ORIGINAL ARTICLE

Promoting inclusion and cognitive development through a basketball teaching laboratory

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ABSTRACT

This experimental study investigated the benefits of a basketball-based educational workshop to improve selective attention and the ability to inhibit automatic responses in 70 children from a first-year secondary school. The intervention had a significant impact on social inclusion and behavioural self-regulation, particularly for students with difficulties in these areas. By integrating physical and cognitive activities, the lab promoted cooperation and strengthened peer relationships, making the school a more inclusive environment. Changes in cognitive abilities were assessed using the Stroop test, The Index for Inclusion measured pre- and post-intervention levels of social inclusion. Statistical analyses using SPSS (version 27) showed significant changes in participants' performance, demonstrating the effectiveness of structured physical activity in improving executive function and cognitive development. The results highlight the importance of practical and playful educational strategies, such as sports workshops, to promote cognitive growth and create a more welcoming and cooperative school environment. This study adds to the literature demonstrating the value of interventions that combine physical and social activities to improve both learning and inclusion.

Keywords: Physical education, Executive functions, Motor-cognitive integration, Social engagement, Educational intervention.

Cite this article as:
Gravino, G., Borghese, V., Di Palma, D., & Tafuri, F. (2025). Promoting inclusion and cognitive development through a basketball teaching laboratory. *Journal of Human Sport and Exercise, 20*(4), 1347-1354. https://doi.org/10.55860/6f8dea17

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Submitted for publication February 06, 2025.
Accepted for publication March 19, 2025.
Published August 23, 2025.
Journal of Human Sport and Exercise. ISSN 1988-5202.

doi: https://doi.org/10.55860/6f8dea17

INTRODUCTION

Selective attention and the ability to inhibit automatic responses are fundamental processes of executive functions, which are closely linked to behaviour regulation, academic success and social development (Diamond, 2013). Executive functions include skills such as inhibitory control, working memory and cognitive flexibility, all of which are necessary to deal with complex situations and to change strategies according to context (Miyake et al., 2000). Numerous studies have shown that physical activity not only contributes to physical well-being, but also plays a crucial role in cognitive development, particularly with regard to executive functions in children and adolescents (Tomporowski et al., 2015). Activities that require motor coordination and quick decision-making, such as basketball, can directly stimulate these skills (Pesce et al., 2019). In addition, interventions that include playful components have been shown to be particularly effective in engaging children with SEN (Egger et al., 2020; Schmidt et al., 2021). Inclusion was promoted through the design of the activity, which ensured that all participants, regardless of their motor or cognitive abilities, could actively participate. The playful and collaborative approach of basketball provided an opportunity for socialisation and engagement, where the boys saw themselves as part of a group rather than as separate individuals with specific difficulties. This approach is supported by research highlighting how group physical activity can promote participation and reduce social exclusion behaviours in school settings (Pesce, Croce, & Benvenuti, 2019; Westfall, Dunsiger, & Bender, 2022). The present study aims to evaluate the impact of a basketball-based educational workshop on selective attention, inhibitory capacity, and level of educational inclusion in first-year secondary school students. To achieve this, the Stroop test was used to measure cognitive abilities and the Index for Inclusion was used to analyse changes in levels of social inclusion before and after the intervention.

MATERIALS AND METHODS

This study adopted a mixed research design using both quantitative and qualitative approaches to assess the effectiveness of a basketball-based teaching laboratory. The quantitative component was represented by the use of the Stroop test and the Index for Inclusion to measure inhibitory control, selective attention and social inclusion. The qualitative component of the study was structured through semi-structured interviews conducted with teachers and students at the end of the teaching workshop. This approach was chosen to explore participants' perceptions of the observed changes in behaviour, group dynamics and social inclusion. The interviews were designed following the methodological guidelines of Braun and Clarke (2006), using a grid of open-ended questions divided into three main thematic areas: (1) perceptions of the laboratory, (2) changes in social relationships and participation, and (3) learning of cognitive and behavioural strategies.

The interviews were conducted in a private setting and lasted on average 20-30 minutes. Questions to teachers focused on observing changes in group dynamics and pedagogical strategies that occurred during the activities. Pupils were asked questions to explore their sense of belonging to a group, their confidence in their peers and their ability to deal with complex situations during the laboratory. The main aim of these interviews was to understand how the intervention had affected both interpersonal relationships and cognitive skills.

The use of semi-structured interviews is based on the effectiveness of these tools in collecting rich and meaningful qualitative data, as suggested by Kvale and Brinkmann (2009). This approach allows the nuances of personal experience to be captured, providing a more complete perspective than quantitative data alone (Maxwell, 2012). In addition, the combination of quantitative and qualitative approaches addresses the need for triangulation of data, increasing the overall validity of the study (Creswell & Plano Clark, 2017).

Participants

The sample consists of 70 students (mean age = 12.4 years, SD = 0.6; 36 males, 34 females) attending an urban primary school. Participants were selected through a school notice and participation was voluntary. Inclusion of all students, regardless of motor or cognitive ability, was ensured.

Measures

Stroop test: The Stroop test (Stroop, 1935) was used to measure inhibitory control and selective attention, two dimensions of executive function. The test consists of three conditions: (a) reading words indicating colours written in black, (b) naming the colours of printed squares, and (c) interference, where participants have to name the colour of ink used to write words of incongruent colours (e.g. "*red*" written in blue). Measures included mean response time and number of errors for each condition. In particular, the interference condition was considered to be the main indicator of inhibitory control. The test has good psychometric properties, with high levels of reliability and validity (Golden, 1978).

Index for Inclusion: To measure the level of social inclusion, the Index for Inclusion was used, which assesses school participation and peer interaction by assigning scores on a five-point scale.

Procedure

The didactic workshop was structured according to educational theories that support the importance of integrating motor and cognitive activities for the development of executive functions (Best, 2010). The sessions took place during school hours over a period of four weeks, with two weekly sessions of 90 minutes each. The proposed activities were modelled on the principles of cognitive training and integrative motor education as described by Diamond (2013) and Pellegrini (2009).

Session 1: Focus on selective attention

- Warm-up (20 minutes): motor exercises that stimulate selective attention, such as dribbling with directional changes in response to visual or auditory cues, were used. The approach is based on studies by Bissonette et al. (2013), which suggest that integrating motor and cognitive tasks improves concentration and attention regulation.
- Main activity (50 minutes): the main activity consisted of structured games that required selective attention. For example, participants had to complete at least three passes before they could draw. This exercise was inspired by research such as that of Hoare et al. (2003), which shows how the practice of cognitive rules in sports games can improve the ability to focus on multiple simultaneous stimuli.
- Cool Down (20 minutes): stretching exercises and guided reflection to improve concentration. The post-activity reflection was suggested by Scheredewahn et al. (2015), who highlight the importance of debriefing to consolidate changes in cognitive and behavioural functioning.

Session 2: Improving inhibitory control

- Warm-up (20 minutes): during the warm-up, exercises involving responses to conflicting stimuli were suggested, such as changing direction in response to opposite commands. This type of motor activity was suggested by Diamond (2013) as useful for improving inhibitory control, as it requires participants to resist automatic responses and respond only to relevant stimuli.
- Main activity (50 minutes): mini-games in which impulsive actions, such as shooting instantly without assessing the situation, were penalised. The adoption of rules that encourage reflection before action is based on the work of Best (2010), which shows how self-control and reflection in motor activities can improve executive functions.

- Cool Down (20 minutes): discussion and feedback on behaviour during the game, with a focus on self-regulation. The importance of reflective feedback is supported by studies such as that of Timmons et al. (2016), which suggest that post-activity discussions help to consolidate self-regulation and the integration of acquired cognitive skills.

Statistical analysis

Quantitative analyses were performed using SPSS software (version 27). Paired sample t-tests were used to compare pre- and post-operative performance on the Stroop test. Cohen's d was also calculated to determine the magnitude of the effect observed. The Index for Inclusion data were analysed using paired samples t-tests to compare mean pre- and post-intervention scores. A significance level of $p < .05$ was used.

Qualitative analysis was conducted using thematic analysis (Braun & Clarke, 2006) applied to data collected through semi-structured interviews. The interviews focused on three main thematic areas: (1) perceptions of the laboratory, (2) changes in social relationships and participation, and (3) learning of cognitive and behavioural strategies.

RESULTS

Quantitative results

Stroop test: the results showed a significant improvement in average response time and number of errors in the interference condition. Before surgery, the average response time was 35.2 4.5 seconds with an average of 5.3 1.2 errors. After surgery, the mean response time decreased to 28.7 3.8 seconds with a mean of 2.1 0.9 errors ($t(69) = 8.62$, $p < .001$, $d = 0.94$). These results indicate a significant improvement in inhibitory control and selective attention.

Social Inclusion Index: average social inclusion scores increased from 3.8 0.6 (pre-intervention) to 4.6 0.5 (post-intervention) on a 5-point scale ($t(69) = 7.54$, $p < .001$, $d = 1.33$). Teachers reported increased participation in group activities and reduced social exclusion behaviour.

Qualitative results

The qualitative analysis made it possible to capture deeper aspects related to the observed change in the students, thanks to the interviews conducted with teachers and participants. One teacher pointed out: "*I have noticed a significant change in the way students relate to each other. Children who were previously isolated started to participate actively, offering solutions during activities and interacting with their peers in a constructive way*". This comment reflects an improvement in self-esteem and a sense of belonging to a group.

The students also had their say. One of them said: "*During the games I felt that I could trust my team-mates and they trusted me. I had never felt like that before*". This testimony highlights how the workshop fostered a climate of mutual trust and cooperation, which helped to build positive relationships.

Another pupil, who initially found it difficult to follow the rules, said: "*At first it was hard not to shoot immediately, but then I realised that it was better to pass the ball and wait for the right moment. I felt calmer and could think more about what I was doing*". This change reflects an improvement in inhibitory control and planning ability.

Teachers also observed a positive impact on group dynamics. One teacher commented: "*The activity created an environment where every pupil felt valued. Even the normally shy ones started talking and working with*

others". This observation suggests that the lab not only improved cognitive skills but also helped to create an inclusive and welcoming environment.

DISCUSSION

The results of this study suggest that the integration of structured physical activity, such as basketball, into the school curriculum can be an effective tool for developing executive function and promoting social inclusion. The improvements observed in participants' cognitive performance on the Stroop test, particularly in the interference condition, are consistent with numerous studies showing how physical activity can positively influence inhibitory control and selective attention (Best, 2010; Pesce et al., 2019). This supports the hypothesis that integrated physical and cognitive training is not only beneficial for physical well-being but also has a profound impact on cognitive development and behavioural self-regulation.

An important aspect of this study is the playful and cooperative approach used in the basketball sessions. This method was found to be particularly effective in engaging students and encouraging active participation, including those with motor, cognitive or social difficulties. The studies by Egger et al. (2020) and Schmidt et al. (2021) have shown that playful and collaborative environments can be a crucial motivational lever to promote inclusion and participation of students with special educational needs. These interventions also contribute to a greater sense of belonging and mutual trust among participants, as evidenced by the qualitative comments collected in this study.

Another interesting element is the multidimensional approach used, which combines motor exercises with cognitive components and guided reflection. This type of intervention, in addition to improving cognitive test performance, seems to have a positive impact on the social behaviour of the students, as evidenced by the increase in scores on the Index for Inclusion. The literature supports the idea that educational interventions that include both physical exercise and cognitive empowerment can significantly improve social inclusion (Tomporowski et al., 2015; Westfall, Dunsiger, & Bender, 2022). In particular, students who were typically on the margins of school activities were encouraged to participate through a structured environment that promoted collaboration rather than competition.

The qualitative findings of the study provide an additional level of understanding, highlighting that the changes observed in participants were not limited to cognitive skills, but also included improvements in relational dynamics and emotional well-being. For example, students' statements about feeling part of a group and teachers' statements about being part of a group that emphasised the active participation of previously isolated students reinforce the concept that group physical activity can foster empathy and positive relationship building (Pesce et al., 2019; Diamond, 2013). These improvements suggest that the workshop promoted not only individual skills, but also social skills that are essential for academic and personal success.

A distinctive feature of this intervention is the integration of exercises designed to stimulate inhibitory control and selective attention in a dynamic, cooperative environment. This approach differs from traditional interventions, which often address executive functions in more static contexts, such as purely cognitive or individual activities. Previous studies, such as those by Diamond (2013) and Best (2010), have highlighted the importance of simultaneously engaging the mind and body to achieve more significant and lasting benefits in cognitive function.

Another point of discussion is the possibility of implementing similar programmes on a large scale. Although the results of this study are promising, large-scale implementation of interventions based on basketball or

other structured sports activities would require appropriate teacher training and specific resources. However, studies such as Schmidt et al. (2021) suggest that investment in such programmes could lead to significant long-term benefits, both for student well-being and for creating an inclusive school environment.

Finally, it is important to recognise some of the limitations of the study. Although the results were statistically significant, the analysis was carried out on a relatively small and limited sample. Future studies could investigate the effectiveness of similar interventions in a larger and more diverse population, including a variety of socio-economic and cultural contexts. It would also be useful to examine the long-term effects of the intervention to determine whether the observed benefits are sustained over time.

In conclusion, this study adds to the body of scientific evidence on the effectiveness of educational interventions based on physical and recreational activities for improving executive functioning and social inclusion. The results suggest that such interventions can be a powerful and versatile educational strategy, able to meet the needs of students with different abilities and backgrounds, while promoting a more welcoming and supportive school environment.

CONCLUSION

The results of the study show how a basketball-based teaching workshop can be an effective educational strategy for improving executive function and promoting social inclusion. This approach was found to be particularly useful for students with self-regulation difficulties, creating a more welcoming and cooperative school environment. Activities that integrate physical and cognitive components, such as those proposed in this study, can be powerful pedagogical tools that can strengthen students' cognitive and relational skills.

A large body of previous research supports the idea that exercise can have a positive impact on executive function. For example, Diamond (2013) highlights how physical activity, including sport, can stimulate the brain area involved in the control of higher cognitive functions, such as attention and working memory. In addition, structured physical activity, such as team-based activities, has been linked to improved emotional and social regulation, as demonstrated by Randler et al. (2014), who found improvements in participants' cooperative skills and relational dynamics. The success of the intervention suggests that the implementation of similar programmes on a large scale could be a significant step towards more inclusive and resilient education. In particular, this type of approach could be used to target groups of students with difficulties in self-regulation and behaviour management. Incorporating structured and playful activities into the classroom not only improves cognitive performance but also promotes a more cooperative and supportive school environment. These approaches are in line with the principles of inclusive education as proposed by Ainscow (2005), who emphasises that a positive and supportive school environment promotes the success of all pupils, regardless of their individual difficulties. Future research could further explore the effectiveness of this approach with different age groups and in different school settings, thus contributing to the validation and expansion of innovative educational strategies. In particular, future studies could examine the impact of these programmes in different cultural and social contexts to better understand how variables such as culture and school resources can influence the effectiveness of physical activity-based interventions.

AUTHOR CONTRIBUTIONS

The writing of this paper was a joint effort by all authors.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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