Improvement of Social Skills in Children with Autism Spectrum Disorder Through the use of a Video Game

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Abstract—The main research objective was to improve social skills through a video game, the type of research was applied with a pure experimental design, with a sample of 60 children with autism spectrum disorder from the Christa McAuliffe school, randomly allocated 30 to the control group (CG) and 30 to the experimental group (GE), the latter using a video game developed with the Unity 3D; Data collection was carried out by means of an adapted test from the cited authors; subsequently, the data collected was analyzed and processed using the Jamovi v2 statistical software. 3.28. The results obtained were an increase of 27.8% on average in the level of communication skills, an increase of 22.4% on average in the level of skills related to feelings, an increase of 20.4% on average in the level of skills alternative to violence and an increase of 19% on average in the level of Pro-amical skills. It was concluded that, the use of a video game significantly improved social skills.

Keywords—*Video games; social skills; autism spectrum disorder; SUM methodology; academic software*

I. INTRODUCTION

The COVID-19 pandemic had a global impact on various sectors, among them economy, education, production, and others. This manifested itself through the restrictions implemented by many countries to control the spread of the infection. On the educational sector, schools struggled to maintain access to education, but were forced to be closed or to hold classes virtually. In addition, many people fell victim to the pandemic, such as people with low income, with chronic diseases and also those with special conditions, such as children with autism spectrum disorder (ASD), who despite being more prone to stress and requiring specialized treatment in education and health, did not have access to these services due to isolation, suffering from stress, habit changes, behavioral changes and likely long-term cognitive changes [1]. Therefore, regardless of the fact that ASD was a topic of conversation around the world, methods and strategies should continue to be researched to ensure that these children could develop their social and communication skills adequately, in order to be able to fully enjoy their lives.

Likewise [2] according to the findings of ADDM (Autism and Developmental Disabilities Monitoring), in the United States for 2020, one in 36 children aged 8 years suffered from autism spectrum disorder, unlike the year 2018, where one in 44 children suffered from it, which is evidence that cases of children with autism were on the rise and gaining visibility day by day. In response to this fact, different specialized institutions were established around the world, an example is the Fundación ConecTEA in Madrid, which provided support to these minors through therapies, activities and specialized guidance. In addition [3]. That the cases of ASD diagnosed by pediatricians in Latin America are few, highlighting that there were not many studies conducted to know the number of patients with this disorder [4]. However, although autism spectrum disorder in children was investigated to a limited extent in Latin America, there were associations such as TAJIBO in Bolivia, which were concerned about the care and development of techniques to ensure that these children could enjoy a full life through online therapies and counseling [5].

Similarly, in 2020, the number of cases of people with autism spectrum disorder in Peru was approximately 5,328, notwithstanding the fact that, according to WHO calculations, there should have been approximately 204,818 people with ASD in the country [6]. In addition, although there was an ASD program in the country for the years 2019 to 2021, it was not satisfactorily carried out. In addition to this, Peruvian teaching and schools were encumbered by old methodologies related to social skills development [7]. Therefore, a scenario of ignorance about the situation of these people, as well as a precarious development on the part of the institutions, was present.

Similarly, in Trujillo a different situation was not evident, as there were no records close to the year 2023 of the number of children with ASD, but there were some specialized schools such as the Christa McAuliffe School, which implemented modern neuroscience methodologies, therapies, workshops, among others, for the development of children in all possible aspects [8].

On the other hand, the developed technologies for supporting the growth of these children with ASD include video games, which have presented different benefits in several studies. Concluded that video games promoted self-motivation, perseverance, time management, commitment and the learning of new skills in individuals with ASD [9].

Taking this information into account, due to the fact that minors in this institution are at risk of not developing these types of skills correctly and virtual education and treatment is becoming increasingly common, the general problem was posed: How will the use of a video game influence social skills? As well as the specific problems, how the use of a video game increased the level of communication skills, feeling-related skills, non-violent alternative skills, and Pro-amical skills?

Likewise, the research was carried out at the Christa McAuliffe educational institution in Trujillo, with the objective of strengthening social skills in enrolled children with autism spectrum disorder.

Finally, the main objective of this research was to improve social skills through the use of a video game, while the specific objectives were to increase the level of communication skills, skills related to feelings, non-violent alternative skills and Pro-friend skills, to corroborate the general hypothesis that if a video game is used, then it significantly improves social skills and the specific hypotheses are that if a video game is used, then it significantly improves the skills mentioned in the specific objectives.

II. THEORETICAL FRAMEWORK

A. Video Game

Defined as a technology that combined audiovisual perception and animated effects from the video, along with the strategy of the games in a game, which involved interacting with a virtual environment to follow its narrative, control the characters and play with its elements, so it also involved the development of strategies, decision making and physical response to face the situations presented [10]. In addition, video games presented the opportunity to make use of virtual environments for their players to interact with different real social problems, controversies and reflections [11].

B. Social Skills

Variety of behaviors that are manifested in interactions with other people, which allow the expression of feelings, attitudes, desires, opinions and rights in an appropriate manner according to the situation, while defending one's own rights and respecting the rights of others [12]. On the other hand, they are also defined as all the skills associated with social behavior in its various expressions [13]. However, it should be noted that the concept of skills has changed and will continue to change over time due to its connection with social concepts [14].

C. SUM Methodology

It is necessary to be guided by a concrete methodology that ensures a path, in this case there is the SUM methodology (Scrum for Unified Method) which guarantees usability over playability and adapts to small multidisciplinary teams and short-term projects [15]. The purpose of this methodology is to develop quality video games with controlled time and costs, in addition to seeking continuous improvement of the process to increase its effectiveness and efficiency [16].

III. MATERIAL AND METHODS

A. Research Design

The research was conducted with an applied research, defined as a research that proposes the resolution of a problem or the intervention in its history [17]. In addition, a purely experimental design was used, defined as a research with a very high validity where the conclusions obtained on cause-effect have solid arguments, because a control of external factors, a manipulation of variables and random assignment and manipulation of the groups are performed [18].

B. Variables and Operationalization

1) Independent variable: Video game.

2) Conceptual definition: Technology that combined audiovisual perception and animated effects from video, along with the strategy of games in a game, which involved interacting with a virtual environment to follow its narrative, control the characters and play with its elements [10].

3) Operational definition: A video game will be used by the experimental group of 30 people. A nominal scale will be used.

4) Dependent variable: Social Skills.

5) Conceptual definition: Variety of behaviors that are manifested in interactions with other people, which allow the expression of feelings, attitudes, desires, opinions and rights in an appropriate manner according to the situation, while defending one's own rights and respecting the rights of others [12].

6) Operational definition: The driver behavior variable was measured through four indicators, which are: Number of action errors, number of intention errors, Number of traffic law violations and number of aggressive attitudes which shall use the ratio scale.

C. Variables and Operationalization

A sample of 60 students enrolled in the Christa McAuliffe School with autism spectrum disorder was taken and two groups were formed. The first group, named Experimental Group, consisted of a sample of 30 randomly assigned children with autism spectrum disorder enrolled in the Christa McAuliffe school. These children were provided with a video game developed in Unity that addressed indicators such as the level of communication skills, level of feeling-related skills, level of non-violent alternative skills, and level of Pro-amical skills. The objective was to collect data and evaluate if the use of this video game had a positive impact on the mentioned indicators. In addition, for the second group, named Control Group, consisted of the same number of randomly assigned minors who were not provided with the video game, collecting data to have a basis for comparison and to be able to perform the testing of the hypotheses, being the null hypothesis that the video game decreases the skills and the non-violent alternatives, that the video game increases the aforementioned skills.

D. Data Collection Techniques and Instruments

The research was carried out using the survey as a data collection technique, defined as a technique which obtains information directly from people related to the object of study but with a lesser degree of interaction with them, which can be through tests, questionnaires or knowledge tests [18]. Taking into account direct observation, defined as a technique that allows connecting with reality and formulating the most precise idea possible of the problem studied [19].

In addition, the research was carried out using the questionnaire as a data collection instrument, for the indicators of the level of communication skills, level of skills related to feelings, level of skills alternative to violence and level of proamic skills, defined as a standardized instrument that allows the operationalization of problems through the use of items in the form of questions, statements or instructions [18].

E. Procedures

As mentioned, a group of 60 students from Crhista McAuliffe High School with ASD were chosen and divided into two groups: The first group, called the control group, would not use the video game and would continue to develop their social skills as before, while the second group, called the experimental group, would use the video game for 2 months, testing one level each week, being 4 after the fourth week the levels would be repeated.

Once the groups were formed, we began to control that the children in the experimental group would use the video game as appropriate, which was simple thanks to the help of the teaching staff of the institution, until the two months were completed. Subsequently, a test was carried out for each student, which was filled out by the teachers in charge of the corresponding student, in which they were questioned about the frequency with which the student presented certain behaviors during class hours, behaviors that are connected to the different social skills that they were trying to improve.

F. Development through SUM Methodology

1) Concept phase: During this period, a conceptual document was created, offering an intricate portrayal of the video game. It covers various aspects, including its unique characteristics, genre, gameplay mechanics, environment, storyline, intended audience, and the inspirations that influenced its development. Further elaboration on some of these mentioned features is presented below:

a) Game vision: Players explore a classroom, which simulates different conversations with an NPC (non-playable character, mentioned as a machine-controlled character that often plays many roles when interacting with players [20]), in which each of them practices behaviors related to communication skills, feelings, alternatives to violence, and pro-amical in order to successfully develop the story.

b) Technology and tools:

- It was programmed in Unity 3D, 2022.3.7f1.
- Models were edited in Blender.
- Sprites were generated in Playgroundai.
- Voices will be generated in Applio.
- Programming language C# for the functionalities.

2) Planning phase: In this phase, the essential project document is drafted, which includes a detailed description of the work performed, the rationale for the project, the parties involved, quantifiable goals, functional requirements in Table I and non-functional requirements in Table II, assumptions and other relevant elements. This document also specifies both the schedule of activities and the project budget.

TABLE I.   RESEARCH INDICATOR FREQUENCY TABLE

Code	Description
RF01	Show dialog on communication skills.
RF02	Show dialogue on pro-amictal skills.
RF03	Show dialogue on alternative skills to violence.
RF04	Show dialogue on skills related to feelings.

a. Source: Own work

TABLE II.   NON-FUNCTIONAL REQUIREMENTS

Code	Description
RNF01	Developed in Unity 3D environment.
RNF02	Developed in C# language.
RNF03	The videogame must be in Spanish.
RNF04	It must work in any size of screen of Laptop or PC.

b. Source: Own work

3) Elaboration phase: The aim of this stage is to carry out the implementation of the video game. This involves adopting an iterative and incremental approach, ensuring the development of a functional version of the video game at the conclusion of each iteration.

a) Iteration 1: During the first iteration, we chose and edited the model of the scenario as shown in Fig. 1, chose the model of the NPC named Lucia as shown in Fig. 2 and programmed the movement of the main character as shown in Fig. 3 and 4.

b) Iteration 2: In this iteration, the main scripts of the dialog system that allowed the visualization shown in Fig. 5, which is when the NPC talks to us, and Fig. 6, which is the screen when we can make choices, were developed, in addition, the sprites were developed as shown in Fig. 7.

c) Iteration 3: During this iteration, the different conversations were carried out for the different levels, using interconnected scriptable objects, where the texts and options that we can choose are stored and then loaded in the screens previously seen.

Fig. 1.   Scenario.
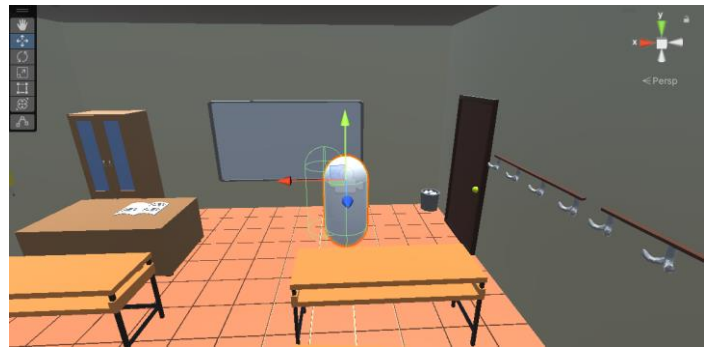
Fig. 2.   NPC model.

Fig. 3.   Main character model.

```
1    using System.Collections;
2    using System.Collections.Generic;
3    using UnityEngine;
4
5    public class Player : MonoBehaviour
6    {
7        private CharacterController _characterController;
8
9        private float _speed = 3.5f;
10       private float _gravity = 9.81f;
11       private float _rotationSpeed = 1f;
12
13       public bool canMove = true;
14
15       void Start()
16       {
17           _characterController = GetComponent<CharacterController>();
18       }
```

```
19
20       void Update()
21       {
22           if (canMove)
23           {
24               CalculateMovement();
25               Rotation();
26           }
27           else
28           {
29               Cursor.lockState = CursorLockMode.None;
30           }
31       }
```

Fig. 4.   Movement of the main character.
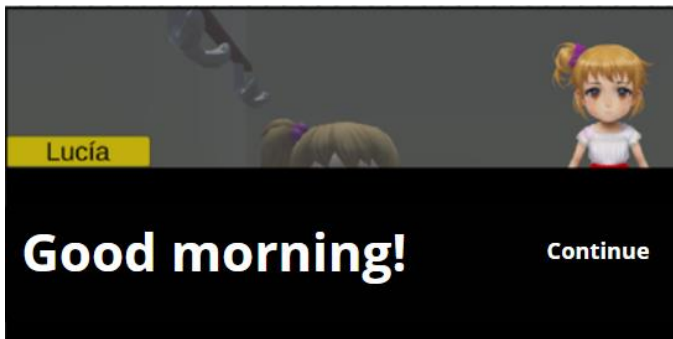

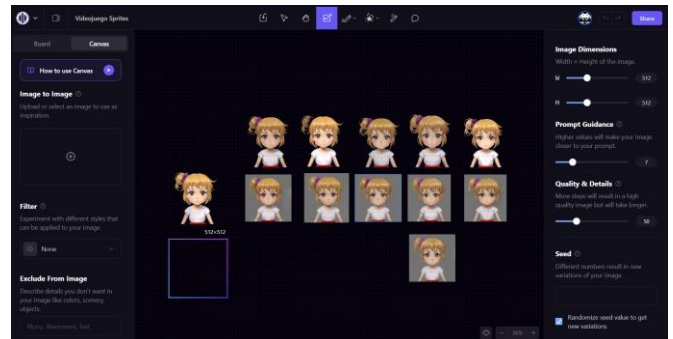Fig. 5.   Conversation dialog system.
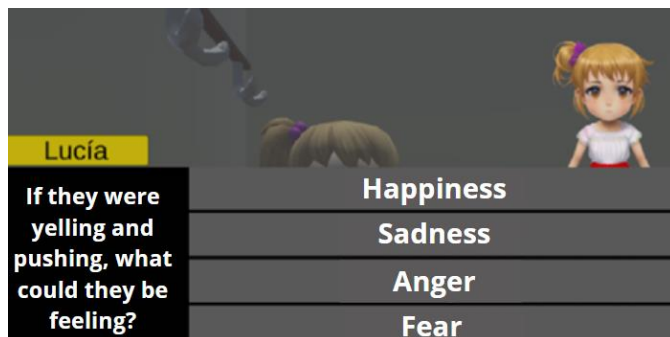

Fig. 7.   Sprite generation.

Fig. 6.   Question dialog system.

d) Iteration 4: In this last iteration, the main menu is developed, some audios are generated to accompany the text in the conversations as shown in Fig. 8, and a system is created to control the number of "errors" during the use of the game

4) Beta Phase: After the development of the video game was completed, it was installed on a variety of computers with different Windows system versions and screen resolutions. This process revealed a number of bugs concerning screen resolution and dialog connection. As a result, measures were taken to correct these errors, the errors can be seen in Table III. A test of the videogame can be performed at the following link: acortar.link/LXdaKe.
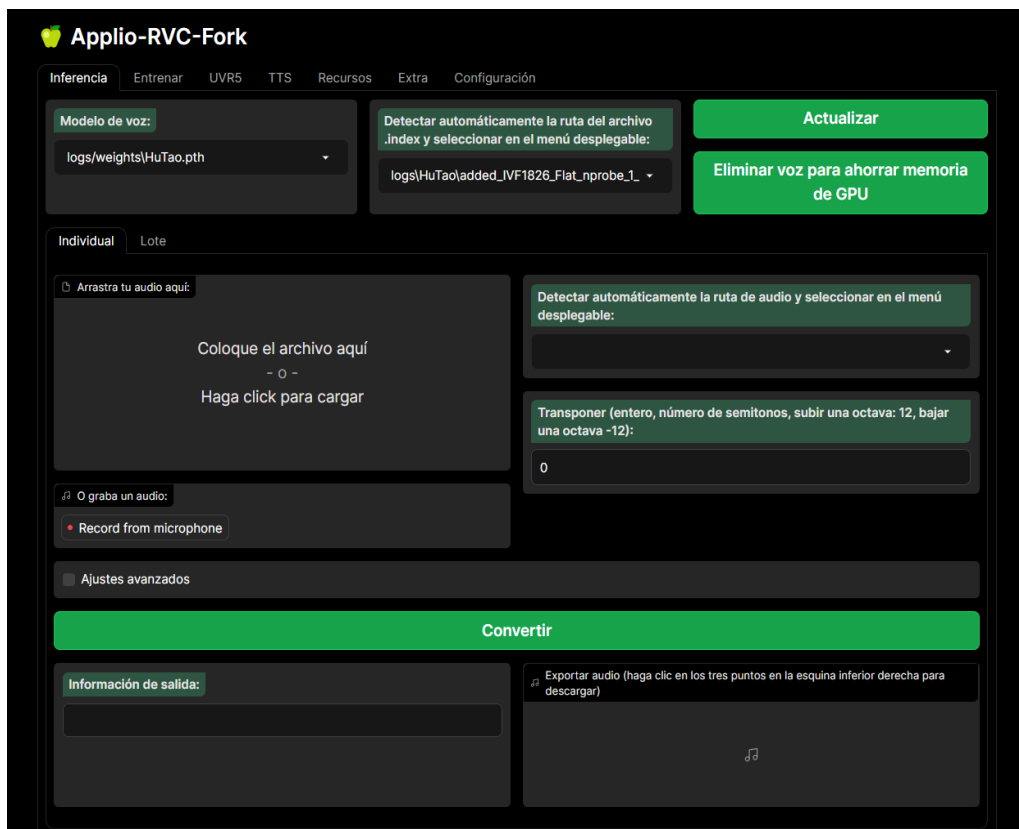
Fig. 8. Audio generation.

TABLE III. TABLE OF ERRORS FOUND

MISTAKES	
TYPE	*DESCRIPTION*
RESOLUTION	The main menu canvas was not satisfactorily adapted.
	The content of the buttons with options was not satisfactorily adapted.
PROGRAMMING	The dialogs of the first conversation loop were not correctly connected.

c. Source: Own creation

5) Closing Phase: The educational institution Christa McAuliffe Trujillo, positively accepted the video game and also provided the facility to apply the implementation of the same for students.

The proposed purpose of implementing the video game was to improve social skills. On October 16, the video game was installed in all the functional machines of the institution, with a positive and interested acceptance by the students.

IV. RESULTS

A. Descriptive Analysis

In the descriptive Analysis, Table IV shows the frequency tables of the control and experimental groups for the research indicators, showing an improvement of 1.39 in the Communication Skills Level (NHC), 1.12 in the Feelings-related Skills Level (NHRS), 1.04 in the Non-violent Alternative Skills Level (NHAV) and 0.95 in the Pro-amical Skills Level (NHPA).

TABLE IV. RESEARCH INDICATOR FREQUENCY TABLE

Research Indicator	Level	Frequency		General Average	
		GC	*GE*	*GC*	*GE*
NHC	Very Low	21	-	1.7	3.09
	Low	9	9		
	Average	-	15		
	High	-	6		
NHRS	Very Low	18	-	1.8	2.92
	Low	10	7		
	Average	1	21		
	High	1	2		
NHAV	Very Low	19	-	1.68	2.72
	Low	10	20		
	Average	1	6		
	High	-	4		
NHPA	Very Low	20	3	1.58	2.53
	Low	10	18		
	Average	-	6		
	High	-	3		

d. Source: Own creation

B. Inferential Analysis

In the inferential analysis, Table V shows the normality tests of the data collected from each group, based on each indicator, by using the Shapiro-Wilk test since each group is less than 50. There are two decision criteria: a) If p<0.05, the null hypothesis (H0) is rejected and the alternate hypothesis (Ha) is rejected and b) If p≥0.05, the contrary is true.

TABLE V.   SHAPIRO-WILK NORMALITY TEST TABLE

Research Indicator	P (GC)	P (GE)
NHC	0.261	0.419
NHRS	0.004	0.056
NHAV	0.12	0.014
NHPA	< .001	0.003

e. Source: Own creation

Finally, the variables backed the specific alternate hypotheses posed (Ha) as seen in Table VI, showing that the Level of Communication Skills (NHC), the Level of Feelings Related Skills (NHRS), the Level of Non-violent Alternative skills (NHAV) and the Level of Proamic Skills (NHPA) increased with the use of a video game as all indicators had a value of p<.001, thus rejecting the null hypotheses (H0) that indicated that these skills decreased.

TABLE VI.   INFERENTIAL ANALYSIS TABLE OF EACH INDICATOR

Research Indicator		Statistics	gl	p	Decision
NHC	T Student	-11.9	58	< .001	
NHRS	U Mann-Whitney	70	-	< .001	Ha is accepted
NHAV	U Mann-Whitney	69	-	< .001	
NHPA	U Mann-Whitney	109	-	< .001	

f. Source: Own creation

V.   DISCUSSION

Based on the obtained results, as evidenced by the use of a video game, it was possible to increase the level of communication skills, the level of feeling-related skills, the level of non-violent alternative skills and the level of Pro-amical skills; thus, demonstrating that the use of a video game significantly improved social skills.

With regard to the general objective, which sought to improve social skills through the use of a video game, it was determined that social skills were indeed significantly improved. This was demonstrated by the increase in the average of all skill levels measured; the results obtained are similar to the research conducted, where he demonstrates the effectiveness of the use of a video game called "Minecraft" for the improvement of social skills in people with autism spectrum disorder[9]. It should be noted defined that, social skills are a variety of behaviors that are evident in the interaction with other people, being that these behaviors are means to communicate emotions, positions, aspirations, points of view and rights in an appropriate manner according to the

context, ensuring the expression of one's own rights while respecting the rights of others [12].

Regarding the first indicator, which is the level of communication skills, a total of 1.7 average points of the level of communication skills was obtained in the control group, and a total of 3.09 average points of the level of communication skills in the experimental group, showing an increase of 1.39 average points of the level of communication skills in the experimental group. In addition, it was calculated that the average of the control group represents 34%, while the average of the experimental group would be equivalent to 61.8%, thus proving an increase of 27.8% in the level of communication skills in the group that used the video game; the results were comparable with the study, which if we follow the same logic, presented an increase in communication skills of 41.53% [21]. It should be defined communication skills as those that encompass the ability to send and receive information, as well as ideas and messages relevant to those involved [22].

Regarding the second indicator, which is the level of skills related to feelings, a total of 1.8 points of average of the level of skills related to feelings was obtained in the control group, and a total of 2.92 points of average of the level of feeling-related skills in the experimental group, showing an increase of 1.12 points of average of the level of feeling-related skills in the experimental group. In addition, it was calculated that the average of the control group represents 36%, while the average of the experimental group would be equivalent to 58.4%, thus proving an increase of 22.4% in the level of feeling-related skills in the group that used the video game; the results were comparable with the study, who showed an improvement in the identification of emotions both their own and that of others in all their cases [23]. It should be defined that skills related to feelings are those that enable the understanding and effective expression of emotions and emotional states to others in order to be understood [22].

Regarding the third indicator, which is the level of, non-violent alternative skills, a total of 1.7 points of average of the , non-violent alternative skills was obtained in the control group, and a total of 2.72 points of average of the level of, non-violent alternative skills in the experimental group, demonstrating an increase of 1.02 points of average of the level of non-violent alternative skills in the experimental group. In addition, it was calculated that the average of the control group represents 34%, while the average of the experimental group would be equivalent to 54.4%, thus proving an increase of 20.4% in the level of non-violent alternative skills in the group that used the video game; the results were comparable with the study, who showed an increase in skills in the face of conflicts among all his cases, especially in cases of speaking with others to negotiate and reach an agreement[24]. It is worth defined that, non-violent alternative skills are those that reduce the possibility of perpetrating or being a victim of violent behaviors [22].

Regarding the fourth indicator, which is the level of proamic skills, a total of 1.58 points of average proamic skills level was obtained in the control group, and a total of 2.53 points of average proamic skills level was obtained in the experimental group, showing an increase of 0.95 points of

average proamic skills level in the experimental group. In addition, it was calculated that the average of the control group represents 31.6%, while the average of the experimental group would be equivalent to 50.6%, therefore, an increase of 19% in the level of proamictal skills was demonstrated in the group that used the video game; the results were comparable with the study, who demonstrated an increase in the frequency of initiation of an interaction and the time it was maintained, although in some cases it was still not constant, the frequency was increased [23]. It should be defined proamictal skills as those that increase the possibilities of establishing relationships with new people and maintaining friendships with other people, mainly friends [22].

Finally, it was concluded that the use of a video game improved social skills through the use of a video game, due to an increase in communication skills by an average of 27.8%, skills related to feelings by an average of 22.4%, alternative skills to violence by an average of 20.4% and proamic skills by an average of 19%.

VI. LIMITATIONS

During the research, there were several limitations, such as not taking into account stereotyped behaviors that are common in people with ASD, which were solved by the novelty that the use of a videogame presented in children, but there was no specific control for these behaviors that can alter the attention given to the software.

Also, there was limited time for the development of the software due to unexpected failures in the laptop intended for the development of the videogame and all its functionalities.

Likewise, the software was developed with the limitation of technical knowledge about the development of video games in the Unity environment by the researcher, and the software could have been much more optimized or include more mechanics in future research.

Finally, there was a hardware limitation of the laptops that the institution had, having a limited processing capacity, so we opted for an offline and resource-light approach.

VII. CONCLUSIONS

It has been established that there is a notable increase in the Communication Skills Level, thus demonstrating with the percentages obtained, with the calculation of the formula, 34% of Communication Skills Level was obtained in the control group and 61.8% of this level in the experimental group, thus proving an increase of 27.8%, in this level, of the group that used the video game, demonstrating that with the parametric statistical test T of Students a p value of <.001 was obtained providing sufficient statistical evidence to accept the alternative hypothesis.

In addition, it was established that there is a notable increase in the Level of Skills Related to Feelings, thus demonstrating with the percentages obtained, with the calculation of the formula, a 36% Level of Skills Related to Feelings was obtained in the control group and 58. 4% of this level in the experimental group, thus proving an increase of 22.4%, in this level, of the group that used the video game,

demonstrating that with the non-parametric statistical test Mann-Whitney U, a p value of <.001 was obtained, providing sufficient statistical evidence to accept the alternative hypothesis.

Similarly, it was established that there is a notable increase in the Level of Alternative Skills to Violence, thus demonstrating with the percentages obtained, with the calculation of the formula, 34% of the Level of Alternative Skills to Violence was obtained in the control group and 54. 4% of this level in the experimental group, thus proving an increase of 20.4%, in this level, of the group that used the video game, demonstrating that with the non-parametric statistical test Mann-Whitney U, a p value of <.001 was obtained, providing sufficient statistical evidence to accept the alternative hypothesis.

Finally, it has been established that there is a notable increase in the Proamic Skills Level, thus demonstrating with the percentages obtained, with the calculation of the formula, 31.6% of Proamic Skills Level was obtained in the control group and 50. 6% of this level in the experimental group, thus proving a 19% increase, in this level, of the group that used the video game, demonstrating that with the non-parametric statistical test Mann-Whitney U, a p value of <.001 was obtained, providing sufficient statistical evidence to accept the alternative hypothesis.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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