

PHYSICAL ACTIVITY

Physical Activity and Motor Skill Trials in an Inclusive Elementary Physical Education Setting: A Case Study

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Abstract

The inclusion of children with disabilities within general physical education contexts poses challenges in maximizing their learning potential. This case study aimed to investigate physical activity levels and correct motor skill trials of a child with a developmental delay in relation to her typically developing peers and the extent to which the physical education teacher made the learning environment inclusive. Nineteen children (12 boys, seven girls; mean age 8 years) and their physical education teacher (female, 50 years) from one second-grade elementary school class in Wallonia (Belgium) participated in this study. The physical activity levels and motor skill trials of an eight-year-old girl with developmental delays caused by a metabolic disease were compared to her typically developing peers. Systematic observation was used to assess physical activity levels and skill trials, while the Lieberman-Brian Inclusion Rating Scale for Physical Education (LIRSPE) was used to assess the teacher. Inter-observer agreement for all variables was above 87%. During physical education, Emily spent

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29% of her time on MVPA, lower than her peers in three out of five lessons. Similar results were found for total skill trials and skill trials/min, while for percentage correct skill trials values were lower during all lessons. The LIRSPE ratios per lesson varied from 3.21-3.53. However, this does not confirm that the setting was highly inclusive. Interactions between children with disabilities, their peers, and teachers should be the topic of future studies.

Introduction

As stated by Article 24 of the UN Convention on the Rights of Persons with Disabilities, children with disabilities have the right to attend general education schools (Hendriks, 2007). This implies that children with disabilities are also integrated into general physical education settings. While integration refers only to the setting where learning or participation may occur (Haegele, 2021), inclusion is defined as a subjective experience associated with individual interpretations, feelings, beliefs, and perceptions (Haegele, 2019). However, Zhang and Griffin (2007) stated that “Inclusive physical education is an educational placement where all children are accepted and educated (p. 33).” This definition enables us to investigate inclusive physical education from a qualitative and a quantitative perspective. Although the conceptualization and views on inclusion differ, children with disabilities are often included in general physical education in a way that does not maximize their learning potential (Lieberman et al., 2019). Few studies have looked into inclusive physical education settings from a quantitative perspective, for example, by investigating their physical activity and motor engagement.

Children with disabilities are especially at risk for a sedentary lifestyle and the associated health risks in terms of cardiovascular and metabolic diseases (Sit et al., 2007). A disability leads to a decline in physical functioning as it limits children’s participation in physical and daily activities (Sit et al., 2007). In addition, children with disabilities tend to have lower fitness levels, higher levels of obesity, and lower physical activity levels (Heath & Gentem, 1997; Murphy et al., 2008; Van der Ploeg et al., 2004). The United Nations (UN) Convention on the Rights of Persons with Disabilities states that physical activity is a right for all children, including those with a disability, within educational institutions (United Nations International

Children's Emergency Fund, 2007). Schools are a unique and important setting that provides children with opportunities for physical activity because they spend many of their waking hours at school (McKenzie & Lounsbury, 2014). In addition, physical education is mandatory, and for some children, it is the only opportunity to engage in moderate-to-vigorous physical activity (MVPA; McKenzie & Lounsbury, 2014). To provide children with the daily recommended 60 minutes of MVPA (WHO, 2023), comprehensive, collaborative school-based efforts are established (i.e., Comprehensive School Physical Activity Program; CSPAP). Physical education plays a central role in this effort, although physical education alone cannot account for the 60 minutes of daily MVPA.

Some authors reported significant differences in MVPA during physical education between adolescents with disabilities and their typically developing peers, for instance, in children (8-11 years) with intellectual disabilities who generated only 23% of MVPA compared to 28% for their typically developing peers (Faison-Hodge & Poretta, 2004). In addition, children with autism spectrum disorder were less active during physical education in two studies (35% versus 45%, Pan et al., 2011; 30% versus 53%, Pan et al., 2015). However, several authors reported no significant differences in MVPA levels in inclusive elementary and secondary physical education settings for children with autism (Pan et al., 2008; Pan et al., 2013; Sandt & Frey, 2015) and auditory disabilities (Lieberman et al., 2000). Although these findings are contradictory, most studies reported values below the benchmark of 50% MVPA during physical education (Institute of Medicine, 2013). Children with intellectual disabilities (8-11 years) generated 23% of MVPA during physical education (Faison-Hodge & Poretta, 2004), while preschool children with developmental delays achieved 33% MVPA (Stanish & Mozzochi, 2000). Whereas children (10-12 years) with auditory disabilities had MVPA levels ranging from 40%-72% MVPA during baseline, a peer tutor intervention increased those values to 62%-96% MVPA (Lieberman et al., 2000). For children with autism spectrum disorder, MVPA levels ranged from 30%-46% (Pan et al., 2008, 2011, 2013, 2015; Sandt & Frey, 2005).

One of the goals of physical education curricula worldwide is to develop motor skill competency (Hardman, 2008). To successfully

participate in physical activities, some level of motor competence is needed (Cheng et al., 2023). Motor skills learned in physical education support children's participation in physical activities both at school (e.g., recess) and outside of school (e.g., sports club) and can support the development of a physically active lifestyle (Drijvers et al., 2022). Research has shown that children with higher skill levels are more likely to meet physical activity guidelines compared to their lower-skilled peers (De Meester et al., 2018). In addition, children with higher motor competence are more likely to engage in various types of physical activity and are more likely to demonstrate increased success and enjoyment in different movement domains (De Meester et al., 2018). For children with disabilities, several studies reported significantly lower motor competence scores than typically developing peers (Capiro et al., 2012; Lourenca et al., 2020; Rintala & Loois, 2013). For children with disabilities, a lack of gross motor development is often a reason for decreased physical activity levels (Ketcheson et al., 2021).

In physical education, children's skill performance has been investigated in terms of total and correct skill trials (Cheng et al., 2023; Graham, 1987; Hastie et al., 2011; Ward & Li, 2017). In a study with elementary school children by Cheng et al. (2023), parkour skill trials per minute ranged from 3.26-4.05, while the percentage of correct skill trials varied from 42%-49%. For both variables, no differences were found between boys and girls, which aligned with the work of Graham (1987), who found similar successful skill trials for boys and girls. However, Graham (1987) reported higher success rates for higher-skilled children (63%-88%) compared to lower-skilled children (22%-67%). In a secondary school study, girls performed fewer correct skill trials than boys during a badminton unit (Ward & Lo, 2017).

Physical education teachers play a crucial role in offering all children developmentally appropriate learning experiences and sufficient opportunities to become skillful (Reeves & Stein, 1999), especially children with special needs. Lieberman et al. (2019) developed the Lieberman-Brian Inclusion Rating Scale for Physical Education (LIRSPE), which measures the actions taken by teachers to include children with disabilities in a general physical education setting. All items included in the LIRSPE align with evidence-based

practices within the inclusion literature, such as providing children with choices or adapting instruction to children's needs (Lieberman et al., 2019a). Physical education teachers must ensure that children with disabilities have the same choices and options as their typically developing peers. If this is not the case adaptations are needed, such as differentiated instruction, equipment modifications (e.g., a lower or softer obstacle to jump on/off), rule modifications (e.g., offering the option to make extra contact with the obstacle), environmental modifications (e.g., increasing accessibility) and instructional modifications (e.g., physically assist the child through the parkour skill) (Lieberman & Houston-Wilson, 2009). Differentiated instruction refers to modifying teaching to meet the needs of every student (Lieberman & Houston-Wilson, 2009). Very few attempts have been made to quantify the quality of inclusive environments during physical education.

The purpose of this study was to (1) investigate the MVPA and (2) correct motor skill trials of a child with a developmental delay in relation to her typically developing peers in an inclusive physical education setting in elementary school. Third, the extent to which the physical education teacher attempted to make the learning environment inclusive was assessed.

Methods

Participants and Setting

A total of 19 children (12 boys, seven girls; mean age 8 years), including Emily (pseudonym) and their physical education teacher (female, age = 50 years, experience = 31 years) from one second-grade elementary school class in Wallonia (Belgium) participated in this study. Emily was an eight-year-old girl with developmental delays caused by a metabolic disease. The teacher taught a seven-lesson parkour unit in physical education. Before the start of the parkour unit, the teacher was asked to label children based on their skill level as lower or higher based on her experience and previous assessments of physical education motor activities. Eight children were labeled as higher-skilled, while 11 were classified as lower-skilled, including Emily. For both children and the physical education teacher, parkour was a new content domain in which they had no prior experience.

Physical Education

Physical education is a mandatory subject in Belgium elementary schools and physical education lessons in this school were scheduled twice a week. A seven-lesson unit in parkour was taught in physical education in the school's gymnasium, which was about 20 by 8 meters in surface. Parkour is an individual movement domain where children overcome obstacles fluently and efficiently (Coolkens et al., 2018; Vanluyten et al., 2023). Station work was implemented during all lessons, and children rotated three stations to work on parkour skills. At the end of the lesson all groups had practiced at each station. The parkour unit initially consisted of 10 lessons, but only seven lessons were taught due to the COVID-19 pandemic and accompanying lockdowns.

Physical Activity

The System for Observing Fitness Instruction Time (SOFIT; McKenzie et al., 1992) was used to code the MVPA levels of all children. SOFIT is a valid and reliable tool to record MVPA levels of elementary school children (Rowe et al., 1997) and Stanish & Mozzochi (2000) used SOFIT to record children's physical activity levels with and without developmental delays. This systematic observation tool uses a six-second observation and six-second record interval. During the observe interval, observers focus on one target child, while at the record prompt his/her activity level was recorded. Physical activity is coded as one of five levels, with (1) lying, (2) sitting, (3) standing, (4) walking, and (5) activities that require more energy than walking. Sedentary behavior is the sum of codes one to three, while code 4 (moderate) and code 5 (vigorous) form the MVPA variable.

Skill Trials

A skill trial was defined as the discrete performance of a parkour movement during physical education (Cheng et al., 2023). Eight different parkour movements, each with several progressions, were taught during this lesson unit, and critical elements were based on the parkour handbook (Coolkens et al., 2018a). Skill trials per minute were calculated as the total amount of skill trials during one lesson divided by the skill practice time in minutes. The proportion

of correct skill trials was calculated as the total correct trials divided by the total amount of skill trials multiplied by 100. A skill trial was coded as correct if all critical elements (two to three, as taught by the teacher) were demonstrated. A skill trial was also coded as incorrect when children didn't finish the full trial, sat down on the object during the performance, and when children were stopped by the teacher during the trial or fell while executing the parkour movement.

The Lieberman-Brian Inclusion Rating Scale for Physical Education

The Lieberman-Brian Inclusion Rating Scale for Physical Education (LIRSPE) assesses the extent to which a physical education teacher provides an inclusive environment for all children (Lieberman et al., 2019a, 2019b). The LIRSPE has 28 items, which can be scored from 1 (no effort) to 5 (high effort) or are not applicable. Since the Belgian context in inclusive physical education is somewhat different only 19 items were used. Items concerning speed of play (4), paraeducators (10, 11), peer-partners (12-15) and summative assessment (the latter was not conducted) (23, 24) were not scored. Emily was present during each physical education lesson, and the LIRSPE was assessed through video coding.

Teacher Training

The physical education teacher received a parkour manual and followed a four-hour content knowledge workshop on parkour in her gymnasium (Vanluyten et al., 2023). During the workshop, different parkour moves were introduced, focusing on critical elements, common errors, and how to correct them. The teacher performed all parkour moves at each difficulty level (common content knowledge), then she instructed them to the research team (specialized content knowledge). Common content knowledge (CCK) includes knowledge concerning rules, etiquette, techniques, and tactics. In contrast, specialized content knowledge (SCK) focuses on instructional tasks to teach children the content (i.e., parkour) and the knowledge of common mistakes made by children to correct these during the lesson (Ward et al., 2020). Several content knowledge interventions with both pre- and in-service teachers showed positive effects on both teacher behavior and student learning (Iserbyt & Madou, 2022; Ward et al., 2022). Throughout the workshop, the

instructor asked questions to check the teacher's understanding of the content. Although the workshop contained several strategies for differentiation, no specific adaptations or recommendations were added concerning Emily.

Coder Training

Observers were trained to collect reliable data on children's MVPA, skill trials, and teacher's LIRSPE data. Training started with learning the definitions of physical activity levels, parkour moves, their critical elements, and the structure of LIRSPE. To assess the observer's understanding, a written test was conducted in which they had to achieve a 100% score to proceed to the next training step. In a second test, written scenarios were given to the observers, and they had to code regarding MVPA, correct skill trials, and LIRSPE code. When a score of 85% or more was achieved, observers proceeded to the last step, in which they were required to get an interobserver agreement score of at least 85% on a video recording of a parkour physical education lesson.

Data Collection

Data collection was conducted from January to March 2020, where the COVID-19 pandemic and the associated lockdown resulted in an early termination (seven lessons instead of ten) of the investigation. Data on physical activity for all children was collected during seven physical education lessons through video recordings. Only five children (including Emily) were selected for coding skills trials per minute and correct skill trials during seven physical education lessons due to problems with video recording. The poor quality of the video, together with the parkour equipment that obstructed the view of the children, limited the number of children whose skill trials could reliably be coded. Besides Emily, one lower and one higher-skilled child of each sex was selected. During lessons three and seven, Emily was absent; therefore, for those lessons, there is no data with regard to the dependent variables. The video recordings were used to assess the LIRSPE. A total of 44 hours of observations were done to code all subjects and cover all dependent variables. For physical activity, 20% of all data was coded by two independent observers, above the 12% recommended by McKenzie et al. (1992), with a reliability of 87%, above the recommendation of behavioral

research (Cooper & Heron, 2007). For skill trials data, all data was coded by two independent observers with a reliability of 95% for total skill trials and 91% for correct skill trials. Similarly, two independent coders assessed the LIRSPE with a reliability of 97%.

Data Analysis

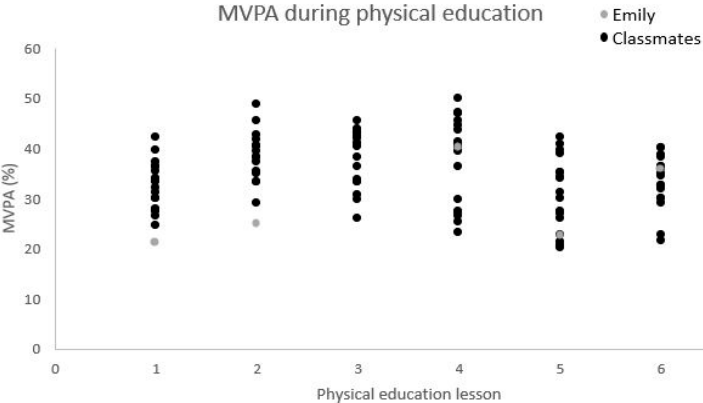
This study was a descriptive case study to investigate Emily's MVPA and correct skill trials in relation to her typically developing peers during physical education. Physical activity was reported as a percentage of intervals spent in MVPA, while skill trials were reported in totals as a function of time (skill trials/min) or as a percentage of correct skill trials. For each lesson, the LIRSPE score was calculated by dividing the total score by the number of items (19).

Results

Physical Activity

Figure 1 shows the percentages of MVPA for all children in each physical education lesson. On average, Emily spent 29% of intervals in MVPA during physical education, compared to 33% for girls and 36% for boys. During physical education lessons one and two, she had the lowest MVPA level compared to her classmates, while in lesson five, she also generated among the lowest activity levels. In contrast, during lessons four and six, Emily had higher levels of MVPA compared to her peers.

Figure 1
MVPA During Physical Education



Skill Trials

During the first lesson, the total amount of skill trials ranged from 96-161, while the values in the other lessons were lower: lesson 2 (31-76 trials), lesson 4 (39-53), lesson 5 (17-37) and lesson 6 (39-62). In Table 1, total skill trials, the skill trials per minute, and the percentage of correct skill trials per lesson are reported for Emily and compared with four other children (two boys and two girls, each of a different skill level). Emily performed lower total skill trials than her peers in lessons two and five. She had lower values for skill trials per minute (ranging from 2-16) and for the percentage of correct skill trials (12-56%) compared to the three other children (2-34 skill trials/min and 53-96% correct skill trials).

Table 1
Skill Trials During Physical Education

		Emily	Girl Low	Girl High	Boy Low	Boy High
	Total skill trials	108	96	100	142	161
PE 1	Skill trials/min	16	20	21	30	34
	%Correct skill trials	56	81	60	67	81
	Total skill trials	31	55	72	/	76
PE 2	Skill trials/min	3	7	9	/	10
	%Correct skill trials	32	76	96	/	76
	Total skill trials	40	43	53	39	42
PE 4	Skill trials/min	4	5	6	5	5
	%Correct skill trials	35	74	83	59	76
	Total skill trials	17	29	37	17	31
PE 5	Skill trials/min	2	3	4	2	4
	%Correct skill trials	12	79	92	53	84
	Total skill trials	44	39	62	57	56
PE 6	Skill trials/min	4	3	5	5	5
	%Correct skill trials	25	54	68	56	70

LIRSPE

In Table 2, the total scores of the LIRSPE are reported, as well as the number of items that were scored. Some items were irrelevant to the Belgian context and therefore not scored, resulting in 19 items. The LIRSPE ratios per lesson varied from 3.21-3.53. While most items remained the same throughout the lesson unit, the scores increased towards the last lesson for three items. These were (1) demonstration by various members of the class, including children with disabilities (item 9), (2) skill-related feedback with use of first names

Table 2
Skill Trials During Physical Education

	PE 1	PE 2	PE 4	PE 5	PE 6
Total score	61	65	65	63	67
Amount of items	19	19	19	19	19
LIRSPE (Ratio)	3,21	3,42	3,42	3,32	3,53

(item 26), and (3) teacher checks for understanding of all children during closure.

Discussion

The purpose of this study was to investigate (1) the physical activity levels and (2) correct motor skill trials of a child with a developmental delay in relation to her typically developing peers in an inclusive physical education setting in elementary school. Third, we investigated the extent to which the physical education teacher attempted to make the learning environment inclusive, which was assessed with the LIRSPE.

Physical Activity

Physical activity levels for Emily were low compared to her classmates, except for lessons 4 and 6. However, overall, the children in this class did not meet the 50% MVPA guideline during physical education. Furthermore, overall MVPA levels were lower than those of typically developing peers (Hollis et al., 2016). On average, Emily generated 29% MVPA during physical education, which is in line with other children with developmental delays (Stanish & Mozzochi, 2000), which was lower than most of her peers, as shown in Table 1. However, during lessons 4 and 6, her MVPA levels were higher compared to her peers. This might be because certain parkour moves could be easily adjusted to Emily's skill level, while this was difficult for others. For example, children ran up an inclined bench for the wall run and jumped off. Because sufficient equipment was available, two setups were built, one with a small inclination and one with a larger inclination. In addition, the teacher adapted this task by instructing children to jump off the bench at a height they felt comfortable. This type of adaptation was not possible for other park-

our moves; for example, the height of a plinth cannot be adapted for every child.

Skill Trials

During the first physical education lesson, the skill trials per minute were higher than during the other lessons (16-34 versus 2-10 skill trials/min). This is a result of precision jumps, landings, and strides that were taught during lesson one. These movements are relatively short, discrete, and can be executed at a high frequency, resulting in more skill trials per minute, in contrast to overcoming an obstacle that takes more time. Although Emily executed fewer skill trials per minute compared to her peers, the differences for correct skill trials were more prominent. Because the correctness of a skill trial depends on the teacher's instruction, the skill trial data shows that the instructions were insufficiently adapted for Emily, resulting in a lower percentage (12-56%) of correct skill trials. Brophy and Good (1986) reported an optimal rate of around 75-80% during guided practice, which tries to balance success and sufficient challenge (Rosenshine, 2009). Skill development in physical education is important for participating in physical activities in school and later in life because some level of competency is needed (De Meester et al., 2018). In essence, the results from this study underline the need for future research to investigate how children with disabilities can improve their motor competence in inclusive settings.

LIRSPE

The LIRSPE ratios are all above three, reflecting that the physical education teacher tried to include Emily (Lieberman et al., 2019). Although very small, an upward trend in LIRSPE ratios was noticeable, which might indicate the teacher's increasing success in creating an inclusive physical education environment. However, the highest LIRSPE values do not correspond with the highest MVPA levels or correct skill trials for Emily. This shows that further analysis might be needed to pinpoint why certain instructions are developmentally appropriate or not for Emily. Furthermore, LIRSPE items with low scores, for example, the provision of a range of equipment to address the learning needs of all students in the class (item 21), can be addressed through intervention studies while collaborating with teachers.

Limitations and Strengths

To our knowledge, it is the first study to report children's physical activity and skill trials in an inclusive physical education setting as well as to document the effort of the physical education teacher to make the learning environment inclusive by means of the LIRSPE ratio. An important limitation of this study is that it does not have detailed information regarding Emily's disability, and it does not have an objective motor competence test (e.g., TGMD-3; Ulrich, 2013) at the start of the study. The comparison of only one child with a developmental delay and her peers is insufficient to perform statistical analyses or generalize any conclusions. However, this case study described a naturalistic, inclusive physical education environment and can serve as a starting point in which possible strengths and weaknesses might be highlighted. It can inform future research by pointing out key aspects of learning in an inclusive physical education setting. In particular, a more in-depth analysis of the developmental appropriateness of tasks for Emily might help us understand how to shape future instruction. Since it has been stated that 75-80% is an optimal rate for success (Brophy & Good, 1986), the percentage of correct skill trials that Emily achieved indicates that extra effort needs to be made to increase Emily's learning process. Future work might focus on teaching in smaller progressions, which implies adapting instruction and equipment to meet the needs of children with disabilities and increase their correct performance of skill trials.

Conclusion

This study found lower values for Emily compared to her typically developing peers for both physical activity and skill trials (skill trials per minute and percentage correct skill trials). Although the LIRSPE ratio is above three, reflecting the effort of the physical education teacher to include all children, it cannot be concluded that this setting was a highly inclusive environment. In future studies, the interactions between children with disabilities and their peers and teachers should be studied. Specific teacher training, emphasizing these interactions and proper adaptations are recommended.

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