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Increasing the Level of Physical Activity Intensity with Child-Designed Games and Creativity of 6-8 Year-Olds during Gymnastics Lessons in Physical Education

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Abstract: *Higher levels of physical activity (PA) during physical education (PE) are important for 6- to 8-year-old children because it can improve their physical health, cognitive skills, academic performance, and social development. The purpose of the study conducted was to determine the effects of incorporating child-designed games and student creativity while waiting for teacher supervision during gymnastics lessons in PE on the quantity and intensity of PA among 1st and 2nd grade students. The sample included 91 1st and 2nd grade students (53 boys) from a Slovenian school. The sample included 91 1st and 2nd grade students (53 boys) from a Slovenian elementary school, of whom 48 (age = 6.8 ± 0.7) participated in the experimental teaching program that included child-designed games and student creativity, while 43 (age = 7.0 ± 0.6) belonged to the control group where traditional teaching continued. They were taught three gymnastics elements that had to be supervised by the teacher: the squat jump on the vault box, the backward roll, and the cartwheel. The results of the nonparametric Mann-Whitney test showed statistically significant differences between groups (EXP vs. CON) in terms of light PA (LPA) and moderate to vigorous PA (MVPA) for all three gymnastics elements taught: the squat jump on the vault box (LPA: p=0.001; MVPA: p=0.001), the backward roll (LPA: p=0.001; MVPA: p=0.001), and the cartwheel (LPA: p=0.002; MVPA: p=0.001). Statistically significant differences between groups in terms of vigorous PA (VPA) did not occur for any gymnastics element: the squat jump on the vault box (p=0.462), the backward roll (p=0.833), and the cartwheel (p=0.636). The results show the effectiveness of incorporating child-designed games and student creativity to reduce inactivity while waiting for teacher supervision and to increase the amount of LPA and MVPA in 1st and 2nd grade elementary school during gymnastics lessons in PE.*

Keywords: *sport, students, school, group work.*

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Introduction

Physical activity (PA) is especially important for children aged 6–8, as it is a critical period for their physical and cognitive development (Vilardell-Dávila et al., 2023; Zhang et al., 2023). During this stage, children are rapidly growing and developing their motor abilities (Basterfield et al., 2023; Sugimoto et al., 2023; Woodward et al., 2022). Engaging in higher levels od activity can help support their physical development and improve their overall health and well-being (Britton et al., 2023; García-Hermoso et al., 2020). Children who engage in regular PA have stronger bones and muscles (Deng et al., 2023; Skinner et al., 2023), improved cardiovascular health (Cao et al., 2023), and a lower risk of developing chronic diseases, such as obesity, diabetes, and heart disease (Carriedo & Cecchini, 2023; Denova-Gutiérrez et al., 2023; Stensel, 2023; Su et al., 2023). Higher levels of PA in children aged 6–8 may also enhance their cognitive development, as evidenced by shown in improved memory, attention, and academic performance (Lin et al., 2023; Luo et al., 2023; Zhang et al., 2023). It can also improve executive function, problem-solving skills and creativity, which are essential for success in school and life (Kliziene et al., 2020; Li et al., 2023; Zhang et al., 2023). For children aged 6–8, creativity helps stimulate their decision-making skills. By exploring their imagination and developing new ideas, children learn to think outside the box and develop a growth mindset (Campbell & Løkken, 2023; Temel et al., n.d.). PE teachers can encourage creativity in PE by allowing students to design their own physically active games, as this is a great way to engage, excite, and motivate them to participate (Madejski, 2023; Mangion & Riebel, 2023). One of the challenges that PE teachers may face is the problem of inactivity among students while waiting for their teacher to supervise them in a gymnastic element, because they miss opportunities for skill development (Rico-González, 2023). Instead of students remaining idle while waiting for the teacher to supervise them, the teacher can take advantage of the students' creativity and provide them with a wide range of sports props on the other side of the gym for them to play with, design games, move freely, and develop their motor skills instead of being idle (Tolgfors et al., 2022). Giving children the opportunity to play independently with a sufficient amount of sports props can help them achieve higher levels of PA (Howells et al., 2023).

The problem with traditional teaching of PE during classes, where the teacher must supervise the gymnastics elements for each individual student, is the insufficient level of activity intensity of the students while

they wait their turn (Ikeda et al., 2022; Petrušič et al., 2022). The purpose of our study was to determine whether a teacher can increase the amount of moderate to vigorous and vigorous PA during gymnastics lessons in PE for 6-8-year-old students by incorporating creativity and child-designed active games.

Methods and Materials

Participants

The study conducted was a randomized interventional trial in which we compared PE classes that incorporated students' creativity and games they designed themselves with traditional PE classes. Gymnastics content was taught in all PE classes, and students learned gymnastics elements that required teacher supervision to perform (squat jump on the vault box, backward roll, and cartwheel). The sample included 91 1st and 2nd grade students from a Slovenian elementary school. Of the 91 students, 48 participated in the experimental group (age = 6.8 ± 0.7 years), in which students used their own creativity and a selection of different sports props in the gym during PE class to develop their own active games while waiting for the teacher to supervise the taught gymnastics element. 43 students participated in the control group (age = 7.0 ± 0.6 years), in which they learned exactly the same gymnastics elements as the experimental group but were unable to use their creativity while waiting for the teacher to supervise them because they had predetermined tasks to complete."

Students participating in both the experimental and control groups had to be between 6 and 8 years old or attending 1st or 2nd grade of elementary school. All participating students who wore accelerometers during PE classes were not allowed to have health problems (physical and cognitive) that could affect their performance in the gymnastic elements, achievement of moderate and vigorous activity levels, and creative thinking. Data on the number of boys and girls from all four grade levels (two first grades and two second grades; experimental and control group) who wore accelerometers are shown in Table 1.

In line with ethical considerations, it is important to note that this research did not require ethics committee approval prior to its initiation due to its non-invasive nature. The study did not involve any procedures or interventions that would have required formal ethical evaluation. The ethical framework of this study extended to all relevant stakeholders, including the parents or guardians of the participating students and the teachers and PE teachers responsible for the delivery of PE in all four grades.

All parents or guardians of the participating students were informed in detail about the exact procedures and the overall objectives of the study. It is worth noting that the PE lessons were closely aligned with the curriculum for the first three years of primary school. After being informed in detail about the aims and methods of the study, the parents or guardians of the students expressed their support and consent by signing a confirmation of participation. This procedure emphasised that the participants were well informed about their voluntary participation and their right to withdraw from the study at any time, without any adverse consequences for their status.

Table 1: Number and age of boys and girls in the experimental and control group

Grade	Age (years)	EXP group		CON group	
		boys	girls	boys	girls
1.	6.3 ± 0.5 (EXP); 6.6 ± 0.5 (CON)	16	8	10	9
2.	7.4 ± 0.5 (EXP); 7.4 ± 0.5 (CON)	11	13	16	8
Total	6.8 ± 0.7 (EXP) 7.0 ± 0.6 (CON)	27	21	26	17

Abbreviations: EXP, experimental; CON, control.

Data on the number of students who wore an accelerometer are shown in Table 1, although there were more students in some classes.

Procedures

In both experimental and control groups, the duration of PA intensity during PE classes was obtained during the scheduled time. Measurements were taken daily in the morning between 8:00 and 12:30. Both groups learned the same gymnastics elements (squat jump on the vault box, backward roll, and cartwheel) and used a station-based teaching approach. One of the stations was supervised by a teacher who ensured the safe execution of the gymnastics element, while the other three stations had various sports props set up. In the experimental group, students used the props at the remaining three stations to create their own active games (with different props available at each station), while in the control group, the teacher provided tasks to be completed at each station.

The main part of both the experimental and control lessons lasted 30 ± 5 minutes.

Statistical Analysis

Statistical analysis was performed with the program IBM SPSS Statistics version 22. Results are presented as means ± standard deviation (SD). First, the basic statistics were calculated and then the Shapiro-Wilk test was used to determine whether the data were normally distributed at a statistically significant risk level ($p > 0.05$). Since the variables were not normally distributed, the non-parametric Mann-Whitney test was used to determine if there were statistically significant differences between the experimental and control groups in terms of achieving low, moderate, and vigorous activity intensity. Activity intensity data were obtained using accelerometers MMOXX1.07 (USB waterproof PA sensor - 35 x 35 x 10 mm). During each lesson, 6 students (3 boys and 3 girls) wore accelerometers attached to their waist with a belt, and their physiological parameters were measured in metabolic equivalents (MET). We measured the oxygen consumption of each student in a given unit of time in MET. Because the oxygen consumption of the students at rest was 3.5 ml of oxygen per kilogram of body weight per minute, which is equivalent to 1 MET, we divided the Pa levels of the students in our study into three categories on this basis: light PA (< 3 MET), moderate-to-vigorous PA (3 ≤ 6 MET), and vigorous PA (> 6 MET).

Statistical significance was set at $p \leq 0.05$.

Results

Results of the nonparametric Mann-Whitney test showed statistically significant differences between groups (EXP vs. CON) in light-intensity PA (LPA) & moderate-to-vigorous-intensity PA (MVPA) for all three gymnastic elements taught: the squat jump on the vault box (LPA: $p=0.001$; MVPA: $p=0.001$), the backward roll (LPA: $p=0.001$; MVPA: $p=0.001$), and the cartwheel (LPA: $p=0.002$; MVPA: $p=0.001$). Statistically significant differences between groups (EXP vs. CON) did not occur in any gymnastics element at vigorous PA (VPA): the squat jump on the vault box ($p=0.462$), the backward roll ($p=0.833$), and the cartwheel ($p=0.636$).

Table 2: The effect of introducing student creativity and child-designed games into PE on student activity intensity parameters.

Variable	Group	LPA	MVPA	VPA	Total
Squat jump on the vault box	EXP	12.91 ± 0.94	23.97 ± 1.24	4.89 ± 0.50	41.93 ± 1.66
	CON	8.25 ± 0.99	17.16 ± 1.52	5.03 ± 0.38	30.68 ± 1.32
	Mann-Whitney U	0,000	0,000	25,000	0,000
	Wilcoxon W	36,000	36,000	61,000	36,000
	Z	-3,361	-3,361	-,736	-3,361
	Asymp. Sig. (2-tailed)	**,001**	**,001**	,462	**,001**
Backward roll	EXP	12.21 ± 1.92	22.95 ± 1.48	4.56 ± 0.86	40.02 ± 2.49
	CON	7.96 ± 1.08	17.56 ± 1.48	4.61 ± 0.33	30.33 ± 0.91
	Mann-Whitney U	1,000	0,000	30,000	0,000
	Wilcoxon W	37,000	36,000	66,000	36,000
	Z	-3,258	-3,361	-,210	-3,361
	Asymp. Sig. (2-tailed)	**,001**	**,001**	,833	**,001**
Cartwheel	EXP	11.77 ± 1.79	22.80 ± 0.84	4.66 ± 0.55	39.39 ± 2.66
	CON	8.71 ± 1.23	19.34 ± 0.83	4.58 ± 0.81	32.72 ± 1.84
	Mann-Whitney U	2,000	0,000	27,500	0,000
	Wilcoxon W	38,000	36,000	63,500	36,000
	Z	-3,151	-3,361	-,473	-3,361
	Asymp. Sig. (2-tailed)	**,002**	**,001**	,636	**,001**

Abbreviations: LPA, light-intensity physical activity; MVPA, moderate-to-vigorous-intensity physical activity; VPA, vigorous-intensity physical activity; EXP, experimental group; CON, control group.

Discussion and conclusion

The aim of the study conducted was to increase the intensity of students' PA by incorporating their own creativity and child-designed games into PE classes while waiting for the teacher to supervise their gymnastics performance. The main findings of the study were that students in the experimental group were more active in all three gymnastics elements (squat jump on the vault box, backward roll, and cartwheel) in classes where they were allowed to incorporate their own creativity and participate in designing their own active games. They spent statistically significantly more time in LPA and MVPA during classes, although there were no statistically significant differences in VPA between the experimental and control groups.

PE classes can often become a repetitive sequence of games and exercises, leading to boredom, demotivation, and a decrease in the intensity of PA. By encouraging student creativity in PE classes, teachers give students the opportunity to express themselves in different ways, explore their imaginations, and develop various motor skills. Involving students in the development of active games that they then play with their classmates in PE classes can increase their motivation for PA and lead to higher levels of intensity, which is also confirmed by Romance et al. (2023), Steinberg & Steinberg (2016), Welch et al. (2021). When the teacher gives free rein to creativity in PE classes, students achieve not only a higher level of PA intensity, but also a sense of pride in their new achievements, which can help improve their self-esteem and self-confidence. The importance of this aspect is also highlighted by Reguera-López-de-la-Osa et al. (2023), as research results have shown that children and adolescents with low self-esteem tend have poorer academic performance and develop work resistance. By incorporating students' creativity into PE classes, teachers can largely avoid this, as such classes are more attractive and interesting for students, leading not only to higher activity levels, but also to greater collaboration and the development of social skills by sharing their ideas and considering those of their classmates.

Our results, as well as the results of several other studies, have shown that incorporating creativity and child-designed games into PE classes can have numerous positive effects on students, such as increasing the level of PA intensity, improving self-confidence and self-esteem, increasing work motivation, practicing social skills, etc.

However, it is important to recognize the practical challenges associated with integrating creativity and child-designed games into any PE lesson. Teachers often need to use a variety of teaching methods to ensure that students fully grasp the prescribed curriculum content and develop both their knowledge and motor skills to the best of their ability. While insightful, this study had some limitations that require closer examination, particularly when considering its representativeness on a larger scale, in a broader context, and in the context of international significance. First, it is important to recognize that our study focused exclusively on the inclusion of creativity and child-designed play within the specific domain of gymnastics. The choice of gymnastics as the primary focus was not arbitrary, but was driven by the finding that gymnastics elements are associated with prolonged periods of inactivity or low physical activity (LPA). Students often had to wait for individual teacher supervision to perform these exercises. However, the applicability of such a pedagogical approach may differ when applied to

other subjects, particularly within a broader international context. Another notable limitation of this study was the relatively small sample size and the fact that the experiment was limited to a single school. In order to fully grasp the scope and implications of our findings, it is crucial to understand that this methodology needs to be explored in different settings. The potential of this teaching method needs to be evaluated in different regions, in larger and smaller gymnasiums and with different amounts of sports equipment available to students. This broader investigation will allow a more comprehensive understanding of the potential of this teaching method on a larger scale and recognize its international importance and applicability. In addition, future research should explore the cultural and contextual differences that may influence the effectiveness of this pedagogical approach in different parts of the world and thus contribute to its international relevance.

Nevertheless, with the experiment conducted, we succeeded in raising the level of LPA and MVPA during PE classes with gymnastics content, giving students the opportunity to be creative and develop and test their own child-designed games.

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