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Can digital games in school improve attention? A study of Brazilian elementary school students

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Abstract Several studies suggest that digital game routine can improve cognitive performance. Most of these studies are performed at laboratory setting and the training occurs individually, while this study aims to evaluate the effect of digital game routine on attention performance of elementary school students. Thirty students played digital games daily (15 min) at the beginning of class for 6 weeks, while a group of 41 students had the normal school routine. The students' attention performance was assessed by the D2 test before and after the training period. A repeated measures ANOVA suggests that main effect of "period" (pre and post comparison) has significant influence on D2 total score ($F = 39.43$, $p = 0.0001$), but the interaction between "period" and "group" shows that training group has a greater improvement than control group ($F = 9.91$, $p = 0.002$). These findings suggest that the use of digital games in school routine can enhance the cognitive improvement that is already obtained in the normal school routine, creating an enriched environment to stimulate students' cognitive development.

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Background and motivation

The traditional school learning method exposes children with different cognitive profiles to the same learning method. The variability between subjects in the same classroom creates an opportunity to propose cognitive stimulation methods to benefit the cognitive development and enhance the learning capacity of the children with some learning disability (Lee and Jones 2008; McGonigal 2011). Moreover, the cognitive stimulation in elementary school children can be more effective when compared with adults due to typical neuroplasticity characteristics of this period of nervous system development (Courage and Richards 2008; Mundkur 2005; Rueda et al. 2005).

Recently, several studies reported that digital game training can improve cognitive performance (Eichenbaum et al. 2014; Homer et al. 2018; Palaus et al. 2017). The cognitive performance improvement by gaming training is observed in healthy young adults samples (Boot et al. 2008; Feng et al. 2007; Green and Bavelier 2003), but also has benefits for clinical samples such as ADHD (De La Guia et al. 2015; Goodman et al. 2015; Halperin et al. 2013; Healey and Halperin 2015), dyslexia (Harrar et al. 2014), and anxiety (Waters et al. 2015). These evidences in adult sample suggest that the improvement of skills in virtual tasks can be extrapolated to real situations that require similar behaviors, like basic visual skills (Li et al. 2010) or perceive objects simultaneously (Dye and Bavelier 2010; Feng et al. 2007) since these cognitive processes are commonly required for better performance in several digital games.

The most cognitive improvement by gaming studies do not use a real scholar routine, performing the cognitive training in a laboratory setting (Feng et al. 2007; Petty and de Souza 2012), child's home (Nouchi et al. 2013), or a quiet place at school (Halperin et al. 2013; Healey and Halperin 2015; Waters et al. 2015). Although all researchers reported a significant improvement on cognitive abilities for the comparison between control group (CG) and experimental group after the training, it is difficult to extrapolate these results to a real-time classroom environment, because the classroom routine has more distractors, the training sessions will be held in groups, and there is only one teacher to supervise all children. The digital gaming features like challenges, dynamic decisions, and fun (Chen et al. 2018; Kirriemuir and McFarlane 2004; Prensky 2006; Sandberg et al. 2014) make digital games a suitable choice for cognitive stimulation in the school environment because it has easy user adherence, but there are few studies that explored the effect of cognitive training on digital games in the school routine.

In addition to ludic gaming features, some researchers suggest that the contextualized training can facilitate the generalization of the cognitive improvement obtained in virtual environments to real-life situations (Chen et al. 2018; Healey and Halperin 2015; Castellar et al. 2015; Rosas et al. 2003; Sandberg et al. 2014; Thorell et al. 2009; Young and Wang 2014). The few studies that used digital games in the school routine reported that there is a difference in cognitive performances when comparing the CG with the training group (TG). The daily practice of digital games (15 min per day for 3 months) improved academic skills related to mathematics, reading, and writing as observed by Rosas et al. (2003) or as reported in other studies that use Digital Game-Based Learning for improvement of language and vocabulary learning (Sandberg et al. 2014; Young and Wang 2014). Similarly, Homer et al. (2018) reported an improvement on shifting and inhibitory control skills after a gaming training for 6 weeks (20 min per week), and Mackey et al. (2011) showed that fluid reasoning and processing speed can be improved after cognitive digital training by 8 weeks (60 min per week). These results suggest that some results observed in non-scholar routine can be extrapolated to school routine, but to the best of our knowledge, there are no studies investigating the effect of digital gaming routine in school context on attention performance.

Worldwide schools are using tablets in the classroom as a new way of exposing lesson content. In this case, the technological tool only replicates the class content, but in a digital way. In Brazil, the Ministry of Education has implemented the Digital Education Project that provides tablets for teachers and students of federal public schools. Thus, the objective of this study is to verify if cognitive training through electronic games of the tablet improves the attention performance of elementary school students. Although other studies already present evidence suggesting that the daily practice of digital games can contribute to better cognitive development, our study aims to investigate whether experimental setting results are replicable to a real-life school routine to verify the viability of this investment in developing countries with fewer resources in education.

In this sense, a game-based routine in school (15 min daily for 6 weeks) is proposed by integrating cognitive challenges into digital games on tablet devices. This *quasi-experimental* research was conducted on an elementary school to investigate the following questions:

(1) Can the results of cognitive enhancement through digital games observed under experimental conditions be extrapolated to stimulation performed in the school routine?
(2) Can the results of cognitive enhancement through digital games observed in interventions with adults or clinical samples be extrapolated to healthy school-age children?
(3) Can the results of cognitive performance enhancement of executive function abilities, inhibitory control, and memory be extrapolated to the attention skill?
(4) Can the digital gaming routine at school be a tool to stimulate attention in preschool children from countries with few educational resources?

Literature review

The attentional span reflects the ability to focus on relevant information and maintain the relevant information processing, while ignoring irrelevant distractors (Buschman and Miller 2007; Gazzaley and Nobre 2012; Kornrumpf and Sommer 2015). This ability is influenced by motivation, previous experience on task, time-on-task effect, and source of distraction, being related to efficiency on learning process (Burns et al. 2009; Cardoso-Leite and Bavelier 2014). Some researchers suggest that attention network is under strong genetic control, but can be improved by interventions during the development (Rueda et al. 2005).

The longer periods of teachers' information exposition during the visual and noisy classroom common distractions make the proper attentional span an essential cognitive ability for effective learning. In addition, the selection of relevant information is very important since human brain does not have the capacity to store all the perceptual stimuli that it receives constantly (Matlin 2004; Sternberg 2008). The attention span is essential to executive functions because the performance of relevant information control to high-order cognitive processes (e.g., planning or decision making), making it an association with general learning capabilities (Diamond 2013). Thus, training attention skills can be beneficent to the improvement of academic skills, like attention is related to general learning capacity (Baniqued et al. 2013).

Studies that investigated the effects of digital games on cognitive performance are focused on ex post facto or *quasi-experimental* research design. The former method compares gamers‘ and non-gamers' groups to evaluate the long-term effects of playing videogame across gamer's life. Several studies using this research design reported significant improvement in gamers cognitive abilities (Boot et al. 2008; Dye and Bavelier 2010; Feng et al. 2007; Li et al. 2010), but there is an important limitation to be noted, since there are no previous cognitive participants' assessments to evaluate whether the observed effect is due to individual characteristics or was something actually developed by digital games. To minimize the effects of individual characteristics, the other experimental design (*quasi-experimental*) performs the cognitive training using digital games and compares the cognitive assessment scores with CG (between scores obtained before and after for both groups).

Cognitive improvement by digital gaming training routine is observed by Shin et al. (2006) wherein the daily practice (15 min) of mathematics games during 5 weeks improved childrens' math score on the regular academic test. Similarly, results are reported by Miller and Robertson (2010) showing that 10 weeks' training (20 min daily) improved students' accuracy and speed of calculations. As observed in academic skills (Miller and Robertson 2010; Rosas et al. 2003; Shin et al. 2006), some researchers reported that digital cognitive training by means of "brain-training" software (Thorell et al. 2009) and commercial games (Homer et al. 2018) can be applied to assess cognitive abilities which, after daily practice (15–30 min) for 5–8 weeks, can help improve inhibitory control, cognitive flexibility, or working memory. The wide variety of games and cognitive abilities investigated by researchers provide an opportunity to test the effects of other games on new cognitive processes (e.g., attention) to know the limits of the game-based cognitive training.

Digital game features like coordinate actions related to game tasks, which respond to relevant stimuli and monitor self-performance to reach long-term objectives, can constitute a suitable training for attention span. In addition to these features, investigating the gaming routine in a classroom can be a suitable model to test the efficiency of this method for cognitive stimulation in a real-life school context. Our study investigates the effect of digital gaming routine in school on attention span approaching to previously reported results since all processes were performed in the real-life context of the classroom (training and pre–post assessments), which makes it a proper and suitable model to evaluate the reliability to adopt gaming routine in school as cognitive stimulation method.

Method

Participants

The study included 100 students of the second and third years of elementary school, aged between 7 and 9 years old (7.64 ± 1.12). The inclusion criteria for the sample were that they (a) are enrolled in regular primary education, (b) sign the informed consent (IC), and (c) have contact with technology at home. The exclusion criteria were they (a) have a lack of collaboration or the presence in the stages of assessment or intervention, and (b) have neuropsychiatric comorbidities or mental disability.

The final sample consisted of 71 students aged between 7 and 9 years old, divided into two groups. CG is composed of 41 students (18 boys) with a mean age of 7.23 (± 0.84) years. TG is composed of 30 students (16 boys) with a mean age of 7.62 (± 0.56) years. The CG maintained its normal routine in the classroom consisting of school activities, film exposure, art classes, and other tasks when the TG performed cognitive training through digital games in tablet daily (15 min) for 6 weeks.

Escola do Cérebro™

The Escola do Cérebro™ (Brain School) program has been developed at the Federal University of Santa Catarina, in Brazil, and is freely available at www.escoladocerebro.org. This is a platform that integrates digital games into a database, allowing participants to perform cognitive training through games in addition to offering feedback to the player on their performance and the possibility of monitoring by teachers.

The platform has included five games (Fig. 1): Connectome, Joaninha, BreakOut, LookTable, and Genius (Table 1 for detailed information). They have their scores measured by these variables: time, speed, stability, and accuracy. These indicators are calculated, and classified proportionally according to the score of the players in three cognitive skills: attention, problem-solving, and working memory.

Fig. 1 Home screen of Escola do Cérebro™—cognitive training software

Table 1 Description of the objectives of the games in Escola do Cérebro™

Names	Game activities	Cognitive abilities required
Conectome	Rotate the neurons in order to form a path for the passage of the synapse between the target neurons	Attention, planning, solving problem
Joaninha	Move the pieces to release the passage of the ladybug out of the woods	Solving problem, attention, working memory
BreakOut	Break as many blocks as possible hitting the ball with the board in the bottom of the screen without leaving the balls get out of the scene	Visual-motor coordination, attention
LookTable	Quickly click to find the numbers mixed on the screen in ascending order	Attention, working memory
Genius	Memorize and repeat the sequence of colors and sounds previously provided by the game	Working memory, attention

Test of Attention: D2

The Test of Attention: D2 was developed at Germany by Rolf Brickenkamp in 1950. The first edition of the test describes the psychometric validation process with 3000 participants (Brickenkamp and Zillmer 1998). The Test of Attention: D2 is validated for the Brazilian population by Psychological Test Evaluation System of the Federal Council of Brazilian Psychology (Araújo 2016), whose psychometric properties assessed sustained attention (Brickenkamp and Zillmer 1998). The Brazilian version was adapted and validated in 1990 by CETEPP—*Centro Editor de Testes e Pesquisas em Psicologia*. The normative database was composed of 3576 participants, comparing groups by age and academic degree, showing similar results to those in the German sample (Araújo 2016).

In the test, participants observe a page with various stimuli. Among them are target stimuli and distractors. The participant should mark only the target stimuli along the page. The markings are restricted by the line, and the participant has 20 s to mark the stimuli of each line. In total, there are 14 lines. The score is based on the amount of correct and wrong stimuli marked. The data extracted for analysis were (a) a number of correct marked stimuli (raw score), (b) number of correct unmarked stimuli (omission error), (c) a number of wrong stimuli marked (commission error), and (d) difference between correct answers and wrong ones (total score).

Procedures for data collection

The study was approved by the Ethics Committee of the Federal University of Santa Catarina in accordance with the document number 200 436 2013. In the first meeting, the participants and their parents were instructed about the research procedure and were invited to sign the informed consent (IC). After signing the IC, the application was made available to the children, and they were given instructions on how to use it.

On the first day of activity, children of both groups were evaluated through a collective application of the Test of Attention: D2. After that, the participating group started to play the games of Escola do Cérebro™ in the classroom, using a single tablet every day for 15 min for a period of 6 weeks, while the CG continued performing regular school activities. At the end of the intervention period, children in both groups were evaluated again with the D2 test.

For each week, the participating group played one of the Brain School games defined by the researcher. In the last week, the children were able to choose one of the six games to play, according to their interests. The training program consists in providing one tablet for a child. Each tablet has a login exclusive to the child, and the children used the same tablet during all the training sessions. During the training, the children can select the game mode of difficulty (easy, medium, or hard), but the game was selected by the researcher (one different game per week). At the end of the training (15 min), the tablets were returned, and the normal class starts. The CG was passive, participating in the normal classroom activities planned by the teacher.

Data analysis

To investigate the effects of “Group” (TG and CG) and “Period” (pre and post the game-based routine in school) on Attention Test: D2 scores, the number of independent variables tested made the repeated measured ANOVA the most appropriate statistical test for statistical analysis. The variable “Group” was analyzed by between-subjects effect because each group receives a different training simultaneously, while the variable “Period” was tested by within-subjects because this effect was common to both groups. The main effects of “Group” and “Period” were tested separately, but their interaction was also tested. The “F” coefficient represents the ratio of variation between sample means and variation within the samples. Lower F-values show that group means are close together to the variability values within each group, whereas higher F-values show that the variability of the group is larger compared to the within-group variability, suggesting that higher F-value is related to null hypothesis rejection ($p < 0.05$). For repeated measures ANOVA, the $p < 0.05$ ones were considered statistically significant. All statistical analyses were performed using SPSS 22.0.

Results

The statistical analysis of repeated measures ANOVA is applied to investigate the main effects of “Groups” (TG vs. CG), “Period” (pre vs. post scores) and the interaction between these variables on D2: Attention Test scores (raw score, commission errors, omission errors, and total score) (Table 2). The ANOVA results showed that the “Group” did not present a significant main effect for all the D2 Attention Test scores ($p > 0.05$). For “Period” main effect, the comparison between pre and post values showed that participants raw score, $F(1,69) = 21.69$, $p = 0.00001$, and total score $F(1,69) = 39.43$, $p = 0.00001$, improved significantly between the assessment periods (mean from 316 ± 80.60 to 365.08 ± 103.23 for raw score and 270.52 ± 61.88 to 308.08 ± 80.02 for total score), suggesting an important time-dependent cognitive development effect on attention scores. There were no significant effects of the “Period” on the variables commission error, $F(1,69) = 1.21$, $p = 0.27$, and omission error, $F(1,69) = 0.60$, $p = 0.44$.

The interaction of main effects with D2 scores suggests that TG showed greater improvement in pre versus post comparison of D2 raw, $F(1,69) = 5.94$, $p = 0.01$, and total score (Fig. 2), $F(1.69) = 9.91$, $p = 0.002$ (126% for raw and 123% for total scores) compared with CG (107% for raw and total scores). There were no significant effects of the interaction between “Group” and “Period” on the variables: commission error, $F(1,69) = 0.01$, $p = 0.94$, or omission error, $F(1,69) = 1.01$, $p = 0.31$.

Discussion

The present paper reports that the digital game routine in school can improve students’ attention performance. The comparison between pre and post D2 assessment scores showed that attention improvement is influenced by time since both groups improved their total score in the final assessment, but the digital game TG had a greater improvement compared with CG.

Similar to our results, several studies investigated the digital game effects on cognitive performance (Baniqued et al. 2013; Diamond and Lee 2011; Dovis et al. 2015; Feng et al. 2007; Homer et al. 2018). Most of these studies are performed at laboratory setting, and the training occurs individually as reported by Nouchi et al. (2013); the daily digital game practice (15 min) enhanced executive functioning, working memory and processing speed after 4-week training, or as shown in Miller

Table 2 Comparison between the effects of Group (training vs. control group) and Period (pre vs. post game-based routine in school) on D2, Attention Test

D2-Attention Test scores	Training group mean ± SD		Control group mean ± SD		*F*	*p*
	Pre	Post	Pre	Post		
Raw score						
Group	337.80 ± 107.06		342.81 ± 86.10		0.07	0.79
Period*	316.16 ± 80.60		365.08 ± 103.23		21.69	0.00001
Interaction*	297.90 ± 77.64	377.70 ± 118.27	330.32 ± 80.96	355.30 ± 90.24	5.94	0.01
Commission error						
Group	23.30 ± 38.29		32.03 ± 46.29		1.15	0.28
Period	24.76 ± 30.29		31.69 ± 52.84		1.21	0.27
Interaction	19.58 ± 24.52	27.03 ± 48.50	28.77 ± 33.86	35.30 ± 56.31	0.01	0.94
Omission error						
Group	24.45 ± 51.75		22.05 ± 33.01		0.10	0.74
Period	20.88 ± 27.02		25.30 ± 53.16		0.60	0.44
Interaction	18.38 ± 23.20	30.51 ± 69.51	22.82 ± 29.79	21.27 ± 36.29	1.01	0.31
Total score						
Group	290.04 ± 93.03		288.725 ± 54.92		0.01	0.93
Period*	270.52 ± 61.88		308.08 ± 80.02		39.43	0.00001
Interaction*	259.93 ± 75.72	320.16 ± 99.96	278.72 ± 48.03	298.72 ± 60.07	9.91	0.002

"Group" represents the main effects of the comparison between training and control groups, "Period" represents the main effects of the comparison between pre and post the game-based routine in school, "Interaction" indicates the main effects of the interaction between "Group" and "Period." Independent variables tagged with "*" showed $p < 0.05$ for repeated measures ANOVA

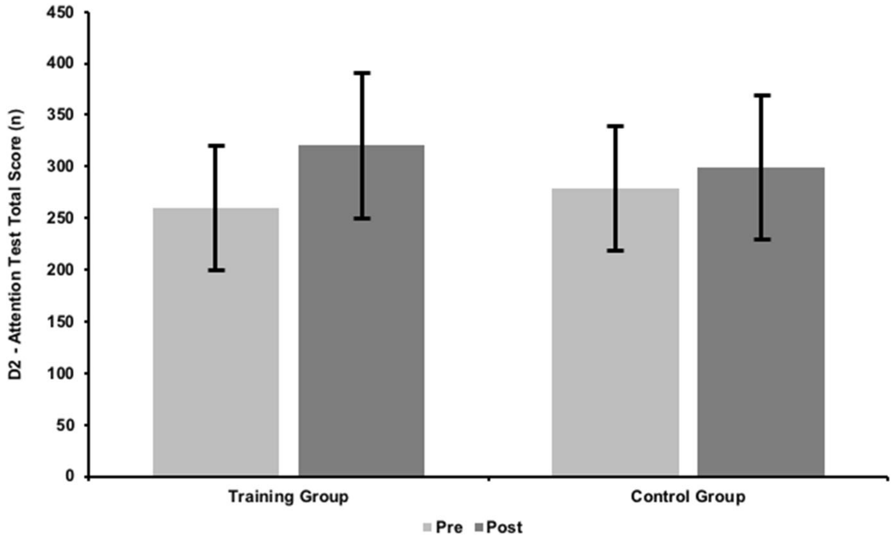

Fig. 2 The effects of Group (training vs. control group) and Period (pre vs. post game-based routine in school) on Total Score of D2: Attention Test

and Robertson (2010), the 20 min of daily gaming for 10 weeks improves the cognitive performance in Number Challenge Task. Similar results are reported in Homer et al. (2018) where 82 students showed an improvement in cognitive flexibility and selective attention after daily digital game training (20 min) for 6 weeks.

Our results support these findings suggesting that cognitive training through digital games can benefit cognitive development even when performed in a group with distractors (such as a normal classroom). However, it remains to be demonstrated which cognitive processes are successfully improved under these training conditions, since our research only evaluated the attentional processes. Probably other cognitive processes may also present improvements as some studies indicated that the daily practice of digital games in the school environment improves overall school skills (Rosas et al. 2003), and these skills are dependent on several cognitive processes (e.g., working memory, planning, making decision, processing speed, etc.) (Cardoso-Leite and Bavelier 2014). To research question No. 1, our results provide evidence that cognitive improvement observed in game-based cognitive training routine under controlled environment (e.g., laboratory setting) can be extrapolated to real-life scholar routine.

Regarding research question No. 2, as expected, the cognitive improvement by gaming training observed in the healthy adult sample (Boot et al. 2008; Feng et al. 2007; Green and Bavelier 2003) can be extrapolated to healthy children. This result can be related to the accentuated capacity of neurogenesis and synaptogenesis in childrens' nervous system (Mundkur 2005; White et al. 2013). The characteristics of this stage of development can contribute to the improvement of training efficiency (Courage and Richards 2008; Rueda et al. 2005). Our results corroborate the previous reports (Miller and Robertson 2010; Rosas et al. 2003; Sandberg et al. 2014; Shin et al. 2006; Thorell et al. 2009; Young and Wang 2014) suggesting that cognitive training by digital games can be a suitable tool for cognitive stimulation in children, even when performed at school routine (for attention improvement). We hypothesize that in addition to the cognitive stimulation propose, digital games can also be used to learn academic lessons, and as reported in Rosas et al. (2003), Young and Wang (2014) and Sandberg et al. (2014), the use of games in the school routine can contribute to the improvement of mathematics, language, and vocabulary skills.

Digital games can contribute to cognitive enhancement, but what is poorly understood is how these virtual environment trainings can result in improved cognitive performance in a real-life situation. Studies suggest that the transfer of cognitive abilities occurs only for tasks that share some similar characteristics to the task, as observed in Oei and Patterson (2013) in which cognitive training from games of different categories (e.g., action or strategy) presented a specific improvement in cognitive performance according to the game played. Similar results are reported in Thorell et al. (2009) that specific training of working memory improved other working memory tasks and some attention skills, but the inhibitory control training group not generalized their training abilities do others inhibitory control tests or other tasks, supporting that cognitive improvement through digital training are restricted to skills of similar characteristics (for other studies see Boot et al. 2008; Dovis et al. 2015; Nouchi et al. 2013; Castellar et al. 2015; Rosas et al. 2003).

In the case of our research, the gaming platform used for cognitive training had five different games (one different game per week), and all children are free to choose the activities that they wish to perform (at the last week). Although the training load in each game was random for each child, there was a congruence in the improvement of the attentional process in the comparison between TG and CG. To research question No. 3, our hypothesis is that attention improvement is not related to the characteristics of the game, but rather to behavioral training to pay attention to activity on the tablet while ignoring the normal distractors in the classroom. In this sense, the tablet offers only a playful environment that increases the child's motivation to train the behavioral ability to pay attention for a period ignoring distractors since the wide variability of games used for training makes it difficult to establish a process of clear generalization between the game situation and the real-life situation.

Our results encourage the use of digital games for cognitive training but highlights that it is important that the training is performed in an environment related to the behavior targeted training. Sometimes the difficulty of generalizing the digital cognitive training improvements is reported to occur due to lack of development of efficient environmental cues in associated characteristics of a particular context for the retrieval of information learned through working memory (Ericsson et al. 2007; Ericsson and Towne 2010). Therefore, the digital game routine in school can help the development of environmental cues for paying attention, thus facilitating the generalization of cognitive training improvements. In this sense, our results suggest that the observed improvement in other cognitive abilities (Dovis et al. 2015; Homer et al. 2018; Oei and Patterson 2013; Thorell et al.

2009) can be extrapolated to attention span, but we do not know if the observed improvement is due to an effect of game features or just a behavioral training to pay attention to a relevant stimulus in the classroom context.

There is another interesting aspect to be discussed: although there is an interaction between the variables, "group" and "period", suggesting a difference between the attention improvements for TG compared with control, the CG also presented a performance enhancement when comparing between pre and post attention assessment scores. We suggest that this improvement may be related to the test–retest factor since the children had already performed the task previously. Other hypotheses for the "period" effect are related to maturational cognitive development curve (Best and Miller 2010; Garon et al. 2008) or the contribution of normal school routine to the development of executive functions (Diamond and Lee 2011). Therefore, the cognitive training of digital games can improve the results of cognitive (Quiroga et al. 2009) and academic (e.g., mathematics or vocabulary) (Rosas et al. 2003; Sandberg et al. 2014; Young and Wang 2014) developments commonly obtained in the school routine. In addition to environmental enrichment development, the digital games can help in the inclusion of students with more severe learning issues, such as dyslexia (Harrar et al. 2014) and ADHD (De La Guia et al. 2015; Dovis et al. 2015).

Important to note, this study has some limitations. First, we do not control the use of digital games outside of school (e.g., at home), which can make the CG also play digital games or the number of hours trained in the TG is much higher. Despite this limitation, the digital games in the school routine will also be influenced by this variable, making our results closer to what will be found in real-life situations. We emphasize that cognitive training by digital games in the classroom is important because it can facilitate the generalization of the cognitive enhancement. Finally, it would also be necessary to evaluate other cognitive processes to see if there are benefits to other abilities related to learning ability or even other attentional tests to corroborate these results.

Regarding research question No. 4, for Brazil or other developing countries, this study suggests that digital gaming routine at school can improve the classroom learning efficiency by cognitive training, being a suitable complementary strategy for cognitive development in children (Diamond 2013; Petty and de Souza 2012; Quiroga et al. 2009; Young and Wang 2014). We report that the daily digital game training (15 min) in the classroom (before the class start) can improve students' attention performance, making this cognitive stimulation strategy to be quickly and easily applied in schools with poor educational resources since no other professional or specific environment is required to do this cognitive training. Future studies may investigate the effect of digital game routines on long-term cognitive enhancement since all studies perform the assessments after the training ends without proper follow-up data.

Conclusion

The digital gaming routine in school can improve the students' attention performance. Although the TG showed a greater cognitive improvement than the CG, the CG also showed an improvement in attention performance in the last assessment. These findings suggest that the use of digital games in school routine can enhance the cognitive gains that are already obtained in the normal school routine, creating an enriched environment to stimulate students' cognitive development. We highlight that the reported attention enhancement is related to the use of games in the school routine, since the training occurs daily (15 min) in the classroom, making this cognitive stimulation strategy to be easily applied in schools that already have technological tools in the classroom.

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