suffer from some mental disorder. The results of the latest National Survey of Psychiatric Epidemiology (ENEP) [2] indicate that 28.6 percent of the population presented some of the 23 disorders of the International Classification of Diseases (ICD-10), conducted by the World Health Organization [3]. Some of these disorders are: neurological, psychotic, bipolar, obsessive-compulsive development, stress disorders, anxiety, depressives, among others [4].

Depression is an emotional disorder that is basically characterized by mood disorders, loss of interest, sadness, inhibition, fatigue, insomnia, negative thoughts, and that produces a decrease in pleasure in habitual activities, a negative view of oneself, the future and the world [5]. The most common treatments are cognitive behavioral therapy and medications [6].

The appearance of depression in children and adolescents has increased in the last fifty years [7]. It is estimated that by 2020, depression will occupy second place as a disabling condition and first in developed countries It is estimated that by 2020, depression will take second place as Disability status and first place in developed countries [8].

There are currently several tools for the detection of depression, several of them based on test, such as that of the human figure of Karen Machover [9]. This test is based on the theoretical basis of the body scheme that is projected through the drawing and that serves as an instrument to reveal the internal dimensions of the personality that generally cannot be evaluated [10]. Another of these test-based depression detection tools is the John Buck H.T.P test (home, tree, person), which allows you to evaluate psychic dynamics in culturally different individuals and allows you to obtain clinical information without awakening threatening experiences [11].

In recent years, with the recent technological development, numerous solutions have emerged to the problems in different areas, including the medical area, in which the procedures that were previously performed manually were automated and optimized. Under this perspective, Information and Communication Technologies (ICTs) have revolutionized these areas and have provided solutions that facilitate everyday life [12].

Many and diverse have been the solutions that have been proposed to facilitate the interaction of the human being with the environment in which it develops [13, 14], among the software products that have been created are the Serious Games, which are digital games used as a tool for learning social behaviors, attitudes and practices [15].

Serious games can be applied to a wide spectrum of areas such as military, government, educational and health care, such as that presented by Martins et al. [16], where a game is presented to investigate the evolution of patients with mental disabilities. This game promotes the development of patient memory, time to make decisions, the ability to observe, learn and the application of known skills.

Serious games are interesting for mental health for three reasons: They offer attractive potential as the popularity of computer games suggests.

Serious Games approaches can increase the scope of mental health interventions, this is important given the large number of people who experience mental disorders and who, however, do not receive treatment. Second, users can experience the game's approaches as something fun, wanting to "win" the game or see how the story unfolds. These dynamics can contribute to reducing high dropout rates in Internet-based interventions naturally.

Third, the game has a potential for effectiveness because it provides opportunities for both conventional and non-traditional processes for behavior change and learning. It can offer immersion experiences where a state of "flow" can be achieved, provide sensory environments to support social learning, allow users to test new skills in a safe and reactive environment, and facilitate repeated behavioral tests [17].

This article proposes a serious game that focuses on the detection of depression through analyzable criteria obtained from the player's behavior. The proposed serious game, has 3 levels in which it allows the player to personalize his avatar taking into account the psychology of color, both in clothes and in hair, interpreting his behavior through the test of the human figure of Karen Machover. In addition, it is also be possible to customize different avatars with which it interacts, taking as a reference the way in which the player sees the people around him and choosing an environment, among several options, to see if the player is sociable or prefers closed and solitary spaces, among other aspects to evaluate.

2   Design

The design of a Serious Game should focus on the user, the playability and the immersion [18], as shown in Figure 1. The playability makes the game easy and fun to use, emphasizing the style and quality of the game-user interaction, usability, narrative and history, interactive intensity, degree of realism, among other aspects [19]. Immersion is the ability to believe what is played and integrate into the virtual world that is shown in the game [20]. From a design point of view, serious play depends on the balance between the proposed challenges and the player's necessary skills to overcome them. If you also consider the characteristics of immersion, such as awareness, concentration, realism, skill and socio-cultural closeness, the need to take the user into account in the game design becomes evident [18].

The first phase when designing Serious Games is the analysis of the context, that is, the identification and study of the requirements of the game [21]. The target audience must be well defined and the design plan clearly delimited. In this phase several criteria are established, such as: objectives of the game, fun complements, that is, sounds, video, 2D and 3D images, effects, etc. In addition, certain stimuli are also defined for the player, such as rewards (during the game and / or at the end of the game) and desirable content focused on children and youth with depression.

In the second phase is the design, the main elements that are included in the serious game are determined, such as the environment, the mechanics of the game, the scenarios, the objects of the game, the learning system and the technical specifications [18]. When we talk about the environment, we talk about the game environment, which
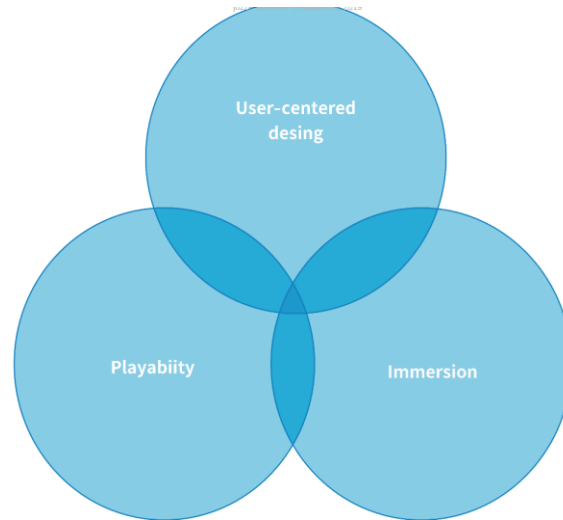
Fig. 1. Design features of a serious user-centered game.

can be physical or virtual, it also promotes an emotional appeal that attracts the attention of the players and an analysis of the general vision is carried out (target audience, purpose, gender, design of levels and market analysis).

The mechanics of the game is the most important element, since here we describe all the actions that allow us to build the rules of the game, the methods designed for the interaction between the player and the serious game [22]. It allows to establish the communication, the score, the rewards or the punishments and the flow of the game, and the elements of the gameplay.

Game objects are virtual elements included in the environment, which allow you to have a combination of skills such as decision making, movement and activities within the game.

They have a set of characteristics (appearance, functions, functions) and are capable of creating actions that describe their aesthetic representation, at this point the attributes are taken into account: avatars, actions (sounds, animations, movements, graphic styles) and appearances [23].

Another important aspect to consider in this design stage is the technical specifications, ranging from coding, emerging technologies applied, within serious gaming and hardware / software resources [18].

Level Design. As mentioned earlier, the serious game consists of 3 particular levels, which allow analyzing the player's behavior through established criteria to obtain information. In this way, it is possible to determine satisfactorily whether the child or young person suffers from depression.

Character Customization. The first level is designed for the player to determine the color of the avatar's clothes and hair, this with the objective of obtaining relevant

information that allows to know the mood of the player, following the criteria established within the psychology of color [24]. An example of this is children who are generally in favor of the colorful and bright, that is, they like light, but there are times when they are attracted to dark colors and shadows, because they correspond symbolically to their mood state at that moment [25]. Dark colors are also used by the child or young person who wants to indicate their sadness. As an example: blue is the deepest of colors, it is a cold color that produces calm and tranquility. The good and affectionate child often uses the color blue, while the nervous and aggressive child prefers red. In the same way, the color brown is the color of the negative, of the difficulties, and of the conflicts of adaptation to a familiar and social environment, for that reason if the player leans towards opaque, dark and sad colors, it would be a key that determine the presence of depression [26]. In other words, level one aims to use the player's perspective on himself through the avatar and the psychology of color as a reference.

Social Environment. In level 2 it is intended that the player personalize a group of avatars with which he will surround himself, taking into account again the psychology of color and the criteria established for the interpretation of the combinations. As an example, the combination of brown with black, according to Luscher [27], has an interpretation of contempt for the same person, or gray with black that is associated with separative isolation or absolute lack of participation. It is intended that the player when choosing this type of combinations for the group of avatars, show the way in which the player perceives the people around him. These avatars have different body characteristics that help the analysis of player behavior following the criteria established by Machover in his famous human figure test. Test [9].

Environment selection At level 3, the player must choose an environment, taking into account the different structures of colors and shapes. You should also choose environments such as cities with avatars, fields, forests, deserts and even swamps, taking as a reference mainly the criteria of the psychology of colors, shapes and all the components that are present in these environments, to know if the player is sociable or inclined towards closed places, that is, that prefers loneliness, associating all this with the appropriate criteria for a successful diagnosis of depression.

3   Development

Unity 3D is one of the most popular video game development environments today [28], which is used for 2D and 3D projects. Among the features that stand out are the ease of use and, in turn, the power to create video games and applications for various platforms using the programming language C# [29].

The serious game proposed in this work was programmed on this platform, using several external components such as Vroid studio [30] to create avatars, Sweet Home 3D [31] to model house, Blender [32] to model some additional components and graphic editors for create and modify icons and logos used, among other external components compatible with unity 3D.
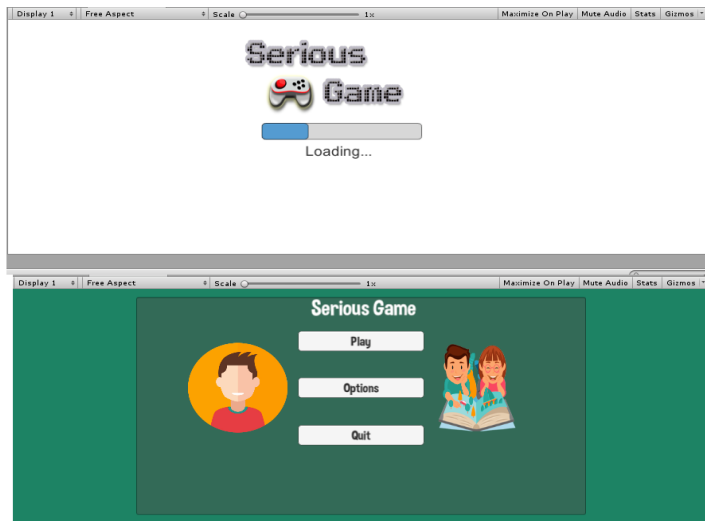
Fig. 2. Home screen and menu.

In the first phase of development, a home screen with white background was created, with the aim of giving greater seriousness and perception of space and breadth. In the center the logo of the serious game was placed, in addition to a loading bar to move to the next scene. Subsequently, a menu with three buttons is presented: "Play" to start the game, "Options" to configure the parameters within it and "Exit" to exit the game. The screens and elements mentioned are shown in Figure 2.

The next stage of development is to create the scene where the player can choose his avatar, according to sex, as shown in Figure 3. For the first level of the Serious Game there are options to choose 4 colors, 2 of them correspond to the specific attributes of the avatar: color of the clothes and hair, the other 2 correspond to the platform and the environment. For the first level of the Serious Game there are options to choose 4 colors, 2 of them correspond to the specific attributes of the avatar: color of the clothes and hair, the other 2 correspond to the platform and the environment. Taking into account the criteria established by the psychology of color, which states that the presence of dark and opaque colors are clear evidence of the presence of depression in young people and children, this scenario will provide information that will help detect the presence of said disease. Figures 4 and 5 show two hypothetical examples of avatars created by people who show signs of depression, according to the psychology of color.

Based on the scenes and objects created for the serious game, the objective is to make an analysis of the choices made by the players, in terms of clothing color, hair and environment, which allows to determine if there are signs of depression.

Figures 6 and 7 show two hypothetical examples of avatars created by players who show high self-esteem, according to the theory of color psychology.

At level 2, the criteria established in the psychology of color are retaken, which allows the player to modify the color of the clothing and hair to different avatars with
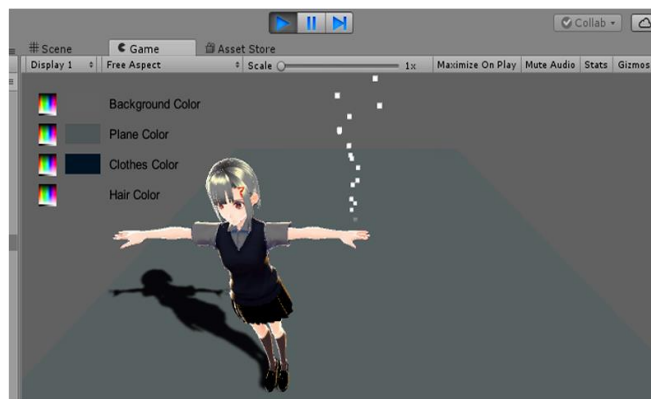
Fig. 3. Avatars selection.

Fig. 4. Female avatar designed by a person showing signs of depression.

which he interacts, taking as a reference the player's perspective towards the people around him.

The above is shown in Figure 8, in which it is possible to perceive a shaded environment with opaque colors. The selection of these colors is directly related to the emotional state of the player, in this way, by observing the combination of gray and black colors in the dress of the avatars, it is possible to determine that the player is an isolated person. The selection of the yellow color of the platform and the black environment determines that the player tends to suffer sudden crises.

In the third and final level of the serious game, the player's behavior is evaluated, choosing environments, interpreting the essential characteristics of these and combining the criteria established by the psychology of color. At this level, shapes, colors and all visible components are interpreted in the environments chosen by the
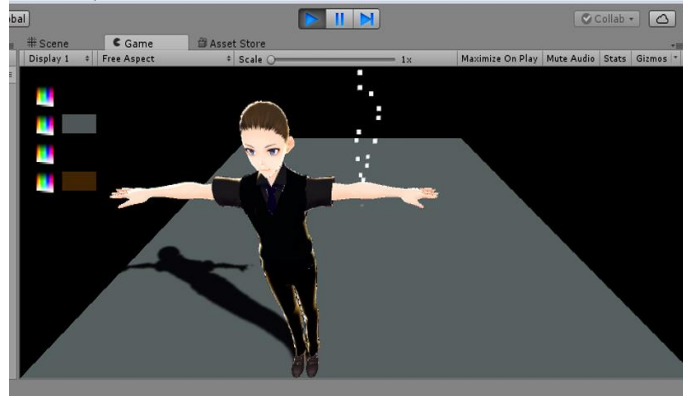
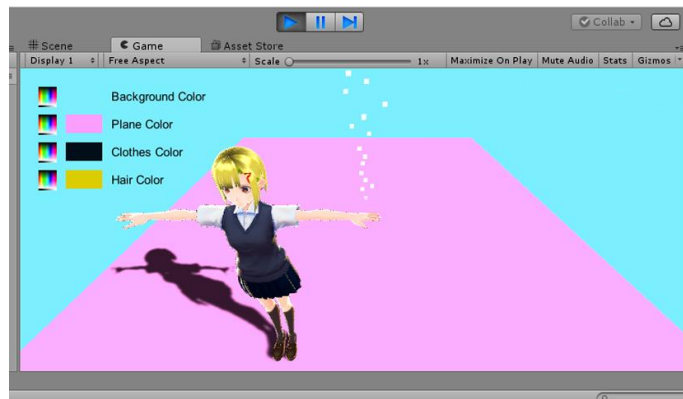**Fig. 5.** Male avatar designed by a person showing signs of depression.

Fig. 6. Female avatar designed by a person who has high self-esteem.

user, it is determined if the user is sociable or lonely and, most importantly, detects if he suffers from depression.

Two examples of this are shown in Figures 9 and 10. Figure 10 shows a shady and lonely forest in contrast to a dark gray background and dry trees, which are interpreted through HTP and color psychology as an eligible environment for people with depression and low self-esteem.

4 Conclusions and Discussion

The Serious Game proposed in this document aims to detect depression in young people and children through the Max Luscher color psychology test [27]. This approach is presented in the Game through the presence of different elements, divided by levels, in which a specific analysis of the choice made by the player is performed based on the colors considered.
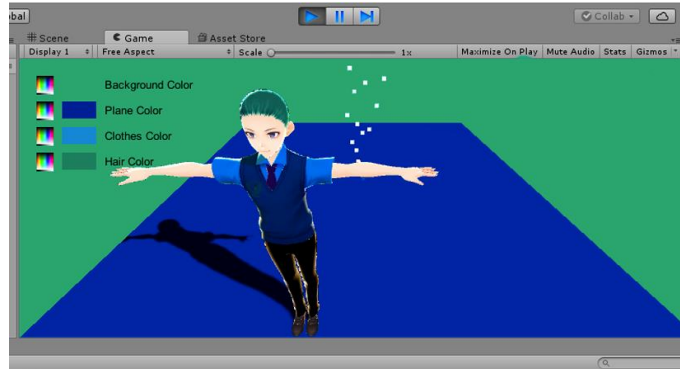
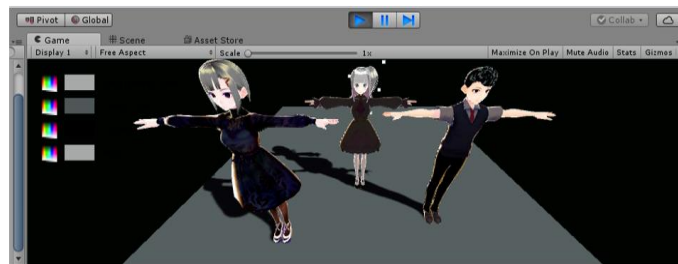**Fig. 7.** Male avatar designed by a person who has high self-esteem.

Fig. 8. Design of a group of avatars with colors associated with mood.
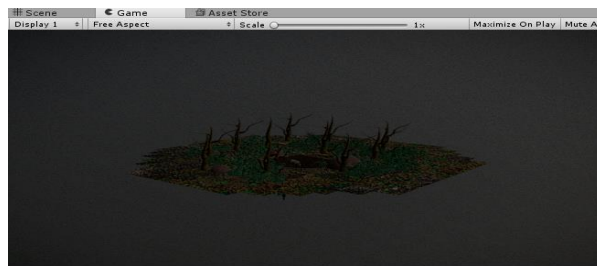

Fig. 9. City with avatars.

Fig. 10. Gloomy forest.

The color blue (dark) has an interpretation of depth of feeling, concentric, passive, associative, heteronomous, sensitive, perceptive and unifying, which in turn is associated with player moods such as tranquility, satisfaction, tenderness, love and affection, allowing making a correct diagnosis according to the preferences that the patient has. The color green (bluish) is representative of the constancy of the will, having as emotional interpretation, persistence, self-affirmation and self-esteem. The color red (orange) is representative of the willpower and represents the eccentric, active, offensive, aggressive, autonomous, locomotor, competitive, efficient and is related to appetite, excitability, authority and sexuality. The yellow (light) color represents spontaneity and is characteristic of someone eccentric, active, planner, heteronomous, expansive, ambitious, inquisitive and its affective aspects are variability, expectation, originality and joy.

In addition to the isolated analysis of colors, an analysis of color combinations, such as gray with blue, was carried out, which has a structural significance of an interval of tranquility. The gray color is representative of a protective shield, while blue precedes the need for peace. The color red combined with black is interpreted as an exaggerated desire or dramatization. The black and yellow combination is interpreted as sudden crisis or stubborn decisions. The black with the violet represents the need for identification or compulsive union.

One of the most obvious combinations that show depression is black with brown, since it is interpreted as contempt of itself, with the help of these three levels together it is possible to determine depression.

5   Future Work

The future work that can be applied to this development is to take into account other test based depression detection models, such as the HTP test, thus creating a new level that allows the player, through basic objects, to make drawings of people, houses and trees taking into account the criteria established in said test. This would allow to analyze in depth the characteristics of the drawings made by the player and interpret every detail to obtain better diagnoses.

Another aspect to consider is to take into account the criteria for the classification of depression levels and, therefore, not only detect depression, but also classify and determine whether the level of depression is moderate or extreme using Itakura distance formula.

References

1.   Gob.mx: Site of the ministry of health. https://gob.mx/salud (2019)
2.   Inpr.gob.mx: National Survey of Psychiatric Epidemiology http://inprf.gob.mx/ psicosociales/archivos/ encuestaepidemiologia.pdf (2019)
3.   Who: World Health Organization: https:// who.int/es (2019)

4. Brämer, G.R.: International statistical classification of diseases and related health problems: Encyclopedia of Clinical Neuropsychology. World Health Stat Q, 41(1), pp. 1347–1347 (1988)

5. Belló, M., Puentes-Rosas, E., Medina-Mora, M.E., Lozano, R.: Prevalencia y diagnóstico de depresión en población adulta en México. Salud Pública de México, 47(1), pp. S4–S11 (2005)

6. López-Ibor, M.I.: Ansiedad y depresión, reacciones emocionales frente a la enfermedad. Anales de Medicina Interna, 24, pp. 209–211 (2007)

7. Bella, M.E., Fernández, R.A., Willington, J.M.: Intento de suicidio en niños y adolescentes: Depresión y trastorno de conducta disocial como patologías más frecuentes. Archivos argentinos de pediatría, 108(2), pp. 124–129 (2010)

8. Acosta-Hernández, M.E., Mancilla-Percino, T., Correa-Basurto, J., Saavedra-Vélez, M., Ramos-Morales, F.R., Cruz-Sánchez, J.S., Duran-Niconoff, S.: Depresión en la infancia y adolescencia: Enfermedad de nuestro tiempo. Archivos de neurociencias, 16(1), pp. 20–25 (2011)

9. Machover, K.: Proyección de la personalidad en el dibujo de la figura humana: Un método de investigación de la personalidad. Ediciones Cultural (1987)

10. Machover, K.: Dibujo de la figura humana: Un método de investigar la personalidad. Técnicas proyectivas del diagnóstico psicológico. Anderson y Anderson (1963)

11. Buck, J.N.: The h-t-p test. Journal of Clinical psychology, 4(2), pp. 151–159 (1948)

12. Altés, J.: Papel de las tecnologías de la información y la comunicación en la medicina actual. Seminarios de la Fundación Española de Reumatología, 14(2), pp. 31–35 (2013)

13. Recuero, A.: La domótica como medio para la vida independiente de discapacitados y personas de la tercera edad. Informes de la Construcción, 50(459), pp. 55–59 (1999)

14. Cortés-Sánchez, I.J.: Diseño, desarrollo y puesta en marcha de un sistema de información de acceso web, que facilite la detección de enfermedades a partir de la historia clínica del paciente para una población, muestra de gambitasantander. Tesis Universidad Piloto de Colombia (2016)

15. Marcano, B.: Juegos serios y entrenamiento en la sociedad digital. Teoría de la Educación. Educación y Cultura en la Sociedad de la Información, 9(3), pp. 93–107 (2008)

16. Martins, T., Carvalho, V., Soares, F., Moreira. M.F.: Serious game as a tool to intellectual disabilities therapy: Total challenge. In: IEEE 1st International Conference on Serious Games and Applications for Health (SeGAH), pp. 1–7 (2011)

17. Fleming, T.M., Bavin, L., Stasiak, K., Hermansson-Webb, E., Merry, S.N., Cheek, C., Lucassen, M., Ming-Lau, H., Pollmuller, B., Hetrick, S.: Serious games and gamification for mental health: Current status and promising directions. Frontiers in Psychiatry, 7, pp. 215 (2017)

18. Evans, F., Spinelli, A., Zapirain, E., Massa, S., Soriano, F.: Proceso de desarrollo de serious games. Diseño centrado en el usuario, jugabilidad e inmersión. In: 3er Congreso Argentino de Ingeniería y 9no Congreso Argentino de Enseñanza de la Ingeniería (CAEDI) (2016)

19. Aarseth, E.: Investigación sobre juegos: Aproximaciones metodológicas al análisis de juegos. Artnodes: Revista de Arte, Ciencia y Tecnología, 7, pp. 4–15 (2007)

20. Gros, B.: Juegos digitales para comprender los sistemas complejos. Comunicación y Pedagogía, 216, pp. 47–50 (2006)

21. Sánchez-Gómez, M.: Buenas prácticas en la creación de serious games (objetos de aprendizaje reutilizables). In: SPDECE (2007)

22. Vilches-Antao, D.G.: Juegos serios, evaluación de tecnologías y ámbitos de aplicación. Tesis Universidad Nacional de la Plata (2014)

23. Elkonin, D.B., Uribes, V.: Psicología del juego. Pablo del Río Madrid (1980)

24. Martínez-Cañellas, A.: Psicología del color. Maina, pp. 35–37 (1979)
25. Heller, E.: Psicología del color: Cómo actúan los colores sobre los sentimientos y la razón. Gustavo Gili (2004)
26. Dorothea-Vernon, M.: Psicología de la percepción/the psychology of perception. Technical report, Hormé (1967)
27. Lüscher, M.: The Luscher color test. Simon and Schuster (1990)
28. Henson Creighton, R.: Unity 3D game development by example: A seat-of-yourpants manual for building fun, groovy little games quickly. Packt Publishing Ltd (2010)
29. Norton, T.: Learning C# by developing games with unity 3D. Packt Publishing Ltd (2013)
30. Home Sweethome-Sweet: 3d Sweet Home 3D (2015)
31. Hess, R.: The essential Blender: guide to 3D creation with the open source suite Blender (2007)