Digital Games and Improvement of the Inhibitory Control: a Study With Children in Specialized Educational Service[1]

Jogos Digitais e Aprimoramento do Controle Inibitório: um Estudo com Crianças do Atendimento Educacional Especializado

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ABSTRACT: Interaction with digital games can have an impact on executive functions and offer contributions to education. Among the dimensions of the executive functions, we highlight inhibitory control and its importance for self-control, selective attention, impulse control and behavioral adjustment. Therefore, interventions were proposed in the Specialized Educational Service (SES), with the support of the family for the use of digital games in the school context for the purpose of exercising executive functions. The objective was to evaluate the contributions of the use of digital games as a complementary strategy in SES, aimed at children who were identified by the teachers as having difficulties in the performance of the inhibitory control. For that, it was performed a quasi-experimental study of mixed approach with 8 children divided into a participant and control group, who were evaluated before and after interventions based on performance in proposed playful activities and psychological test application. The results indicated superior improvement in general, in the participant group when compared to the control group that did not participate in the interventions with the digital games. In the playful activities, they showed greater assertiveness, control of actions and performance. In the tests, it was observed better performance when comparing the pre and post interventions and the groups in four of the five tests applied. It is concluded that digital games can be used as an alternative intervention in SES to enhance executive functions and improve the conditions for learning in the school context.

KEYWORDS: Special Education. Games. Educational technology. Cognitive process. Self control.

RESUMO: A interação com jogos digitais pode ter impacto sobre as funções executivas e oferecer contribuições à educação. Dentre as dimensões das funções executivas, destaca-se o controle inibitório e sua importância para o autocontrole, atenção seletiva, controle dos impulsos e adequação do comportamento. Diante disso, propôs-se intervenções no Atendimento Educacional Especializado (AEE), contando com o apoio da família para o uso de jogos digitais no contexto escolar com o propósito de exercitar as funções executivas. O objetivo foi avaliar as contribuições do uso dos jogos digitais como estratégia complementar no AEE, voltado a crianças que foram identificadas pelas professoras como tendo dificuldades no desempenho do controle inibitório. Para tanto, realizou-se um estudo quase-experimental de abordagem mista com 8 crianças divididas em grupo participante e controle, as quais foram avaliadas pré e pós intervenções com base no desempenho em atividades lúdicas propostas e na aplicação de testes psicológicos. Os resultados indicaram, de modo geral, melhora superior no grupo participante quando comparado ao controle que não participou das intervenções com os jogos digitais. Nas atividades lúdicas, revelaram maior assertividade, controle das ações e desempenho. Nos testes, observou-se melhor desempenho ao compararem-se as intervenções pré e pós e os grupos em quatro dos cinco testes aplicados. Conclui-se que os jogos digitais podem ser recursos alternativos às intervenções que ocorrem no AEE para aprimorar as funções executivas e melhorar as condições para aprendizagem no contexto escolar.

PALAVRAS-CHAVE: Educação Especial. Jogos. Tecnologia Educacional. Processo cognitivo. Autocontrole.

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1 Introduction

In this study, we discuss the cognitive impact of digital games and the contributions they can offer to education, more specifically in the context of Specialized Educational Service (SES), when the use is based on objectives, intentionality and pedagogical mediation. Interaction with digital games involves the exercise of important cognitive abilities, which influence learning (Moita, 2007; Lalueza, Crespo, & Camps, 2010; Rivero, Querino, & Starling-Alves, 2012; Ramos, 2013). Among the cognitive abilities developed by the use of digital games, some research indicate advances in the inhibitory control of children (Dovis, Van Der Oord, Wiers, & Prins, 2015; Martinovic, Burgess, Pomerleau, & Marin, 2015; Ramos, 2013).

Inhibitory control refers to an important dimension of executive functions, which involves the ability to control attention, thoughts, behavior and emotions to overcome internal predispositions or external attraction, in order to act contrary to the impulses to respond to what is necessary or more appropriate (Diamond, 2013). Considering the breadth and relevance of this function, we emphasize that the capacities contemplated by the inhibitory control are essential for children's cognitive development.

Executive functions are "the set of mental operations that organize and direct the various categories of cognitive domains to function in a biologically adaptive way" (Lent, 2013, p. 289). These functions influence the performance of daily activities, even if we have external interferences that hinder execution, and help us to stay focused and concentrated until these activities are completed (Diamond, 2012).

The dimension of the inhibitory control is responsible for the domain of internal and external interferences that act as distractors, which can compromise student performance in school tasks (Klawe-Schiavon, Viola, & Grassi-Oliveira, 2012). In addition to the aspect of self-control, inhibitory control is more comprehensive, when contemplating the control of emotions, discipline and selective attention (Diamond, 2013). According to the author, as a consequence of all these characteristics, it is the inhibitory control that allows us to evaluate situations and choose the best way to act, which is not easy, considering that we have more environmental stimuli than we realize.

Several conditions may lead to difficulties in the performance of executive functions, including inhibitory control. Among them, we highlight, in the context of this study, children with special needs and attend SES in schools, as a proposition and alternative to inclusive education due to the recognition of different conditions for learning and attending them, which includes learning or development difficulties (Carvalho, 2013).

Inclusive education contemplates a series of differences, related to social and economic aspects as well. However, our focus was on target public students of Special Education in the context of regular education. To González (2007, p. 19), Special Education is understood as "the set of personal and material resources placed at the disposal of the educational system so that it can adequately respond to the needs that, in a transient or permanent way, some students may present".

Among the strategies, resources and methodologies used in SES, we highlight the use of digital games, which are already described as resources used with students in the activities

developed in the SES, as indicated in research on the area (Emer, 2011; Salomão, 2013; Alves, Santos, Hostins, & Santos, 2014). In addition, we point out the use of digital games as a playful alternative for the exercise of cognitive abilities.

Digital games are presented as a didactic resource that can bring a number of benefits to teaching and learning practices, such as motivating effect, cognitive skills development and learning by discovery (Savi & Ulbricht, 2008; Ramos, 2013). In relation to the developed skills, to Santaella and Feitoza (2009), digital games lead the players to learn without noticing, to develop teamwork, to anticipate experiences and the readiness in decision making, as well as to exercise the resolution of problems.

Several features can be associated with digital games such as rules, goals or objectives; results and feedback (Gee, 2009; Mcgonigal, 2012; Prensky, 2012); immersion and interactivity (Ranhel, 2009; Santaella & Feitoza, 2009; Prensky, 2012), active agency and player participation (Gee, 2009; Santaella & Feitoza, 2009). The combination of these characteristics creates experiences that influence cognition as a result of the decoding of a series of complex symbolic relations, as well as the development of spatial perception by these digital technologies and the new form of interaction between users and digital media (Luz, 2010).

Considering the contributions of the games and the specific audience, we call attention to a study conducted by Mason et al. (2014), which proposes the use of games during recess as an important space for the development of the interaction and communication of autistic students with their peers. The research was carried out with a sample of three boys from 6 to 8 years old, all with diagnosis of autism. These children were chosen among participants enrolled in a randomized clinical trial. Interventions with proposed games occurred for 13 sessions, distributed two or three times a week, each lasting about 10 minutes. Regarding the changes that arose after the intervention of the research, the children presented significant improvements in language development and interaction with their peers (Mason et al., 2014).

Another study conducted by Sande, Segers and Verhoeven (2014) examined the use of serious games designed with a focus on goals such as vocabulary, social-emotional learning skills and problem solving. Based on this conception, researchers carried out a study with a sample of 106 children, about six years old, who attended Early Childhood Education, which were randomly selected by class. Interactions with the games were conducted individually in two 15-minute sessions and presented educational benefits (Sande et al., 2014).

In the study developed by Thorell, Lindqvist, Bergman, Bohlin and Klingberg (2009), preschool children participated in a computerized memory training for visuospatial work and inhibition for 5 weeks. The children were organized into different groups and the results revealed that children trained in working memory improved significantly on the tasks being trained, including improvements in attention. Children involved in inhibition showed a significant improvement in two of three trained tasks (Thorell et al., 2009).

Considering the importance of executive functions in human development and its implications for learning, the characteristics of the games and the evidence that they can contribute to the improvement of executive functions, we propose, in this study, interventions in SES, with the support of the family for the use of digital games in the school context with

the purpose of exercising executive functions in a more playful way. Based on this intervention, the objective of this study was to evaluate the contributions of the use of digital games as a complementary strategy in SES, aimed at children who were identified by the teachers as having difficulties in the performance of the inhibitory control.

2 Methodology

The context of the research refers to SES, an important space, where different strategies and methodologies are sought and used to favor the participation of the target public student of Special Education in regular education. Considering this, our study proposes the use of digital games for students, who attend this service in a school. However, the intervention with games was carried out in the homes, with an invitation to the parents to mediate in order to contribute to the improvement of the inhibitory control. To do so, we proposed the use of digital games integrated to the Brain School, because they present results related mainly to the development of attention and inhibitory control (Ramos & Rocha, 2016).

2.1 Participants

The study was carried out in a federal public school, which had, during the collection of data from this research, 32 target public students from the Special Education. Of those students 24 performed the Specialized Educational Service at the school itself. However, of these students, eight of them participated in the research. During the development of this study, as criteria for selecting participants, we included children who presented difficulties in inhibitory control, verbal communication, family interest in participating in the research, as well as children's interest in digital games.

The identification of difficulties in inhibitory control was performed by means of an instrument to assess behaviors indicative of difficulties in inhibitory control completed by the SES teacher in conjunction with the class teacher. The results obtained with the application of this instrument allowed identification of eight students with difficulty in inhibitory control.

From this, the sample consisted of the participation of these eight children in the age group from 8 to 11 years old (6 boys and 2 girls) enrolled in different classes - two students attended the second grade, three students the fourth grade, two students the 5th and one student the 6th grade.

Group	Identification	Age	Gender	Access to the media	Interest in the use of technologies
Participating Group	Participant 1 (P1)	8 years old	M	Console, computer, and tablet	Play and watch videos
	Participant 2 (P2)	11 years old	M	Computer and tablet	Watch videos
	Participant 3 (P3)	9 years old	M	Computer, tablet and cell phone	Play and watch videos
	Participant 4 (P4)	7 years old	M	Computer and tablet	Play and watch videos

Control Group	Participant 5 (C1)	9 years old	M	Cell phone, computer and tablet	Play and watch videos
	Participant 6 (C2)	8 years old	F	Computer and tablet	Play and watch videos
	Participant 7 (C3)	10 years old	F	Computer and tablet	Watch videos
	Participant 8 (C4)	10 years old	M	Computer	Play, listen to music and watch videos

Table 1. Profile of the participant group related to the use of ICT.
Source: Elaborated by the authors.

For the organization of the children in the participant and control group, the child's interest in playing the "Brain School" games and the parents' willingness to participate in the research were considered in order to help mediate the use of games at home.

2.2 Procedures

The procedures used in the research observed the design of a quasi-experimental study, in order to infer if the proposed intervention could be associated with the results obtained (Cozby, 2003). To do so, we organized the participants into two groups: participant and control and a participant group, we used the same procedures and evaluation instruments before and after the intervention, in order to isolate possible intervening variables.

After all groups were organized, the participants were evaluated through the proposition of three play activities and the application of some psychological tests. After that, the participating students received tablets, which were taken home; parents and students received guidelines on how to access digital games. Parents were advised that children should have access to the game at least three times a week for 15 minutes on average. The intervention period lasted five weeks.

At the end of the interventions, the children were again evaluated, both the participants in the control group and the participant group, in order to use the same activities and tests. It should be noted that we have the understanding that the interval of the tests should be higher, as indicated by Lavratti and Bastos (2010). However, we had to reduce the application period due to the end of the school year.

Among the procedures used to evaluate the children of both groups, we highlight the proposition of three play activities. In the first activity, the child chose a song that he knew best. Then the music was accessed and listened to. After this stage, the child was invited to sing along until the music was paused. This was the first evaluation moment, which aimed at verifying if the child could continue singing even though he/she could not hear the background music as a reference. The next step of this activity was to listen to the music until the next break; however, the child should create different lyrics from the one he/she was listening to as soon as the melody was paused. In this activity, self-control was observed, when the child could contain the impulse to continue singing the lyrics that he/she already knew and attributed other lyrics to continue that song.

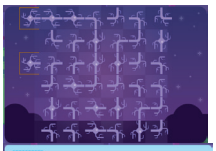
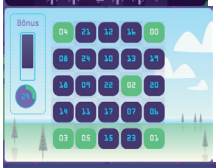
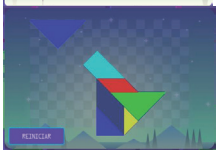
In the second activity, the child was initially asked to imitate the researcher's movement. There were six movements that ranged from the closed fist to the thumb pointing

upward. Then, if the child who was able to perform this first step would go to the second, which consisted in performing the reverse movement, that is, when making the movement of the closed fist, the child should perform the movement of the thumb pointed upwards.

Activity 3 was aimed at verifying the interaction with digital games different from those presented by the Brain School. These digital games were chosen according to the profile of the students, considering different possibilities of intervention with different levels of gameplay, some using the computer keyboard, others only the mouse. It started from the pre-selection of some games, which were suggested to the children. In interaction with the games, before and after the intervention, it could be observed the skills related to the gameplay, such as avoiding colliding with some obstacle or time to pass the stage.

2.3 Brain school

The games used in the development of the research, in the intervention with the participating group, are part of the Brain School, a system that integrates digital cognitive games into a database as an alternative to the playful exercise of cognitive abilities. The games can be downloaded as applications on Android mobile technologies and can then be played online or offline, as well as accessed online through computers (Ramos & Rocha, 2016). In the period of interventions, the Brain School had seven games described in Table 2 below.

Screen	Description
	*Ladybug* The aim of the game is to free the ladybug, which is trapped due to blocks that are arranged in a random way, with the least number of movements possible. The player must move the blocks strategically, using only two moves to the sides, in each block, to clear the way and thus the ladybug can get out.
	*Breakout* The objective of this game is to reach the bars located at the top of the game, alternating the two balls with movements controlled by movements of the bar of the base, which moves horizontally. To reach the final goal, the player needs to keep bouncing at least one of the balls until the last block is cleared.
	*Connectone* The purpose of this game is to establish a path by connecting the two indicated neurons. This path is built by the connection of other neurons, which must be connected with as few motions and little time as possible.
	*Looktable* The goal is to locate and click numbers in ascending order in the shortest time possible. Numbers from zero to 24 are randomly distributed.
	*Tangran* The goal is to complete the figure using all seven pieces. The player must click on the pieces, spinning them until they are in the position to drag and fit the figure.

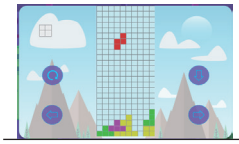
	*Genius* The objective is to reproduce the sequence of colors presented. The degree of difficulty gradually increases, as the sequence of colors is extended, according to the correctness presented.
	*Tetris* The goal is to complete lines by arranging the pieces that fall randomly. As soon as the line is completed horizontally, it disappears, and points are scored. The game ends if the stacked pieces reach the top.

Table 2. Description of the Brain School Games.
Source: Elaborated by the authors.

2.4 Instruments

The instruments used in the research were the questionnaire answered by the teachers to select the children and the psychological tests used in the pre and post intervention evaluation:

1. Raven's Coloured Progressive Matrices applied with the objective of evaluating the potential of non-verbal reasoning; it proposes tasks in which the child needs to complete images by choosing options (Dovis et al., 2015). This test assesses the intellectual development of children between the ages of 5 and 11 (Bandeira, Alves, Giacomel, & Lorenzatto, 2004).
2. Subtest of WISC IV Digits that aims to evaluate attention, concentration, sequencing and short-term memory. A series of numerical sequences is presented orally and the child is invited to repeat some of them in a direct order and others in reverse order (Wechsler, 2015).
3. Subtest Sequence of numbers and letters of the WISC IV aims to evaluate the operational memory. The evaluator reads to the child a sequence of letters and numbers, and the child should repeat by arranging the letters in alphabetical order and the numbers in ascending order (Wechsler, 2015).
4. Subtest WISC Code IV aims to evaluate processing speed, including short-term memory, learning, motivation, cognitive flexibility and visual perception. In the proposed task, a series of simple forms (Code A) or numbers (Code B) are presented, written on a sheet, each paired with a simple symbol for the child to draw the corresponding symbol at a given time (Wechsler, 2015).
5. Subtest Search WISC IV Symbols aims to evaluate processing speed, also involving visual memory, visual and motor coordination, cognitive flexibility and attention. To do so, it presents a set of stimuli (symbols) written on a sheet that the child must examine whether or not they appear in a set of symbols that are presented on the same line at a given time (Wechsler, 2015).

In the research, four WISC-IV subtests were used, which constitute a battery of tests to evaluate the intellectual capacity of people from 6 to 16 years old (Figueiredo, Pinheiro, &

Nascimento, 1998). For the research, we used some subtests of the Operational Memory Index (OMI) and the Processing Speed Index (PSI).

3 Results

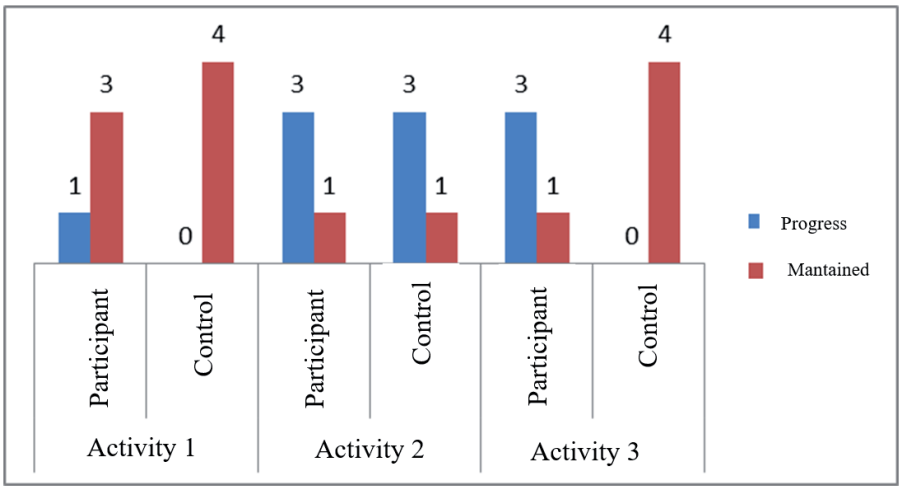
The results are based on observations and records made by the researcher in proposing play activities and applying psychological tests, before and after the interventions, also comparing the performance between the participant group and the control group. Although the research has focused on the intervention with digital games, evaluative activities that could offer indications about the performance of the inhibitory control in other contexts, such as a game with music, body movements, interaction with other digital games and realization of paper tasks in psychological tests were envisaged.

In Table 3, the evaluation of each child in the three proposed activities can be observed in relation to what was identified in terms of progress and performance in the task performed, comparing to the accomplishment before the beginning of the interventions and after their completion.

Child*	Evaluation		
	Activity 1	**Activity 2**	**Activity 3**
P1	P1 presented the same performance, having difficulty in the second moment.	P1 advanced in the second moment, managed to make 6/6**, before P1 had not got even one.	P1 advanced, managed to collide less often (Pac-Xon Deluxe).
P2	P2 presented the same performance, without difficulty in both moments.	P2 advanced in the second moment, managed to realize 6/6, before P2 had obtained 2/6.	P2 presented the same performance, difficulty in the phase (Pac-Xon Deluxe).
P3	P3 advanced the second time, managed to create other lyrics for the song.	P3 advanced in the second moment, managed to realize 6/6, before P3 had obtained 3/6.	P3 advanced, managed to collide less often (Drake and the Wizard).
P4	P4 presented the same performance, managed without difficulty in both moments.	P4 presented the same performance, managed without difficulty in both moments.	P4 advanced, managed to pass the stage without losing lives (Fancy Snowboarding).
C1	C1 presented the same performance, difficulty in the second moment.	C1 showed progress, got 3/6 in the second moment, before that C1 had not.	C1 had the same performance (*Jogo Peixe* - Game Fish).
C2	C2 presented the same performance, difficulty in the second moment.	C2 presented the same performance, achieved in both moments.	C2 had the same performance (Pac-Xon Deluxe).
C3	C3 presented the same performance, difficulty in the second moment.	C3 made a breakthrough, got 6/6 in the second, before that C3 had gotten 3/6.	C3 had the same performance (Pac-Xon Deluxe).
C4	C4 presented the same performance, difficulty in the second moment.	C4 showed advance, got 6/6 in the second moment, before that C4 had not.	C4 had the same performance (*Pega Peixe* - Catch fish).

Table 3. Evolution of performance in activity 1 before and after interventions.
Source: Elaborated by the authors.
Note. (*) P identifies the children who composed the participating group; and C the children of the control group. (**) This fraction represents the number of movements that the child was able to perform as expected. The numerator represents how many times the child has performed the correct movement and the denominator how many movements have been made in total.

In activity 1, in the participating group, three children had the same initial performance, only one child progressed. In activity 2, both the children in the control group and the children in the participating group had one child from each group with the same initial performance and three children with advances. In activity 3, in the participant group, one child presented the same performance; three children improved their results; where as the control group had exactly the same result. When we observed the results by groups in general, there were 7 advances in the participant group and 3 in the control group, indicating a better performance in the participating group.



Graph 1. Comparison of the results presented between the control and participant groups.
Source: Elaborated by the authors.

Evaluations conducted through the application of psychological tests were used as indicators to compare performance gains in some skills related to executive functions before and after interventions without any intention of evaluating or classifying children. The results obtained offered other indicators to analyze the differences obtained, aiding in the comparison of the development presented during the period of data collection for the research.

		Test scores				
Test	**Children**	**Pre**	**Post**	**Pre Average**	**Post Average**	**Average Difference**
Raven's Matrices	P1	26	28	30,5	32,5	2
	P2	30	32			
	P3	31	34			
	P4	35	36			
	C1	8	11	19,75	19,75	0
	C2	32	27			
	C3	28	35			
	C4	11	6			
OMI – Digits	P1	7	6	12,5	14	1,5
	P2	14	16			
	P3	12	14			
	P4	17	20			
	C1	3	4	7,25	6	-1,25
	C2	14	14			
	C3	10	5			
	C4	2	1			
OMI – Sequence of numbers and letters	P1	4	6	7,25	12	4,75
	P2	9	14			
	P3	4	8			
	P4	12	20			
	C1	0	0	2,25	5	2,75
	C2	4	12			
	C3	5	4			
	C4	0	4			
PSI – Code	P1	12	10	22	27	5
	P2					
	P3	22	29			
	P4	32	42			
	C1	0	7	15,75	18,75	3
	C2	31	30			
	C3	23	26			
	C4	9	12			

PSI – Search symbols	P1	12	7	19	16,5	-2,5
	P2	27	18			
	P3	15	19			
	P4	22	22			
	C1	3	10	9	12	3
	C2	19	21			
	C3	10	8			
	C4	4	9			

Table 4. Results of psychological tests by groups.
Source: Elaborated by the authors.

From the table, we can observe that all students in the participating group showed improvement in the general intelligence test. In the Matrix test, two students in the control group showed improvement in results; whereas two others reduced the score, which, in the end, maintained the same score of the initial test.

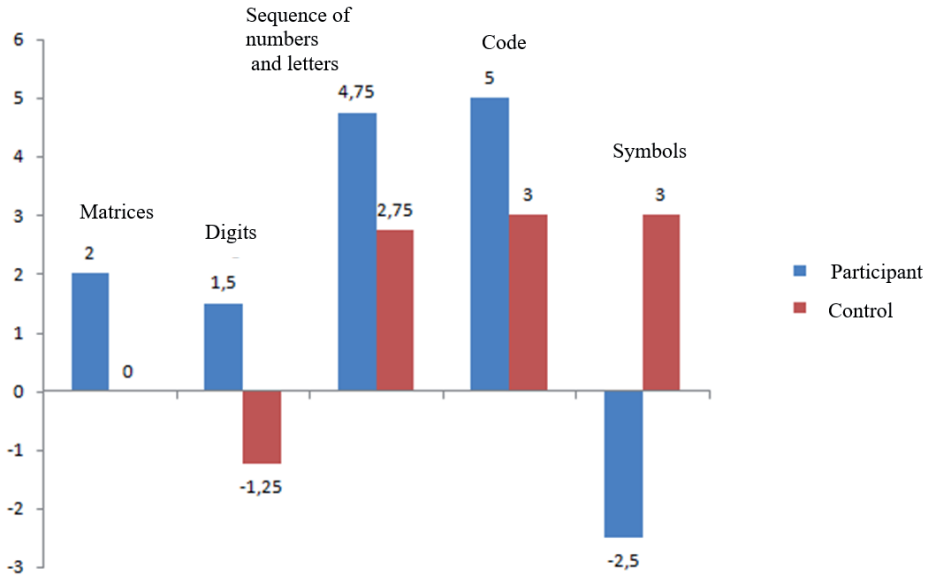
The results of the WISC subtests also revealed, on average, superior improvements in the participant group compared to the control group. In the IMO Digits test, it can be observed that, of the four children in the participating group, three presented advances. In the control group, of the four children, one presented improvement, one presented the same performance and the other two had a lower performance.

In the subtest Sequence of numbers and letters, an improvement was observed in all the participating children. In the mean of the final result, this group showed an improvement of two points in relation to the control group. Whereas the students in the control group presented the same mean, since two presented better performance and two worsened in relation to the initial score.

In the PSI Code test, the participant group had improvement in two participants and had one underperformed when comparing to the initial one. In the control group, one of the students reduced the score; however, three others improved the score. Nevertheless, on average, the comparative performance between the two groups showed better performance in the participating group.

In the PSI Symbols 2 test, the participant group presented an important decrease in the final mean of the group - 2.5. One of the participants had exactly the same score, one of them presented improvement and two of them presented lower scores than in the initial evaluation. The control group showed an improvement in the final group mean in 3 points, and only one of the students presented a worse result in the second evaluation and three students improved their results.

Considering all the subtests used, in the next graph we present the mean of the psychological tests in both groups, to observe the changes presented in the two periods.



Graph 2. Comparison between the means of the psychological tests between the two groups.
Source: Elaborated by the authors.

When we consider the average difference between the groups, we can observe that, in four of them, we have a better performance of the participant group. Only one test had a better outcome for the control group.

4 Discussion

The results observed in the playful activities proposed with the children, in general, revealed superior improvements in the participant group, which highlighted a more qualitative performance in relation to self-control. To Diamond (2013), self-control is one of the aspects of inhibitory control responsible for the adequacy of behavior and emotions, involving aspects such as resisting temptations and not acting impulsively.

We emphasize that the proposition of activity 2 was inspired by the reports described by Luria (1992). In his research, the author describes an experiment performed with children, in which he proposed a provocation to them. He explained that when he lifted his fist, the child should raise his/her finger; when Luria lifted his finger, the child should raise his/her fist. The activity aimed to generate a conflict, between what children saw and what they should do, since the initial tendency was to imitate the researcher (Luria, 1992). Thus, in order to perform correctly, it was necessary to make use of attention and self-control, as the child had to observe the movement with focused attention, to contain his/her impulses to imitate and to respond with the contrary movement.

The result obtained in the proposed playful activities indicates that the children who had access to the cognitive games presented a better performance in this stage of the activities in the SES. These activities involved the exercise of cognitive skills essential to learning, such as

attention, self-control, and self-regulation. This better performance reinforces the use of games in an intentional way in the school context to favor the improvement of cognitive abilities in a playful way, which can influence the learning processes (Ramos, 2013). An advance, especially in activity 3 with digital games, was observed; however, the children who participated in the interventions with the use of the Brain School games also presented better performance in music activity (activity 1).

To Moita (2007), when playing, the child needs to appropriate the rules, demonstrate persistence, exercise the reasoning to overcome challenges and, thus, achieve the ultimate goal of winning the game. In addition, to the author, interaction with games favors the development of cognitive abilities, which impacts on how players behave, interact and work out problem solving.

The improvements observed also reinforce the contributions of the games described by Mason et al. (2014) who, when proposing the use of games with autistic students, reported significant improvements in language and peer interaction.

It is also added, in relation to the changes presented in the course of the data collection, an improvement in the execution time in the last stage of tests. In the first round, it took around three weeks; most children needed two sessions to perform the tests, one child needed three sessions. At the end of the data collection, the tests for each child could be performed in only one session. This aspect can be taken as an indicative in the improvement of the speed of cognitive processing, which can be related to the mental capacity, the performance in tasks and the learning (Wechsler, 2015). Moreover, the results observed in the playful activities proposed with the children could be triangulated with the performance compared in the psychological tests applied to evaluate some abilities related to the executive functions.

The result obtained in the Raven's Matrix test, which evaluates general intelligence, reinforces that what often influences learning in the school context are other factors, such as those related to motivation or social interaction, since the children participating in the study did not perform below expectations.

In the Matrix test, the participant group presented a better performance related to the reasoning, considering that the control group presented exactly the same average of the beginning of the data collection. These data point to the enhancement of the reasoning due to the contact with digital games, as indicated by studies in the area (Diamond & Lee, 2011; Dovis et al., 2015; Moita, 2007; Ramos, 2013).

Considering that the objective was to evaluate non-verbal reasoning ability, we highlight the study conducted by Dovis et al. (2015), which includes, among other tests, the Matrix Test, to evaluate executive functions with children with Attention Deficit Hyperactivity Disorder (ADHD), indicating improvements in inhibition and short-term visual memory in children who have counted on the "partially active" and "full active" experience after 25 interventions that lasted 3 months with 89 children aged 8 to 12 years (Dovis et al., 2015).

Taking into account that the two subtests that make up the WISC operational memory index, which is one of the main dimensions of executive functions (Center on the developing child at Harvard University, 2011), we can infer that interventions with the use

of digital games on average influenced in the skills evaluated in the tests, such as attention, concentration, sequencing and short-term memory, corroborating with results obtained in other studies that sought to establish relationships between interaction with digital games and the improvement of executive functions (Diamond & Lee, 2011; Ramos, 2013; Ramos & Rocha, 2016) and memory (Diamond & Lee, 2011; Dovis et al., 2015; Ramos, 2013).

The advances presented in the aspects evaluated in this group point out to a study that examines how executive control contributes to behavior in children when playing the Brain School, which can be considered a serious game because it has a defined goal aimed at the improvement of specific cognitive skills. These results corroborate with those obtained by Sande et al. (2014) when they used the game for benefits on socioemotional aspects and problem solving.

Even without the data presented by one of the students, the participating group showed a 5-point advance in the PSI Code test. This data refers to the influence of interaction with digital games on memory (Dovis et al., 2015; Ramos 2013), learning (Prensky, 2012; Santaella, 2013) and motivation (Gee, 2009; Santaella, 2013; Savi & Ulbricht, 2008).

The result of the Code subtest, which composes the Processing Speed Index and involves skills such as concentration, visual memory and short-term memory, visual discrimination and cognitive flexibility (Wechsler, 2015), showed a better performance of the participating group. However, in the Search Symbols subtest, we obtained a better performance in the control group, which may be justified because it was the last test applied or, still, other environmental or psychological factors may have influenced. Despite this, we emphasize that, in general, the participant group performed better in activities and tests when compared to the control group. The results reinforce the idea that children with difficulties related to executive functions end up benefiting more from training when using digital games. This offers the possibility of these children reaching levels close to their peers, which guarantees better learning conditions (Diamond, 2012).

5 Final considerations

The results obtained reinforce that the use of games can contribute to the development of executive functions, including children participating in the SES. We emphasize that the characteristics of the game, such as rules, create experiences for the exercise of self-control, when defining limits and what can be done. At the same time that challenges and storytelling create a fun and playful context, the ability to repeat actions and feedbacks often provide a safe learning environment.

Despite the described indicatives of improvement, we recognized the limitations of the study that was based on observations and application of tests, since it would be necessary to deepen, especially in the context of the classroom, on the changes resulting from the interventions. In addition, the games were used for a few weeks due to circumstances other than the research and the end of the school year.

Many questions can be raised from the approach carried out with the games in the context of SES, which can encourage and guide future studies, such as valuing the use of the digital game as a differentiated context of learning and exercise of cognitive functions.

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