

Strengthening cognitive processes in early childhood through a pedagogic tool with video games

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Abstract— The objective of the study is to design a video game as a technological tool to favour the cognitive processes of children in early childhood. The methodology corresponds to a qualitative research of descriptive type with an instructional design model ADDIE that takes into account: analysis of the learning needs, training objectives, memories appropriate to the purpose of the learning process, content and activities development, low levels of structural difficulty. Favouring the operation functions by elements applied in the design of the video game, the child organizes, associates, identifies, and improves the capacity of concentration, orientation and the spatial notion. In the future is expected to implement a detailed analysis for the strengthening of cognitive abilities, improving the structuring of elaborate sentences required to make their social interaction in the context towards the recognition of objects, figures and colours from the abstraction of linguistic symbolism. It is recommended to continue research that includes broad samples, as well as objective tests for the evaluation of the cognitive pattern, increasing the number of video game sessions to determine the effects of ludic in the virtual reality of learning.

Keywords— Videogame, pedagogical model, cognitive processes, social interaction

I. INTRODUCTION

THE technological advance in which the present world is immersed requires that the different disciplinary areas optimize the learning processes in early ages where the cognitive abilities favour the integral development of the human being. In the same sense, it is necessary to strengthen these skills in favour of their social interaction during the development of children in early childhood in a playful way and incorporating new information and communication technologies, including video games, since these skills influence social interaction as it is stated [1]: "A range of psychosocial and emo language disorders."

These disorders show difficulties such as: omissions, phoneme substitutions, unstructured sentences, and very fluctuating instructions follow-up or with an exaggerated support from the adult.

Therefore, the development of the study is based on the themes of video game as a didactic strategy, cognitive

processes and their influence on the integral development of human being from an early age, which favour the fulfilment of social skills, in the pedagogical framework of constructivism. Despite the limitations of coordination of these ages, the video game generates patterns of integration where it achieves communicative skills by strengthening the emission and reception of concepts, interpreting messages, decoding the different sounds and expressing them in a coherent way.

Benefits are promoted from the creation and implementation of video games in the educational field for the development of cognitive and communicative skills considered from the constructivist pedagogical model; where children learn by association, and meanings of construction as their knowledge is based on their context, the explanations given by adults and their experiences. For this they need to recognize linguistic signs as part of the development of language, which in turn develop more structured thought processes through video game as a technological tool in didactics.

From this perspective, pedagogy is consolidated as a product of the specific historical moments of humanity, in which it strengthens its mission from the construction of a project capable of preparing children for the society in which they are called to live and transform. The school must form children to be integral citizens into society

This condition must be supported by the incorporation of new information and communication technologies (NICTs), which can include virtual reality games, as simulators of scenarios that increase motivation, attention and memory as part of the process that underlies learning. In this same sense, these games have been used as methods of cognitive rehabilitation [2] since interactivity fosters mental learning and motor learning, which are two aspects of human learning.

Defining mental learning [3] as the acquisition and improvement of knowledge, skills and intellectual abilities. And the Motor to the development of locomotive processes that are influenced by the use of recreational activities that induce the corporal movement, as can be influenced by the use of video games.

According to this, the process of human development and learning adapt and evolves in an accelerated way, especially in the childhood stage where biological, environmental and educational factors are involved.

Providing this with a relevant role in the interaction of the human being in the context and society where it develops. Therefore, it is relevant to review the way children learn in the early stages of their lives (4-7 years). Therefore, the evolution of the thought process of preschool children is based on: the advances in their way of thinking from the simplest and most concrete to the complex; that goes hand in hand with biological development. For Piaget [4]: "Knowledge is constructed by the child through the interaction of their mental structures with the environment, experiences and stimuli received from the environment. Necessarily you must present a combination of factors."

This learning action is influenced in the population of interest by virtual reality games that have also been used for the maintenance of active lifestyles [5] [6] [7]. Some authors establish the relationship between the practice of physical activity and motor development [8]. That conditioned to cognitive processes influence their way of learning, due to these findings it can be inferred that there is a relationship between the use of virtual reality games and the maturation of basic locomotor patterns, as well as the development of communicative, cognitive skills.

Officially in Colombia, Law 1098 of 2006, Code of Childhood and Adolescence, [9] it explicitly speaks of Initial Education: "Article 29, the right to integral development in early childhood. Early childhood is the stage of the life cycle in which the bases for the cognitive, emotional and social development of the human being are established. It includes the population range that goes from zero (0) to six (6) years of age. From early childhood, boys and girls are holders of the rights recognized in international treaties, in the Political Constitution and in this Code.

Unlike the benefits derived from the use of virtual reality games, some studies have observed negative effects derived from their practice, mainly for the visual system [10] and the musculoskeletal system [11]. Despite the previous thing, the technological tools framed in pedagogical processes and suitable didactic elements, will allow altogether to benefit the cognitive development of the users.

The studies recommend increasing research on attention processes and its relationship with the maturation of locomotor patterns involved in the use of this type of video game in children, as well as the action derived from the development of communication and cognition processes.

II. THEORETICAL DISCUSSIONS

There are several types of video games, among which you can name the adventure games, arcade (dexterity activities), sports, strategy (coordinate actions), role (the player manages a character, and evolves during the game according to user decisions) and simulation (some type of action is simulated, such as flying an airplane) [12].

These types of video games are an opportunity to develop didactic strategies in the classroom, where students' attention can be captured to understand the different topics and fulfil the competences that are framed in the study plans to follow. The creation of such strategies are the responsibility of teachers, because they must achieve learning based on the quality of their teaching strategies; therefore, it is important that interdisciplinary work spaces are created where the didactic strategies mediated by technology can be strengthened according to the age of the participants in the educational processes.

Among the features of video games are: the quality of the graphics (at first in two dimensions, currently in three), the control of the game must be easy and intuitive, the sound of the didactic tool must be clear and strong (from the speaker to surround sound) [12].

For this reason, it is important to note that for the execution of projects based on the development of video games, it is necessary to work with an interdisciplinary group formed by an expert in the area of knowledge (mathematics, language, languages) a professional in charge of design and development of the software (systems engineer or program developer) and an expert in charge of graphic interfaces (graphic designer); These professionals, through collaborative and cooperative work, build videogames where all the components of the competences established in the curricula are articulated. In such a way that, this didactic tool fulfils the objectives of acquiring and developing cognitive, communicative and linguistic abilities of the children doing it through a playful interaction showing the infant natural and pleasant interfaces.

Virtual reality games fall into a unique range of tools, in which the user can venture creatively, as far as the limit of their imagination allows. There lies, quite possibly, the greatest attraction, as imagination and creativity could run in an artificial and unlimited "world" [13].

In this same line of characterization of video games, there are those of pedagogical type, who under a specific theme are designed. The goals can be very broad, the search for mathematical, motor, language, memory, attention, etc. In this line, - the communicative patterns represent an interest within that design, even more in children population and through modification processes cognitive [14] that becomes more evident at ages 0 to 7 years.

These communicative patterns include [15] that belong to the Listening Comprehension (CA) and those pertaining to the Expressive Communication (CE). Which can be considered with the scale of questions and answers, objects, categorization and comparison of objects, recognition of relationships in equal parts, inferences, addition and subtraction of numbers).

This process defined that the design of a video game that aims to develop communicative, linguistic and cognitive skills allows children at the same time, the exploration of space, the recognition of laterality. As well as the development of locomotor processes such as walking, running, jumping and limb extension processes (arms and legs).

These fundamental movements are observable patterns that can be divided into three stages [16] Initial, elementary and mature stage, which in relation to the patterns of communicative development can be related to three stages in the acquisition of knowledge (introductory, advanced and expert) and argues that constructive learning environments are more effective in the stages of acquisition of advanced knowledge, where the initial prejudices and misinterpretations acquired during the introductory stage can be discovered, negotiated, and if necessary, modified or eliminated [17]

Considering that, the video games and the use of virtual reality has spread to different human activities in populations of all ages [18]. In addition to the technological advances, one of the reasons why the use of these games has increased, are the family dynamics where parents spend their time in work activities and children spend their free time in video games, the Internet and television, as the time to share with the family in outdoor activities has been reduced. This has contributed to the growth of digital culture in different countries.

A professor of psychology at Nottingham Trent University conducted a study [19] to see the different benefits of video games in education. He concluded that video games could not only help young people to develop basic skills, such as linguistic or oral skills, but also to address other issues such as helping to rehabilitate students with learning disabilities, lack of motivation, and deficits of attention.

Information and Communication Technologies (ICTs or TICs in Spanish), in addition to virtual reality games, have become strategically allied in the processes of learning since interactivity increases motivation, a process that underlies learning. In the same way, the mentioned games have been used as methods of cognitive rehabilitation.

Other researcher [20] tells us that there are better video games than others for education. It is understood that the world of video games has different genres and not all are valid for our educational objectives as could happen, for example, with any book or movie. This author adds that these video games have narrative context, objectives, goals, and interactivity that can help stimulate educational competencies.

A. The video game in the early childhood teaching-learning process

A video game is an interactive computer program for entertainment that can work on different devices: computer, consoles, mobile phones, and so on; which integrates audio

and video, and allows you to enjoy experiences that in many cases would be very difficult to live. Within the characteristics of video games the quality of the graphics is defined as it is referred [21]: initially in two Dimensions, currently in three, game control should be easy and intuitive, and the sound should be clear and strong.

Video games have great diversity of uses and characteristics that make them a perfect tool for education. Professionals [19] point out different characteristics that can make them a beneficial instrument for education. The first, and one of the most important, is that video games "attract the participation of individuals without limits of age, gender, ethnic origin, educational situation..." (p.47). Often the reason for educational failure comes from lack of motivation. Video games are fun, and if something is fun it is easier to achieve and maintain a person's attention for long periods of time because of the fun and excitement.

There are different types of video games, among them can be named adventure games (intelligence tests or puzzle solving to advance), activities-skills ark, sports, strategy (coordination actions), role (player controls a character and continues to evolve during the game according to the decisions of the users) and the simulation (that simulates some type of action, like flying an airplane). These benefits are attributed in many ages to improve learning, attention, concentration and meaning-making.

The actions selected for each video game reflects the student's concern to use the best learning strategy while they are playing, a situation that underlies the Constructivist Pedagogical Model that not only observes how to teach but how to learn [22].

In the same sense, it is required an articulation of the didactic benefit of video games, with the constructivist model, the communicative and cognitive processes. Since the communicative process is based on the interpretation of linguistic signs, which consists of three main components, not necessarily of the same relevance: form, content and use [23].

The form contains morphosyntax and phonology, these components connect the sound or symbols in each order; the content constitutes the semantics, which allows giving the meaning of the words; - and the use contains the pragmatics, which establishes the language within a social context.

The early childhood stage is very important for the development of skills in an integral way in 0 - 5 years old. Therefore, it is fundamental to consider cognition and communication along with the attention skills as an important role in this process, as the knowledge building feeds on daily activities. Besides, communication is the tool that any human being can use to demonstrate his knowledge. However, these two processes could not be possible without the attention focusing skills or - cognitives.

The communication allows children to express their feelings and emotions and it is also a fundamental tool to express, exchange, defend and propose ideas, opinions and for the building of knowledge [24]. That's why communication in the educational context is seen as a variable that allows the success in all the academic processes.

In the same sense, the educational environment is characterized by the effectiveness in communication, where students identify conceptual or theoretical processes and then they elaborate on their thought process where it is possible to solve the community's problems, generating thought processes of greater complexity.

Also, cognition understood as the way in which the human being knows and obtains knowledge is presented throughout human evolution as one of the most fascinating reasons to research, which is a privileged interest in history by philosophy, even though nowadays this is also tackled by other disciplines where it is necessary to highlight cognitive psychology, neuroscience, linguistics and psycholinguistics [25].

For this reason, teaching in all stages of development of the human being requires recognition of the functions of the Central Nervous System, especially of the brain because each specialized cell favours the processes of thought and memory; each process has a specific place in the brain where it is developed, and in the classroom it is proposed to elaborate didactic strategies according to the way the brain understands or processes it.

The latest findings from studies in neuroscience allow us to state that the brain gathers thinking, feeling and acting in a whole.

For children, at pre-school and basic levels, knowledge must be transferred in a way that adapts to their rhythms and styles of learning [26]. But this is only achieved when educators know in depth the neuropsychological development of learning processes [27].

Pre-school children develop through videogames, cognitive skills related to the use and application of Information and Communication technologies [28]. Then, the learning environment must include technologies in classroom pedagogical practices that can support different dynamics, develop skills and basic informational skills and how they enable the process of formation of child development dimensions to facilitate and optimize the continuity of the school process.

Therefore, the design of teaching and learning situations arises from the need to improve the educational quality, where it is possible to create playful scenarios mediated by technology based on instructional designs. In Instruction

designs you can build didactic strategies such as videogames, where the student can acquire and develop mental skills in processes such as: identification, organization, classification and attention.

That is, the instructional design [29] provides the development of the technological tool because it favors: 1. Speed as a greater experience to process the information when designing a videogame of pedagogical type; 2. Connectivity, from synchronous and asynchronously operable; 3. Constant action, in which children and young people need fewer manuals to learn the operation of computer elements, in an intuitive way; 4. Orientation to the resolution of problems, oriented from the approach to the design capacity in which there is a constant review of the action; 5. Immediate reward, in which children and young people ask for the use of contextualized knowledge; 6. Importance of fantasy, is a fundamental element of current video games; 7. Positive vision of technology, being the non-existence of fears associated with it and what allows its use.

These characteristics allow to delimit processes of the design of instruction under constructivist referents, of these we can mention: the time of action of the video game must be optimal to complete the challenges making sure then [30] that the students have the necessary time to finish the levels of the game and benefit from the educational characteristics.

Therefore, the value of rewarding the virtual score associated with the achievement obtained, a process that is related to components of intent-error, intent-achievement, would define a possible cognitive modifiability, insofar as cognitive processes are consolidated that include identification, classification, attention, and memory as processes of greater complexity, coinciding [31] in which constructivism is a mental activity, filtering what comes from the world [32] to produce its own unique reality. The child's mind processes information in multiple and varied ways; of which both the individual experience and direct experience with the environment influences their learning [33].

In recent years, electronic games have assumed an important place in the lives of children and adolescents. Children acquire digital literacy informally, through play, and neither schools nor other educational institutions take sufficient account of this important aspect. We believe that multimedia design for training and education should combine the most powerful features of interactive multimedia design with the most effective principles of learning sustained on educational tools based on the use of technology. [34].

A learning where teachers or diverse professionals can use tools based on technology to establish a communication that favors human relationships through collaborative work, selecting games that allow synthesizing, organizing and constructing concepts where the players can compete but at the same time acquire skills of playful way

This playful activity mediated by technology promote thought where knowledge is built, meaningful learning is potentiated and a strategy where educators apply didactics to teach.

Then, Videogames are cultural practices installed in our societies that require a critical and specialized look; the lines of research that have addressed this phenomenon go through cultural studies, ludology, narratological studies, game design theory and video game semiotics. All these perspectives have delivered different conceptualizations regarding this object of study, views considering them as contemporary means of expression to promoters of violence, isolation and school failure [35].

Currently, both the influence of videogames on culture and its consequences are the reason for various studies on this educational tool, such as ludology, narratological studies, game design theory and video game semiotics [36]., such as it is shown in figure 1, below:

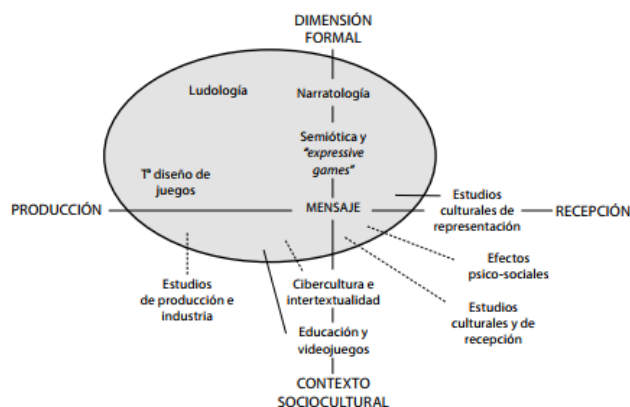


Fig. 1. Perspective of analysis of video games [37]

Therefore, it is necessary to contextualize the environment surrounding the subject in a teaching and learning process, and in the same way educational institutions are developed to impart education.

Therefore, the educational system strategically presents each of the elements that interfere in the teaching and learning processes, these elements correspond to curricula, pedagogical models, educational plans and evaluative models framed in the Institutional Curriculum. A Curriculum that presents the opportunity to create didactic strategies based on tools mediated with technology such as video games for the compliance of competences, goals or objectives in the institutional educational framework

A videogame as a teaching tool requires completing the stages of the instructional design that includes the evaluation. In respect to the evaluation an examination is necessary for the

evolution of the design of videogames, it is a good way to analyze the main contributions and characteristics of games-based learning environments. At the same time, the development of video games as a teaching tool of preschool children, it is important to bear in mind that they can also generate obstacles and challenges in learning [37].

After the theoretical revision, the design of the activities in each one of the interfaces was developed based on the communicative, cognitive, and linguistic levels according to the age of the students in order to structure the dimensions of the video game and complexity according to the different skills to be developed and acquired at the stage where the actors interact. After this planning, it was considered a conceptual assessment by the work team to determine the relevance of the activities and the fulfillment of the objective proposed for each exercise.

III. METHODOLOGY

This work articulates methodologies for the development and design of educational software, using tools based on the software construction process. This vision is considered from the traditional research model based on the scientific method [37], which initially determines a need or situation to be solved, then the structural design of the videogame is developed and subsequently the test or validation is established. In this sense and following the parameters of this model that together are part of the software development process, the following steps are summarized: 1. Obtain the software requirements. 2. Carry out a preliminary design and a detailed design. 3. Perform the implementation. 4. Perform the tests. 5. Perform the installation. 6. Run and update the software tasks.

For the construction of the video game design, difficulty levels are established from the foundation of constructivist processes, using communicative abstraction processes: listening and projecting sounds; linguistics: description of objects and their use; cognitive: spatial location, classification of different objects, recognition of forms and figures from the interaction with the school; application software: objective design action is aimed at evaluating learning in the strengthening of cognitive and communicative processes from the earliest stages of school formation.

In the creative phase, the capacity of graphic library according to preschool ages (colors, figures and spaces of the appropriate context) was recognized. It develops the head and the menu with symbolic language accessible to the preschool.

IV. RESULTS

The design of a video game with educational characteristics allows, from pedagogical engineering, to strengthen and enhance four fundamental dimensions in

human development; namely motor, intellectual, affective and social development.

Although no question of definitive research, this type of descriptive work on preschool population can begin to develop skills that are favored by the use of video games from the features based on the promotion and development of skills such as relationship, classification, categorization, interpretation, identification, description and decoding of information presented in a symbolic way and in language of association to the school context, which in a structured way should be included in the design process of a video game under low, medium and high difficulty levels structure for this type of population.

Thus, skills of communicative, linguistic and cognitive type may be evident from the design of levels of increasing difficulty, and progressive in the video game for preschool that is adaptable to the interest and rate of the boy / girl with the possibility of extending the ability to listen to the activities oriented, since experiences in video game design have rooted in the difficulty of looking for elements that connect the world outside the school from the appropriate and motivating language. This allows the development of interaction processes in the classroom, as well as increasing skills in understanding instructions.

During the process of development of the video game, several changes were made for improvements: accessible language under a playful component according to age, association activities, elaboration of questions of low and medium structure, and motor development components such as concentration, basic spatial ability and notion, allowing orientation within the video game (up, down, near, far).

This type of video game design strategies from pedagogical engineering allows basing learning processes in which, from constructivism as a design model, it complicates, in a challenging way, the different levels of effort faced by early childhood children. In this way, authors refer that this position influences processes of trial and error [38], which implies the subject's abilities (boy / girl) to interpret past and present experiences and thus update their content. Condition that supposes greater processes of abstraction, internalization and elaboration of learning processes associated to the development of the language and particular processes.

In such a way that, in early childhood, a quality education is important where it is necessary to strengthen the integral and affective development of the child (39); where the creations of pedagogical strategies mediated by technology facilitate the achievement of academic competences as the generation of strategies for social interaction.

V. CONCLUSIONS

However, if we try to look for examples of how to build a video game that fits our educational goals and objectives, we

cannot find just the relevant information that can be helpful. Almost all of the literature so far is based mainly on the use of videogames already created and how they are use in the classroom, and even so it is difficult to find any clear example of the application of a video game for very specific objectives in a didactic proposal. We can conclude, therefore, that this is a field that needs to be developed much more to make videogames a fully functional tool in the classroom.

The design of the video game allows, from the pedagogical point of view, to strengthen four fundamental dimensions of human development; namely motor, intellectual, affective and social development after the results obtained, it can be concluded that the use of technological tools strengthen the abilities in the children in the communication processes.

On the other hand, the possibility of expanding the listening capacity to the oriented activities, since experiences in video game design have been in the difficulty of finding elements that connect the world outside the school from the appropriate language

In addition, it is necessary to continue building technological tools. This research begins a journey in which science can perform research involving larger sample sizes, and more objective tests that may be useful in the process of therapeutic support and other related contexts, such as school and the familiar.

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