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EVALUATION OF MOTOR ABILITIES OF PRIMARY SCHOOL PUPILS IN THE CONTEXT OF HYBRID LEARNING THROUGH PHYSICAL EDUCATION

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ABSTRACT. ***Introduction***: Physical education represents the formation and harmonious development of primary school pupils, contributing both to their physical health and to their adaptation to the requirements of modern education. In the context of hybrid learning, the application of motor tests provides a clear picture of children's developmental levels and the effectiveness of the teaching methods used. ***Hypothesis***: It is assumed that integrating physical education tools adapted to the hybrid learning context significantly contributes to maintaining and improving the motor skills of primary school pupils. ***Research aim****:* The aim of this study is to highlight the role of physical education in assessing and developing pupils' motor abilities within a hybrid learning process. ***Objectives of the study****:* To apply standardized motor tests: the 10x5 m shuttle run, trunk lifts, static balance test, upper limb strength test, and joint mobility test. To analyze the obtained results to identify the current level of physical abilities. To formulate methodological recommendations for improving physical education activities in a hybrid system. ***Results****:* The results confirm the importance of integrating varied and adapted methods within physical education, even under hybrid learning conditions, demonstrating that pupils can maintain and develop basic motor skills when the educational process is well-structured and oriented toward their specific needs.

Keywords: motor abilities, primary school pupils, hybrid learning, physical education

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INTRODUCTION

Physical education is a component of the educational process, contributing to the harmonious development of children starting in primary school. Through motor activities, students develop both basic motor skills (strength, speed, endurance, coordination, balance) and social abilities such as cooperation, discipline, and team spirit. Recent changes in the educational system, driven by the shift to hybrid learning formats, have necessitated the adaptation of teaching and assessment methods in the field of physical education as well. The implementation of hybrid pedagogical models helps overcome the limitations of traditional approaches and improves learning outcomes in physical education (Shen at al., 2022). In the context of combining face-to-face activities with online sessions, teachers face challenges in maintaining an optimal level of physical activity, making adapted tools necessary to monitor student progress. Hybrid digital learning has proven to be an innovative approach for developing motor performance in physical education classes (Hidayatullah et al., 2024). Recent studies confirm the effectiveness of hybrid learning in developing motor skills and self-learning abilities. Author (Chen, 2025) highlighted that hybrid environments contribute to increased physical activity, improved cognitive performance, and reduced stress. Another study by (Moon et al., 2023) emphasizes that blended learning offers flexibility while retaining the benefits of direct interaction. Additionally, (Gonzalez-Villora et al., 2019) show that the hybridization of pedagogical models supports the development of both motor and psychosocial skills, if teachers are adequately trained. The integration of gasification into the blended learning process stimulates motivation and knowledge retention (Ghorbel et al., 2025), while the use of direct video feedback has proven effective in improving motor techniques in primary school students (Kyriakidis et al., 2022). The research conducted by (Golikova et al., 2023) supports the idea that the digitalization of physical education allows for an optimal combination of practical instruction and online theoretical resources through models such as the “flipped classroom” or “station rotation.” The investigation by (Carr, 2021) highlights the role of hybrid learning in students’ social and emotional development, emphasizing their active engagement in the educational process. Likewise, the analysis conducted by (Mohammed Fahid Al-Matiry, 2020) shows that blended learning methods significantly improved motor performance in children across various athletic disciplines. In this context, the present study aims to analyze the role of physical education in developing the motor skills of primary school students by applying standardized tests and interpreting the obtained results, with the goal of optimizing the hybrid educational process.

MATERIAL AND METHODS

Participants

The study was conducted on primary school students in the 4th grade, under the guidance of teacher Lungu Adrian. Students were selected based on the following inclusion criteria: enrollment in the 4th grade during the 2024 school year; adequate general physical fitness, with no medical conditions limiting participation in physical activities; parental consent for participation in the assessment; and active attendance in physical education activities conducted in a hybrid format.

Procedure

The experiment was conducted during Module IV of the 2024–2025 school year at the "Vasile Gherasim" Technological High School in Marginea, within physical education classes. The activities were organized in a hybrid format, combining face-to-face lessons in the gym with the control group and online exercises, also conducted in the gym, with the experimental group. Both the initial and final assessments were carried out for the experimental group as well as the control group. Each student underwent a set of standardized motor tests, applied in the following order: Shuttle Run 10x5 m (speed in the resistance regime), Sit-ups in 30 seconds (abdominal strength); Static Balance Test (ability to maintain position); Upper Limb Strength Test – Push-ups; Joint Mobility Test (flexibility and range of motion).

Experimental Physical Education Program – 7 Weeks (Hybrid System)

General Objectives: Improve speed and endurance. Develop abdominal and upper limb strength. Maintain and stimulate static balance. Increase joint mobility. Adapt activities for hybrid learning. Weekly Structure: Face-to-face lessons: 2 sessions per week (gym). Online lessons (simulated in the gym as if at home): 1–2 sessions per week (video platform, demonstration exercises, interactive activities). Week 1 – Introduction and Initial Assessment. Face-to-face: General warm-up: 5 min light jogging, joint mobility exercises. Initial tests: Shuttle Run 10x5 m, sit-ups, push-ups, static balance, joint mobility. Simple motor games for familiarization. Online: Mobility exercises: shoulders, hips, ankles. Video tutorial: correct technique for sit-ups and push-ups. Week 2 – Speed and Endurance. Face-to-face: Warm-up: 5 min jogging, mobility exercises. Shuttle Run 10x5 m: 3 sets with 2 min rest between sets. Reaction games and short sprints. Online: Gym circuit: running in place, knee-to-chest jumps, lateral jumps. Breathing and coordination exercises. Week 3 – Abdominal Strength. Face-to-face:

Warm-up: 5 min mobility and dynamic stretches. Sit-ups: 3 sets of 20–25 seconds, 1 min rest. Plank and simple variations (side plank). Week 3 – Online: Abdominal exercises via video: knee-to-chest raises, bicycle crunches, plank 15–30 sec. Interactive games to maintain attention and motivation. Week 4 – Upper Limb Strength. Face-to-face: Warm-up: shoulder and arm mobility, 5 min. Modified push-ups (knees on the floor) and standard push-ups: 3 sets. Exercises with a ball or resistance band for arms. Online: Bodyweight exercises: wall push-ups, arm raises, exercises with water bottles. Video guidance on correct posture. Week 5 – Balance and Coordination. Face-to-face: Warm-up: walking on toes and heels, 5 min. Static balance test: 3 sets of 30 sec. Exercises on a straight line or over small obstacles Online: Home balance exercises: standing on one leg, lateral swaying. Coordination and reaction games: video with visual and auditory cues. Week 6 – Joint Mobility and Flexibility. Face-to-face: Warm-up: 5 min dynamic exercises. Global stretching: shoulders, back, hips, calves. Active and passive flexibility exercises. Online: Video tutorials for stretching: each muscle group, hold 30–45 sec. Breathing and relaxation exercises. Week 7 – Final Assessment and Consolidation. Face-to-face: Repetition of initial tests: Shuttle Run 10x5 m, sit-ups, push-ups, static balance, joint mobility. Motor games for consolidation and progress assessment. Online: Exercise recap: mobility, balance, strength, coordination. Individual feedback and personalized recommendations. Methodological Note: All online exercises are adapted to the limited space available at students' homes. Common materials are used: stopwatch, balls, water bottles, mats. Progress is monitored by comparing the results of the initial and final tests.

Materials

Standard sports equipment: markings for shuttle runs, digital stopwatches. Materials for hybrid learning: 3 m mat used for students to perform exercises online, simulating a home environment; demonstration and monitoring videos. Individual evaluation sheets: for recording initial and final values for each test.

Data analysis

The obtained values were compiled and analyzed for each test, comparing the performance of the experimental group with that of the control group. For each test, the following were calculated: mean ($\bar{x}$) for the initial and final tests; mean difference (D = FT − IT); standard deviation (σ); coefficient of variation (Cv%); and maximum and minimum values. The results were interpreted in the context of maintaining and developing students' motor skills under hybrid learning conditions. The analysis allowed for the identification of motor components that respond positively to the adapted activities.

RESULTS

The collected data were analyzed to identify relevant differences and trends between the control group, which worked face-to-face, and the experimental group, which worked online.

In Fig. 1, the 10×5 m shuttle run test shows an improvement in average speed, with the initial mean time being 16.66 seconds and the final mean time 16.44 seconds, representing a difference of 0.23 seconds. However, the post-test coefficient of variation of 47.48% indicates a high variability among students, suggesting that the effect of the online program was not uniform. The maximum and minimum values were similar between the initial test (18.41 – 13.97 seconds) and the final test (18.39 – 13.94 seconds).

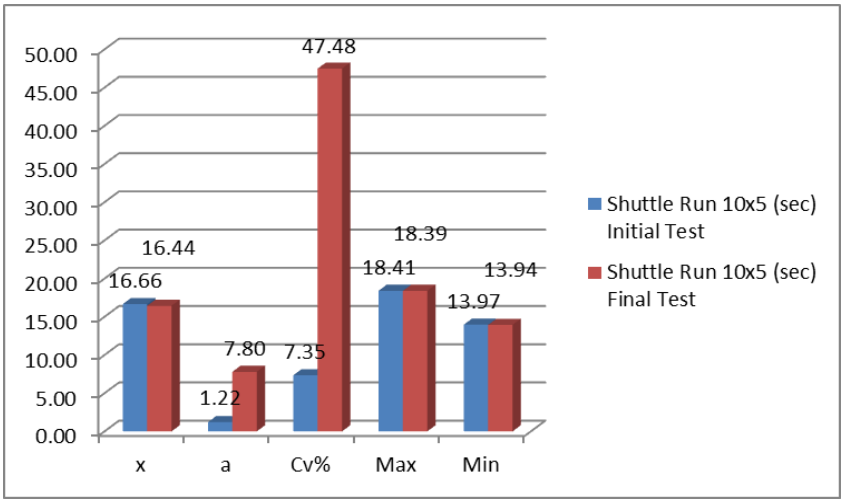

Fig. 1. Progress of students in the face-to-face control group, 10×5 m shuttle run test

In Fig.2, the 30-second trunk lift test shows a significant average increase, from 16.13 repetitions in the initial test to 19.00 repetitions in the final test, with a mean difference of 2.88 repetitions. The standard deviation increased from 2.75 to 7.07, and the coefficient of variation rose from 17.03% to 37.21%, indicating that although overall performance improved, progress was not uniform among students. The range of values shifted from 10–20 repetitions initially to 13–20 repetitions in the final test, highlighting that some students made greater gains than others.

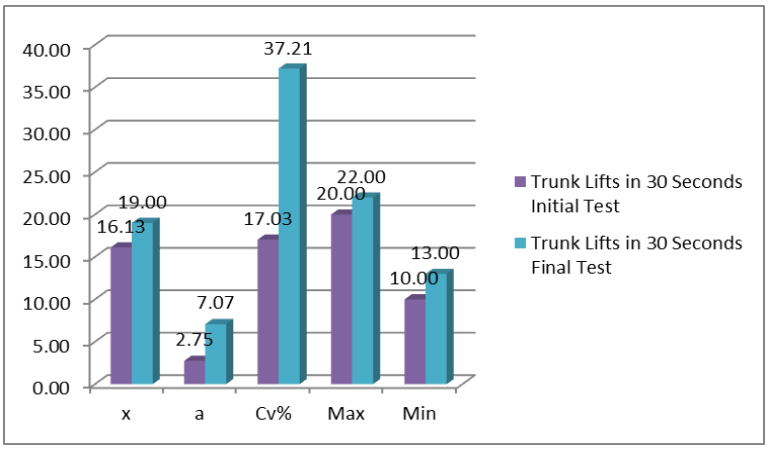

Fig. 2. Progress of students in the 30-second trunk lift test, face-to-face control group

In Fig. 3, the Static Balance Test shows a decrease in performance, with the mean time dropping from 7.13 seconds to 5.13 seconds, a difference of 2 seconds. The standard deviation increased from 1.50 to 3.86, and the coefficient of variation rose significantly from 21.01% to 75.30%, indicating extremely high variability among students. The maximum and minimum values were 9–5 seconds initially and 7–4 seconds in the final test, suggesting that the intervention's effect on balance was either negative or unevenly distributed.

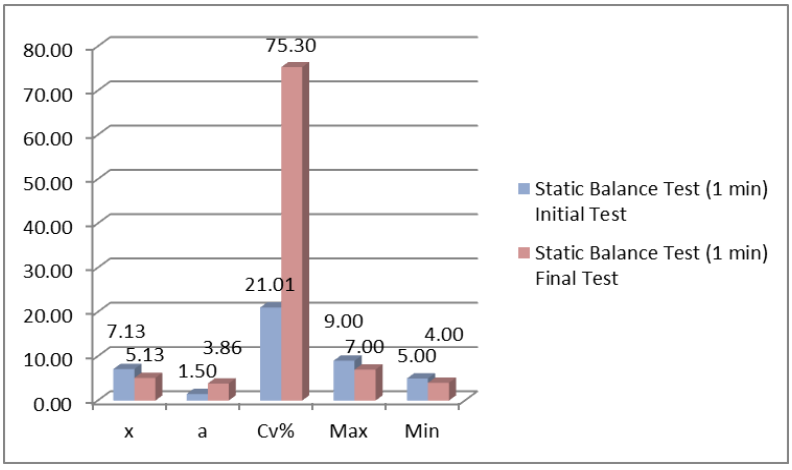

Fig. 3. Progress in the Static Balance Test – face-to-face control group

In Fig. 4, the Upper Limb Strength Test – push-ups shows an average improvement from 7.88 push-ups in the initial test to 10.31 push-ups in the final test, with a mean difference of 2.44 push-ups. The standard deviation was relatively high (5.50 initially, 5.72 finally), and the coefficient of variation was also high (69.88% initially, 55.46% finally), indicating that some students achieved significant gains while others showed smaller improvements. The range of values was 17–1 initially and 20–3 in the final test.

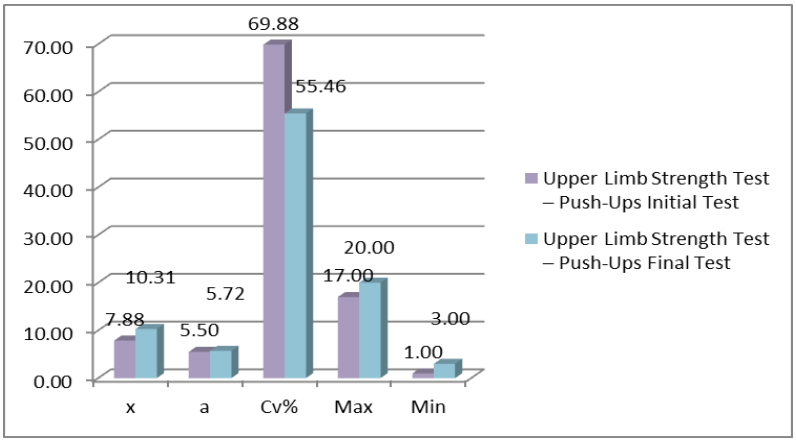

Fig. 4. Progress in the Upper Limb Strength Test – Push-ups – face-to-face control group

In Fig. 5, the Joint Mobility Test shows a decrease in the mean value from -7.88 to -10.31, a difference of -2.44, suggesting a reduction in mobility.

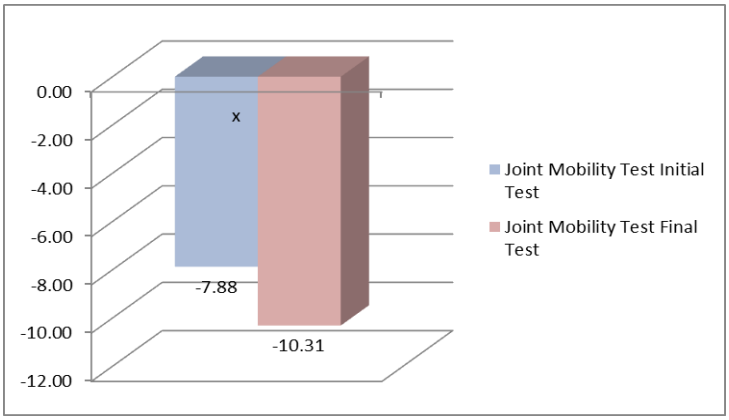

Fig. 5. Progress in Joint Mobility – face-to-face control group

In Fig. 6, the 10×5 m shuttle run test shows a slight improvement in speed. The initial mean time was 16.83 seconds, and the final mean time was 16.71 seconds, corresponding to a mean difference of 0.12 seconds. The standard deviation was 1.19 at the initial test and 1.10 at the final test, and the coefficient of variation was low, 7.04% at IT and 6.60% at FT, indicating relatively consistent performance among students. The maximum and minimum values were 18.82–13.67 seconds at IT and 18.39–13.65 seconds at FT. Therefore, it can be concluded that the intervention had a minor but positive effect on students' speed.

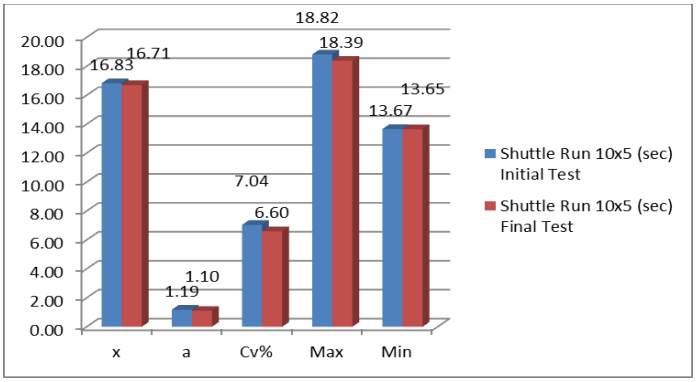

Fig. 6. Progress in the 10×5 m Shuttle Run Test – online experimental group

In Fig. 7, the 30-second trunk lift test shows a moderate increase, from an initial mean of 15.31 repetitions at IT to a final mean of 16.38 repetitions at FT, with a mean difference of 1.06 repetitions. The standard deviation was similar between the initial and final tests (1.89 vs. 1.86), and the coefficient of variation slightly decreased from 12.33% to 11.34%. The range of values was 18–11 repetitions at IT and 19–13 repetitions at FT, indicating that most students achieved consistent progress.

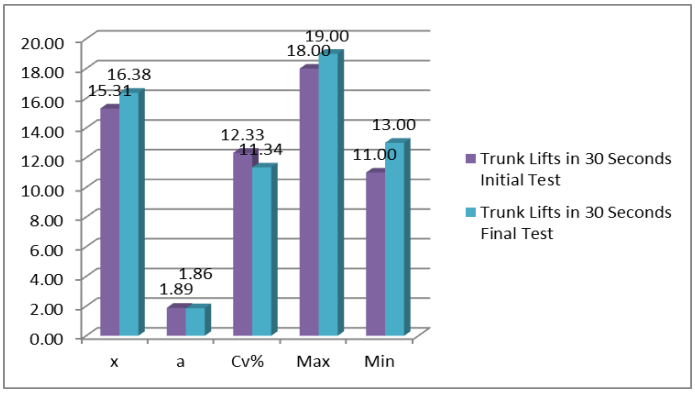

Fig. 7. Progress in the 30-Second Trunk Lift Test – online experimental group

In Fig. 8, the Static Balance Test shows a decrease in mean performance, from 7.50 seconds at IT to 6.94 seconds at FT, with a mean difference of 0.56 seconds. The standard deviation was 1.15 at IT and 1.29 at FT, and the coefficient of variation slightly increased from 15.40% to 18.59%, suggesting slightly greater variability among students after the test. The maximum values remained unchanged (9 seconds), while the minimum values decreased from 6 to 5 seconds. This indicates that, for some students, static balance was maintained, while others showed slight declines.

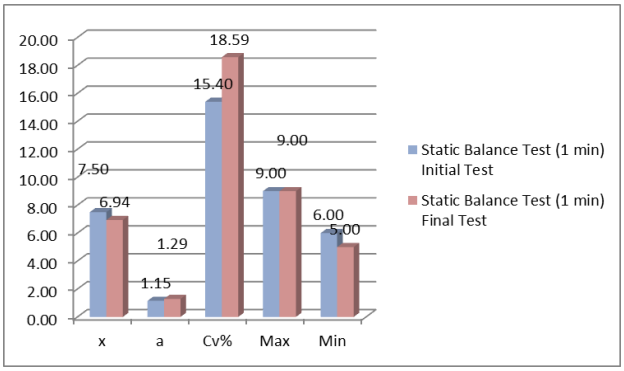

Fig. 8. Progress in the Static Balance Test – online experimental group

In Fig. 9, the Upper Limb Strength Test (push-ups) shows an average increase from 7.81 push-ups at IT to 8.69 push-ups at FT, with a mean difference of 0.88 push-ups. The standard deviation was similar between the initial and final tests (5.06 vs. 4.94), and the coefficient of variation was high but slightly lower after the physical education lessons (64.80% at IT and 56.82% at FT), indicating that progress was uneven among students, although a slight uniformity was observed. The maximum values increased from 17 to 18 push-ups, while the minimum values rose from 2 to 4 push-ups.

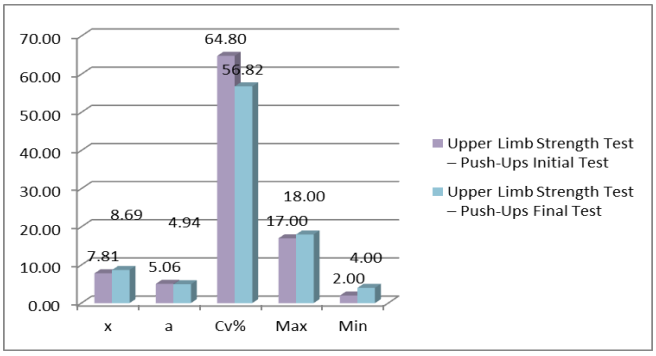

Fig. 9. Progress in the Upper Limb Strength Test (Push-ups) – online experimental group

In Fig. 10, the Joint Mobility Test shows a slight decrease in the mean value, from -7.81 at IT to -8.69 at FT, with a mean difference of -0.88. This suggests that joint mobility was not significantly stimulated by the intervention, and a slight reduction was even observed in some individuals.

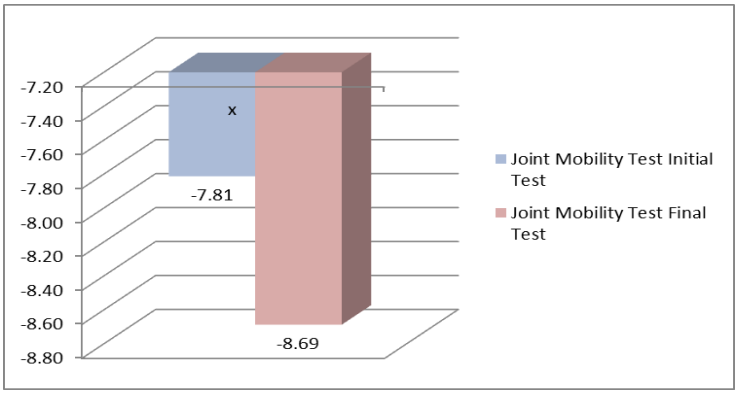

Fig. 10. Progress in Joint Mobility – online experimental group

In Fig. 11, the 10×5 m shuttle run test shows that the face-to-face control group recorded a mean time reduction from 16.66 seconds to 16.44 seconds, with a mean difference of 0.23 seconds. The online experimental group had a slight reduction from 16.83 seconds to 16.71 seconds, with a difference of 0.12 seconds. The difference between the two groups regarding improvement was 0.10 seconds, indicating a moderate effect of the intervention on speed.

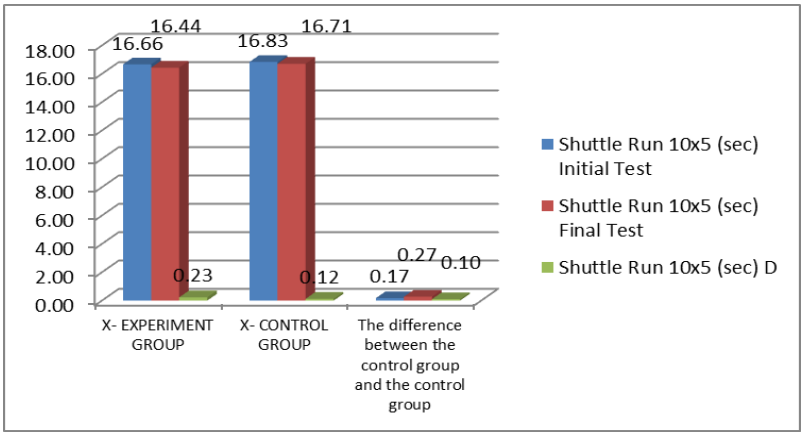

Fig. 11. Comparison of Speed Progress in the 10×5 m Shuttle Run Test between the Face-to-Face Control Group and the Online Experimental Group

In Fig.12, the 30-second trunk lift test shows that the control group progressed from 16.13 to 19.00 repetitions, with a mean difference of 2.88 repetitions. The online experimental group increased from 15.31 to 16.38 repetitions, with a mean difference of 1.06 repetitions. The difference between the two groups is 1.81 repetitions.

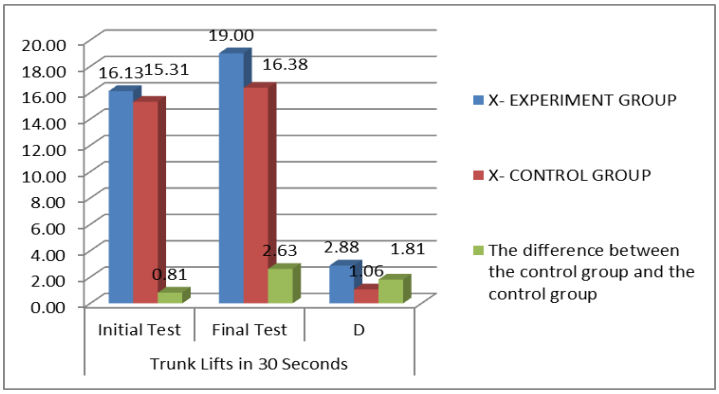

Fig. 12. Comparison of Progress in the 30-Second Trunk Lift Test between the Face-to-Face Control Group and the Online Experimental Group

In Fig. 13, the 1-minute Static Balance Test shows that the face-to-face control group recorded a decrease in mean time from 7.13 seconds to 5.13 seconds, a difference of 2 seconds. The online experimental group decreased from 7.50 seconds to 6.94 seconds, a difference of 0.56 seconds. The difference between the two groups is 1.44 seconds, indicating that the intervention did not have a positive effect on static balance, and performance declined more in the control group.

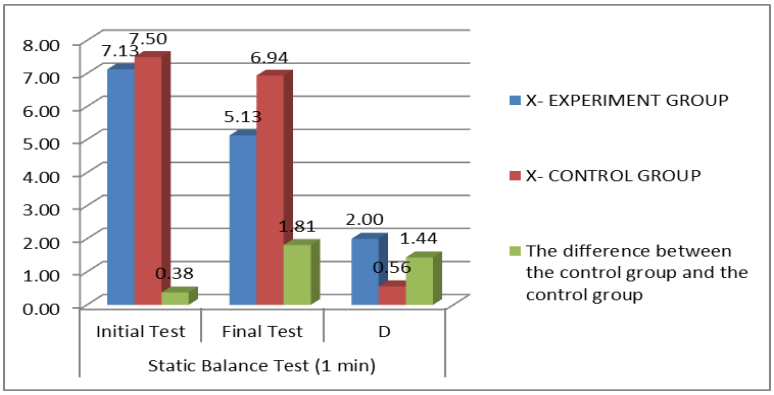

Fig. 13. Comparison of Progress in the 1-Minute Static Balance Test between the Face-to-Face Control Group and the Online Experimental Group

In Fig. 14, the Upper Limb Strength Test – push-ups shows that the control group increased from 7.88 to 10.31 push-ups, with a mean difference of 2.44 push-ups. The experimental group increased from 7.81 to 8.69 push-ups, with a mean difference of 0.88 push-ups. The difference between the two groups of 1.56 push-ups suggests a positive effect of the intervention on upper limb strength, greater than the spontaneous progress of the experimental group.

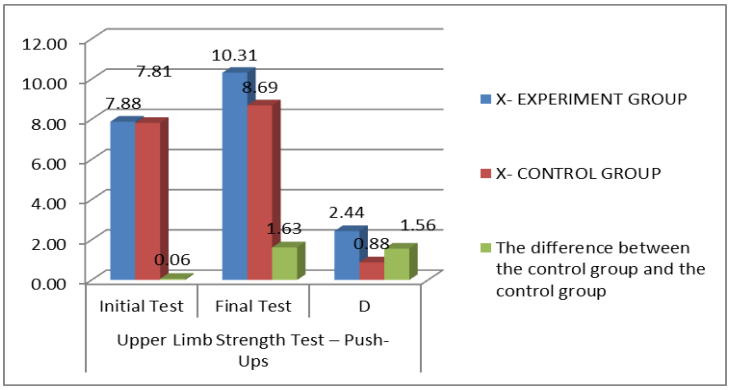

Fig. 14. Comparison of Progress in the Upper Limb Strength Test (Push-ups) between the Face-to-Face Control Group and the Online Experimental Group

In Fig. 15, the Joint Mobility Test shows that the control group decreased from -7.88 to -10.31, a difference of -2.44. The experimental group decreased from -7.81 to -8.69, a difference of -0.88. The difference between the two groups is -1.56, indicating that the applied program did not improve joint mobility and that the decrease was more pronounced in the control group.

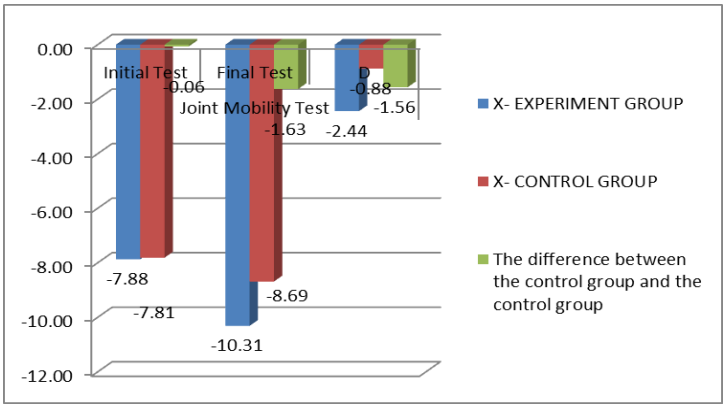

Fig. 15. Comparison of Joint Mobility Progress between the Face-to-Face Control Group and the Online Experimental Group

DISCUSSION

The results of the study conducted by (Bayburtlu et al., 2024) highlighted, through a quantitative pretest–posttest design with a single group of 34 primary school students, significant improvements in motor competence ($p<0.05$) following a hybrid physical activity program conducted over 8 weeks, both face-to-face and online via the Moodle platform. Similarly, the study by (Melero et al. 2021) demonstrated that a hybrid physical education program implemented over 9 months with 150 adolescents led to significant increases in physical fitness and physical activity levels, as well as a reduction in sedentary time ($p<0.05$), confirming the effectiveness of an approach based on personal responsibility and gamification.

CONCLUSIONS

In the control group, the implementation of the physical program for fourth-grade students led to significant increases in abdominal strength (trunk lifts) and upper limb strength (push-ups), as well as a slight improvement in speed (10×5 m shuttle run), confirming the effectiveness of exercises adapted to a hybrid context. The static balance and joint mobility tests showed stagnation or decline, indicating the need to include specific exercises for these components. High coefficients of variation highlight significant differences between students, emphasizing the importance of adapting exercises to each individual's level. The study confirms that varied and personalized methods allow the maintenance and development of basic motor skills even in hybrid learning conditions, recommending the inclusion of additional exercises for balance and mobility and tailoring physical tasks to each student's fitness level.

AUTHOR CONTRIBUTIONS

LUNGU Adrian Constantin and Vizitiu Lakhdari Elena contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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