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ORIGINAL ARTICLE

Screen time and its relationship with the development of physical literacy in primary school students

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ABSTRACT

This study examined the relationship between screen time, physical literacy, motor competence, and physical fitness in primary school students, and assessed the implementation of a physically active learning (PAL) intervention. A mixed-methods design was used with 24 sixth-grade students from a primary school in Valencia (Spain). Screen time and sedentary behaviours were assessed with an adapted version of the Youth Leisure-Time Sedentary Behavior Questionnaire (YLSBQ), physical competence was evaluated through the CAMSA, PACER, and Plank tests from the Canadian Assessment of Physical Literacy (CAPL2), and perceived physical literacy was measured with the Physical Literacy Questionnaire for Children (PL-C Quest). In addition, a one-week PAL intervention was implemented in Spanish Language and Mathematics, combined with active breaks. The results showed that physical competence was positively associated with perceived physical literacy, whereas screen time was negatively associated with physical competence and several dimensions of physical literacy. Girls reported higher screen time and lower physical competence than boys. The intervention was associated with an increase in the number of daily steps and was positively valued by both students and the teacher. These findings suggest that PAL may be a useful strategy to increase movement opportunities during the school day and promote healthier and more active learning environments.

Keywords: Health science, Physical literacy, Screen time, Motor competence, Physical fitness, Physically active learning, Sedentary behaviour.

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INTRODUCTION

In today's digital age, screen time has become an integral part of the daily lives of primary school students. With the widespread availability of electronic devices and the increasing reliance on technology for entertainment and education, children are spending more time in front of screens than ever before. While the benefits of technology for enhancing learning experiences are undeniable, concerns have arisen regarding the potential negative effects of excessive screen time on children's development, particularly in relation to physical literacy and broader cognitive and psychosocial outcomes (Mallawaarachchi et al., 2024).

Reduced engagement in physical activity (PA) and increasing sedentary screen-based behaviours are major concerns during childhood. Research in Spanish youth has shown problematic patterns of sedentary behaviour and lifestyle habits (Lizandra & Gregori-Font, 2021), whereas evidence on children's screen use has linked excessive exposure to cognitive and psychosocial outcomes (Mallawaarachchi et al., 2024). This pattern may also be relevant for physical literacy (PL), understood as the process through which individuals develop the motivation, confidence, physical competence, knowledge, and understanding to value and engage in PA (Wainwright et al., 2020). In this regard, it has been suggested that children who do not develop these abilities may lack confidence in their skills and may be less motivated to participate in physical activity.

For this reason, it is necessary to analyse the factors that influence students' PL, physical fitness, and motor competence, as these elements are closely related within the multidimensional construct of physical literacy (Ortega-Benavent et al., 2024). In addition, it is relevant to explore physically active learning (PAL) as a school-based strategy to compensate for the limited movement opportunities associated with traditional sedentary classroom routines. In this regard, PAL has been shown to contribute to improvements in children's movement behaviour and components of PL (Romero-Martínez et al., 2025).

Previous research supports the use of PAL and active breaks in school settings as effective strategies to increase movement opportunities during the school day and to promote health-related and educational outcomes. In particular, school-based interventions aimed at promoting physical literacy appear to be a promising approach because they address the physical, cognitive, and affective domains in an integrated way (Grauduszus et al., 2024). In addition, classroom-based physical activity interventions may have a positive effect on academic-related outcomes (Watson et al., 2017), while classroom exercise breaks of 10 and 20 minutes have also been associated with better mathematics performance compared with sedentary conditions (Howie et al., 2015). More broadly, previous studies have shown that children accumulate considerable amounts of sedentary time during the school day, including class time, recess, and lunch periods (Bailey et al., 2012; Nettlefold et al., 2011). At the same time, implementation studies have noted that time pressure and the need for additional teacher competence may act as barriers to the regular adoption of classroom-based physical activity (Lomsdal et al., 2022).

Accordingly, this study had two aims. First, it aimed to examine the cross-sectional relationships between screen time, physical literacy, physical fitness, and motor competence in primary school students, including the relationship between perceived physical literacy and actual physical competence. Second, it aimed to explore the implementation of a one-week physically active learning (PAL) proposal in a real school context by descriptively examining daily step counts and collecting students' and teacher's perceptions. Given the characteristics of the sample and design, both components were approached from an exploratory perspective.

MATERIAL AND METHODS

This study followed a mixed-methods design with two complementary components. The first component was a cross-sectional correlational study examining the associations between screen time, physical literacy, physical fitness, and motor competence in a sample of primary school students. The second component was an exploratory implementation of a one-week physically active learning (PAL) proposal, examined through descriptive step-count data and qualitative information gathered from students and the classroom teacher. The quantitative component combined descriptive and correlational analyses, whereas the qualitative component was used to examine participants' perceptions of the PAL experience.

Participants

The sample consisted of 24 sixth-grade students from one primary school in Valencia (Spain), aged between 11 and 12 years. The study was conducted within the ordinary educational context of Physical Education (PE), and the intervention was implemented as part of regular school activity. Participation in the study was voluntary, and the questionnaires were implemented in the classroom setting with the approval of the school. The centre held a general authorisation for the processing of anonymised data, and all data used in the study were handled anonymously.

Measures

Firstly, screen time and related sedentary behaviours were assessed using an adapted version of the Youth Leisure-Time Sedentary Behavior Questionnaire (YLSBQ). This self-report instrument asks students to report the average time spent on different sedentary leisure activities separately for weekdays and weekends. In the present study, students reported the time devoted to activities such as watching television, using the computer or the internet, chatting on WhatsApp, reading, and travelling by motorised transport. The YLSBQ has shown acceptable reliability and validity for assessing sedentary behaviours in young people (Cabanas-Sánchez et al., 2018).

Secondly, three tests were conducted to measure the students' physical competence using the Canadian Assessment of Physical Literacy (CAPL2), as suggested by Longmuir et al. (2018). This assessment allows for reliable scoring of children's physical skills and abilities. The physical competence domain includes measures of aerobic fitness, musculoskeletal endurance, and motor skills. In this study, the three selected tests were the Plank, PACER (Progressive Aerobic Cardiovascular Endurance Run), and CAMSA (Canadian Agility and Movement Skill Assessment). Each test could contribute up to 10 points, resulting in a total physical competence score out of 30.

On the one hand, the CAMSA test requires children to perform a motor circuit of seven skills (jump, hop, slide, catch and throw, gallop, and kick) in a setting that simulates the dynamic situations of daily physical activity and training as quickly as possible. The correct execution of each skill and the total execution time are scored individually, and the individual scores are combined to obtain a total score. On the other hand, the PACER was used to measure physical fitness. In this test, children are encouraged to run a distance of 20 meters at a gradually increasing pace. A greater number of laps completed indicates better physical fitness (cardiorespiratory endurance). Thirdly, the plank test assesses trunk muscle strength by requiring participants to hold a plank position for as long as possible. The longer the duration, the higher the score on the test.

Finally, the Physical Literacy Questionnaire for Children (PL-C Quest; Barnett et al., 2022) was used to assess the perceived physical (12 items), psychological (7 items), social (4 items), and cognitive (5 items) domains. This questionnaire includes items rated on a 4-point scale, where 1 indicates low perceived

competence and 4 indicates high perceived competence. The Spanish 4-point version of the PL-C Quest has shown evidence of validity and good-to-excellent internal consistency, with Cronbach's alpha values of .90 at test and .91 at retest for the overall scale, and values ranging from .72 to .83 across domains (Ortega-Benavent et al., 2024).

Procedures

Data on motor competence, screen time, and PL were collected across three 45-minute sessions. In the first session, the CAMSA test was administered. In the second session, students completed the PACER test and the PL-C Quest. In the third session, they completed the Plank test and the YLSBQ. PA was measured through the number of steps recorded during the day using a smartphone pedometer (Fong et al., 2016). The second aim of this study was to explore the implementation of a one-week PAL proposal, described through daily step counts and participants' perceptions.

The activities implemented varied according to the subject content. In Spanish Language, the intervention included five movement-based activities related to poetry, text analysis, reading, dictation, and verbs. In Mathematics, the intervention included five movement-based activities focused on routes, stations, relays, measurement, and goal calculation.

In addition, at least one active break was incorporated into the school day. After the explanation of a subject, five minutes were devoted to asking students key questions related to the syllabus. If students answered correctly, they performed three jumping jacks; if they answered incorrectly, they performed five squats. Some active breaks also included simple movement-based activities such as stretching, breathing exercises, or short guided movements in the classroom. These activities were not always directly linked to academic content.

Finally, an ad hoc open-ended questionnaire was administered at the end of the intervention to explore students' perceptions of the proposed activities. The questionnaire was specifically designed for this study and included questions about students' opinions on the introduction of PAL activities in Spanish Language and Mathematics, as well as their perceived usefulness, interest, and enjoyment.

Analysis

For the cross-sectional component, mean scores were calculated for the study variables derived from the questionnaires and physical tests. Descriptive analyses (means and standard deviations) and bivariate correlation analyses were conducted using SPSS, with statistical significance set at $p < .05$. Given the small sample size, these analyses were considered exploratory and the results were interpreted with caution. For the PAL component, daily step counts were examined descriptively by comparing the values recorded on days without PAL activities and on days including PAL activities. No inferential pre–post analyses were conducted and no control group was included. Qualitative information from the ad hoc questionnaire and the teacher interview was analysed using a descriptive qualitative approach, identifying recurring ideas related to enjoyment, motivation, concentration, and feasibility.

RESULTS

Cross-sectional correlational findings

The descriptive results showed mean scores of 4.33 in the PACER test, 5.18 in the CAMSA test, and 8.67 in the Plank test. The mean total score for the physical competence domain was 18.18 out of 30 points. In addition, gender was negatively associated with motor competence CAMSA ($r = -.47$), physical fitness

Table 1. Descriptive and bivariate correlations between the study variables.

Variable	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12
1. Motor competence (CAMSA)	5.18 ± 0.94	-											
2. Physical Fitness (PACER)	4.33 ± 1.79	.619**											
3. Physical Fitness (Plank)	8.67 ± 2.22	.598**	.720**										
4. Total competence	18.18 ± 4.39	.768**	.903**	.926**									
5. Total screen time	1480.03 ± 589.69	-.562**	-.644**	-.590**	-.681**								
6. Screen time on weekends	801.76 ± 290.20	-.506*	-.638**	-.604**	-.673**	.520**							
7. Screen time on weekdays	2281.78 ± 810.73	-.612**	-.722**	-.669**	-.763**	.951**	.758**						
8. Physical literacy domain	2.77 ± 0.74	.744**	.795**	.695**	.834**	-.732**	-.688**	-.807**					
9. Psychological literacy domain	3.01 ± 0.68	.709**	.805**	.674**	.820**	-.534**	-.556**	-.609**	.807**				
10. Social literacy domain	3.67 ± 0.41	-.363	-.078	-.090	-.155	.378	.223	.369	-.434*	-.174			
11. Cognitive literacy domain	3.21 ± 0.56	.302	.492*	.451*	.492*	-.381	-.307	-.402	.523**	.433*	.094		
12. Total physical literacy	3.17 ± 0.41	.634**	.831**	.716**	.836**	-.580**	-.583**	-.653**	.845**	.872**	.018	.772**	
13. Gender	-	-.473*	-.443*	-.396	-.482*	.598**	.403	.602**	-.681**	-.302	.583**	-.101	-.316

*Note. Gender was coded as 0 = boys and 1 = girls. * p < .05; ** p < .01.*

Table 2. Average daily steps excluding and including PAL activities.

Measure	Day 1	Day 2	Day 3	Day 4	Day 5
Without activities	8,368.83 (1,531.82)	9,573.25 (1,830.56)	8,873.42 (1,268.48)	7,972.38 (2,419.38)	9,453.92 (1,906.99)
With activities	9,940.83 (1,626.18)	11,284.13 (1,993.39)	10,619.96 (1,302.65)	10,466.04 (2,476.10)	10,563.67 (1,934.93)

Note. Values are presented as mean (SD).

PACER (r = −.44), and total physical competence (r = −.48), indicating lower scores in girls than in boys. Physical competence was positively associated with perceived physical literacy, especially with the physical literacy domain (r = .83) and total physical literacy (r = .84) (see Table 1).

Regarding screen time, boys reported an average of 31 hours per week, whereas girls reported an average of 45 hours per week. Total screen time was negatively correlated with motor competence (r = −.56), physical fitness (PACER, r = −.64; Plank, r = −.59), and total physical competence (r = −.68). Likewise, screen time on weekdays showed negative correlations with motor competence (r = −.61), physical fitness (PACER, r = −.72; Plank, r = −.67), and total physical competence (r = −.76). It was also negatively associated with the physical literacy domain (r = −.73), the psychological literacy domain (r = −.53), and total physical literacy (r = −.58).

Exploratory PAL implementation

Concerning daily steps, the mean number of steps increased on all five days when the physically active activities were included (see Table 2).

With regard to students' perceptions, responses to the ad hoc open-ended questionnaire were generally positive. Most participants rated the activities highly, with scores ranging from 7 to 10 out of 10 (M = 8.75), and described them as innovative, interesting, and fun. Three recurring ideas emerged from students' responses: enjoyment, increased motivation and concentration, and the positive role of movement and competition during classroom activities. Several students reported that these activities helped them feel more focused and motivated in class, particularly because they involved standing up, moving, or working in a different way. Some students also highlighted the motivational role of group-based or competitive tasks, with comments such as "*I do not want to let my team down, I want to win*" and "*I force myself to concentrate because it does not depend only on me*."

In the interview, the sixth-grade teacher also positively evaluated the proposal, although she identified lack of time as the main difficulty for its regular implementation, stating*:* "*I would love to implement it, but I do not have time*." She also emphasised the positive impact of the intervention on students' engagement and motivation, noting that "*what surprised me the most was how motivated they were and their eagerness*."

DISCUSSION

The present study included two complementary components. First, it examined the cross-sectional relationships between screen time, physical literacy (PL), physical fitness, and motor competence in a small sample of primary school students. Second, it explored the implementation of a one-week physically active learning (PAL) proposal through descriptive step-count data and participants' perceptions. Overall, the correlational findings suggest meaningful associations among the study variables, whereas the PAL component provides preliminary information about the feasibility and perceived value of introducing more movement into the school day. Given the small sample size and the characteristics of the design, both components should be interpreted from an exploratory perspective.

With regard to the cross-sectional component, both boys and girls showed generally low levels of motor competence and physical fitness. According to the reference values proposed by Longmuir et al. (2018), sufficient physical fitness at the age of 12 ranges from 20.8 to 23.3 points out of 30 for girls and from 21.7 to 24.5 points for boys. Based on these cut-off points, 11 out of 15 girls and 5 out of 9 boys in the present sample could be considered to have low physical proficiency. In total, 66.66% of participants were below the

expected level. In addition, the mean score for the total physical competence domain was 18.18 out of 30, which is consistent with the low levels previously reported in Spanish schoolchildren by Menescardi et al. (2022). In terms of gender, girls showed lower physical competence than boys. This difference may be related to the fact that boys often receive greater encouragement, support, and opportunities to engage in physical activity and sport, which may widen the gender gap in motor competence over time (Barnett et al., 2016). Similarly, Dudley et al. (2018) observed that girls spent a greater proportion of recess time in sedentary activities than boys.

Similarly, the PACER cardiorespiratory endurance test showed the lowest mean score (4.33 out of 10). This result may reflect lower engagement in activities that contribute to the development of cardiorespiratory fitness, as Kolunsarka et al. (2024) reported that organised sport participation is positively associated with physical fitness in young people, and Raghuveer et al. (2020) highlighted cardiorespiratory fitness as an important marker of health in children and adolescents. In contrast, the Plank test showed a higher mean score (8.67 out of 10). The CAMSA results also indicated lower performance in motor competence (mean = 5.18 out of 10). This finding is relevant because throwing and catching are core object-control skills within the broader construct of fundamental movement skills, and recent evidence suggests that many children do not achieve full mastery of these skills during childhood (Lorenzo-Martínez et al., 2025). In addition, Chen et al. (2024) found that boys tend to outperform girls in several ball-related skills, including throwing and catching. Therefore, the lower scores observed in this test seem consistent with previous literature showing that object-control skills, particularly throwing and catching, are often among the most challenging skills for children to master.

Furthermore, the negative correlations observed between screen time and motor competence are consistent with previous compositional studies on 24-hour movement behaviours. In this regard, Tyler et al. (2022) argued that movement behaviours such as moderate-to-vigorous physical activity, light physical activity, sedentary time, and sleep should be understood as co-dependent parts of the 24-hour day. Therefore, an increase in sedentary time may be associated with a reduction in moderate-to-vigorous physical activity and, consequently, with lower motor competence. In the present study, gender was positively associated with total screen time and weekday screen time, indicating higher screen exposure in girls. This pattern may help to explain the lower motor competence observed in girls in this sample. Similarly, Alvariñas-Villaverde and González-Valeiro (2020) reported gender differences in extracurricular sport participation, with boys showing higher levels of sport practice and physical activity than girls.

Regarding screen time, students reported high levels of weekly screen exposure, with higher values among girls than boys. This pattern suggests that screen-based behaviours may reduce the time available for physical activity and other active leisure opportunities. In the present study, this pattern may also be related to physical fitness and physical literacy, as higher screen exposure among girls was accompanied by lower motor competence and lower scores in the physical domain. At the same time, the positive associations observed between physical competence and perceived PL are consistent with the multidimensional nature of physical literacy, in which physical, psychological, social, and cognitive elements are interconnected rather than independent. In this sense, the present study contributes by examining these relationships jointly in a Spanish primary school context.

Regarding gender differences across the domains of physical literacy, girls scored higher in the social domain, whereas boys scored higher in the physical domain. These differences may be related, at least in part, to gendered patterns of playground use and participation in physical activity. Previous research has shown that boys tend to occupy the central spaces of the playground more frequently for sports and ball

games, whereas girls are more often located in peripheral areas and engage in less physically active forms of interaction. This unequal use of playground space may influence children's opportunities to develop motor competence and participate in physical activity during recess (Blasco, 2018). In this regard, Ayuso et al. (2021) also suggested that the social organisation of playground spaces can contribute to lower levels of physical activity and more passive behaviours among girls during recess.

Regarding the exploratory PAL component, the descriptive data showed higher daily step counts on the days when physically active activities were implemented. However, this result should be interpreted cautiously, as no control group was included and no inferential pre–post analyses were conducted. Therefore, rather than demonstrating effectiveness, these findings provide preliminary support for the potential feasibility of PAL as a strategy to increase movement opportunities during the school day. Even so, it was also observed that the recommended target of 12,000 daily steps was not reached on average for the whole class, even when the steps accumulated through PAL activities were included. This finding suggests that school-based physically active strategies may contribute positively to daily activity, but should probably be complemented with broader opportunities for movement throughout the day.

Regarding participants' perceptions of PAL, most students rated the activities between 7 and 10 out of 10 and described the proposal as innovative, interesting, and fun. Several participants reported feeling more focused and motivated when activities involved movement, leaving the classroom, or working in a different way. Some students also highlighted the motivational value of competition and teamwork, as reflected in comments such as "*I do not want to let my team down, I want to win*" and "*I force myself to concentrate because it does not depend only on me*." In line with this, Fredriksen et al. (2025) found that active learning in the classroom can improve academic performance, while González-Pérez et al. (2025) reported positive effects of physically active learning on students' time-on-task. Overall, the students' responses suggest that the PAL proposal was well accepted and perceived as engaging, although these findings should be interpreted as descriptive qualitative evidence rather than proof of effectiveness.

In addition, an interview with the sixth-grade tutor revealed a generally positive evaluation of the proposal, although lack of time was identified as the main barrier to its regular implementation. The teacher explained that the curriculum was extensive and that not all planned content could always be completed during the school year. She also pointed out that transitions to and from the playground reduced the time available for instruction and suggested that these activities might be more feasible once a week. This view is consistent with previous research showing that lack of time is one of the main barriers to the implementation of physically active classroom practices. In this regard, Dyrstad et al. (2018) emphasised that successful implementation requires time for planning, adaptation to new routines, and adequate teacher support. Together with the students' perceptions, this qualitative information adds exploratory evidence about the acceptability and practical feasibility of PAL in a real school context.

Finally, this study is subject to several limitations that should be acknowledged. First, the sample was small (n = 24) and drawn from a single school, which limits statistical power, may affect the stability of the correlations obtained, and reduces the generalisability of the findings beyond this specific context. In addition, some relatively high correlations should be interpreted cautiously, as the small sample size may have inflated their magnitude. Second, the correlational component was cross-sectional, which means that no causal inferences can be made about the relationships observed between screen time, physical literacy, physical fitness, and motor competence. Third, the PAL component was exploratory in nature and should not be interpreted as an experimental intervention. The implementation lasted only one week, no control group was included, and no inferential pre–post analyses were conducted. In addition, some of the measures used may

have introduced bias. Screen time was assessed through self-report, which may be affected by recall bias, and step counts were recorded using smartphone pedometers, which may vary in accuracy across devices and may underestimate actual movement. Finally, although the qualitative information provided valuable insight into students' and teacher's perceptions, it was analysed descriptively and should therefore be interpreted as complementary exploratory evidence. Future studies should consider larger and more diverse samples, longer intervention periods, control or comparison groups, and more objective measures such as accelerometers.

CONCLUSIONS

The findings of this study suggest that, in this small sample of primary school students, physical competence was positively associated with perceived physical literacy, whereas screen time was negatively associated with physical competence and several dimensions of physical literacy. In addition, girls reported higher screen time and lower physical competence than boys, and gender differences were also observed across the domains of physical literacy. Taken together, these results reinforce the importance of considering screen-related behaviours, motor competence, and physical literacy as interconnected elements within children's active lifestyles.

With regard to the PAL component, the one-week implementation was descriptively associated with higher daily step counts and was positively perceived by both students and the teacher. The qualitative information gathered also suggested that the proposal was experienced as motivating, enjoyable, and engaging, particularly because it introduced movement, variation, and active participation into the school day. At the same time, the teacher's perspective highlighted an important practical issue: although PAL may be well received in real educational settings, its regular implementation may be constrained by time demands, curricular pressure, and organisational factors.

These findings should nevertheless be interpreted with caution. The correlational component was based on a small sample from a single school, and the PAL proposal was exploratory in nature, short in duration, and implemented without a control group or inferential pre–post analyses. Therefore, the present study does not allow causal conclusions to be drawn, nor can the results be generalised beyond this specific context. Even so, the study provides preliminary evidence that PAL may represent a promising strategy for increasing movement opportunities during the school day and for supporting more active and meaningful learning environments in primary education. Future research should examine these relationships and interventions in larger and more diverse samples, using more robust designs and more objective measurement tools.

AUTHORS CONTRIBUTIONS

All authors meet the criteria for authorship in accordance with established ethical guidelines. Contributions are specified according to the CRediT (Contributor Roles Taxonomy) as follows: Conceptualisation: Cristina Menescardi Royuela. Methodology: Cristina Menescardi Royuela. Formal analysis: Emma Calleja Hortelano. Investigation: Emma Calleja Hortelano. Data curation: Cristina Menescardi Royuela, Emma Calleja Hortelano. Writing – original draft: Emma Calleja Hortelano. Writing – review & editing: Emma Calleja Hortelano, Cristina Menescardi Royuela. Supervision: Cristina Menescardi Royuela.

All authors have critically reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

AI USE DISCLOSURE

In accordance with current publishing ethics and transparency recommendations, artificial intelligence (AI) tools were used solely to assist with translation and language editing, with the aim of improving clarity and readability. No AI tools were used in the generation of scientific content, including the study design, data collection, analysis, interpretation of results, or the formulation of conclusions. The authors retain full responsibility for the content of the manuscript and confirm its originality, integrity, and accuracy.

ETHICAL CONSIDERATIONS

The study was conducted within the framework of ordinary educational practice in Physical Education. The centre held a general authorisation for the processing of anonymised data, and all data analysed in the study were handled anonymously. The study complied with the current laws of the country in which it was performed.

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