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Original article

THE IMPACT OF DYNAMIC GAMES AND PLAY-BASED PHYSICAL EXERCISES ON COORDINATION IN STUDENTS WITH DISABILITIES DURING PHYSICAL EDUCATION AND SPORTS LESSONS

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Abstract

Aim. The present research aims to assess the impact of dynamic games and play-based physical exercises on the development of coordination in students with disabilities during adapted physical education lessons.

Methods. The study was conducted over one school semester at the "Bonitas" Inclusive Education Center in Oradea and involved 19 students aged 11 to 17, divided into an experimental group (12 students) and a control group (7 students). The experimental group participated in two weekly sessions of dynamic games integrated into physical education lessons, while the control group followed the standard curriculum without additional intervention. Four standardized motor coordination tests were used: hand-eye coordination (ball catching), target throwing, basketball shooting, and ball rolling into a hoop. Initial and final results were analyzed using descriptive statistics.

Results. The experimental group showed significant improvements in all motor coordination tests compared to the control group. Notably, the average number of successful catches in the hand-eye coordination test increased by 60%, and performance in the ball-rolling test with the dominant hand improved by 86%. These results suggest that structured, game-based activities had a meaningful positive effect on motor skills in students with special educational needs.

Conclusions. The findings confirm the effectiveness of dynamic and play-based exercises in enhancing motor coordination, particularly in tasks requiring precision and fine motor control. The results also emphasize the broader educational and social value of integrating such activities into adapted physical education programs, promoting motivation, engagement, and self-confidence among students with disabilities.

Keywords: dynamic games, motor coordination, students with disabilities, adapted physical education, social integration.

Introduction

Motor coordination is essential in the development of students with disabilities, significantly influencing their social integration and quality of life. According to a study by Kalyvas and Reid (2003), adapted physical education plays a fundamental role in improving coordination and social integration among children with intellectual disabilities, emphasizing that dynamic games are a valuable tool in this regard. Similarly, Rintala and Loovis (2013) demonstrated through an experimental study that game-based and dynamic activities lead to significant improvements in both fine and gross motor skills in students with physical and cognitive disabilities.

Block and Obrusnikova (2007) also argue for the importance of using dynamic games in adapted physical education lessons, highlighting that such activities foster coordination development and increase active participation among students with special needs. Another relevant study by Pan and Frey (2006) emphasizes that implementing physical exercises in a playful format significantly contributes to improving balance and motor dexterity in students with motor and cognitive difficulties. Physical activity is a fundamental need for individuals with intellectual disabilities, contributing not only to motor development but also to social integration, emotional balance, and cognitive functioning (Bechar & Grosu, 2016).

The participation of students with special educational needs in physical education lessons supports their social integration and increases self-confidence. However, the lack of specialized teaching staff remains a significant obstacle to achieving effective inclusion (Cristea, Moțoc & Pop, 2020, in Buhaș, ed.).

In this context, the present study aims to analyze the impact of dynamic games and play-based physical exercises on the coordination of students with disabilities, complementing existing literature and supporting the need to integrate these methods into educational programs to optimize students' motor and social development.

Materials and Methods

This study included 19 students aged between 11 and 17 years, from grades V to VIII of the "Bonitas" Inclusive Education Center in Oradea. The participants were divided into two groups: an experimental group composed of 12 students (7 boys and 5 girls) and a control group consisting of 7 students (3 boys and 4 girls).

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The small number of participants reflects the specific context of special education, where small class sizes are essential for implementing differentiated teaching tailored to the individual needs of children with disabilities. This structure allowed for more focused interventions and justified the exclusive use of descriptive analysis in interpreting the results, as homogenization of the groups was not feasible due to the diversity in the degree of disability among the participants.

To evaluate the impact of play-based physical exercises on coordination in students with disabilities, an organized experimental framework was designed, involving two groups of participants: an experimental group and a control group. The experimental group participated in two weekly sessions of dynamic games and playful physical exercises, integrated into physical education lessons. The control group followed the standard curriculum without any special intervention.

A series of standardized tests were used in the study to assess motor coordination:

- Hand-eye coordination test: This test involves throwing a small ball (e.g., a tennis ball) at a wall and catching it with the opposite hand. The student, positioned 2 meters away from the wall, alternates between throwing with the right hand and catching with the left, and vice versa. The exercise lasts for 30 seconds, and the teacher records the total number of successful catches. The test is preceded by a general warm-up lasting 7–8 minutes.
- Target throwing test: The student stands 5 meters away from a bench on which three cones are placed. At the start signal, the student sprints to the bench, builds a pyramid from the cones, then returns to the starting point where a tennis ball is available. The goal is to knock down the pyramid with a throw. The entire sequence is timed, and the final time represents the performance score.
- Ball shooting test: The student performs 10 throws with the right hand and 10 with the left hand from a distance of 2.5 meters from a basket. The number of successful throws with each hand is recorded, and the final score is the total number of successful attempts out of 20.
- Ball rolling into a ring test: The student stands 3–4 meters away from two gymnastic rings placed on the ground. The task is to roll a tennis ball so that it reaches and remains inside the target ring—once using the left hand and once using the right hand. Each student has 3 attempts with each hand, and the score is based on the number of successful rolls.

Results

To observe the evolution of the participants' performance, the results of the initial and final tests were analyzed using descriptive statistics, focusing on minimum and maximum values, means, and standard deviations.

Test 1 assessed hand-eye coordination by recording the number of catches made in 30 seconds. In the initial testing (Table 1), the performance of the 19 students ranged from 0 to 15 catches, with a mean of 5 and a standard deviation of 4.16. These data indicate a variable level of coordination, with lower results observed in some of the participants.

Table 1. Initial Test 1 results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
T1initial	19	.00	15.00	5.0000	4.16333
Valid N (listwise)	19				

In the final testing (Table 2), the scores improved: the lowest value was 1 catch, and the highest was 25. The overall mean increased to 8 catches, with a standard deviation of 7.38, suggesting both general progress and greater variability in the results. The difference between the means of the two tests indicates a positive trend in the development of hand-eye coordination as a result of the activities conducted during the intervention period.

Table 2. Final Test 1 results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
T1final	19	1.00	25.00	8.0000	7.37865
Valid N (listwise)	19				

Test 2 focused on evaluating precision and motor coordination by recording the time required to complete a target-throwing task.

Table 3. Initial Test 2 results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
T2 initial	19	12.50	51.40	25.5905	13.70722
Valid N (listwise)	19				

According to Table 3, in the initial testing, the recorded values ranged from 12.50 seconds (the fastest completion of the task) to 51.40 seconds (the slowest). The average time achieved by the 19 participants was 25.59 seconds, with a standard deviation of 13.70, indicating a fairly wide dispersion in performance.

Table 4. Final Test 2 results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
T2 final	19	10.60	45.50	25.3400	12.53092
Valid N (listwise)	19				

The results of the final testing (Table 4) show a slight improvement: the minimum time was 10.60 seconds, and the maximum time was 45.50 seconds. The average recorded time was 25.34 seconds, with a standard deviation of 12.53. Although the difference between the means of the two tests is small, there is a noticeable decrease in both minimum and maximum times, which may indicate a trend toward more efficient motor execution in some participants. However, the overall variation remains high, suggesting that progress was not uniform across the group.

Test 3 aimed to assess throwing accuracy with both hands (left and right) by counting the number of successful attempts out of 10 trials.

Table 5. Initial and Final Test 3 results – left hand

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
T3 initial left hand	19	2.00	9.00	4.6316	1.97795
T3 final left hand	19	2.00	9.00	5.6316	2.11373
Valid N (listwise)	19				

According to Table 5, in the initial testing of ball throwing with the left hand, students achieved between 2 and 9 successful throws out of 10, with a mean of 4.63 and a standard deviation of 1.97. In the final testing, the scores remained within the same range (2–9 successful throws), but the mean increased slightly to 5.63, with a standard deviation of 2.11. Although the extreme values did not change, the increase in the mean suggests a general improvement in throwing accuracy with the left hand, even if the progress was modest and inconsistent.

Table 6. Initial and Final Test 3 results – right hand

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
T3 initial right hand	19	1.00	9.00	4.5789	2.38783
T3 final right hand	19	3.00	10.00	6.2105	2.09706
Valid N (listwise)	19				

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The results presented in Table 6 show a clearer improvement in throwing with the dominant (right) hand. In the initial test, scores ranged from 1 to 9 successful throws out of 10, with a mean of 4.58 and a standard deviation of 2.38. In the final test, performance improved, with scores ranging from 3 to 10 successful throws, and the mean increasing to 6.21, with a standard deviation of 2.09. This increase in both the mean and maximum value indicates more evident progress in throwing with the right hand, suggesting greater effectiveness of the activities in enhancing dominant motor skills.

Test 4 aimed to evaluate precision and fine motor control by measuring the number of successful ball rolls into a ring with each hand, out of a total of 3 attempts.

Table 7. Initial and Final Test 4 results – left hand

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
T4 initial left hand	19	.00	3.00	1.1053	.80930
T4 final left hand	19	1.00	3.00	1.8421	.60214
Valid N (listwise)	19				

According to Table 7, in the initial testing of ball rolling with the left hand, participants achieved between 0 and 3 successful rolls. The mean was 1.11, with a standard deviation of 0.81, indicating modest results and a relatively dispersed distribution. In the final testing, performance improved: scores ranged from 1 to 3 successful rolls, the mean increased to 1.84, and the standard deviation decreased to 0.60. This progression indicates both an improvement in precision and a greater consistency of results among the participants.

Table 8. Initial and Final Test 4 results – right hand

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
T4 initial right hand	19	.00	3.00	1.1579	.83421
T4 final right hand	19	1.00	3.00	2.1579	.68825
Valid N (listwise)	19				

The results for ball rolling with the right hand, presented in Table 8, follow a similar pattern. In the initial testing, the number of successful rolls ranged from 0 to 3, with a mean of 1.16 and a standard deviation of 0.83. In the final testing, the minimum performance increased to 1, the mean rose to 2.16, and the standard deviation decreased to 0.68. These results suggest significant progress in motor control and precision, more pronounced with the right hand, which was likely the dominant hand for most participants. Following the general analysis of the results obtained by the entire sample, the next section presents a comparative overview of the performance of the two groups—experimental and control—for each applied test. This approach aims to highlight the differentiated progress of the students depending on the type of educational intervention. For each test, the means and standard deviations of the two groups are analyzed for both the initial and final assessments. Table 9 and Figure 1 present the statistical indicators for the hand-eye coordination test, for both the experimental and control groups, during the initial and final assessments.

Table 9. Statistics of the experimental and control groups

Test 1	grup	N	Mean	Std. Deviation.
T1initial	experimental	12	3.7500	3.51943
	control	7	7.1429	4.56175
T1final	experimental	12	6.0000	6.20850
	control	7	11.4286	8.42332

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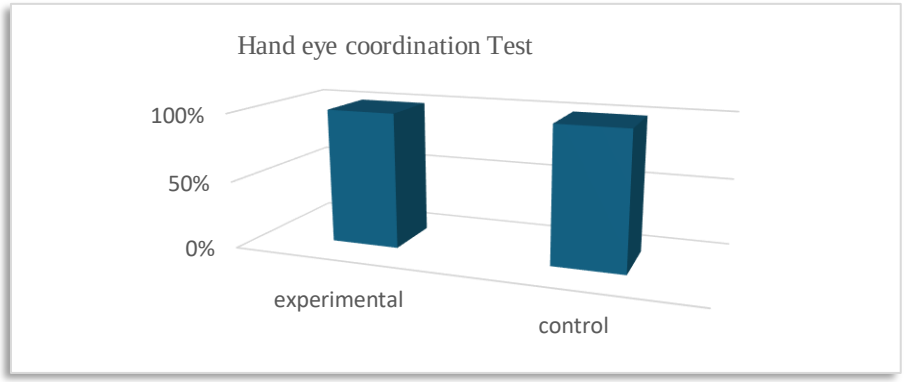

Figure 1. Test 1 – Mean scores of both groups

For the experimental group, the mean score in the initial assessment was 3.75, with a standard deviation of 3.52, while in the final assessment the mean increased to 6.00, with a standard deviation of 6.20. This growth indicates a positive trend in skill development, although the variation in results among participants remained relatively high.

In the case of the control group, the initial values were higher, with a mean of 7.14 and a standard deviation of 4.56. In the final test, the mean increased to 11.42, with a standard deviation of 8.42. This suggests that the control group also experienced positive progress in hand-eye coordination, even though they did not participate in the specific extracurricular activity.

Table 10 and Figure 2 present the statistical indicators for the target throwing test for both the experimental and control groups during the initial and final assessments.

Table 10. Statistics for the experimental and control groups

Test 2	grup	N	Mean	Std. Deviation.
T2 initial	experimental	12	26.3483	15.74831
	control	7	24.2914	10.28894
T2 final	experimental	12	25.2267	12.99824
	control	7	25.5343	12.69851

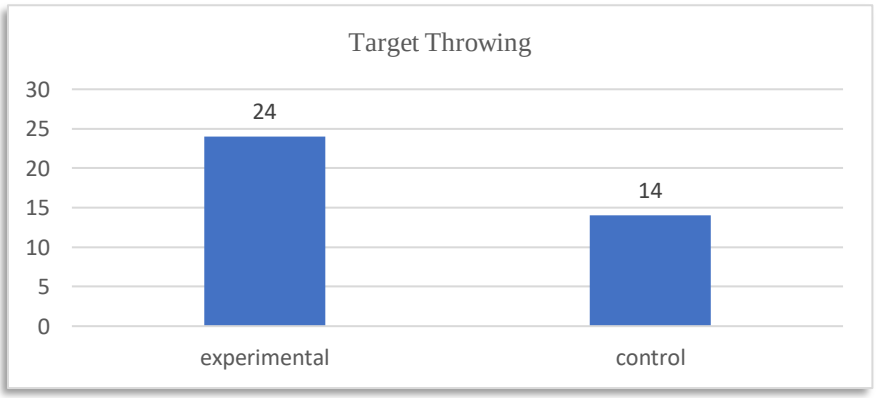

Figure 2. Test 2 – Mean scores of both groups

For the experimental group, the mean time required to complete the task during the initial test was 26.34 seconds, with a standard deviation of 15.75, indicating significant variability in performance among participants. In the final test, the mean decreased to 25.22 seconds, and the standard deviation to 12.99, suggesting a slight improvement in execution efficiency and a trend toward more consistent results.

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In the case of the control group, the initial mean was 24.29 seconds, with a standard deviation of 10.28. In the final test, the mean slightly increased to 25.53 seconds, with a standard deviation of 12.69. This result suggests a stagnation in performance and a possible slight regression in terms of execution speed and precision.

Table 11 and Figure 3 present the statistical indicators for Test 3 – ball shooting, performed with both hands (left and right), for the experimental and control groups during the initial and final assessments.

Table 11. Statistics of the experimental and control groups

Test 3	grup	N	Mean	Std. Deviation.
T3 inițial left	experimental	12	4.5833	2.19331
	control	7	4.7143	1.70434
T3 final left	experimental	12	5.9167	2.31432
	control	7	5.1429	1.77281
T3 final right	experimental	12	6.2500	2.17945
	control	7	6.1429	2.11570
T3 initial right	experimental	12	5.5000	2.31595
	control	7	3.0000	1.63299

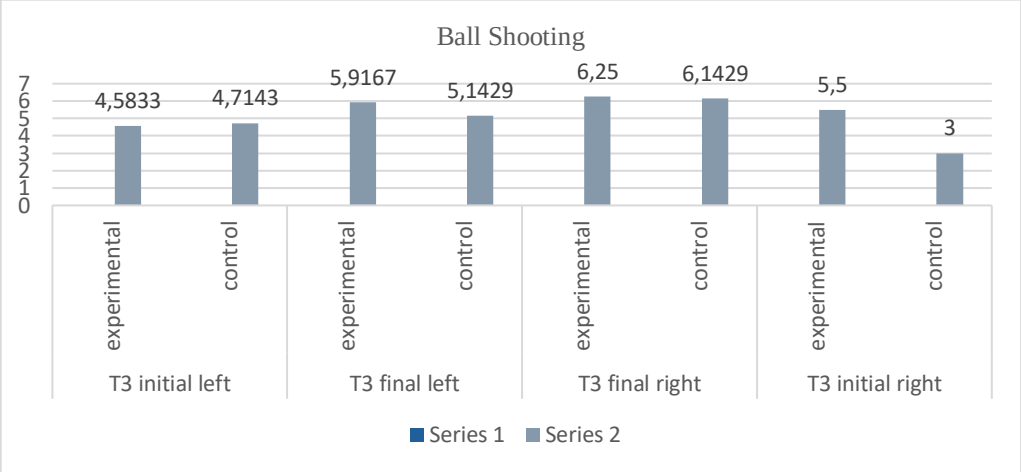

Figure 3. Mean scores of both groups

For the experimental group, in the ball throwing test with the left hand, the initial mean was 4.58 successful throws out of 10, with a standard deviation of 2.19. In the final assessment, the mean increased to 5.91, with a standard deviation of 2.31. These values indicate moderate progress in throwing accuracy with the left hand and a relatively consistent variation among participants.

In the control group, the initial mean was 4.71 and the final mean was 5.14, with standard deviations of 1.70 and 1.77, respectively. Although there is a slight increase in performance, the progress is more limited compared to the experimental group.

Results for the experimental group in throwing with the right hand also show a positive evolution: the mean increased from 5.50 in the initial test to 6.25 in the final test, with the standard deviation remaining around 2.17. This suggests a slight but steady improvement in dominant-hand performance.

For the control group, the progress was more significant. The mean increased from 3.00 in the initial assessment to 6.14 in the final assessment, while the standard deviation rose slightly from 1.63 to 2.11. This may reflect greater variability in individual performance but also a notable improvement at the group level.

Table 12 and Figure 4 present the statistical indicators for Test 4 – rolling the ball into a ring, performed with the left and right hand, during both the initial and final assessments, for the experimental and control groups.

Table 12.Statistics of the experimental and control groups

Test 4	grup	N	Mean	Std. Deviation.
T4 initial left	experimental	12	1.1667	.93744
	control	7	1.0000	.57735
T4 initial right	experimental	12	1.2500	.75378
	control	7	1.0000	1.00000
T4 final left	experimental	12	1.6667	.49237
	control	7	2.1429	.69007
T4 final right	experimental	12	1.9167	.66856
	control	7	2.5714	.53452

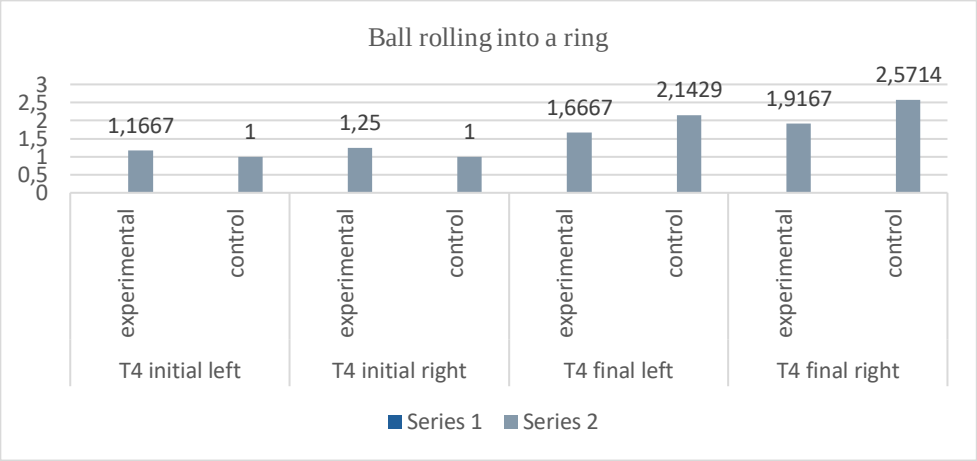

Figure 4. Mean scores of both groups

For the experimental group, in the ball rolling task with the left hand, the initial mean was 1.17 successful rolls out of 3 possible, with a standard deviation of 0.94. In the final test, the mean increased to 1.67, with a standard deviation of 0.49. This result indicates moderate progress in task execution and a reduction in performance variability among participants. For the control group, the initial mean was 1.00, with a standard deviation of 0.57, and it increased to 2.14 in the final test, with a standard deviation of 0.69. This progression reflects a more noticeable improvement than in the experimental group, although starting from a slightly lower baseline.

Regarding the experimental group's performance in rolling the ball with the right hand, the initial mean was 1.25, with a standard deviation of 0.75, and increased to 1.92 in the final test, with a standard deviation of 0.67. These results suggest a positive development in execution accuracy, as well as a slight homogenization of performances. For the control group, the initial mean was 1.00, which increased significantly to 2.57 in the final test, with a standard deviation of 0.53. This progress is notable, indicating a substantial improvement in skill when performing this type of motor task.

Discussions

The results obtained in this study are consistent with the specialized literature supporting the effectiveness of dynamic physical activities with a playful character in the development of motor coordination in students with disabilities. The study conducted by Pentiuc (2021) demonstrated that, following a structured program of dynamic games, average coordination scores in students with special educational needs (SEN) increased by over 30%, highlighting improvements in movement precision as well as motivation toward physical activity. Our results support this conclusion, showing an average increase from 5 to 8 successful catches in the hand-eye coordination test—an improvement of 60%—and a mean increase in basket throws from 4.58 to 6.21 successful shots with the dominant hand.

Moreover, the research by Vahapoglu et al. (2024) on the impact of educational games in children with learning disabilities showed significant improvements in balance and general coordination (with mean scores increasing from 2.4 to 3.7 on a functional scale), but no clear progress in hand-eye coordination. In contrast, our study reveals notable

advancements in this area as well, reflecting the efficiency of the structured intervention and the variety of applied exercises, which included catching, throwing, and rolling tasks.

A recent meta-analysis by Gao et al. (2023) regarding the use of Active Video Games (AVGs) reported significant improvements in balance ($d = 0.68$) and locomotor skills ($d = 0.52$), but emphasized a lack of consistent results in object control skills ($d < 0.2$). By comparison, our study offers valuable insight, showing an increase in rolling precision scores with the dominant hand from an average of 1.16 to 2.16 successful attempts out of 3—a relative increase of 86%, which is significant for fine motor control development.

Furthermore, literature in the field of adapted physical education (Block & Obrusnikova, 2007) highlights the benefits of such interventions not only for physical development, but also for social integration, self-confidence, and active participation. These benefits were also observed during our intervention, where students displayed greater engagement, cooperation, and enthusiasm during game-based activities. Thus, our findings confirm the educational and therapeutic value of dynamic games in physical education lessons, particularly within special education environments.

Conclusions

This study confirms the importance of integrating dynamic games and play-based physical exercises into adapted physical education lessons, highlighting clear positive effects on the development of motor coordination in students with disabilities. The results obtained by the experimental group, in comparison with the control group, demonstrate that the use of dynamic and interactive exercises significantly contributes to improving accuracy, reaction speed, and neuromotor control, both in tasks involving the use of both limbs and in those requiring the unilateral use of a single limb.

The improvements recorded in the hand-eye coordination, target throwing, ball shooting, and ball rolling tests reflect not only motor progress but also increased student engagement and motivation. These findings support the idea that play-based educational methods enhance learning through enjoyment and promote better adaptation of content to the individual needs of students with special educational needs.

Beyond the motor dimension, dynamic activities have also proven effective in facilitating social integration and building self-confidence, reinforcing the foundations of inclusive and effective physical education.

Therefore, the systematic integration of dynamic games into the curriculum of special education institutions is recommended, as well as the continuous training of teachers in the use of these adaptive motor strategies, in order to support a coherent and personalized educational path aimed at optimizing the motor, cognitive, and socio-emotional development of students with special educational needs.

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