EXPLORING THE EFFECTS OF MOVEMENT-BASED LEARNING ON ELEMENTARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT: A SYSTEMATIC REVIEW

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ABSTRACT

The development of motor skills and cognitive abilities in children is an important focus in elementary education, considering its potential for academic readiness and social adaptation. Physically active children possess better levels of motor competence and faster development rates. Good cognitive development will have an impact on improving academic achievement. This study aims to understand whether movement-based lessons (physically active academic lessons) can improve the academic achievement of elementary school students. A systematic review of studies involving elementary school students that combine physical activity and that initiate physical fitness and learning outcomes or learning achievement was conducted using the PRISMA guideline. The search was conducted on studies of elementary school students aged between 6 and 12 years old in educational contexts that include physical activity and activities in natural environments that radiate physical fitness and/or learning outcomes (PubMed, Web of Science, and Scopus). A total of 44 studies with a sample size of 26,073 students were eligible for the qualitative synthesis. The risk of bias assessment using the Effective Public Health Practice Project revealed moderate quality of included studies, with only three considered weak. Despite differences in the processes studied, physically active academic lessons increased the time students spent engaging in physical activity, improved motor skills, and/or enhanced academic achievement. All interventions conducted in the study, that involved physical activity in the learning process, although there were differences in the implementation protocols, had the same aspect, namely increasing physical activity and/or academic achievement. These observations suggest that movement-based learning is an effective and enjoyable strategy for elementary school children.

Keywords: *movement-based learning, motor skill, cognitive, academic achievement, primary school*

1. INTRODUCTION

Sedentary behavior in children is increasing, especially with the increasing access to electronic devices such as television, mobile phones, and tablets. Many children spend hours watching or playing games, both at home and at school. This lack of physical activity is associated with an increased risk of obesity and other health problems (National, K. P. P. & United Nations Children's Fund, 2027; UNICEF, 2020). In the school environment, most of the learning time is still centered on sitting and listening activities, with little time dedicated to physical activity. Given that students spend most of their time at school, the classroom or school environment is considered to be an ideal place to encourage more physical activity.

Increasing physical activity in schools, benefits not only felt in academic achievement, but also has a positive impact on children's health and well-being, both inside and outside the school environment (Kriemler S et al., 2011; Donnelly JE & Lambourne K., 2011).

Research has shown that physical activity can provide significant benefits to children's motor, cognitive, and even academic achievement. Physical activity, especially that involving gross motor skills, can stimulate brain development and improve cognitive function, which in turn can support academic achievement. Children with good motor skills tend to have better academic outcomes, especially in subjects that require visual and spatial understanding. These skills are also closely related to executive function, which includes the ability to focus attention, control impulses, and plan. Children who have good motor skills tend to show better self-control in learning situations, which allows them to focus on academic tasks (Kamphorst E et al, 2021). Several studies have shown that physical activity programs conducted in schools not only improve physical fitness but also contribute to improved cognitive abilities and achievement in the classroom (Singh, A. S. et al., 2019; Doherty, A., & Forés Miravalles, A., 2019). This implies that educational programs that develop motor skills can also improve children's executive function.

Regular physical activity can improve focus, memory, and even problem-solving skills, which are important aspects of academic success. Children who are skilled in motor skills are better able to participate in group activities, which in turn improves their social skills (Van Dyck D et al, 2022). These positive social interactions are important for healthy emotional development and self-confidence, which are important factors in school readiness and long-term success. Good motor skills allow children to be more active in exploring their environment, which contributes to a better understanding of objects and social interactions. Good motor stimulation at an early age can improve cognitive development by improving brain structures and functional networks related to attention, memory, and executive function (Libertus K and Hauf P, 2017; Shi P and Feng X, 2022). In other words, there is a strong reciprocal relationship between motor skill development and improved cognitive abilities, suggesting that investing in physical and motor education programs in elementary school children can support academic achievement and overall social development.

Elementary schools can be an effective early intervention site to increase children's daily physical activity. Niemi H., (2002) stated that schools and teachers are facing a transformation in their educational approach, with the increasing adoption of active learning methods. However, improvements are still needed to ensure optimal implementation of these programs. According to Erwin et al. (2012), more research is needed to study the effects of physical activity, both on learning outcomes and physical condition levels, especially in childhood. Therefore, this systematic review aims to analyze various protocols and the impact of physical activity-based learning on the development of elementary school students' learning outcomes.

2. RESEARCH METODOLOGY

The method used to systematically map the research literature with a Systematic Mapping Study (SMS). The systematic review was conducted by referring to the principles in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. PRISMA provides detailed guidance on how to compile, report, and assess the quality of systematic reviews, including inclusion/exclusion criteria, search strategies, and presentation of results. This approach is designed to improve transparency and reproducibility in research, ensuring that all steps in the review process are well-documented and reliable

(Moher et al., 2009). This review uses the PICOS (Population, Intervention, Comparison, Outcome, Study) approach to determine inclusion and exclusion criteria. The population included children aged 6–12 years in elementary school. The intervention focused on activities that combined physical movement and education in the natural environment, while physical activity without education was not used. Comparisons and outcomes included physical fitness parameters and educational attainment. The selected studies included intervention, cross-sectional, longitudinal, and correlational studies, all in English.

A literature search was conducted on the scientific databases Scopus, Crossref, and PubMed with specific keywords. The following keyword groups were adopted and matched with the Boolean operators AND/OR which were divided into three groups. The first group is child, pupil, and kindergarten. The second group is primary school, elementary school, student, and education. The third group is psychomotor education, physical education, kinesiology education, active play, motor play, active learning, nature play, whole school, movement integration, comprehensive school, and physical activity break. Inclusion criteria include publications in reputable international journals that are relevant to the topic. The data collected includes information on the methods used, study design, and variables studied (types of motor skills studied, cognitive aspects measured).

Articles selected for analysis were entered into EndNote software (version X8), which was used to identify duplicates. After the elimination of duplicates, researchers independently screened articles based on the inclusion and exclusion criteria in the title, abstract, and full article. In case of disagreement, the study coordinator was involved in making the final decision. Data on sample characteristics (age, sex, sample size), interventions (type, duration, frequency), and outcomes related to physical fitness and education were collected and presented narratively and in tabular form. The risk of bias assessment in this study was conducted using the Effective Public Health Practice Project tool (29) which evaluates the quality of the study based on seven aspects (1) selection bias assessment, (2) study design evaluation, (3) confounder factors, (4) blinding, (5) data collection methods, (6) withdrawals, and (7) dropouts, to provide an overall rating. Each aspect is assessed using three categories (weak, moderate, strong), and the results determine the overall rating of the study. This method provides a numerical score (3 for strong, 2 for moderate, 1 for weak) to ensure a systematic and measurable evaluation.

3. RESULTS AND DISCUSSION

Results

Based on the search results in electronic databases, 16751 studies were found. A total of 6710 articles were immediately removed because they were duplicates. Then proceed with selection based on title, abstract, and full text. The final number of studies included after screening the eligibility criteria was 44. A summary of the search process is provided in Figure 1. The results of the Risk of Bias check, the overall quality of the study is included in the moderate category, with only two studies considered weak. The score for study design was 2.5 out of 3, for confounding factors 2.4 out of 3, for blinding 1.3 out of 3, for data collection 2.2 out of 3, and for non-participants 2.9 out of 3, reaching an overall average total score of 1.8 out of 3.

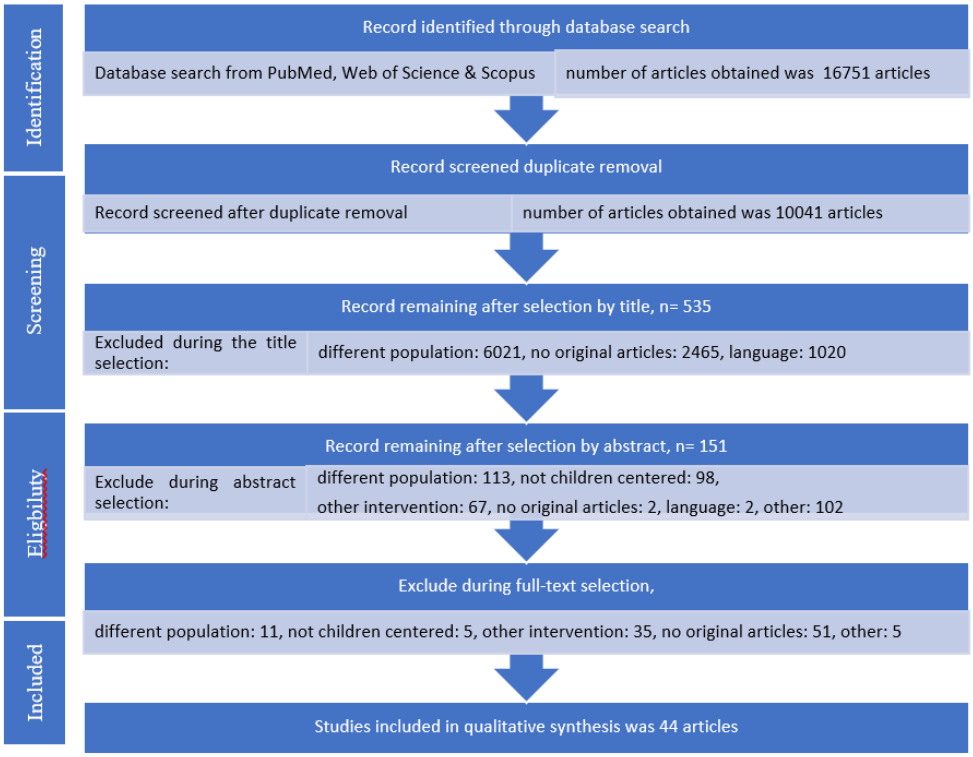

Figure 1. PRISMA Flow Chart Illustrating The Systematic Process
Source: Personal documents

The following are the characteristics study of the analyzed. The study characteristics are the number of participants included in the study was 26073 elementary school students; one study did not mention the number of students, but the number of classes included was 4 classes. Of these participants, 41.78% were female (10894), 40.26% were male (10496) and the remaining 17.96% did not explain the details of gender (4683). The mean age and standard deviation of the participants included were 9.07 (1.21) years, and ranged from 6.7 to 11.2 years. The studies were conducted in various countries. The majority of studies were conducted in the United States with 17 studies. In Australia, a total of five studies were conducted. as well as in the United Kingdom and Norway. less than five studies were conducted in Denmark and Netherlands with 4 studies, and in Ireland with 2 studies. Only one study was conducted in Greece, Italy, New Zealand, and Vietnam. The majority of studies (n = 21) used a randomized controlled trial method (RCT). Thirteen studies used a quasi-experimental design, three observational studies, and two studies each used intervention and pilot study methods. While other study designs such as mixed factorial experiments, mixed experiments, within-subjects, and pedagogical experiments were only adopted once. Of the 44 studies analyzed, eight interventions provided negative feedback on the impact of integrated lessons on physical activity and/or academic outcomes. None of the eight studies explained in detail aspects among the studies that could indicate the exclusion of some aspects of the intervention such as the duration of the program or sessions, the type of intervention, or the subjects considered.

The studies were based on intervention programs that exist in each country and also those that apply internationally. Various assessment methods were used in the studies, the most widely used being the Comprehensive School Physical

Activity Program and Active Smarter Kids. The assessment methods used are provided in Table 2. Most interventions were aimed at improving mathematics learning outcomes and language. Language arts were proposed as an integrated subject in five studies, social studies in only three studies, and geography and history in two studies. In addition, other subjects such as reading, crafts, science, general health, statistics, biology, and religion were also studied in one study each. Twenty-seven studies did not provide information on the subjects in the curriculum studied. The average duration of intervention in each study was 149.56 days, with a range of 5 to 730 days. The average duration of physical activity was 30.21 minutes, with interventions lasting 10 minutes per day and others reaching 60 minutes. Various studies proposed the frequency of intervention provided. Nine studies provided interventions three times a week, four studies proposed only 2 days a week of curriculum-integrated physical activity. Five studies proposed more than 3 days a week. Unfortunately, most studies (n = 26) did not provide information on the frequency of intervention provided.

Table 1. Synthetic Description of The Intervention

References	Inter-vention	Subjects	Academic evaluation	Physical assessment	Conclusion	Effect on PA
Aadland et al. (2019)	ASK	Norwegian, math, English	Executive functions	Acc; executive functions; Andersen test; motor skills	Small effects on executive functions, cognitive flexibility	0% MVPA
Bacon and Lord (2021)	No info	Math	No info	Acc	Improve PA and academic outcomes	+22-5% (steps)
Bartholomew et al. 2018	I-CAN!	Math, language arts	Time on task	Acc	Significantly increased time on task	+43.6% MVPA
Bartholomew et al. 2018	I-CAN!	Math, language arts	No info	Fitnessgra m	Increases PA within elementary students	ND
Braun et al. (2017)	CSPAP	Math	No info	PACER	Need for more prospective research	+19% (min/ week)
Brusseau et al. (2016)	CSPAP	No info	No info	Acc, Fitnessgra m; PACER	Improve PA	+17.9% MVPA
Bugge et al. (2018)	CHAMP S	Math, Danish	Academic achievement	Andersen test	No negative effects of additional PA on scholastic outcomes	ND
Burns et al. (2015)	CSPAP	No info	No info	Acc	Increase PA	+26.2% (steps
Burns et al. (2017)	CSPAP	No info	No info	TGMD-2	Motor skills improved	ND
Christodoulos et al. (2006)	No info	Math, reading, handicraft	No info	20-m shuttle run; sit and reach, sit-up test	Slow the age-related decline in PA	ND
Cradock et al. (2014)	SPARK	No info	No info	Acc	Increase moderate to vigorous PA	+45.7% MVPA
Dyrstad et al. (2018)	No info	Language, math	No info	No info	Appropriate pedagogical method	ND
Egan et al. (2018)	PACES	Math	No info	SOFIT	Effectiveness of the research	ND
Goh et al. (2019)	TAKE 10!®	Language arts, math, science, social studies, general health	No info	Pedom	Improvement of children's PA	+15% (steps)
Grieco et al.	No info	No info	Time on task	Acc	PA increases time on	+96.9%

References	Inter-vention	Subjects	Academic evaluation	Physical assessment	Conclusion	Effect on PA
(2016)					task	MVPA
Invernizzi et al. (2019)	No info	No info	No info	PAQ-C; MFT; TGMD-2; PACES	Positive effects on physical literacy development	ND
Konijnenberg and Fredriksen (2018)	HOOP	Language, math	Stroop/Eriksen, flanker tasks	No info	No positive effect of the PA intervention	ND
Martin and Murtagh (2014)	No info	English, math	No info	Acc	Improve PA	+96.2% MVPA
Martin and Murtagh (2017)	No info	No info	No info	Acc	Improve PA	+4.2% MVPA
Mattson et al. (2020)	CSPAP	English, math	No info	No info	Increase PA	ND
Miller et al. (2015)	PLUNGE	No info	Time on task	Pedom; TGMD-2	Improve object control motor skills proficiency and PA	+95.9% (steps/min)
Mullender-Wijnsma et al. (2015)	F&V	Math, language	Time on task	20-m shuttle run test	Positively influence time on task	ND
Mullender-Wijnsma et al. (2015)	F&V	Math, language	Time on task, Tempo-Test-Rekenen, Eén-Minuut-Test	No info	The lessons contributed to the academic outcomes	ND
Norris et al. (2018)	Virtual Traveler	Math, English	No info	No info	Low- cost PA intervention	+7.7% MVPA
Norris et al. (2018)	Virtual Traveler	No info	No info	Acc	Integrated PA has no negative effects on education	ND
Oliver et al. (2006)	No	English, social studies, math, statistics	No info	Pedom	Significant increases in step counts	ND
Pham et al. (60)	BRAINball	Language, math, history, geography, biology	No info	TGMD-2	Positive effect on children's motor performances	ND
Powell et al. (61)	SHARP	No info	No info	SOFIT	Significant increases in PA	+4.1% MVPA
Powell et al. (62)	SHARP	No info	No info	SOFIT	Effective teaching strategy	+37% MVPA
Reed et al. (63)	No info	Language arts, math, and social studies	Fluid intelligence Academic performance	Pedom	Movement can influence fluid intelligence	ND
Resaland et al. (64)	ASK	Norwegian, math, English	Academic performance	Acc	No evidence to affirm the correlation	+3.4% MVPA
Resaland et al. (65)	ASK	Norwegian, math, English	Academic performance	Acc	Increase in academic performance	ND
Riley et al. (66)	EASY Minds	Math	On-task behavior	Acc	Improve on-task behavior in mathematics lessons	+3% MVPA
Ruiter et al. (68)	No info	Math	Math test, Evaluation Questions	No info	Movement conditions increase test results	ND
Schneller et al. (69)	EOtC	Math, history, language, religion	No info	Acc	Time- and cost-neutral increase time spent in PA for boys	+7.5% MVPA
Schneller et al. (70)	EOtC	No info	No info	Acc	Opportunity to accumulate PA	+8.4% MVPA
Seljebotn et al. (71)	Active school	Several subjects	No info	Acc	Increased PA	+13% MVPA
Vazou et al. (73)	Move 4 Thought	Math	No info	Acc	Contribute to increasing PA levels	+60.6% MVPA
Vazou et al. (74)	Walkabouts	Math, language arts	No info	SOSMART	Academic does not impact PA	ND

References	Inter-vention	Subjects	Academic evaluation	Physical assessment	Conclusion	Effect on PA
Vetter et al. (75)	Maths on the move	Math	NAPLAN	Acc; shuttle run test	Improve of learning and PA	+92.7% MVPA
Vetter et al. (76)	No info	No info	Numeracy	Aerobic fitness	Positive combination of PA with learning	ND
Weaver et al. (78)	PACES	No info	No info	Acc	Routine practice increase PA	+5.6% MVPA
Weaver et al. (79)	PACES	No info	No info	Acc	Increase PA	+1.8% MVPA
Webster et al. (79)	PACES	No info	No info	No info	No impact	ND

Acc, Accelerometer; ASK, Active Smarter Kids; CHAMPS, Childhood Health, Activity, and Motor Performance School Study; CSPAP, Comprehensive School Physical Activity Program; EASY, Encouraging Activity to Stimulate Young; EOtC, education outside the classroom; F&V, Fit and Academically Proficient at School; HOPP, Health Oriented Pedagogical Project; MVPA, moderate to vigorous physical activity; MFT, Multistage Fitness Test; PACER, Progressive Aerobic Cardiovascular Endurance Run; PACES, Partnerships for Active Children in Elementary Schools; PA, physical activity; PAQ-C, Physical Activity Questionnaire for Older Children; Pedom, pedometer; PLAYCE, Play Spaces and Environments for Children's Physical Activity; ND, no data; SPARK, Sports, Play, and Active Recreation for Kids; I-CAN!, Texas Initiatives for Children's Activity and Nutrition; SOFIT, System for Observing Student Movement in Academic Routines and Transitions; SOSMART, System for Observing Student Movement in Academic Routines and Transitions; TGMD-2, Test of Gross Motor Development 2.

Most of the 28 studies (Table 2) that included data on physical activity levels collected with accelerometers or pedometers had positive results, with percentage increases ranging from 1.8 to 96.2. Only one study reported no increase with an integrated movement program. Unfortunately, the data were not heterogeneous; indeed, studies compared different groups or the same group before and after the intervention. Studies reported the time children engaged in moderate to vigorous physical activity or the number of steps. Studies collected data during school hours or over a week or day. Academic achievement or cognitive function was often assessed through academic outcomes and time on task (n = 3). In three studies, the authors evaluated it through "on-task" behavior. Less commonly adopted assessment methods are provided in Table 2. Regarding physical activity assessment, 28 studies assessed it through accelerometers or pedometers. Several studies evaluated health-related physical fitness characteristics through physical tests such as Gross Motor Development Test 2 (n = 4), Andersen test (n = 2), 20-m shuttle run test (n = 3), and Progressive Aerobic Cardiovascular Endurance Run (n = 2). Less adopted evaluation methods are listed in Table 2. Skill-related physical fitness was evaluated through tests to assess executive function and motor skills (n = 1). Studies also used battery tests to assess physical fitness such as FITNESSGRAM (n = 2). The most interesting subjective physical activity evaluation methods were the Student Movement Observation System in Academic Routines and Transitions, the Physical Activity Questionnaire for Older Children, interviews, and observations.

Few studies report interventions in detail or examples of interventions provided. The following are suggestions from studies that have been conducted. Several studies have proposed utilizing the learning process with structured outdoor nature-based games (Seljebotn PH et al., 2019) or adopting outdoor environments (not only in the classroom) to learn several subjects such as mathematics, language, history, or religion (Schneller MB et al., 2017). Other interventions that focus on games (Bartholomew JB et al., 2018; Bartholomew JB et al., 2018) or games that link the assessment of step times using a pedometer with mathematics lessons (Braun HA et al., 2017) or free play or semistructured physical activity have also been suggested (Burns RD et al., 2015). The interventions carried out by Pham and his colleagues were always through games, which adopted balls with numbers, letters, and mathematical symbols on their surfaces (Pham VH et al. 2021). Other suggestions include cooperative activities that integrate health education into several school subjects (Christodoulos AD et al., 2006). Interventions proposed as language activities "Scrabble relay," where children work in groups, or "Bingo" to improve mathematics learning outcomes (Dyrstad SM et al., 2018). In another

study, a teacher read a story while students performed the movements in the story (Goh TL et al., 2019). Oliver and colleagues proposed different interventions for different subjects to learn geography (Oliver M et al., 2006). Norris et al. (2018) proposed in their presentation session an intervention known as Virtual Field Trip, which was designed to be delivered using an interactive whiteboard in an existing classroom. Other language and mathematics interventions consisted of performing jumping in place for each letter mentioned or jumping to complete multiplication. Similar academic tasks with different words or quantities were also carried out during one lesson (Mullender-Wijnsma MJ et al., 2015; Mullender-Wijnsma MJ et al., 2015). Another intervention consisted of constructing two-digit numbers by making and simultaneously saying them out loud followed by different-sized steps (Ruiter M et al., 2015). Students stood and jumped to answer problems given by the teacher and the second was by moving around the classroom, choosing cards containing questions and then working in groups or with partners (Vazou S er al., 2018). In addition, locomotor skills such as running, jumping, hopping, and galloping (Vetter M et al., 2020) integrated structured movement and motor skill practice with the learning concepts carried out.

Dicussion

The results of this study indicate that various interventions have been proposed to integrate subject learning into the school curriculum through a movement-based approach. However, the findings also reveal inconsistencies in the standardization of protocols applied by the authors, as summarized in Table 2. The absence of uniform standards may affect the validity and reliability of research results and program implementation in the field.

The integration of physical activity into the academic curriculum was suggested alongside other strategies, such as recess. However, specific details regarding its effects on children's learning outcomes and physical fitness were often lacking (Erwin H et al., 2012). Therefore, there is a need for structured intervention proposals, so that findings can be better contextualized and generalized, while ensuring safer procedures (Petrigna L et al., 2021). In this regard, teachers play a crucial role in implementing the proposed guidelines (Stewart JA et al., 2004). Other differences were also found in terms of length, duration, and frequency per week, which makes it difficult to compare results between studies. Where differences in design, intervention, duration and intensity, and outcomes were detected, these are similar to the study by Daly-Smith et al. (2018). The intervention duration in this study ranged from 5 days to more than 1,000 days, which is very different compared to other studies which have intervention durations ranging from 13 to 300 days (Erwin H et al., 2012). Furthermore, Erwin H et al. (2012) also explained that the length of the intervention did not affect the effects of the intervention given, following the literature. Thus, according to the opinion of Goh TL et al. (2017), the development of a more structured program, for example in the form of a daily or weekly schedule, is an important step to propose because it not only provides a clear framework but also significantly increases physical activity during the school day. Ideally, this physical activity intervention is carried out at least three times a week to optimize its impact on children's cognitive development and academic achievement (Fedewa AL & Ahn S., 2011). With this approach, the program not only becomes more systematic but also contributes to achieving maximum results for students.

Significant variations were also identified in the types of interventions implemented in the studies analyzed. These differences include the methods, approaches, and main focus of each intervention, which ultimately provide several options for activities that can be utilized. Movement integration programs are designed to teach students learning materials through physical activity, so that students not only understand the concepts but also experience them directly through movement.

Previous studies have confirmed that physical activity has a significant positive impact on children's cognitive abilities and academic achievement (Vazou S et al., 2019; Singh A et al., 2012). Furthermore, physical activity that is designed in a structured and integrated manner in the classroom environment has been shown to increase children's intrinsic academic motivation, perception of self-competence, and learning effort without disrupting the academic learning process (Vazou S et al., 2012). This approach not only supports physical development but also provides holistic benefits to children's development. Studies using play approaches as a form of intervention have shown positive results. Learning through play provides opportunities for children to make choices, take responsibility for their decisions, and enjoy the learning process while engaging in internal cognitive transactions and fostering intrinsic motivation. It is important to remember that for learning through play to be effective, the process must be fun, voluntary, safe, and able to actively involve students. In this way, students' intrinsic motivation can develop optimally, so that learning becomes more meaningful.

In addition, some other interventions are conducted outside the classroom or school hall, creating learning experiences in an open environment. This approach can be combined with conventional teaching methods to provide a balance between theoretical and practical learning (MacQuarrie S., 2018). The benefits of this method include increasing students' physical activity and reducing sedentary behavior, which ultimately contributes to their physical and mental health (Stone MR & Faulkner GE, 2014). Open learning environments offer a rich and diverse approach to educating students by emphasizing the development of skills such as initiative, planning, experimentation, elaboration, and self-evaluation (Niemi H., 2002). This approach not only facilitates more independent learning but also creates an engaging and enjoyable learning experience for students. With the freedom to explore and make decisions, students can be more actively involved in the learning process, which in turn increases their intrinsic motivation and sense of responsibility for learning outcomes. This approach also helps students develop critical and reflective thinking skills that are essential for future success. The combination of play, physical activity, and conventional learning conducted indoors and outdoors offers a holistic approach that supports holistic development.

The intervention implemented successfully showed significant improvements in academic performance, motor skills, and physical activity levels (measured by step count). The key findings of this study are that the intervention was not only cost-effective and easy to implement without requiring elaborate preparation from teachers, but also enjoyable for both teachers and children, creating a more dynamic and positive learning environment (Donnelly JE & Lambourne K, 2011). These conditions are ideal for implementation in elementary school students. Thus, this learning activity is very suitable to be implemented at the elementary school level. One of the main advantages of a classroom-based physical activity program integrated into the curriculum is its ability to optimize time without disrupting other lessons. This program not only increases students' physical activity levels but also improves their behavior in carrying out tasks, without sacrificing or negatively affecting their academic performance (Mahar MT et al., 2006; Trudeau F & Shephard RJ, 2008). This approach presents an ideal balance between physical and academic learning, supporting the holistic development of students.

On the contrary, the impact is very positive. Integrating physical exercise lessons into the curriculum and incorporating physical activity into classroom lessons has been shown to improve skills related to mathematics, reading, and even composite scores, including positive classroom behavior (Álvarez-Bueno C et al., 2017). Interestingly, short sessions of active outdoor play, even just 1 hour long, can also have a significant impact by increasing students' positive behavior in completing tasks (Lundy A & Trawick-Smith J, 2021). This approach shows that physical activity not only supports physical development, but also improves the overall

quality of learning. The level of physical activity enjoyed outdoors, such as in a playground, has been shown to have a greater impact, improving students' behavior in completing tasks in class, compared to simpler outdoor play activities (Lundy A & Trawick-Smith J, 2021). The learning process becomes more enjoyable for children and teachers, because it does not require complicated preparation and can effectively improve students' academic achievement scores (Donnelly JE & Lambourne K, 2011). Thus, academic lessons that combine physical and active activities are not only beneficial for students' development, but also bring benefits to schools, as these programs are proven to be cost-effective and efficient. Integrating physical activity into children's daily routines can be an effective strategy to support their holistic development, both physically and cognitively.

4. CONCLUSION

All interventions conducted in the study, that involved physical activity in the learning process, although there were differences in the implementation protocols, had the same aspect, namely increasing physical activity and/or academic achievement. These observations suggest that movement-based learning (physically active academic lessons) is an effective and enjoyable strategy for elementary school children. Thus, this kind of approach is ideal for elementary school students.

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