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Less is More: Movement in Secondary Mathematics

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Introduction

Secondary mathematics classrooms are often characterized by long periods of sedentary instruction, even as research continues to link physical activity with improved attention, engagement, and learning. Physically Active Learning (PAL) has emerged as a pedagogical approach that integrates movement into academic lessons without altering curricular content. While PAL has been examined extensively in primary education, far less is known about how it functions in secondary mathematics settings, where instructional demands increase and student disengagement becomes more common.

This study addresses that gap by exploring teachers' and students' experiences following participation in a PAL mathematics intervention implemented in secondary schools. Rather than focusing solely on academic achievement, the authors examine how PAL influences key classroom conditions, including student motivation, engagement, learning depth, cooperation, and feasibility of implementation. These classroom conditions are closely linked to the skills students need to succeed in advanced coursework and postsecondary pathways, such as sustained engagement, collaboration, and persistence in learning. By elevating both teacher and student perspectives, the study provides practical insight into how movement-integrated mathematics instruction may support meaningful learning and classroom participation in secondary education, while also identifying considerations for sustainable use in real-world school contexts.

Methodology

Research Design:

This study used a qualitative design embedded within a larger randomized controlled trial (ACTIVE CLASS). Specifically, it focuses on post-intervention interviews and focus groups conducted with participants who took part in the PAL intervention group.

Sample:

The study included 104 secondary school students between the ages of 12 and 14. Forty-five boys were represented in the overall intervention sample. All participating students took part in the physically active learning (PAL) mathematics intervention. For qualitative data collection,



a subsample of 36 students—six students per participating class with a balanced gender distribution—was randomly selected to participate in focus groups.

In addition, five secondary mathematics teachers (two male and three female) participated in the intervention implementation and subsequent interviews. The study took place in two public secondary schools located in urban areas of Cadiz and Caceres, Spain. Both schools had access to outdoor spaces, including sports grounds, natural areas, and tarmac surfaces, which were used for PAL lessons. Neither teachers nor students had prior experience with physically active learning, and the study was conducted within a typical secondary education context serving students aged 12 to 16.

Intervention Description:

The intervention integrated physical activity into secondary mathematics instruction without modifying curricular content over a 16-week period. Students participated in mathematics lessons that embedded movement—such as moving, jumping, and throwing—directly into standard mathematics exercises. Activities were structured as games, collaborative tasks, or competitive activities, requiring students to engage physically while working on mathematics problems aligned with the existing curriculum, including topics such as equations, geometry, fractions, proportionality, and decimal operations.

The intervention replaced one traditional mathematics lesson per week with an outdoor physically active learning (PAL) lesson. Each lesson began with the teacher introducing the mathematical content, followed by movement-based tasks that incorporated physical activity into textbook-based exercises. Mathematics teachers delivered all PAL lessons, supported by a specialized technician present at every session to assist with implementation. Lessons were co-designed by mathematics teachers and members of the research team. Planning meetings were held prior to each lesson to align physical activities with instructional goals.

Dosage:

The physically active learning intervention was implemented once per week over a 16-week period. Each session lasted 55 minutes. This resulted in a total of 16 PAL lessons, representing approximately 880 minutes, or 14.7 hours, of physically active mathematics instruction across the intervention period.

Data Analysis:

Data were collected through **semi-structured interviews** with teachers and **focus groups** with students following the completion of the intervention. All sessions were audio-recorded and transcribed verbatim. Researchers analyzed the data using **conventional qualitative content analysis**, developing codes and categories inductively to reflect participants' experiences. Peer debriefing and repeated review of transcripts were used to enhance credibility and consistency.

Results

Teachers and students reported a general increase in student motivation during physically active learning lessons. Teachers noted that some students who were typically disengaged or disruptive participated more actively and displayed improved behavior, although not all students showed changes compared to traditional lessons.

Both teachers and students perceived that less content was covered per lesson compared to traditional classroom instruction. However, they emphasized that learning was more meaningful, with improved understanding and retention of mathematical concepts. Students reported being more focused and less distracted during PAL lessons.

The intervention also supported cooperation and socialization, as lessons emphasized group work and collaborative problem-solving. Teachers reported improved peer relationships and increased participation, particularly among students who struggled academically. Finally, teachers viewed PAL as feasible with adequate planning and support but preferred using it occasionally rather than as a fixed instructional approach, noting its usefulness for reinforcement, review, or engagement purposes.

Application into Practice

This intervention demonstrates how physically active learning can be integrated into secondary mathematics instruction to support student engagement and meaningful learning without altering curricular content. By emphasizing engagement, collaboration, and persistence during academic instruction, the approach also supports classroom conditions associated with readiness for advanced coursework and postsecondary pathways.

Action-oriented implementation considerations:

- Schedule one mathematics lesson per week as a physically active lesson.
- Use outdoor or open spaces that allow for movement (e.g., sports grounds, courtyards).
- Embed physical movement directly into existing mathematics exercises, rather than adding new content.
- Plan lessons collaboratively to ensure alignment between movement and mathematics objectives.
- Provide implementation support (e.g., coaching, technical assistance) during initial adoption.
- Structure activities around games, collaboration, or friendly competition to encourage participation.
- Allocate approximately 55 minutes per session, totaling 14-15 hours over a semester.
- Consider PAL as a strategic instructional tool, particularly for review lessons or to increase engagement.



Replication constraints:

The article does not provide detailed lesson scripts or standardized activity sequences, which may limit direct replication without additional planning or professional development.

Work Cited

González-Pérez, M., Grao-Cruces, A., Bandera-Campos, F. J., Chalkley, A., Camiletti-Moirón, D., & Sánchez-Oliva, D. (2025). *Less is more: Qualitative insights into physically active learning in secondary math education*. PLOS ONE, 20(11), e0336641. <https://doi.org/10.1371/journal.pone.0336641>