Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 198 (2022) 626–631

Procedia Computer Science

www.elsevier.com/locate/procedia

The second International Workshop of Innovation and Technologies
November 1-4, 2021. Leuven, Belgium

Design and Production of Educational Video Games for the Inclusion of Deaf Children

Clemencia Zapata Lesmes[a], Jairo Acosta-Solano[b], Luis Blanquicett Benavides[c], Samir F. Umaña Ibáñez[d,*]

[a]*Corporación Universitaria Rafael Núñez, Cartagena, Colombia*
[b]*Corporación Universitaria Rafael Núñez, Cartagena, Colombia*
[c]*Corporación Universitaria Rafael Núñez, Cartagena, Colombia*
[d]*Universidad de la Costa CUC, Barranquilla, Colombia*

Abstract

This work presents the design and development of an educational video game, a product committed to the project "Model for the production of educational digital content for the inclusion of deaf people" attached to the national program financed by Colciencias - Colombia: "Educational and technological pedagogical architecture for teacher training in and for diversity". The video game was made under the logic of applied and design research. It recognizes the importance of this resource as a didactic tool, which enhances and strengthens the learning process in deaf and hearing children, in the area of natural sciences. Instructional design includes: topic, purpose, target audience, learning objectives, and competencies. For its planning, elaboration and development, the environment, the rules, the challenge and the genre of the game were taken into account, deriving the prototype in the Unity engine.

Keywords: Educational video games; video game characterization; Quality evaluation of video games

* Corresponding author. Tel.: +573045879955
E-mail address: sumana1@cuc.edu.co

1877-0509
10.1016/j.procs.2021.12.297

1. Introduction

Videogames have positioned themselves as an important source of audiovisual entertainment due to their dynamism and accessibility, in addition to increasing the imagination of their players [1] ; The video game is a fun, motivating and attractive experience for the participants, who live it in the first person and as part of a team, which increases their self-esteem, confidence and ability to growth [2]; on the other hand, there is a possibility of using them to strengthen skills and abilities within society, such as the appropriation of cultural meanings, this is how video games are becoming a playful phenomenon, important in children's and youth culture [3]. Video games, in addition to being entertaining, enhance the function of the attentional system, stimulate visual attention, reduce reaction time, improve the ability to discriminate shape and color, plus efficiency when following multiple objects, as stated by Shawn Green & Bavelier [4]; As a didactic means, they promote interest and motivation, facilitating learning by establishing the relationship between playfulness and pedagogical function, winning against the use of traditional strategies, by giving the teaching-learning process a fun nuance [5]; The learning process supported by technologies is innovative from the same format and attractive to students, it increases without pressure the possibility of developing their cognitive abilities, the time dedicated to self-learning, motivates them to learn, improves their levels of concentration and attention while working and playing [6]

2. Design and Production of Educational Video games

The game is a free activity that is carried out without an external obligation, which encourages the student to experiment, to try multiple solutions, to discover information and new knowledge without fear of making mistakes. In a game, being versatile and interactive, different learning objectives can be set. To establish an order, the project is based on aspects that must be considered in the design and production of educational video games. Authors in [7] propose a series of incremental phases of: definition of the concept, planning and elaboration in coherence with the development cycle of the educational resource; For this study, the proposed video games are categorized as serious games, because they are used in different disciplines of education to initiate, improve and facilitate learning; Four structural components were considered: the objectives, the rules, the challenges and the interaction [8], to determine the order, the rights and the responsibilities of the players. In addition, they allow players to face problems for which they have to find solutions. With regard to interaction, in a serious game, this component arises from the mechanics and dynamics of the game itself, and gives rise to the experiences of the player. For the design of the educational video game in the definition of the concept, three activities are considered [9]: Identify the theme of the game, establish the purpose of the game and define the instructional objectives; According to [10], three important aspects for video game design were considered in this project: multimedia design, interaction and the technologies to be used. On the other hand, the model proposed by Shi and Shih [11] for the design of educational games based on the interrelation of factors was taken as a reference can be shown in Figure 1, in addition to the previous experience of the research team in the development of educational resources for the deaf population. the following aspects reflected in table 1 were taken into account.

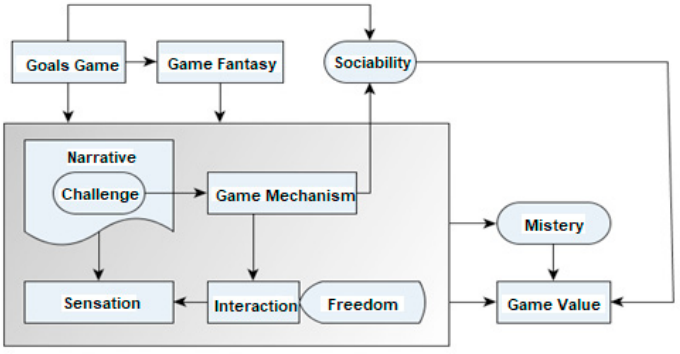

Fig 1. Design of games for learning [11]

2.1. Description of video games in the project "Model for the production of educational digital content for inclusion of the deaf"

The literature review made it possible to clarify the approach and contextualization of the area of knowledge, the subject, the purpose, the target audience, the instructional objectives, the environment, the rules, the challenge and the genre of the game; as well as adjusting the contents and pedagogical activities in order to the standards established by the Ministry of National Education of Colombia [12]. Two main references were taken, the proposal of an "Education for all" [13] and the Global commitment of Dakar [14] in the World Education Forum, to provide quality basic education to all children, youth and adults, where 164 governments committed to make this initiative a reality based on six objectives to be achieved by 2015, including Colombia. The complementary reference was social pedagogy [15], which considers aspects such as open-mindedness and social sensitivity, among others; problems derived from deprivation, social conflict, urbanization, wars, marginalization and helplessness; and, some tendencies linked to the Kantian tradition, pedagogy as practical knowledge, the historicist and hermeneutical tradition. These elements have favored its staging to attend to the good training of all people and at the same time the correction of the social deviations that some of them present during their social adaptation.

2.2. Characterization of the video game "Traffic Signals"

Name: Traffic Signs - Knowledge Area: Social Sciences -Topic: Knowledge and application of Traffic Signs - Purpose: To enhance the location in the physical environment and representation using spatial references. -Target audience: Children in Grades: 1st and 3rd - Objectives: To Establish relationships between the physical spaces that the child occupies and their representations, Identify everyday situations that indicate fulfillment of the functions of some social organizations in the environment, identify rules that govern some communities to which it belongs and explained its usefulness, recognize socially constructed norms and distinguish those in which it is possible to participate, recognize the construction of norms for coexistence in the social and political groups to which it belongs and value aspects of social and environmental policies that promote individual and community development - Environment: Virtual city - Rules of the Game: The player, pizza delivery man, must learn to use 16 traffic signals while traveling through the city, the game is won by reaching the amount of 1,000 accumulated points after which the delivery man passes the test and finally gets the work, when the score is reached, the game must stop and show the above. The delivery man as the first mission receives the order from the owner of the pizzeria to drive freely through the city attending to the signs, traffic lights and floor signals. In case of non-compliance, 100 points will be deducted. The traffic signals that will be implemented are: School zone, Pedestrians on the road, Workers on the road, Cyclist on the road, Parking place, Stop, Give way, No right turn, No left turn, Forbidden turn in U, Zebra, Disabled Parking and Closed Way, among others - Challenges: Ability to control the vehicle properly through the virtual city - Interface Design. Considering the aspects of the inclusive educational resource listed in table 1. The interface designs of the Traffic Signals video game are shown in figure 2. In the Start option, a video is presented with the narrative of the game, in the options are placed the mechanisms of the game, that is to say the keys that allow: accelerate, brake and move the vehicle to the right and left.

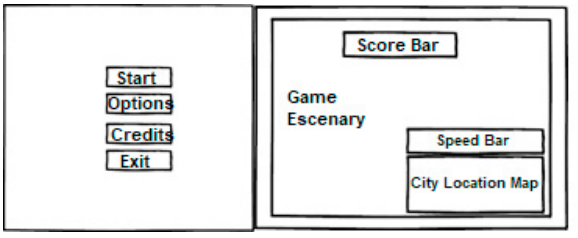

Fig 2. Interface and Main menu of the Traffic Signals video game. Source: Authors

2.2 Characterization of the video game "The life of the Dionosaurs"

- **Name**: The Life of the Dinosaurs - **Knowledge Area**: Natural Sciences - **Topic**: Life Cycle of Dinosaurs - **Purpose**: To know about the origin of the living being and its behavior **- Target audience**: Grade students: 6th, 7th and 8th - **Objectives**: Recognize the origin of the universe and life from various theories, establish relationships between the climate in different geological eras and the adaptations of living beings and compare different theories about the origin of species. - **Environment**: The environment is jungle, rocky and volcanic- **Rules of the Game**: The player will be able to choose a character, with whom he must complete the proposed missions, which are in written, auditory and sign language, and they introduce him to the characteristics of each species of dinosaurs. When starting the mission, he must remain alive, to achieve this he must eat, drink water, and if necessary defend himself. If the player falls into the water, and it is not aquatic, he will automatically lose. For each achievement achieved a score will be generated. The character in the first mission must protect his pack at any cost, if he dies protecting them, he is awarded extra points and a second chance to return to the level. The player must complete the mission to advance successfully at the end - **Challenges**: Ability to control various types of dinosaurs with different abilities and characteristics such as strength, speed and endurance - **Interface Design**. Considering the aspects of the inclusive educational resource listed in table 1. The interface designs of this video game The Life of Dinosaurs are shown in figure 3. When the video game starts, the story is presented and the characters are described, then the player has the possibility to choose a character. The game mechanisms include the keys that allow: Forward, Backward, Move right, Move left, Run Attack, Drink water, Eat, Jump and pause.

Fig. 3. Main interface and scene of the Game Life of the Dinosaurs. Source: Authors

3. RESULTS AND DISCUSSION

3.1. Video game production.

The development of the video games was based on the principles of the agile methodologies for educational software development Scrum and eXtreme Programming XP, which focus on the human factor and the software product, as described by [16], which made it possible success in our short-term serious video game projects, with the particularity of design and development with reduced equipment, volatile requirements and the use of new technologies. On the other hand, deaf students who are beneficiaries of these educational contents will participate in the first tests of the prototypes. The prototypes were developed using routines programmed in the JavaScript and C # languages, making use of the Unity 5 engine, in its free version, and tools to generate content to be used by this Integrated Development Environment (IDE) specialized in generating video games for various platforms. For the creation of the land, height maps were used, the texturing of the materials was done directly in Unity, in addition to the development of the cities, the fractal technique was used in which the resources are built based on a central piece that replicates to create other more complex derived resources.

3.2. Prototypes

For the development of the prototypes, the Unity 3D tool was chosen, due to its ease of use and its powerful graphics engine, and I also know that it has the advantage of the large amount of documentation on the web. The selected tool integrates a powerful rendering engine to create interactive 2D / 3D content, it also supports the deployment of multiple platforms including mobile, web, desktop and console. In the package diagram of figure 4, the development architecture of the video game and how each package is composed is shown.

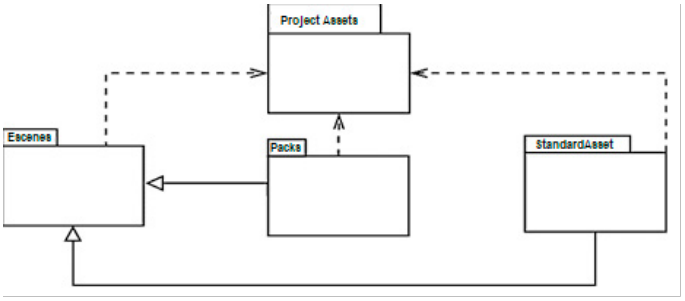

Fig. 4 Package diagram of the video game. Source: Authors

Packages are a collection of Unity project files and data, which are compressed and stored in a single file. The Assets package is the main package on which the other packages depend on it. In the Scenes package you will find all the developed scenes. In the Pack package contains components such as C # development scripts and javaScript. The Standard Asset package has components such as: camera, effects, terrain textures among others. In figure 5, the design of a city is shown, the main environment of the video game traffic signals.

Fig. 5. Virtual City as an environment for the Video Game “Traffic Signals”. Source: Authors

Figure 6 shows the innovative result in the development of video games, the integration of the Colombian sign language, for which it was necessary to have the advice of an expert and an interpreter. In the left part of the interface, the written text that is related to the specific objective of the mission is placed, in the central part the game character and in the right area a video of the interpreter is presented.

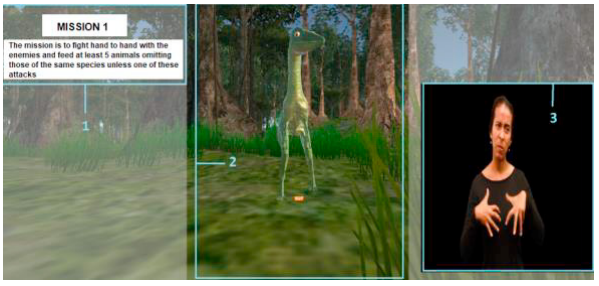

Fig. 6. Start interface of the videogame "Life of the Dinosaurs". Source: Authors

The game environment can be seen in figure 7, it is made up of: life bar, thirst and hunger bar, among the characters are the player and the enemy.

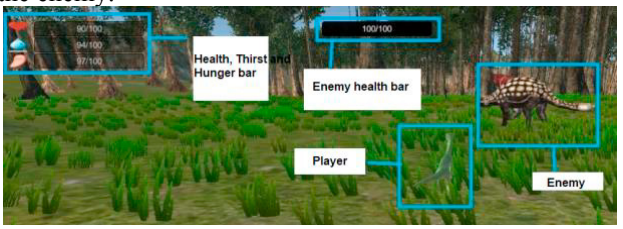

Fig. 7. Components of the Life of the Dinosaurs Videogame scenario. Source: Authors

4. Conclusions

The video games developed are intended to integrate a learning model that involves all the senses of deaf children in processes of experimentation, imagination and description of reality. The essential characteristic of designed and developed video games was represented through self-regulation; This is defined as the set of mechanisms that adapt the game and its contents to the level of mastery shown by the user, making a record in statistics with which the performance of the child can be read, both in skills to play the video game and at the level of knowledge and mastery of educational content.

The proposed video games enhance motivation, quick thinking, responsibility and constant feedback, which is especially important for student participation. They rely heavily on the narrative, the integration of the selected factors allows to increase the sensation of reality of the virtual worlds and the interactions with it, thanks to the integration of 2D / 3D technology and audiovisual effects it is possible to capture attention of the player, and undoubtedly stimulate deaf students, given that much of the information from the environment is captured through vision and tactile kinesics, including content in sign language allows them to be more accessible to the deaf user population.

References

[1] F. J. Sánchez i Peris, “Videojuegos: Una Herramienta en el Proceso Educativo del ‘Homo Digitalis,’” *Teoría la Educ. Educ. y Cult. en la Soc. la Inf.*, vol. 9, no. 3, pp. 4–10, 2008.

[2] M. Castellana Rosell, X. Sanchez-Carbonella, C. Graner Jordana, and M. Beranuy Fargues, “Adolescents and Information and Communications Technologies: Internet, Mobile Phone and Videogames,” *Papeles Psicol.*, vol. 28, no. 3, pp. 196–204, 2007.

[3] P. A. Boudon and L. Rehbein Felmer, “Usuarios Habituales de Videojuegos: Una Aproximación Inicial,” *Última Década*, no. 29, pp. 11–27, 2008.

[4] G. C.S and D. Bavelier, “Enumeration versus multiple object tracking: the case of action video game players,” *Cognition*, vol. 101, 2006.

[5] R. T. Salguero, “Efectos psicosociales de los videojuegos,” *Comunicación*, vol. 1, no. 7, pp. 235–250, 2009.

[6] James Kulik, *Technology Assesment in Education and Training*. 1994.

[7] N. Acerenza *et al.*, “Una metodología para desarrollo de videojuegos,” *38º JAIIO - Simp. Argentino Ing. Softw. (ASSE 2009)*, no. Asse 2009, pp. 171–176, 2009.

[8] S. Grau, R. Reig, A. Puig, M. López, and I. Rodríguez, “Games4Learning: How to integrate serious games to personalized learning itineraries?,” *10th Iber. Conf. Inf. Syst. Technol.*, 2015.

[9] M. C. Gómez Álvarez, “Diseño E Implementación de Un Videojuego Para La Enseñanza de Requisitos No Funcionales,” *Cist. - Iber. Conf. Inf. Syst. Technol.*, 2013.

[10] M. C. Sogono and D. Richards, ““A Design Template for Multisensory and Multimodal Games to Train and Test Children for Sound Localisation Acuity,” *Proc. 9th Australas. Conf. Interact. Entertain. Matters Life Death*, vol. 25, 2013.

[11] S. Yen-Ru and S. Yu-Ling, “Game Factors and Game-Based Learning Design Model,” *Int. J. Comput. Games Technol.*, vol. 1, pp. 1–11, 2105.

[12] G. G. Calderón Rodríguez, “Competencias TIC Para El Desarrollo Profesional Docente,” 2013.

[13] UNESCO, “Una educación de calidad para todos los jóvenes,” *47a Conf. Int. Educ. la UNESCO, Ginebra*, p. 156, 2004.

[14] C. Saperas, “Objetivos de Dakar : Acercándonos a la situación de la educación en Centroamérica,” 2012. [Online]. Available: https://www.itakaescolapios.org/wp-content/uploads/2017/10/Anexos-declaración-de-Dakar.pdf.

[15] M. Perez Serrano, “Pedagogía Social. Revista Interuniversitaria,” *Rev. Interuniv.*, vol. 15, pp. 99–110, 2008.

[16] L. Metodologías, D. D. Ágil, A. O. Duarte, and M. R. C, “The Methodologies of Agile Development like an Opportunity for the Engineering of Educative Software,” vol. 5, no. 2, 2008.