

The effects of hybrid physical activity program on various motor skills in primary school children

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Abstract

Background and Study Aim Physical activity in children is fundamental to the development of motor skills. Despite its importance, physical activity programs do not fully address the needs of this age group. This study examined the effects of a hybrid physical activity program on specific motor skills in primary school children.

Material and Methods A quantitative single-group pretest-posttest model was used in this study. The research group included 34 voluntary students, with 19 boys and 15 girls, all in the 3rd and 4th grades of primary school. Participants followed a hybrid physical activity program developed by the researcher. The program lasted for 8 weeks, with sessions conducted 3 days a week face-to-face and 4 days a week at home. Home sessions involved parental support through the Moodle system, using educational videos or visual games. Each session lasted one hour and was supervised by an expert trainer. Motor competence data were collected using the second version of the "Test of Gross Motor Development-2" (TGMD-2), known for its reliability and validity. The data were analyzed using the SPSS 26.0 statistical package, with a significance level set at $p < 0.05$.

Results The study's findings showed significant differences in some sub-skills and total raw scores of the locomotor and object control tests between boys and girls ($p < 0.05$). Significant differences were also found between the 8- and 9-year-old groups in sub-skills and total raw scores ($p < 0.05$). Additionally, a significant difference was observed in certain sub-skills and total raw score assessments between the 3rd and 4th grades ($p < 0.05$).

Conclusions The hybrid physical activity program proved to be an effective approach for enhancing motor skills in primary school children. The findings highlight the importance of tailored physical activity programs that consider individual characteristics such as age, gender, and grade level. Implementing such programs in both school and home settings can promote more comprehensive motor development in children.

Keywords: hybrid model, physical activity, exercise, motor skills, TGMD-2

Introduction

The primary school age is a crucial period for children's growth and development, as it lays the foundation for acquiring skills essential for becoming healthy individuals. During this phase, children benefit greatly from diverse stimuli that foster their cognitive, sensory, social, and physical growth [1]. Physical activity and technological advancements are particularly engaging to primary school children, offering experiences that support their overall development.

Engaging in physical activity from an early age supports neuromuscular development and contributes to the development of motor skills, while also reducing sedentary behaviors and promoting an active lifestyle [2, 3, 4, 5, 6]. Regular participation in physical activity plays a protective role against many chronic conditions, particularly obesity, in

children [7, 8, 9]. Additionally, regular exercise aids in healthy growth and bone development, enhances cardiovascular health, supports psychosocial well-being, and assists in weight control in children [10]. It is thus evident that one of the most crucial factors in maintaining weight control is the productive use of free time through physical activity [11, 12]. Leisure time activities are an important concept that directly influences an individual's happiness, quality of life, and overall health [13, 14]. Therefore, increasing opportunities for leisure-based activities and utilizing them effectively can enable children to engage in regular physical activities, ultimately leading to a healthier lifestyle [15].

Technological advancements have become a significant aspect of human life, influencing nearly all areas of life [16, 17]. The rapid advancements in technology since the late 20th century have been particularly evident in the field of education [18]. This acceleration has led to the emergence of hybrid learning models, which have become

integral to modern education. Hybrid learning is a blend of face-to-face and online learning methods [19], combining various learning resources through technological tools such as TVs, computers, phones, and presentations, offering students opportunities for lifelong learning and development [20]. It can be applied across diverse learning environments and provides flexibility, allowing for the creation of varied educational settings and maximizing the use of available resources. Additionally, it empowers students to tailor their learning processes according to their individual characteristics and needs [21].

Hybrid learning and education models are not limited to specific scientific disciplines but are also applied in sports sciences. In the field of physical education and sports, especially concerning physical activity and exercise, hybrid learning supports the processes of learning and applying movements [22]. Additionally, technology-driven hybrid activities enhance children's and young people's interest and participation in physical activity, offering opportunities for increased motivation, social interaction, accessibility, and equality [23, 24].

Despite the numerous studies emphasizing the importance of physical activity and hybrid learning models in supporting children's development, there remains a need for more effective solutions to address these challenges. Current approaches have made significant progress in promoting active lifestyles and incorporating technological advancements into education. However, identifying the most efficient methods to integrate these elements in a way that maximizes their benefits for primary school children is still a critical area of research.

This research aims to examine the effects of a hybrid physical activity program on specific motor skills in primary school children.

Materials and Methods

A quantitative single-group pretest-posttest model was used in this research. This quantitative research design aims to determine the cause-effect relationship between variables. The single-group pretest-posttest model involves taking measurements before and after the intervention in a randomly selected group [25, 26].

Participants

The research group consisted of 34 students, including 15 third-grade and 19 fourth-grade students from Fatih Primary School in Bartın. Before the study, participants were provided with detailed information about the test protocols and study procedures. Informed consent forms were obtained from the parents of the participants. Ethical approval for the study was granted by the Bartın University Social and Human Sciences Ethics Committee, with the protocol number 2022-SBB-0644. The demographic characteristics of the study

participants, including gender, age, grade level, and preferred hand and foot, are summarized in Table 2.

Table 1. Demographic Characteristics of Study Participants

Characteristic	Category	n	%
Gender	Male	19	55.9%
	Female	15	44.1%
Age	8 years old	14	41.2%
	9 years old	18	52.9%
	10 years old	2	5.9%
Grade Level	3rd grade	15	44.1%
	4th grade	19	55.9%
Preferred Hand	Right hand	31	91.2%
	Left hand	3	8.8%
Preferred Foot	Right foot	31	91.2%
	Left foot	3	8.8%

Study Design

The data collection tools included the "Parent Permission Form" for minors, the "Moodle System," and the short form of the "Test of Gross Motor Development-2" (TGMD-2) for assessing motor competence.

Test of Gross Motor Development-2 (TGMD-2) Ulrich developed and revised this test to assess the motor development levels of children aged 3 to 10 years [27, 28]. The TGMD-2 consists of two subtests: locomotor skills and object control skills. Locomotor skills include running, galloping, hopping, leaping, horizontal jumping, and sliding. Object control skills include striking a stationary ball, dribbling, catching, kicking, overhand throwing, and underhand rolling. Each subtest comprises six sub-skills, resulting in a total of 12 sub-skills. Each sub-skill test involves 3 or 5 movement analysis items.

The Turkish adaptation and reliability-validity studies of the TGMD-2 were conducted by Boz [29]. Boz reported Cronbach's Alpha internal consistency coefficients ranging from 0.83 to 0.88 for locomotor skills, 0.75 to 0.82 for object control skills, and 0.88 to 0.92 for the total test. However, in the Turkish validity and reliability study, the "striking a stationary ball" item showed a low correlation (0.19) with the object control subtest. As a result, this item was removed, and the validity and reliability studies were adjusted accordingly [29, 30].

Physical Activity Plan

Participants followed a hybrid physical activity program developed by the researcher (Table 2). The program lasted 8 weeks, with activities conducted 3 days a week face-to-face and 4 days a week at home. Home sessions were supported by parents through the Moodle system using educational videos or visual games. Each session lasted one hour and was supervised by an expert trainer. The hybrid physical

Table 2. Physical activity program for developing fundamental movement skills for 3rd and 4th grade students

Week	Activity Type	Frequency (day)	Time (minute)	Intensity	Targeted Motor Skill for Development
1	Face-to-Face	3	60	Low	Locomotor skills (Walking, Running, Jumping, Hopping, Stepping, Skipping, Sliding, Climbing)
1	Moodle system	4	60	Low	Locomotor skills (Walking, Running, Jumping, Hopping, Stepping, Skipping, Sliding, Climbing)
2	Face-to-Face	3	60	Moderate	Non-Locomotor skills (Bending, Twisting, Swaying, Stretching)
2	Moodle system	4	60	Moderate	Non-Locomotor skills (Bending, Twisting, Swaying, Stretching)
3-4, 5-6	Face-to-Face	3	60	Moderate	Manipulative skills (Holding, Throwing, Catching, Dribbling, Kicking, Controlling)
3-4, 5-6	Moodle system	4	60	Moderate	Manipulative skills (Holding, Throwing, Catching, Dribbling, Kicking, Controlling)
7-8	Face-to-Face	3	60	Moderate	Balance and rhythm skills (Bending, Stretching, Static and Dynamic balance, rhythm)
7-8	Moodle system	4	60	Moderate	Balance and rhythm skills (Bending, Stretching, Static and Dynamic balance, rhythm)

activity plan was designed by expert educators. It considered the developmental characteristics of children and included weekly development goals, such as locomotor, balance, and manipulative skills. The plan combined face-to-face and online (hybrid) activities to achieve these goals.

This structured program gradually introduces different motor skills, allowing students to progress from basic locomotor skills to more complex manipulative and balance skills. The combination of face-to-face and home-based activities provides a balanced approach to motor development, ensuring consistent practice and skill acquisition.

Moodle System

The Moodle system is a free and open-source learning platform based on pedagogical principles, designed to assist educators [31]. Usernames and passwords were created for administrators, parents (as students), and teachers to access the system. Each parent and teacher received a detailed explanation of how to use the Moodle system, including instructions on logging in and conducting physical activities at home. To ensure the continuity of the study, regular checks were performed on parents’ system logins. Reminders were sent to those who forgot or did not log in, emphasizing the importance of participating in the activities. Parents who did not regularly log in were excluded from the study. Figure 1 provides an example of a physical activity conducted both face-to-face and through the Moodle system to develop basic motoric features.

Statistical Analysis

The data were analyzed using the SPSS 26.0 statistical package program, with the significance level set at $p < 0.05$. To determine whether there were

significant differences in the students’ motor skill test results before and after the intervention based on different variables, a paired sample t-test was employed. Prior to the test, Skewness and Kurtosis values were examined to verify if the data followed a normal distribution. Values between -2 and +2 indicate that the data are normally distributed [32]. Additionally, the minimum and maximum score values obtained were recorded. Correlation measures the degree of mathematical relationship between two variables [33], with the correlation coefficient (r) ranging between +1 and -1 [34]. Double asterisks indicate a correlation at the 1% significance level, while single asterisks denote a correlation at the 5% significance level.

Results

The results of the study are presented in Tables 3-9. In Table 3, when examining the locomotor sub-skills of participants based on gender, it was found that male participants showed statistically significant differences in running, galloping, jumping over an obstacle, long jumping, and sliding, while female participants showed statistically significant differences in running, hopping, jumping over an obstacle, and sliding ($p < 0.05$). No statistically significant differences were found in hopping for male participants and in galloping and long jumping for female participants ($p > 0.05$). When examining the object control sub-skills of participants based on gender, it was found that male participants showed statistically significant differences in dribbling, kicking, throwing, and rolling a ball, while female participants showed statistically significant differences in dribbling,



Figure 1. Example Physical Activity in Face-to-Face and Moodle System to Develop Basic Motoric Features

throwing, and rolling a ball ($p < 0.05$). No statistically significant differences were found in catching for male participants and in catching and kicking for female participants ($p > 0.05$).

In Table 4, when examining the total raw scores of participants based on gender, statistically significant differences were found in the pre-test and post-test scores for locomotor skills, object control skills, and the overall Test of Gross Motor Development-2 (TGMD-2) for both male and female participants ($p < 0.05$).

In Table 5, when examining the locomotor sub-skills of participants based on age, it was found that 8-year-old participants showed statistically significant differences in galloping and hopping, while 9-year-old participants showed statistically significant differences in running, jumping over an obstacle, and sliding ($p < 0.05$). No statistically significant differences were found in running, jumping over an obstacle, long jumping, and sliding for 8-year-old participants, and in galloping, hopping, and long jumping for 9-year-old participants. For 10-year-old participants, no

statistically significant differences were found in locomotor sub-skills ($p > 0.05$). When examining the object control sub-skills of participants based on age, it was found that 8-year-old participants showed statistically significant differences in dribbling, catching, kicking, throwing, and rolling a ball, while 9-year-old participants showed statistically significant differences in dribbling, throwing, and rolling a ball ($p < 0.05$). No statistically significant differences were found in catching and kicking for 9-year-old participants, and no statistically significant differences were found in object control sub-skills for 10-year-old participants ($p > 0.05$).

In Table 6, when examining the total raw scores of participants based on age, it was found that there were statistically significant differences in the pre-test and post-test scores for locomotor skills, object control skills, and TGMD-2 for 8- and 9-year-old participants ($p < 0.05$). No statistically significant differences were found in the pre-test and post-test scores of sub-skills for 10-year-old participants ($p > 0.05$).

In Table 7, when examining the locomotor

Table 3. T-test Results of Participants’ Relocation and Object Control Skill Scores According to the Gender Variable

Sub-skills	Gender	n	Pre-test X±SD	Post-test X±SD	SD	t	p
Running	Male	19	5.316±1.4550	7.053±1.2236	2.130	3.554	0.002*
	Female	15	4.667±1.6330	6.933±1.3345	2.250	3.900	0.002*
Gallop	Male	19	6.316±1.2933	7.421±1.0174	1.822	2.643	0.017*
	Female	15	6.467±0.9904	7.267±1.0328	1.521	2.037	0.061
One-Legged Hop	Male	19	7.632±2.0333	8.368±1.6737	2.256	1.423	0.172
	Female	15	7.933±1.8696	9.000±0.6547	1.667	2.744	0.027*
Running Over Hurdle	Male	19	4.053±1.5802	5.105±1.2425	2.223	2.064	0.54*
	Female	19	4.000±1.3628	5.200±0.8619	1.698	2.736	0.016*
Long Jump	Male	19	5.895±1.7605	7.105±1.1002	2.347	2.248	0.037*
	Female	15	6.067±1.6676	6.200±1.2071	2.231	0.231	0.820
Sliding	Male	19	6.000±1.9149	7.158±0.8983	1.708	2.955	0.008*
	Female	15	5.467±2.1996	6.933±1.0328	2.294	2.475	0.027*
Bouncing the Ball	Male	19	5.895±1.6632	7.526±0.6967	1.605	4.429	0.000*
	Female	15	5.267±1.7512	6.800±1.0142	1.995	2.976	0.010*
Holding the Ball	Male	19	5.053±1.1291	5.211±0.8550	1.463	0.470	0.644
	Female	15	5.533±1.1127	5.533±0.6399	1.014	0.764	0.458
Kicking the Ball	Male	19	6.526±1.3068	7.632±0.5973	1.448	3.325	0.004*
	Female	15	6.467±1.1255	7.000±0.8452	1.060	1.948	0.072
Throwing the Ball	Male	19	6.368±1.7705	7.789±0.4189	1.773	3.492	0.003*
	Female	15	4.800±1.9346	6.933±1.1629	1.807	4.571	0.000*
Rolling the Ball	Male	19	5.632±1.8622	7.158±1.1673	1.836	3.622	0.002*
	Female	15	5.600±1.7238	7.000±1.3628	1.681	3.224	0.006*

Note. * - p<0.05

Table 4. T-test results for participants’ raw scores on locomotor-object control skills and total scores on the Test of Gross Motor Development-2 (TGMD-2) by gender variable

Total Raw Score	Gender	n	Pre-test X±SD	Post-test X±SD	SD	t	p
Locomotor raw score	Male	19	35.211±3.7650	42.211±3.5836	5.416	5.634	0.000*
	Female	15	34.600±4.9828	41.533±3.2264	5.020	5.348	0.000*
Object Control Raw Score	Male	19	29.474±3.0252	35.316±1.8575	2.930	8.691	0.000*
	Female	15	26.800±5.3077	33.267±2.9147	4.793	5.224	0.000*
BKMGT-2	Male	19	64.684±1.3313	77.526±4.2865	6.202	9.025	0.000*
	Female	15	62.067±7.6108	74.800±4.9019	5.637	8.748	0.000*

Note. * - p<0.05

sub-skills of participants based on class, it was found that 3rd-grade participants showed statistically significant differences in galloping and hopping, while 4th-grade participants showed statistically significant differences in running, jumping over an obstacle, and sliding (p<0.05). No statistically significant differences were found in running, jumping over an obstacle, long jumping, and sliding for 3rd-grade participants, and no

statistically significant differences were found in galloping, hopping, and long jumping for 4th-grade participants (p>0.05). When examining the object control sub-skills of participants based on class, it was found that 3rd-grade participants showed statistically significant differences in dribbling, catching, kicking, throwing, and rolling a ball, while 4th-grade participants showed statistically significant differences in dribbling, throwing, and

Table 5. T-test Results of Participants' Displacement and Object Control Skill Scores According to the Age Variable

Sub-skills	Age	n	Pre-test X±SD	Post-test X±SD	SD	t	p
Running	8	14	5.571±1.5549	6.000±1.3009	1.910	0.840	0.416
	9	18	4.722±1.5265	7.722±0.5745	1.715	7.422	0.000*
	10	2	4.000±0.0000	7.500±0.7071	0.707	7.000	0.090
Gallop	8	14	6.000±1.1094	7.786±0.5789	1.476	4.524	0.001*
	9	18	6.556±1.1490	7.056±1.1618	1.581	1.342	0.197
	10	2	7.500±0.7071	7.000±1.4142	2.121	-3.33	0.795
One-Legged Hop	8	14	6.786±1.5281	7.857±1.4064	1.542	2.599	0.022*
	9	18	8.556±1.9470	9.222±1.0603	2.351	1.203	0.246
	10	2	7.500±2.1213	9.000±0.0000	2.121	1.000	0.500
Running Over Hurdle	8	14	4.214±1.2514	4.857±1.1673	1.736	1.385	0.189
	9	18	3.889±1.5676	5.389±0.9785	1.977	3.218	0.005*
	10	2	4.000±2.8284	5.000±1.4142	4.242	0.333	0.795
Long Jump	8	14	5.714±2.0164	6.571±1.5046	2.851	1.125	0.281
	9	18	6.167±1.5049	6.833±1.0432	2.000	1.414	0.175
	10	2	6.000±1.4142	6.500±0.7071	2.121	0.333	0.795
Sliding	8	14	6.500±1.6984	7.286±0.9139	1.528	1.924	0.077
	9	18	5.056±2.1275	6.889±0.9634	2.229	3.489	0.003*
	10	2	7.000±1.4142	7.562±7078	2.122	0.353	0.825
Bouncing the Ball	8	14	6.286±1.5407	7.143±0.9493	1.027	3.122	0.008*
	9	18	5.389±1.5770	7.278±0.8948	1.996	4.014	0.001*
	10	2	3.000±1.4142	7.000±0.0000	1.414	2.000	0.300
Holding the Ball	8	14	4.571±1.2225	5.357±0.6333	1.181	2.474	0.028*
	9	18	5.667±0.7670	5.278±0.8948	1.092	-1.511	0.149
	10	2	5.000±1.4142	6.000±0.0000	1.414	1.000	0.500
Kicking the Ball	8	14	6.214±1.4239	7.429±0.6462	1.423	3.191	0.007*
	9	18	6.833±0.9852	7.222±0.8782	1.036	1.591	0.130
	10	2	5.500±0.7071	8.000±0.0000	0.707	5.000	0.126
Throwing the Ball	8	14	5.429±1.8277	7.071±1.1411	1.691	3.633	0.003*
	9	18	5.667±2.1420	7.611±0.6978	1.954	4.221	0.001*
	10	2	7.500±0.7071	8.000±0.000	0.707	1.000	0.500
Rolling the Ball	8	14	5.429±2.0273	6.571±1.3425	1.915	2.232	0.044*
	9	18	5.667±1.6803	7.389±1.0922	1.708	4.277	0.001*
	10	2	6.500±0.7071	8.000±0.0000	0.707	3.000	0.205

Note. * - $p < 0.05$

rolling a ball ($p < 0.05$). No statistically significant differences were found in catching and kicking for 4th-grade participants ($p > 0.05$).

In Table 8, when examining the total raw scores of participants based on class, it was found that there were statistically significant differences in the pre-test and post-test scores for locomotor skills, object control skills, and TGMD-2 for both 3rd- and 4th-grade participants ($p < 0.05$). In Table 9 a significant relationship was observed between the

TGMD-2 pre-test and post-test scores collected from students both before and after the intervention.

Discussion

Our study aimed to predict the findings and compare them with the information in the literature by analyzing the effects of a hybrid physical activity program applied to primary school children on specific motor skills. According to the gender variable, statistically significant differences were

Table 6. T-test results for participants' raw scores on locomotor-object control skills and total scores on the Test of Gross Motor Development-2 (TGMD-2) by age variable

Total Raw Score	Age	n	Pre-test X±SD	Post-test X±SD	SD	t	p
Locomotor raw score	8	14	34.786±5.4091	40.357±3.6712	5.094	4.092	0.001*
	9	18	34.944±3.6051	43.111±2.9082	5.316	6.517	0.000*
	10	2	36.000±1.4142	42.000±1.4142	2.828	3.000	0.205
Object Control Raw Score	8	14	27.214±5.8596	33.571±2.8747	4.684	5.078	0.000*
	9	18	29.222±2.8606	34.778±2.1843	3.072	7.672	0.000*
	10	2	27.500±0.7071	37.500±1.4142	2.121	6.333	0.100
BKMGT-2	8	14	62.714±8.7656	73.929±5.2545	5.577	7.524	0.000*
	9	18	64.167±5.1933	77.889±3.6924	6.266	9.290	0.000*
	10	2	63.500±0.7071	79.000±0.0000	0.707	31.000	0.021

Note. * - p<0.05

Table 7. T-test Results for Participants' Locomotor and Object Control Skill Scores by Grade Variable

Sub-skills	Grade	n	Pre-test X±SD	Post-test X±SD	SD	t	p
Running	3rd Grade	15	5.400±1.6388	6.067±1.2799	2.058	1.254	0.230
	4th Grade	19	4.737±1.4469	7.737±0.5620	1.666	7.846	0.000*
Gallop	3rd Grade	15	5.933±1.0998	7.733±0.5936	1.424	4.895	0.000*
	4th Grade	19	6.737±1.0976	7.053±1.1773	1.600	0.860	0.401
One-Legged Hop	3rd Grade	15	6.667±1.5430	7.867±1.3558	1.567	2.965	0.010*
	4th Grade	19	8.632±1.8016	9.263±0.9912	2.290	1.202	0.245
Running Over Hurdle	3rd Grade	15	4.333±1.2910	4.733±1.2228	1.919	0.807	0.433
	4th Grade	19	3.789±1.5839	5.474±0.8412	1.887	3.890	0.001*
Long Jump	3rd Grade	15	5.867±2.0307	6.533±1.4573	2.845	0.907	0.380
	4th Grade	19	6.053±1.4327	6.842±1.0145	1.902	1.809	0.087
Sliding	3rd Grade	15	6.600±1.6818	7.333±0.8997	1.486	1.911	0.077
	4th Grade	19	5.105±2.0789	6.842±0.9582	2.207	3.430	0.003*
Bouncing the Ball	3rd Grade	15	6.400±1.5492	7.200±0.9411	1.014	3.055	0.009*
	4th Grade	19	5.000±1.5986	7.211±0.9177	1.988	4.846	0.000*
Holding the Ball	3rd Grade	15	4.667±1.2344	5.333±0.6172	1.234	2.092	0.055*
	4th Grade	19	5.579±0.8377	5.368±0.8951	1.182	-776	0.448
Kicking the Ball	3rd Grade	15	6.200±1.3732	7.467±0.6399	1.387	3.537	0.003*
	4th Grade	19	6.737±1.0457	7.263±0.8719	1.172	1.957	0.066
Throwing the Ball	3rd Grade	15	5.200±1.9712	7.067±1.0998	1.846	3.915	0.002*
	4th Grade	19	6.053±1.9571	7.684±0.6710	1.801	3.948	0.001*
Rolling the Ball	3rd Grade	15	5.600±2.0633	6.667±1.3452	1.869	2.210	0.044*
	4th Grade	19	5.632±1.5709	7.421±1.0706	1.618	4.819	0.000*

Note. * - p<0.05

found in some sub-skills of the locomotion and object control tests, as well as in the total raw scores of male and female participants when comparing pre-test and post-test results (p<0.05). When the literature is reviewed, a study conducted with 30 male and female students - 16 of whom received traditional education and 14 of whom received

Montessori education - implemented a movement and play education program that lasted 45 minutes twice a week for 12 weeks. The results of this study showed that the play education program applied to both groups led to a significant difference in the TGMD-2 locomotor and object control sub-skills scores, resulting in improved motor skills [35].

Table 8. T-test results for participants' raw scores on locomotor-object control skills and total scores on the Test of Gross Motor Development-2 (TGMD-2) by Grade variable

Total Raw Score	Grade	n	Pre-test X±SD	Post-test X±SD	SD	t	p
Locomotor raw score	3rd Grade	15	34.800±5.2126	40.267±3.5550	4.926	4.298	0.001*
	4th Grade	19	35.053±3.5351	43.211±2.6994	5.166	6.882	0.000*
Object Control Raw Score	3rd Grade	15	27.400±5.6921	33.733±2.8402	4.514	5.433	0.000*
	4th Grade	19	29.000±2.8284	34.947±2.2428	3.274	7.918	0.000*
BKMGT-2	3rd Grade	15	62.867±8.4673	74.000±5.0709	5.383	8.010	0.000*
	4th Grade	19	64.053±5.0495	78.158±3.5318	6.045	10.171	0.000*

Note. * - $p < 0.05$

Table 9. Participants' Pearson correlation analysis results

		Pre-test Locomotor Skill	Pre-test Object Control Skill	Pre-test Total	Post-test Locomotor Skill	Post-test Object Control Skill	Post-test Total
Pre-test Locomotor	R	1					
	P						
	N	34					
Pre-test Object Control	R	.537**	1				
	P	.001					
	N	34	34				
Pre-test Total	R	.873**	.842**	1			
	P	.000	.000				
	N	34	34	34			
Post-test Locomotor	R	.110	.482**	.344*	1		
	P	.536	.004	.047			
	N	34	34	34	34		
Pre-test Object Control	R	.364*	.486**	.488**	.231	1	
	P	.034	.004	.003	.189		
	N	34	34	34	34	34	
Post-test Total	R	.278	.613**	.514**	.848**	.711**	1
	P	.112	.000	.002	.000	.000	
	N	34	34	34	34	34	34

Note. * - $P < 0.05$; ** - $P < 0.01$; R - Pearson correlation coefficient; N - sample size

In another study conducted with children with characteristics similar to those of our study group, it was found that the group receiving movement education for 2 hours a week for 14 weeks showed improvements in motor performance and skills [36]. The results of other studies are consistent with our findings [37, 38, 39]. However, the existing literature emphasizes the positive effects of physical activities supported by individual assistance rather than those of technology-supported interventions on motor skills. In this context, our study demonstrates the positive effects of integrating technology support with individual assistance on the development of

motor skills.

In another study similar to ours, a study was conducted with 183 primary school students, dividing the participants into three groups: control, information technology-supported movement education, and teacher-supported movement education. The information technology-supported group learned the movements through an information-based system, while the teacher-supported group performed the movements under the guidance of physical education teachers. The TGMD-2 motor test was used before and after the eight-week program, which took place for two

hours a week. The results showed positive effects on locomotion, object control, and gross motor development in both the information technology-supported and teacher-supported groups. Gender did not impact motor performance, locomotion, object control, or total scores [40]. Other studies in the literature also demonstrate that gender does not influence motor performance and skills [41, 42, 43]. This discrepancy may be due to differences in the sample groups and the content of the physical activity programs applied.

According to the age variable, statistically significant differences were found in some sub-skills of the locomotion and object control tests, as well as in the total raw scores of 8-9-year-old participants when comparing pre-test and post-test results ($p < 0.05$). In a study involving a similar age group, 17 female students participated in a gymnastics training program two days a week, one hour per day, for eight weeks, with motor performance and skills assessed using the TGMD-2 test. The results showed positive improvements in all parameters except locomotor skills in the post-test measurements [44]. In another study, a 12-week coordination-based movement training program was observed to improve motor performance [45]. A similar study in the literature involved 906 preschool children - 662 Turkish and 244 Bulgarian - using the Ulrich Gross Motor Development Test. This study applied video-based digital physical exercise videos for 15 minutes over eight weeks, and the results indicated that the digital exercise program significantly improved gross motor skills in the experimental group [46].

In addition, other studies in the literature align with our findings. Regularly performed fundamental movement training and gymnastics education in children have been shown to positively support the development of motor skills [47, 48, 49, 50]. Similarly, it has been reported that educational game-based training has positive effects on the subcomponents of motor skills in children [51, 52, 53]. Furthermore, another study found that a video game-supported model contributed to the motor development of children [54]. In other studies, it has been determined that physical activity conducted for a duration of 3 months supports motor development in children [55, 56, 57]. Other studies have indicated that motor skill training and structured games enhance children's motor and movement development [58, 59]. Additionally, a study found that the motor skills of children who engage in sports differ from those who do not, with children participating in sports showing better motor skills [60]. Some studies have also found that specially designed developmental training and multidimensional exercise plans for children positively impact motor development [61, 62, 63, 64].

According to the grade variable, statistically significant differences were found in some sub-skills of the locomotion and object control tests, as well as in the total raw scores of 3rd- and 4th-grade participants when comparing pre-test and post-test results ($p < 0.05$). In a study from the literature involving 54 children in 1st, 2nd, 3rd, and 4th grades, physical activity using physical activity cards (PAC) was implemented three days a week for eight weeks, followed by height and weight measurements of both groups, and the TGMD-2 test was applied. The results indicated positive effects on movement, object control, and gross motor development in the experimental group [65]. Similarly, in a study conducted with a total of 40 4th-grade students in experimental and control groups, futsal training was added to the Ministry of National Education curriculum for motor skills training and implemented for eight weeks. The TGMD-3 test was used for pre- and post-program measurements. The results showed that the training program applied to the experimental group improved locomotor skills, ball skills, and gross motor skills [66]. The results of other studies in the literature are consistent with our findings [67, 68, 69].

The findings of our study indicate that a hybrid physical activity program positively influences the development of motor skills in primary school children. The observed improvements in locomotor and object control skills align with existing literature. This supports the effectiveness of both traditional and technology-supported programs. However, our study has certain limitations. These include a relatively small sample size and a short duration of the intervention. Future research should consider using larger and more diverse samples. Additionally, it is important to investigate how different components of these programs can be optimized to further enhance motor development in children.

Conclusions

The hybrid physical activity program applied in this study improved certain motor skills in children. Unlike traditional methods, hybrid activities can stimulate curiosity in children, fostering motivation and the development of regular physical activity habits. Additionally, hybrid programs help reduce inequalities in access to physical activities, strengthen family bonds, and encourage parental involvement in their children's physical activities. They also support the development of children's social skills, making hybrid approaches a valuable addition to traditional physical education methods.

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