ISSN 2708-7581 (Online)
ISSN-L 2708-7573

JLTM Journal of Learning Theory and Methodology

Scientific journal

August 2025
Volume 6
Number 2

JLTM
LLC OVS

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

Journal of Learning Theory and Methodology
Журнал теорії та методології навчання
Abbreviated key-title: J. learn. theory methodol. (Online)

Scientific journal
Науковий журнал

Three issues per year. Established in 2020
Три випуски на рік. Заснований у 2020 році

https://www.ltmjournal.com. E-mail: editor-in-chief@ltmjournal.com

Editor-in-Chief

Olha Ivashchenko, Doctor of Pedagogy, Professor,
Kharkiv State Academy of Physical Culture, Ukraine

Editor Board

Roberto Araya, PhD, Professor,
University of Chile, Santiago, Chile

Oksana Blavt, Doctor of Pedagogy, Professor, Lviv Polytechnic National University, Ukraine

Wojciech J. Cynarski, Prof. Dr hab., Full Professor,
University of Rzeszow, Poland

Francesca D'Elia, PhD in Methodology of Educational Research, Associate Professor, University of Salerno, Italy

Karol Görner, Prof. PaedDr., PhD,
Matej Bel University in Banská Bystrica, Slovakia

Sergii Harkusha, Doctor of Pedagogy, Professor,
T. H. Shevchenko National University "Chernihiv Colehium", Ukraine

Oleg Khudolii, Doctor of Sciences in Physical Education and Sport, Professor, Kharkiv State Academy of Physical Culture, Ukraine

Nur Ikhwan Mohamad, PhD, Professor, Sultan Idris Education University, Malaysia

Kukuh Wahyudin Pratama, M.S.Sc., Institute of Advanced Science, Engineering, and Education (IASEE), Malaysia

Valentina Voronova, PhD in Pedagogy, Professor, National University of Ukraine on Physical Education and Sport, Ukraine

Головний редактор

Ольга Іващенко, докторка педагогічних наук, професорка,
Харківська державна академія фізичної культури, Україна

Редакційна колегія

Роберто Арайя, доктор філософії, професор,
Університет Чилі, Сантьяго, Чилі

Оксана Блавт, докторка педагогічних наук,
професорка, Національний університет «Львівська політехніка», Україна

Валентина Воронова, кандидатка педагогічних наук,
професорка, Національний університет фізичного виховання і спорту України, Україна

Сергій Гаркуша, доктор педагогічних наук, професор,
Національний університет «Чернігівський колегіум» імені Т. Г. Шевченка, Україна

Кароль Гернер, доктор філософії, професор, Університет Матея Бела в Банській Бистриці, Словаччина

Франческа Д'Еліа, докторка філософії з методології освітніх досліджень, доцентка, Університет Салерно, Італія

Войцех Кінарський, доктор наук, професор, Жешувський університет, Польща

Нур Іхван Мохамад, доктор філософії,
професор, Університет освіти Султана Ідріса, Малайзія

Кукух Вахюдін Пратама, M.S.Sc., Інститут передової науки, техніки та освіти, Малайзія

Олег Худолій, доктор наук з фіз.вих і спорту, професор,
Харківська державна академія фізичної культури, Україна

Abstracting and Indexing:

CrossRef; ROAD (Directory of Open Access scholarly Resources); DOAJ (Directory of Open Access Journals); ICI Journals Master List / ICI World of Journals; Google Scholar; Open Ukrainian Citation Index (OUCI); Scilit (A database of scientific & scholarly literature); WorldCat

DOI: https://doi.org/10.17309/jltm.2025.6.2

© «ОВС» ТОВ, оформлення, 2025
© «Журнал теорії та методології навчання», 2025

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

Journal of Learning Theory and Methodology
Scientific journal
August 2025, Vol. 6, Num. 2

Contents

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

Журнал теорії та методології навчання
Науковий журнал
Серпень 2025, Том 6, Номер 2

Зміст

Journal of Learning Theory and Methodology
Журнал теорії та методології навчання

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

Original Scientific Article

Influence of Varying Backpack Loads and Selected Carrying Durations on Time Elapsed Between First and Second Peak Forces of Walking Gait of School-going Boys

Rabiya Husain[1ABCDE] **and Dhananjoy Shaw**[2ABCDE]

[1]University of Delhi

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

DOI: 10.17309/jltm.2025.6.2.01

Abstract

Objectives. To examine the effects of varying backpack loads and carrying durations on the time elapsed between the first peak force (FPF) and the second peak force (SPF) during the walking gait of school-going boys.

Materials and Methods. Eighty-five boys (aged 10–12 years) from the National Capital Territory of Delhi participated. Temporal gait parameters were measured using a Zebris Force Distribution Measurement pressure plate under five backpack load conditions (0%, 8%, 12%, 16%, and 20% of body weight) and five carrying durations (0, 5, 10, 15, and 20 minutes). Participants walked barefoot along a 10 m walkway with the plate positioned centrally. Data from five trials per condition were analyzed descriptively.

Results. Increasing load and duration significantly prolonged the interval between FPF and SPF, indicating an extended midstance phase. At 15–20% body weight, compensatory gait mechanisms began to fail, leading to longer intervals and greater variability, suggesting biomechanical strain and reduced walking efficiency.

Conclusions. Backpack weight and carrying duration markedly influence temporal gait parameters, particularly the FPF–SPF interval. These findings support the need for effective load management and ergonomic strategies to ensure safe backpack use in schoolchildren.

Keywords: backpack load, first peak force, gait analysis, load carriage, midstance phase, second peak force, time interval.

Introduction

Walking gait is the coordinated sequence of movements critical for locomotion, providing insights into physical health, rehabilitation, and biomechanics. The analysis of gait mechanics is particularly relevant for understanding how forces are distributed during walking. Key components of gait analysis include the first and second peak forces, which occur at heel strike and toe-off, respectively (Husain et al., 2024a). These peak forces are critical indicators of the stresses placed on the body during walking and offer valuable information on the body's balance and load-bearing capacity (Whittle, 1993; Buldt et al., 2018; Husain et al., 2024b).

Backpacks, commonly used by schoolchildren, are intended to align with the body's center of gravity to enhance stability (Pascoe et al., 1997; Sheir-Neiss et al., 2003). However, as the weight of the backpack increases, so does the strain on the body, which can alter walking mechanics (Perrone et al., 2018). Studies have shown that carrying heavy backpacks can lead to changes in gait patterns, increased energy consumption, and potential musculoskeletal discomfort (Macias et al., 2008; Castro et al., 2013; Castro et al., 2015; Pau et al., 2015). Furthermore, carrying a backpack for extended periods can lead to fatigue, which in turn reduces walking speed and affects the overall gait cycle (Chow et al., 2005; Hong et al., 2008). Chow et al. (2005) also observed that loads exceeding ten percent of body weight notably increased demands on the hip and ankle joints, suggesting this as a critical threshold for load-induced biomechanical adaptations.

Kellis and Arampatzi (2009) highlighted that carrying schoolbags alters both temporal characteristics of gait and ground reaction forces. They found that modes of carrying, such as by hand versus on the back, influence gait efficiency, with low-back backpack positions causing fewer alterations compared to hand-carried bags. Furthermore, Hong and Cheung (2003) identified trunk inclination as a significant factor in load-bearing, emphasizing that backpacks exceeding fifteen percent body weight induce notable increases in

© Husain, R., & Shaw, D., 2025.

JLTM
LLC OVS

Corresponding Author: Rabiya Husain,
e-mail: rabiyahsn70@gmail.com

forward lean. While stride parameters remained stable under loads of fifteen percent body weight, prolonged carrying distances exacerbated mechanical stress.

Despite extensive research on general gait alterations due to backpack loads, studies rarely investigate the temporal dynamics between the first and second peak forces during the gait cycle. This interval is critical for understanding how the body dynamically adapts to varying loads and prolonged durations. The current study addresses this gap by exploring how different backpack weights and carrying durations influence the time elapse between these peaks in school-aged children. By examining this specific aspect of the gait cycle, this research aims to contribute to evidence-based recommendations for safe backpack use, helping to mitigate injury risks and enhance musculoskeletal health.

Based on the existing literature and preliminary observations, the current study hypothesizes that increasing backpack load and prolonged carrying duration will significantly affect the temporal dynamics of gait, specifically by increasing the time elapse between the first and second peak forces, which may indicate biomechanical stress and compensatory gait patterns.

Materials and Methods

Study Participants

A total of eighty-five school going boys from National Capital Territory of Delhi, India, age ranged between 10 to 12 years were selected randomly. Participants eligible for the study had to meet the following criteria: they were required to be male, aged between 10 and 12 years, and confirmed to be in good health. Those with acute or chronic illnesses or incomplete documentation were excluded. Additionally, participants were clearly informed of their right to withdraw from the study at any stage during the data collection process.

Study Design

The study aimed to investigate the impact of increasing backpack loads and extended walking durations on the time interval between the first and second peak forces within the gait cycle. The experimental design was utilised, where participants experienced five varying levels of backpack loads and five durations of carrying, structured in a 5x5 experimental factors. Further specifics of this research design are outlined in Table 1.

Instruments

A Zebris FDM (Force Distribution Measurement) pressure plate, measuring 40x30 cm (Figure 1), was used in the study to evaluate the time elapsed between the first peak force and second peak force during walking gait. The Zebris FDM pressure plate functions with a sampling frequency of 120 Hz and has a measurement accuracy of ±5% within its calibrated range of 1–120 N/cm². It utilizes capacitive pressure sensors arranged in a matrix, enabling detailed mapping of force distribution. The Zebris FDM-S system has shown excellent internal consistency (Cronbach's alpha exceeding 0.90) for gait-related metrics, supported by a double retest protocol conducted over two consecutive days. Prior studies, such as Van Alsenoy et al. (2019), have validated the platform's reliability and accuracy in test-retest assessments. The plate operated with Win FDM-S software (Zebris GmbH, Germany), and its user manual is publicly available online (https://www.zebris.de/fileadmin/Editoren/zebris-PDF-Manuals/Medizin/Software/Alte_Versionen/Manual_zebris_FDM_1.16.x_R1_EN_web.pdf). The platform's reliability and validity for gait analysis were confirmed by Van Alsenoy et al (2019).

Fig. 1. The Zebris Pressure Plate

In addition, a standard backpack with double-strap, which was similar to those commonly carried by school students was used. It was filled with essential items typically carried by students, replicating realistic conditions. The total weight of the backpack was adjusted according to the experimental requirements. A calibrated weighing scale was employed to ensure the accuracy of the backpack's weight as per the body weight of each subject before each trial.

Selection of the Variables

Following variables were selected for the study:
Experimental Variables (Independent Variables)

Table 1. Backpack Load and Time Duration Protocol for Data Collection

Duration/ Backpack Load	D 0 minute	D 5 minutes	D 10 minutes	D 15 minutes	D 20 minutes
BL 0 Percent of BW	S1…S85	S1…S85	S1…S85	S1…S85	S1…S85
BL 8 Percent of BW	S1…S85	S1…S85	S1…S85	S1…S85	S1…S85
BL 12 Percent of BW	S1…S85	S1…S85	S1…S85	S1…S85	S1…S85
BL 16 Percent of BW	S1…S85	S1…S85	S1…S85	S1…S85	S1…S85
BL 20 Percent of BW	S1…S85	S1…S85	S1…S85	S1…S85	S1…S85

Note. S= Subject, S1= Subject First, S85= Subject Eighty-Fifth, BL = Backpack Load, BW = Body Weight, D = Duration

Backpack load

- Zero percent (no) backpack load of the bodyweight of the subject.
- Eight percent backpack load of the bodyweight of the subject.
- Twelve percent backpack load of the bodyweight of the subject.
- Sixteen percent backpack load of the bodyweight of the subject.
- Twenty percent backpack load of the bodyweight of the subject.

Duration of carrying the backpack load (recording time)

- At zero minute (at the start of the walking gait).
- At 5th minute of the walking gait.
- At 10th minute of the walking gait.
- At 15th minute of the walking gait.
- At 20th minute of the walking gait.

Observational Variables (Dependent Variables)

- Time elapse between first and second peak forces of the left foot (millisecond).
- Time elapse between first and second peak forces of the right foot (millisecond).

Procedure

Data collection was conducted at the Biomechanics Laboratory. The informed consent was obtained from participants' guardians in advance. Before data collection, each subject's body weight was measured using a calibrated scale verified with a standard weight. A 10-meter-long wooden walkway was constructed, with the pressure plate placed at its center to ensure a seamless walking path. Participants walked barefoot to allow for more accurate and clinically appropriate gait analysis.

The testing protocol began with participants starting from a designated line 4.5 meters before the pressure plate. Each participant initially stepped onto the plate with their left foot, walking naturally at a comfortable pace across the platform while wearing the backpack. Upon reaching the end of the walkway, 4.5 meters past the plate, they turned 180 degrees and walked back, stepping onto the plate with their right foot. This sequence was repeated for five trials, ensuring that each foot made contact with the pressure plate five times. The Zebris FDM-S pressure plate collected data on the selected variables, including the time interval between the first and second peak forces, which were then processed using Win FDM-S software for analysis.

This approach ensured that the data reflected real-life conditions, providing reliable and clinically relevant insights into the temporal dynamics of gait under varying backpack loads.

Statistical Analysis

The pressure platform data was exported to Excel for analysis. Descriptive statistics, including mean, standard deviation were applied to interpret the results.

Results

The Figure 2 defines several key time intervals related to gait mechanics while stepping on a pressure plate as per

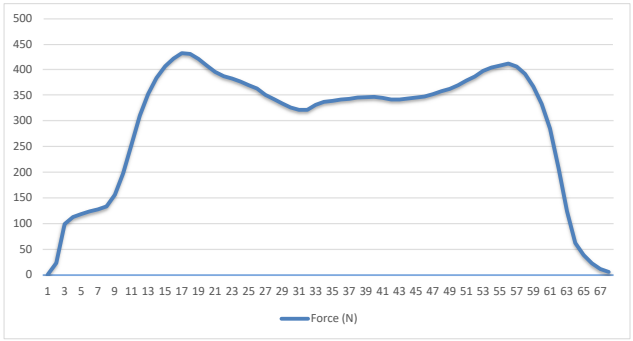

Fig. 2. Defining different Time Elapses of Right Foot and Left Foot of Walking Gait. Note. a = represents the time elapse to get the first peak force from the beginning; b = represents the time elapse to get the second peak force from the beginning; c= represents the time elapse to get the second peak force from the first peak force

the protocol of the study. The time elapse to reach the first peak force (a) represents the time duration from the beginning of the recording until the occurrence of the first peak force, which is typically associated with the initial contact and impact absorption during gait. The time elapse to reach the second peak force (b) refers to the time duration from the start of the recording until the second peak force, which reflects the propulsion phase of the gait cycle. Additionally, the time elapse (c) between the first and second peak forces is an important focus of this study, which indicates the duration of the mid-stance phase, which is critical for understanding the transition from impact absorption to propulsion.

This interval, from the first peak force to the second peak force, is a vital aspect of gait analysis. It represents the period during which the body shifts from absorbing the impact of foot contact to preparing for push-off and forward propulsion. The duration of this phase can vary depending on factors such as load distribution, balance, and muscle strength. Studying the time interval provides crucial insights into the efficiency of gait mechanics, as shorter or longer durations could indicate potential imbalances or compensatory mechanisms, especially under varying physical conditions.

In this context, understanding the time elapse between the first and second peak forces is essential for evaluating how different factors, such as varying backpack loads and carrying durations, influence gait stability and efficiency. A longer time elapse between these two peaks could suggest altered biomechanical strategies to cope with increased load, while a shorter duration might reflect an adaptive response to minimize the impact of such loads. By focusing on this temporal pattern, the current study aims to assess how these variations affect overall gait performance and to provide insights into the biomechanical implications of load carrying during walking.

The result of the study is depicted from Table 2 to Table 7.

The table 2 represents the time elapse to get the first peak force of left foot at the selected bag weights with selected recording time.

The table 3 represents the time elapse to get the second peak force of left foot at the selected bag weights with selected recording time.

The table 4 represents the time elapse to get the second peak force from first peak force of left foot at the selected bag weights with selected recording time.

Table 2. Descriptive Statistics of the Time Elapse to Get First Peak Force of Left Foot at the Selected Bag Weights with Selected Recording Time

S.No.	Bag/ Time	Time Elapse to Get First Peak Force (millisecond) of Left Foot				
		B1	B2	B3	B4	B5
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1	T1	150.94 ± 30.65	155.18 ± 54.13	155.06 ± 28.89	150.00 ± 32.11	153.88 ± 29.44
2	T2	147.29 ± 26.52	148.12 ± 33.40	153.88 ± 26.64	144.12 ± 27.18	162.71 ± 38.93
3	T3	147.65 ± 27.59	156.35 ± 45.30	154.24 ± 28.05	147.76 ± 24.17	159.76 ± 61.16
4	T4	153.41 ± 37.75	149.29 ± 31.61	148.82 ± 26.30	147.06 ± 32.62	151.76 ± 25.87
5	T5	144.24 ± 26.20	147.53 ± 28.15	156.24 ± 32.95	147.88 ± 21.22	151.76 ± 29.16

Note: Rounded to two digits after the decimal; N=85; T1= Recording at zero minute; T2= Recording at fifth minute; T3= Recording at tenth minute; T4= Recording at fifteenth minute; T5= Recording at twentieth minute; B1= 0Percent Backpack Load of Bodyweight (No bag); B2= 8Percent Backpack Load of Bodyweight; B3= 12Percent Backpack Load of Bodyweight; B4= 16Percent Backpack Load of Bodyweight; B5= 20Percent Backpack Load of Bodyweight.

Table 3. Descriptive Statistics of the Time Elapse to Get Second Peak Force of Left Foot at the Selected Bag Weights with Selected Recording Time

S.No.	Bag/ Time	Time Elapse to Get Second Peak Force (millisecond) of Left Foot				
		B1	B2	B3	B4	B5
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1	T1	494.00 ± 55.34	497.18 ± 71.02	505.29 ± 61.35	483.76 ± 64.73	485.88 ± 56.62
2	T2	484.82 ± 51.26	484.24 ± 59.89	491.18 ± 51.81	475.65 ± 63.76	503.18 ± 61.03
3	T3	471.41 ± 54.40	496.59 ± 68.06	500.35 ± 55.62	484.71 ± 55.52	496.12 ± 67.63
4	T4	485.18 ± 61.27	497.65 ± 69.64	492.71 ± 62.59	482.00 ± 58.18	491.65 ± 58.65
5	T5	474.59 ± 49.63	496.47 ± 58.45	504.12 ± 64.37	484.71 ± 55.84	496.71 ± 61.01

Note: Rounded to two digits after the decimal; N=85; T1= Recording at zero minute; T2= Recording at fifth minute; T3= Recording at tenth minute; T4= Recording at fifteenth minute; T5= Recording at twentieth minute; B1= 0Percent Backpack Load of Bodyweight (No bag); B2= 8Percent Backpack Load of Bodyweight; B3= 12Percent Backpack Load of Bodyweight; B4= 16Percent Backpack Load of Bodyweight; B5= 20Percent Backpack Load of Bodyweight.

Table 4. Descriptive Statistics of the Time Elapse to Get Second Peak Force from First Peak Force of Left Foot at the Selected Bag Weights with Selected Recording Time

S.No.	Bag/ Time	Time Elapse from First Peak Force to Second Peak Force (millisecond) of Left Foot				
		B1	B2	B3	B4	B5
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1	T1	343.06 ± 24.69	342.00 ± 16.89	350.23 ± 32.46	333.76 ± 32.62	332.00 ± 27.18
2	T2	337.53 ± 24.74	336.12 ± 26.49	337.30 ± 25.17	331.53 ± 36.58	340.47 ± 22.10
3	T3	323.76 ± 26.81	340.24 ± 22.76	346.11 ± 27.57	336.95 ± 31.35	336.36 ± 06.47
4	T4	331.77 ± 23.52	348.36 ± 38.03	343.89 ± 36.29	334.94 ± 25.56	339.89 ± 32.78
5	T5	330.35 ± 23.43	348.94 ± 30.30	347.88 ± 31.42	336.83 ± 34.62	344.95 ± 31.85

Note: Rounded to two digits after the decimal; N=85; T1= Recording at zero minute; T2= Recording at fifth minute; T3= Recording at tenth minute; T4= Recording at fifteenth minute; T5= Recording at twentieth minute; B1= 0Percent Backpack Load of Bodyweight (No bag); B2= 8Percent Backpack Load of Bodyweight; B3= 12Percent Backpack Load of Bodyweight; B4= 16Percent Backpack Load of Bodyweight; B5= 20Percent Backpack Load of Bodyweight.

The table 5 represents the time elapse to get the first peak force of right foot at the selected bag weights with selected recording time.

The table 6 represents the time elapse to get the second peak force of right foot at the selected bag weights with selected recording time.

The table 7 represents the time elapse to get the second peak force from first peak force of right foot at the selected bag weights with selected recording time.

Discussion

The study highlights the significant influence of varying backpack loads and carrying durations on the temporal dynamics of walking gait, particularly the time elapse between the first peak force (FPF) and the second peak force (SPF), which reflects the midstance phase. The results indicate that both heavier loads and prolonged durations lead to a longer midstance phase, reflecting increased biomechanical stress and adaptive responses to maintain stability. These findings

Table 5. Descriptive Statistics of the Time Elapse to Get First Peak Force of Right Foot at the Selected Bag Weights with Selected Recording Time

S.No.	Bag/ Time	Time Elapse to Get First Peak Force (millisecond) of Right Foot				
		B1	B2	B3	B4	B5
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1	T1	147.53 ± 20.17	148.90 ± 35.32	154.59 ± 49.08	146.59 ± 25.43	147.40 ± 24.11
2	T2	144.35 ± 19.55	144.50 ± 28.31	147.53 ± 24.68	146.24 ± 28.99	152.50 ± 27.60
3	T3	144.59 ± 21.58	150.70 ± 25.90	151.06 ± 25.17	143.76 ± 21.60	151.90 ± 40.28
4	T4	143.06 ± 26.05	156.00 ± 41.44	151.41 ± 25.87	145.76 ± 24.61	150.20 ± 23.40
5	T5	140.12 ± 17.89	150.70 ± 24.73	157.88 ± 40.65	143.65 ± 19.20	150.50 ± 27.38

Note: Rounded to two digits after the decimal; N=85; T1= Recording at zero minute; T2= Recording at fifth minute; T3= Recording at tenth minute; T4= Recording at fifteenth minute; T5= Recording at twentieth minute; B1= 0Percent Backpack Load of Bodyweight (No bag); B2= 8Percent Backpack Load of Bodyweight; B3= 12Percent Backpack Load of Bodyweight; B4= 16Percent Backpack Load of Bodyweight; B5= 20Percent Backpack Load of Bodyweight.

Table 6. Descriptive Statistics of the Time Elapse to Get Second Peak Force of Right Foot at the Selected Bag Weights with Selected Recording Time

S.No.	Bag/ Time	Time Elapse to Get Second Peak Force (Newton) of Right Foot				
		B1	B2	B3	B4	B5
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1	T1	494.47 ± 51.26	498.60 ± 63.90	509.29 ± 71.01	481.88 ± 50.93	489.70 ± 49.17
2	T2	486.35 ± 46.36	483.30 ± 55.75	491.06 ± 48.23	470.94 ± 68.10	494.80 ± 52.14
3	T3	482.82 ± 43.52	502.50 ± 55.48	495.65 ± 50.41	477.88 ± 43.10	492.70 ± 55.71
4	T4	479.65 ± 55.39	502.50 ± 65.10	498.24 ± 58.31	481.06 ± 58.23	494.80 ± 51.33
5	T5	476.82 ± 41.55	499.30 ± 50.77	503.41 ± 54.89	488.24 ± 56.76	491.20 ± 47.29

Note: Rounded to two digits after the decimal; N=85; T1= Recording at zero minute; T2= Recording at fifth minute; T3= Recording at tenth minute; T4= Recording at fifteenth minute; T5= Recording at twentieth minute; B1= 0Percent Backpack Load of Bodyweight (No bag); B2= 8Percent Backpack Load of Bodyweight; B3= 12Percent Backpack Load of Bodyweight; B4= 16Percent Backpack Load of Bodyweight; B5= 20Percent Backpack Load of Bodyweight.

Table 7. Descriptive Statistics of the Time Elapse to Get Second Peak Force from First Peak Force of Right Foot at the Selected Bag Weights with Selected Recording Time

S.No.	Bag/ Time	Time Elapse to Get Second Peak Force from First Peak Force (millisecond) of Right Foot				
		B1	B2	B3	B4	B5
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1	T1	346.94 ± 31.09	349.70 ± 28.58	354.70 ± 21.93	335.29 ± 25.50	342.20 ± 25.06
2	T2	342.00 ± 26.81	338.80 ± 27.44	343.53 ± 23.55	324.70 ± 39.11	342.40 ± 24.54
3	T3	338.23 ± 21.94	351.80 ± 29.58	344.59 ± 25.24	334.12 ± 21.50	340.80 ± 15.43
4	T4	336.59 ± 29.34	346.50 ± 23.66	346.83 ± 32.44	335.30 ± 33.62	344.60 ± 27.93
5	T5	336.70 ± 23.66	348.60 ± 26.04	345.53 ± 14.24	344.59 ± 37.56	340.70 ± 19.91

Note: Rounded to two digits after the decimal; N=85; T1= Recording at zero minute; T2= Recording at fifth minute; T3= Recording at tenth minute; T4= Recording at fifteenth minute; T5= Recording at twentieth minute; B1= 0Percent Backpack Load of Bodyweight (No bag); B2= 8Percent Backpack Load of Bodyweight; B3= 12Percent Backpack Load of Bodyweight; B4= 16Percent Backpack Load of Bodyweight; B5= 20Percent Backpack Load of Bodyweight.

align with studies such as Kellis and Arampatzi (2009), which reported that load carriage alters gait parameters, increasing ground reaction forces and leading to prolonged support phases. Similarly, Chow et al. (2005) noted disruptions in gait mechanics, including slower walking speed and reduced stride length, with heavier backpack loads. However, the present study uniquely focuses on the time elapse between peak forces, a variable that has received limited attention in the literature. In comparison, Han (1993) demonstrated similar findings of increased double-support phase and forward trunk lean under heavy loads, emphasising compensatory adaptations like greater knee flexion during the weight-bear-

ing phase. Han's study complements these findings by showing how load redistribution strategies under high loads are biomechanically essential but introduces insights from joint torque and muscle activity, especially in spinal erectors.

Existing research often emphasises broader gait parameters, such as ground reaction forces (Hong et al., 2003; Sokhi et al., 2022) and plantar pressures (Pau et al., 2015; Ahmad et al., 2019; Balkó et al., 2022). While these variables provide valuable insights, they do not capture the detailed effects of load carriage on the time elapse between FPF and SPF. The current study addresses this gap, demonstrating how temporal changes (time elapse) in peak forces reflect the interplay of load and fatigue.

Interestingly, the results also reveal fluctuations in peak force timing at critical load thresholds (e.g., 15–20% of body weight). These fluctuations may indicate a biomechanical tipping point where compensatory strategies begin to falter, leading to inefficient gait patterns. Studies such as those by Knapik et al. (2004) and Harman et al. (2000) similarly observed critical thresholds beyond which load-induced strain becomes pronounced. However, unlike these studies, which primarily focus on static measures such as posture or broad kinetic metrics, the current study offers a dynamic perspective by analysing the temporal interval between peak forces, providing a more comprehensive understanding of how gait adapts over time under load. This is further corroborated by Thakurta et al. (2016), who found gender-specific sensitivity to loads, particularly in females, where stride length decreased, and stride rate increased with heavier loads.

Moreover, while previous studies (Chow et al., 2005; Paez-Moguer et al., 2019) have examined the effects of backpack weight and walking duration on posture and stride characteristics, the specific variable of time elapse between FPF and SPF remains underexplored. This temporal measure is critical because it reflects both the impact absorption and propulsion phases of gait, offering insights into load redistribution and stability. The study contributes to the growing body of evidence on load carriage by emphasising this novel variable, which has implications for injury prevention and ergonomic design. Han (1993), for example, suggested that maintaining the body's centre of mass at a lower vertical position under load was a compensatory mechanism to mitigate strain. Similarly, Figueiredo (2011) noted increased plantar pressure in specific foot regions with heavier loads, aligning with the temporal gait disruptions observed in our results.

The study highlights the underappreciated impact of backpack loads and carrying durations on the temporal dynamics of peak forces during walking gait. By focusing on a variable that has been largely overlooked in existing research, present work not only fills a critical gap in the literature but also offers actionable insights for improving the safety and efficiency of load carriage in school-aged children. These findings underscore the importance of continued exploration into load-induced biomechanical adaptations to inform guidelines and interventions aimed at promoting health and well-being. In conjunction with related studies (Han, 1993; Thakurta et al., 2016; Figueiredo, 2011) the results further reinforce the importance of dynamic gait analysis in understanding load distribution and its implications for human locomotion. The findings of the present study align with the proposed hypothesis. As predicted, increasing backpack loads and extended carrying durations significantly affected the temporal dynamics of gait. Specifically, the significant increase in time elapse between the first and second peak forces observed at loads exceeding 15% body weight indicates compensatory biomechanical responses. These results suggest that excessive loads may compromise normal walking patterns, thereby increasing the risk of musculoskeletal strain in school-going boys.

Limitations of the Study

The study has certain limitations. The sample comprised only school-going boys aged 10 to 12 years from the Delhi NCR region, which may restrict the generalisability of the findings to other genders, age groups, or populations from different geographical areas. Additionally, the data was collected under controlled laboratory conditions on a wooden walkway, which might not fully replicate real-world scenarios where uneven terrain and varying surfaces could influence gait patterns.

Strengths of the Study

The study fills a critical gap in existing literature by examining the underexplored temporal interval between the first and second peak forces during the gait cycle. This unique focus provides valuable insights into how varying backpack loads and carrying durations impact the midstance phase of gait, a crucial aspect of stability and propulsion. The use of advanced instrumentation, such as the Zebris FDM pressure plate, ensures precise and reliable data collection, adding to the robustness of the findings. Additionally, well-structured 5x5 experimental framework allow for the validity of the results.

Future Implications

Future research can expand upon this study by exploring diverse populations, including younger children, adolescents and those with pre-existing musculoskeletal conditions, to increase the generalisability of the findings. It would also be valuable to examine other biomechanical variables, such as muscle activation patterns, joint torques, and angular kinematics, to gain a more comprehensive understanding of how the body compensates under different load conditions. Furthermore, conducting studies in real-world environments with varying terrains could provide deeper insights into the practical implications of load carriage. Ultimately, this research can contribute to policy recommendations for schools, parents and healthcare professionals, promoting awareness and preventive measures to safeguard children's health and well-being.

Conclusions

The study highlights the significant influence of increasing backpack loads and prolonged carrying durations on the temporal dynamics of walking gait. It highlights the extended midstance phase as an adaptive response to biomechanical stress, suggesting that load thresholds beyond 15–20% of body weight may lead to inefficiencies in gait. These findings contribute to the development of evidence-based guidelines for safe backpack use, particularly for school-aged children, and emphasise the need for ergonomic interventions to reduce potential musculoskeletal risks. Further research could

expand on this work by exploring diverse populations, additional biomechanical variables, and more dynamic environments to enhance the applicability of these insights.

Consent to Participate

Participants were assured that their participation was voluntary, with the freedom to withdraw at any time, and were continuously informed of their rights in accordance with the Declaration of Helsinki.

Conflicts of interest

No conflicts of interest exist.

Funding

None.

Acknowledgments

We wholeheartedly acknowledge the participants for their invaluable involvement in the research experiment. Additionally, we extend our sincere appreciation to the laboratory in-charge for their support and permission to facilitate data collection.

References

Husain, R., Mola, D. W., & Shaw, D. (2024a). Effect of Selected Backpack Loads Carried for Selected Durations on Temporal Pattern of Peak Forces of Walking Gait of School-Going Boys. *International Journal of Kinesiology and Sports Science, 12*(4), 48-56. https://doi.org/10.7575/aiac.ijkss.v.12n.4p.48

Whittle, M. W. (1993). Gait analysis. *The Soft Tissues,* 187-199. https://doi.org/10.1016/b978-0-7506-0170-2.50017-0

Buldt, A. K., Forghany, S., Landorf, K. B., Murley, G. S., Levinger, P., & Menz, H. B. (2018). Centre of pressure characteristics in normal, planus and cavus feet. *Journal of foot and ankle research, 11*(1), 3. https://doi.org/10.1186/s13047-018-0245-6

Husain, R., & Mola, D. W., & Shaw, D. (2024b). Understanding the Effects of Selected Backpack Loads Carried for Certain Durations on Peak Forces of Walking Gait in School-Going Boys. *Journal of Learning Theory and Methodology, 5*(3), 144-152. https://doi.org/10.17309/jltm.2024.5.3.08

Pascoe, D. D., Pascoe, D. E., Wang, Y. T., Shim, D.-M., & Kim, C. K. (1997). Influence of carrying book bags on gait cycle and posture of youths. *Ergonomics, 40*(6), 631-640. https://doi.org/10.1080/001401397187928

Sheir-Neiss, G. I., Kruse, R. W., Rahman, T., Jacobson, L. P., & Pelli, J. A. (2003). The association of backpack use and back pain in adolescents. *Spine, 28*(9), 922-930. https://doi.org/10.1097/01.BRS.0000058725.18067.F7

Perrone, M., Orr, R., Hing, W., Milne, N., & Pope, R. (2018). The Impact of Backpack Loads on School Children: A Critical Narrative Review. *International Journal of Environmental Research and Public Health, 15*(11), 2529. https://doi.org/10.3390/ijerph15112529

Macias, B. R., Murthy, G., Chambers, H., & Hargens, A. R. (2008). Asymmetric Loads and Pain Associated with Backpack Carrying by Children. *Journal of Pediatric Orthopaedics, 28*(5), 512–517. https://doi.org/10.1097/bpo.0b013e31817d8143

Castro, M. P., Figueiredo, M. C., Abreu, S., Sousa, H., Machado, L., Santos, R., & Vilas-Boas, J. P. (2015). The influence of gait cadence on the ground reaction forces and plantar pressures during load carriage of young adults. *Applied Ergonomics,* 49, 41-46. https://doi.org/10.1016/j.apergo.2015.01.004

Castro, M., Abreu, S., Sousa, H., Machado, L., Santos, R., & Vilas-Boas, J. P. (2013). Ground reaction forces and plantar pressure distribution during occasional loaded gait. *Applied Ergonomics, 44*(3), 503–509. https://doi.org/10.1016/j.apergo.2012.10.016

Pau, M., Mandaresu, S., Leban, B., & Nussbaum, M. A. (2015). Short-term effects of backpack carriage on plantar pressure and gait in schoolchildren. *Journal of Electromyography and Kinesiology, 25*(2), 406-412. https://doi.org/10.1016/j.jelekin.2014.11.006

Chow, D. HK., Kwok, M. LY., Au-Yang, A. CK., Holmes, A. D., Cheng, J. CY., Yao, F. YD., and Wong, MS. (2005). The effect of backpack load on the gait of normal adolescent girls. *Ergonomics, 48*(6), 642-656. https://doi.org/10.1080/00140130500070921

Hong, Y., Li, J. X., & Fong, D. T. P. (2008). Effect of prolonged walking with backpack loads on trunk muscle activity and fatigue in children. *Journal of Electromyography and Kinesiology, 18*(6), 990-996. https://doi.org/10.1016/j.jelekin.2007.06.013

Kellis, E., & Arampatzi, F. (2009). Effects of sex and mode of carrying schoolbags on ground reaction forces and temporal characteristics of gait. *Journal of Pediatric Orthopaedics B, 18*(5), 275-282. https://doi.org/10.1097/bpb.0b013e32832d5d3b

Hong, Y., & Cheung, C.-K. (2003). Gait and posture responses to backpack load during level walking in children. *Gait & Posture, 17*(1), 28-33. https://doi.org/10.1016/s0966-6362(02)00050-4

Van Alsenoy, K., Thomson, A., & Burnett, A. (2019). Reliability and validity of the Zebris FDM-THQ instrumented treadmill during running trials. *Sports Biomechanics, 18*(5), 501-514. https://doi.org/10.1080/14763141.2018.1 452966

Han, K. (1993). The effects of walking speed and backpack weight on gait biomechanics (Order No. 9319016). *Available from ProQuest Dissertations & Theses Global.* (304042927). https://www.proquest.com/dissertations-theses/effects-walking-speed-backpack-weight-on-gait/docview/304042927/se-2

Sokhi, S.S., Shaw, D., Andrabi, S.M.H., & Singh, D. (2022). Back Pack Load Carried for Extended Time Durations Correlated with Mean Ground Reaction Force on the Plantar Aspect of the Foot of School Going Children's Gait (A Descriptive Approach). *International Journal of All Research Education and Scientific Methods, 10*(4), 1410-1415.

Ahmad, H. N., & Barbosa, T. M. (2019). The effects of backpack carriage on gait kinematics and kinetics of schoolchildren. *Scientific Reports, 9*(1). https://doi.org/10.1038/s41598-019-40076-w

Balkó, Š., Tufano, J. J., Jelínek, M., Svoboda, Z., Błaszczyszyn, M., & Vaverka, F. (2022). Influence of school backpack load on plantar foot pressure during walking in 9-11 years old girls. *Central European Journal of Public Health, 30*(3), 185-189. https://doi.org/10.21101/cejph.a7109

Knapik, J. J., Reynolds, K. L., & Harman, E. (2004). Soldier Load Carriage: Historical, Physiological, Biomechanical, and Medical Aspects. *Military Medicine, 169*(1), 45-56. https://doi.org/10.7205/milmed.169.1.45

Harman, E., Han, K. H., Frykman, P., & Pandorf, C. (2000). The effects of backpack weight on the biomechanics of load carriage. *US Army Research Institute of Environmental Medicine.* https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=20b4476b66eb7962d2bd0668eabb2b04433a6f99.

Thakurta, A. G., Iqbal, R., Bhasin, H. V., De, A., & Maulik, S. (2016). Human gait with reference to age, gender and impact of load: a review. *Advances in Applied Physiology, 1*(2), 24-30. https://doi.org/10.11648/j.aap.20160102.12

Paez-Moguer, J., Montes-Alguacil, J., Garcia-Paya, I., Medina-Alcantara, M., Evans, A. M., & Gijon-Nogueron, G. (2019). Variation of spatiotemporal parameters in school children carrying different backpack loads: a cross sectional study. *Scientific Reports, 9*(1), 12192. https://doi.org/10.1038/s41598-019-48675-3

Figueiredo, Maria Cristina Pinto Leite Braamcamp. (2011). Influence of Walking Speed in Backpacker's Gait: Ground Reaction Forces and Plantar Pressure Analysis (Order No. 30764042). *Available from ProQuest Dissertations & Theses Global.* (2917302296). https://www.proquest.com/dissertations-theses/influence-walking-speed-backpackers-gait-ground/docview/2917302296/se-2

Вплив варіації маси рюкзака та тривалості його носіння на інтервал часу між першим і другим піковими зусиллями під час ходьби школярів-хлопців

Рабія Хусейн[1ABCDE], Дхананджой Шоу[1ABCDE]

[1]Університет Делі, Індія

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 7 табл., 2 рис., 25 джерел.

Вступ. Підтримання стійкості та поступального руху під час ходьби — особливо з навантаженням — вимагає постійного коригування параметрів ходи.

Мета. Визначити вплив різної маси рюкзака та тривалості його носіння на інтервал часу між першим піковим зусиллям (FPF) і другим піковим зусиллям (SPF) під час ходьби школярів-хлопців.

Матеріали і методи. У дослідженні взяли участь 85 хлопців віком 10–12 років з Національної столичної території Делі. Темпоральні параметри ходи вимірювали за допомогою тискової платформи Zebris Force Distribution Measurement у п'яти умовах навантаження рюкзаком (0%, 8%, 12%, 16% та 20% маси тіла) та при п'яти тривалостях носіння (0, 5, 10, 15 та 20 хв). Учасники проходили босоніж 10-метрову доріжку з платформою, розташованою посередині. Для кожної умови виконували п'ять спроб; дані аналізували з використанням описової статистики.

Результати. Зі збільшенням навантаження та тривалості носіння інтервал між FPF і SPF суттєво зростав, що вказує на подовження середньої фази опори. При навантаженні 15–20% маси тіла компенсаторні механізми ходи починали втрачати ефективність, що проявлялося збільшенням інтервалів і варіабельності, свідчачи про біомеханічне напруження та зниження ефективності ходьби.

Висновки. Маса рюкзака та тривалість його носіння істотно впливають на темпоральні параметри ходи, зокрема на інтервал між FPF і SPF. Отримані результати підкреслюють необхідність ефективного контролю ваги рюкзака та впровадження ергономічних стратегій для безпечного його використання школярами.

Ключові слова: маса рюкзака, перше пікове зусилля, аналіз ходи, носіння навантаження, середня фаза опори, друге пікове зусилля, інтервал часу.

Information about the Authors

Husain, Rabiya: rabiyahsn70@gmail.com; https://orcid.org/0000-0003-1434-1191; Department of Physical Education and Sports Sciences, University of Delhi, Delhi, India.

Shaw, Dhananjoy: dhananjoyshaw1960@gmail.com; https://orcid.org/0000-0002-4275-6389; Indira Gandhi Institute of Physical Education and Sports Sciences, University of Delhi, Delhi, India.

Cite this article as: Husain, R., & Shaw, D. (2025). Influence of Varying Backpack Loads and Selected Carrying Durations on Time Elapsed Between First and Second Peak Forces of Walking Gait of School-going Boys. *Journal of Learning Theory and Methodology, 6*(2), 63-70. https://doi.org/10.17309/jltm.2025.6.2.01

Received: 20.06.2025. Accepted: 04.08.2025. Published: 30.08.2025

This work is licensed under a Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0)

Journal of Learning Theory and Methodology
Журнал теорії та методології навчання

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

Original Scientific Article

Small Shifts, Big Gains: Rethinking Creativity in the Age of Accountability

Timothy Hinchman[1ABCDE]

[1]Georgia Southern University

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

DOI: 10.17309/jltm.2025.6.2.02

Abstract

Objectives. This study explored the impact of intentionally designed constraints on the creativity of Generation Z pre-service teachers (GZ-PSTs) enrolled in a public educator preparation program (EPP). Grounded in Stokes' (2009) Constraint-Based Model of Novelty (C-BMN), the research investigated whether input ("use what you got") and output ("this is what it looks like") constraints could enhance creative problem-solving, particularly in the context of captioning a visual prompt.

Materials and Methods. A nonequivalent posttest-only quasi-experimental design was used with a convenience sample of 39 GZ-PSTs, randomly assigned to one of three conditions: input constraint, output constraint, or constraint-free (control). All participants completed the same creative task—captioning a cartoon image. Captions were evaluated using the validated NEW rubric (Henriksen et al., 2015), which measures novelty, effectiveness, wholeness, and total creativity score (TCS). Two trained faculty raters independently scored the responses. Kruskal-Wallis and Dunn's (1964) post hoc analyses were used to test differences between groups, and inter-rater reliability was confirmed via Cohen's kappa.

Results. Statistically significant differences were found across all creativity dimensions, with the constraint-free group scoring the lowest (TCS M = 5.54) and the output constraint group scoring highest (TCS M = 12.27). Effect sizes were moderate to large. These findings support the premise that designed constraints—when thoughtfully implemented—can scaffold creative thinking in pre-service teachers.

Conclusions. The study highlights the value of integrating constraint-based strategies in educator preparation, especially for Generation Z learners who have experienced highly structured, test-driven K–12 environments. Embedding such strategies may empower pre-service teachers to think creatively within standardized curricular frameworks.

Keywords: generation Z pre-service teachers, creativity, designed constraints, educator preparation, C-BMN framework.

Introduction

Standardized testing in the United States has significantly shaped classroom instruction, often narrowing the curriculum to focus on tested subjects and changing how teachers perceive education (Wéick & Shaughnessy, 2024). This is particularly relevant for Generation Z pre-service teachers (GZ-PSTs)—individuals born between 1995 and 2010 (Fodor & Jaeckel, 2018) - and raised within highly structured K–12 environments—who are now entering educator preparation programs (EPPs) shaped by similar top-down expectation (Fraser & Hawly, 2023). These pre-service teachers must be prepared not only to traverse through content-rigid curriculm and high accountability standards but also be able to design engaging and differentiated lessons to meet their students' needs. While there is an abundance of anecdotal observations and general descriptions of Generation Z in popular media and educational literature, there remains a lack of empirical research specifically focused on their creative thinking skills within the context of pre-service teacher education (Nicholas & Arlene, 2020).

One promising approach to promoting creativity within such environments is the use of intentionally designed constraints, which structure the problem space in ways that foster originality rather than limit it (Stokes, 2009). Constraints can take many forms: input constraints, or "use what you got," which limit available tools or information; and output constraints, or "this is what it looks like," which limit the format or structure of the final product. Research findings suggest

© Hinchman, T., 2025.

JLTM
LLC OVS

Corresponding Author: Timothy Hinchman,
e-mail: thinchman@georgiasouthern.edu

that when applied purposefully, such constraints can enhance creative performance by focusing attention, reducing decision fatigue, and fostering more divergent thinking (Roskes, 2015; Tromp & Baer, 2022).

While designed constraints have been studied in the context of business, engineering, and the arts, limited empirical research exists on their effects in teacher education, particularly among Generation Z learners. Given their background in standards-based schooling, GZ-PSTs may respond uniquely to constraint-based tasks. This study addresses that gap by examining how input and output constraints influence the creativity of GZ-PSTs in a specific task that does not require any prior creative talent, captioning a cartoon. Framed by the Constraint-Based Model of Novelty (C-BMN) (Stokes, 2009), this research investigates whether these structured limitations enhance or inhibit creative performance.

Statement of the Problem

Prior research has demonstrated that intentionally designed constraints can positively influence creativity and performance among Millennial populations, including pre-service teachers (Hinchman, 2022) and collegiate athletes (Hinchman et al., 2023). These studies provided evidence that structured limitations—such as input constraints ("use what you got") and output constraints ("this is what it looks like")—can serve as productive cognitive tools that foster innovation within defined boundaries. However, despite these promising findings, there remains a critical gap in the literature regarding how Generation Z pre-service teachers (GZ-PSTs) respond to constraint-based tasks.

Despite growing calls for creativity in education, educator preparation programs (EPPs) often operate within rigid curricular standards that mirror the structured environments in which Generation Z pre-service teachers (GZ-PSTs) were themselves educated (McLaughlin & Berlinghoff, 2022). These future educators are expected to foster creative thinking in their own classrooms, yet they have limited experience navigating or designing instruction under constraint-based conditions that promote creativity. The problem addressed in this study is the lack of empirical research on how constraint-based instructional strategies influence the creativity of GZ-PSTs, particularly in contexts where creative flexibility must coexist with highly structured curricula.

Literature Review

This study is grounded in Stokes' (2009) Constraint-Based Model of Creativity (C-BMN), which conceptualizes creativity not as the absence of limitation, but as the productive navigation of structured problem spaces. The framework consists of four interrelated constructs: (a) the creativity problem, (b) constraints, (c) variability, and (d) the problem space (Stokes, 2006, 2009). Any problem that requires creativity to resolve typically begins as an ill-structured one, meaning it lacks a linear or singular resolution pathway. The problem's resolution depends on the strategic usage of constraints, which serve to both block conventional pathways and activate novel solutions. Constraints guide the problem-solver to reframe the task, reinterpret resources, and renovate within imposed boundaries. Variability relates to assortment of possible outcomes that emerge within the constrained problem space, where higher variability is associated with more novel and original outputs (Stokes, 2006). The problem space represents the mental arena in which cognitive operations occur—its design, structure, and constraints influence the types of behaviors and ideas that can emerge. The C-BMN emphasizes that creative acts are not spontaneous or free-form but are shaped by how individuals perceive and navigate constraints in a bounded space (Stokes, 2001, 2006, 2014). In this study, the C-BMN guided both the design of the experimental tasks and the interpretation of how Generation Z pre-service teachers (GZ-PSTs) responded to input and output constraints in a structured captioning problem.

Recent research findings confirm that constraints can have both facilitative and inhibitory effects on creative performance, depending on their type, combination, and implementation context. A comprehensive meta-analysis by Damadzic et al. (2022) found that designed constraints generally enhance creative output, particularly when they are moderately restrictive and well-aligned with task demands. Constraints help reduce cognitive overload by narrowing the problem space, thereby encouraging individuals to engage in deeper processing, explore non-obvious solutions, and avoid default or habitual responses (Hatchuel & Chen, 2017; Haught-Tromp, 2017). This supports prior work suggesting that input constraints (e.g., "use what you got") and output constraints (e.g., "this is what it looks like") can activate divergent thinking by limiting choices in ways that direct attention and stimulate novelty (Stokes, 2013; Rosso, 2014). Constraints do not uniformly benefit all individuals or situations. The interaction of constraint types—whether imposed, self-imposed, or resource-based—plays a key role in shaping creative problem-solving (Cromwell, 2024).

Generation Z pre-service teachers (GZ-PSTs) have been shaped by a cultural and educational landscape marked by heightened fear, stress, and standardization (Adrian & Sahrani, 2021). Their K–12 educational experiences often emphasized rote memorization and performance on standardized assessments, which can suppress opportunities for synthesizing knowledge and applying it in novel contexts (Gölogluu Demir & Kaplan Keles, 2021). As a result, educator preparation programs (EPPs) face unique challenges in cultivating creativity among GZ-PSTs, who often require supportive learning environments that address both their cognitive and social-emotional needs (Erenli, 2016; Hosek & Titsworth, 2016; Miller & Mills, 2019).

The purpose of this quantitative, nonequivalent posttest-only quasi-experimental study was to examine the effects of intentionally designed constraints—input or output—on the creativity of Generation Z pre-service teachers (GZ-PST) enrolled in a US southwestern educator preparation program. A convenience sample of 39 students, all over the age of 18 and participating under exempt IRB approval, were assigned to one of three groups: an input constraint group (ICG), an output constraint group (OCG), or a control group with no constraint (CCG). Participants completed a creative captioning task for the same AI-generated cartoon image. Creativity was assessed using the NEW rubric (Henriksen et al., 2015), which evaluates three dimensions of creative performance: novelty, effectiveness, and wholeness. A Total Creativity Score (TCS) was also calculated by summing the three

domain scores. This study aimed to determine whether the type of constraint imposed produced statistically significant differences in creativity outcomes among GZ-PST, addressing a critical gap in the literature on specific constraint-types influence creative outputs of this educator cohort.

This study tasked 39 GZ-PST to caption the same AI-generated cartoon (Appendix A). 13 GZ-ST captioned the cartoon using an input constraint (ICG), 13 GZ -ST using an output constraint (OCG), and 13 GZ -ST without a constraint (CCG).

Research Questions and Hypotheses

To address the study's central problem and purpose, the following overarching research question was posed: How do intentionally designed constraints influence the creative captioning performance of Generation Z pre-service teachers (GZ-PST)? This guiding question was further explored through three specific research questions focused on comparing creativity outcomes—measured by the NEW rubric domains of novelty, effectiveness, and wholeness, as well as the composite Total Creativity Score (TCS)—across participants assigned to input-constraint, output-constraint, and control conditions.

RQ_1: Is there a statistically significant difference between the means of the Total Creativity Scores (TCS) among the input-constraint, output-constraint, and control groups in caption creativity produced by GZ-PST?

H_{01}: No statistically significant difference exists in in the mean Total Creativity Scores (TCS) among the three groups: input-constraint, output-constraint, and control.

H_{01}: μICG=μOCG=μCCG

H_{A1}: A statistically significant difference exists in in the mean Total Creativity Scores (TCS) among the three groups: input-constraint, output-constraint, and control.

H_{A1}: μICG μOCG or μICGμCCG or μOCG μCCG

RQ_2: Is there a statistically significant difference in creativity—measured by novelty, effectiveness, wholeness, and the Total Creativity Score (TCS)—between the Input Constraint Group (ICG) and the Control Group (CCG)?

H_{02}: There are no statistically significant differences in the mean scores for novelty, effectiveness, wholeness, or the Total Creativity Score (TCS) between the Input Constraint Group and the Control Group.

H_{02}: μICG, novelty=μCCG, novelty and μICG, effectiveness=μCCG, effectiveness and μICG, wholeness =μCCG, wholeness and μICG, TCS=μCCG, TCS

H_{A2}: There is a statistically significant difference in at least one of the mean scores (novelty, effectiveness, wholeness, or TCS*) between the Input Constraint Group and the Control Group.

H_{A2}: μICG μCCG

for at least one of the creativity dimensions or the TCS

RQ_3: Is there a statistically significant difference in creativity—measured by novelty, effectiveness, wholeness, and the Total Creativity Score (TCS)—between the Output Constraint Group (OCG) and the Control Group (CCG)?

H_{03}: There are no statistically significant differences in the mean scores for novelty, effectiveness, wholeness, or the Total Creativity Score (TCS) between the Output Constraint Group and the Control Group.

H_{03}: μOCG, novelty=μCCG, novelty and μOCG, effectiveness=μCCG, effectiveness and μOCG, wholeness =μCCG, wholeness and μOCG, TCS=μCCG, TCS

H_{A3}: There is a statistically significant difference in at least one of the mean scores (novelty, effectiveness, wholeness, or TCS*) between the Output Constraint Group and the Control Group..

H_{A3}: μOCG μCCG

for at least one of the creativity dimensions or the TCS

Materials and Methods

This study employed a nonequivalent posttest-only quasi-experimental design with a comparison group (NPQCG) to investigate the effects of intentionally designed constraints on the creative performance of Generation Z pre-service teachers (GZ-PST). This design was selected due to the natural classroom grouping structure within a US southwestern Educator Preparation Program (EPP), which precluded random assignment while still enabling comparative analysis across experimental and control conditions (Leedy et al., 2019). In this design, two treatment groups—the Input Constraint Group (ICG) and the Output Constraint Group (OCG)—were compared to a Constraint-Free Control Group (CCG). Each group included 13 participants, resulting in a total sample size of 39 GZ-PSTs.

This NPQCG design allowed for the examination of treatment effects post-intervention without a pretest. As all participants were drawn from intact course sections within the same EPP and received similar academic instruction and program experiences, this quasi-experimental approach provided practical internal validity despite the lack of random assignment.

Participants

The participants were 39 Generation Z pre-service teachers (GZ-PSTs) enrolled in a public university educator preparation program (EPP) in the US southwest. All participants were publicly educated within the region and were accepted into the EPP under consistent admission criteria, which included a minimum cumulative grade point average (GPA) of 3.0.

To ensure relative homogeneity across groups, all participants completed the same sequence of coursework, participated in gradual-release style field experiences, and were taught by the same faculty members. This uniform academic and clinical background helped to reduce potential variability in instructional exposure and cognitive development that might influence creativity outcomes.

All participants were 18 years of age or older and voluntarily consented to participate under an exempt protocol approved by the university's Institutional Review Board. Participants were assigned to one of three conditions: the Input Constraint Group (ICG; n = 13), the Output Constraint Group (OCG; n = 13), or the Constraint-Free Control Group (CCG; n = 13). The sample was predominantly female (66.7%), with all participants reporting a public-school background. The majority identified as White (87.2%) and unmarried (92.3%). Participants represented a range of certification areas, with the largest proportion pursuing elementary

certification (43.6%), followed by high school Social Studies (17.9%), and various content-specific and specialty areas across grade bands (see Table 1).

Table 1. Demographic Characteristics of Participants

Variable	Category	n	%
Gender	Male	13	33.3
	Female	26	66.7
Educational Experience	Public School	39	100
Race	African America	3	7.7
	White	34	87.2
	Other	2	5.1
Marital Status	Married	3	7.7
	Unmarried	36	92.3
Certification Area	Elementary	17	43.6
	Middle School Math	1	2.6
	Middle School Science	1	2.6
	High School Math	2	5.1
	High School Science	1	2.6
	High School Social Studies	7	17.9
	Physical Education	4	10.3
	Art/Music/Theatre	6	15.4

Note. Note, n= 39; Percentages are rounded to one decimal place.

Data Source

Two primary data sources were used in this study: a captionless cartoon image and a standardized creativity assessment rubric. The cartoon, adapted from a New Yorker-style format, served as the stimulus for a captioning task designed to elicit creative responses from participants. Creativity was evaluated using the NEW rubric (Henriksen et al., 2015), which assessed each caption across three domains—novelty, effectiveness, and wholeness—as well as a composite Total Creativity Score (TCS).

A brief demographic questionnaire was also administered to collect descriptive data on participants' gender, educational background, ethnicity, marital status, and certification area. The survey was accompanied by clear written instructions to minimize misinterpretation and enhance response validity. Though surveys and rubrics have known limitations related to subjectivity and consistency, these concerns were mitigated by training two independent raters and establishing inter-rater reliability procedures. The alignment between the rubric and the constructs being measured was also verified through content validity review.

These data sources were essential in addressing the study's research questions and hypotheses, enabling a quantitative analysis of how intentionally designed constraints influenced creative performance among GZ-PSTs.

Instrumentation

The captions generated by the participants were evaluated using the NEW Rubric (Henriksen et al., 2015). The rubric measures creative products across three subdimensions: novelty, effectiveness, and wholeness, using a 5-point Likert-type scale (1 = minimal, 5 = exceptional). These three subdimension scores were summed to produce a Total Creativity Score (TCS) ranging from 3 to 15.

This study adapted the original rubric to assess cartoon captions instead of full projects as intended by the original authors. The structure and scoring anchors remained unchained, the descriptors were slightly modified to reflect the short-form caption responses. In this study, novelty refers to the originality and uniqueness of the caption; effectiveness assess is clarity and communicative strength; and wholeness reflects its alignment contextually with the image presented.

Two trained raters independently scored each caption using the rubric. Inter-rater reliability and content validity procedures are described in the following section.

Validity and Reliability

Two trained university faculty members independently evaluated each caption using the adapted NEW Creativity Rubric (Henriksen et al., 2015). To establish the alignment between the rubric criteria and the intended constructs of creativity, a content validity ratio (CVR) was calculated following the guidelines of Ayre and Scally (2014). Three subject matter experts reviewed the rubric's alignment with the constructs of novelty, effectiveness, and wholeness. The resulting CVR was 1.00, which exceeds the recommended threshold of .99, indicating strong content validity.

Inter-rater reliability was assessed using Cohen's kappa for each scoring dimension. The results indicated substantial to almost perfect agreement: novelty ($\kappa = .798$), effectiveness ($\kappa = .900$), wholeness ($\kappa = .837$), and total creativity score (TCS) ($\kappa = .704$). These values suggest a high level of consistency between raters, supporting the reliability of the scoring process (Landis & Koch, 1977).

Procedure

Three problem space packets were prepared corresponding to the study conditions: Input Constraint Group (ICG), Output Constraint Group (OCG), and Constraint-Free Control Group (CCG). Each packet included (a) an informed consent form, (b) a demographic questionnaire, (c) group-specific instructions for captioning, and (d) the visual problem space—a captionless cartoon image modeled in the style of The New Yorker (see Appendix A).

Participants were recruited from professional educational courses during the fall term at the US southwest public university EPP during a four-day window. The researcher visited six courses during that window across the morning and window to administer the materials in person. The data collection procedure was standardized across all sessions.

At the beginning of each session, participants reviewed and signed the informed consent form. They were then provided with a sealed, opaque envelope containing one of the pre-randomized problem-space packets. Packet distribution was randomized using a sequential number generator to minimize researcher bias in group assignment. Participants were unaware of which constraint group they were assigned to until opening the packet.

After completing the demographic form, participants were instructed to review the cartoon and compose a caption according to the instructions specific to their assigned

group. This task required approximately 15 minutes. Upon completion, participants placed all materials—the informed consent form, demographic questionnaire, and completed caption—back into the provided nontransparent envelope and returned it to the researcher.

All 39 completed packets were then reviewed by two independent faculty raters, who assessed each caption using the adapted NEW Rubric (Henriksen et al., 2015). Each caption was evaluated for novelty, effectiveness, and wholeness, with scores combined to yield a Total Creativity Score (TCS). Inter-rater reliability and content validity procedures were implemented prior to analysis to ensure scoring consistency and construct alignment (Ayre & Scally, 2014).

Data Analysis

The data were analyzed using the Statistical Package for Social Sciences (IBM SPSS Statistics, 2024). Prior to analysis, data were screened for normality and outliers. Due to the presence of significant outliers and non-normal distribution across several variables, a nonparametric Kruskal–Wallis H test was used to assess differences among the three groups: Input Constraint Group (ICG), Output Constraint Group (OCG), and Constraint-Free Control Group (CCG).

Results

To address the first research question, a Kruskal–Wallis H test was used to compare creativity scores across the three constraint conditions: Input Constraint, Output Constraint, and Constraint-Free Control. Statistically significant differences were found across all creativity dimensions.

For novelty, the test revealed a significant difference among the groups, $\chi^2(2) = 18.532$, $p < .001$. A similar pattern was found for effectiveness, $\chi^2(2) = 14.315$, $p < .001$, and wholeness, $\chi^2(2) = 19.434$, $p < .001$. The groups also differed significantly on Total Creativity Score (TCS), $\chi^2(2) = 18.093$, $p < .001$.

These results indicate that the type of constraint applied had a significant effect on the creative captioning abilities of Generation Z pre-service teachers across all measured domains, rejecting Null Hypothesis 1. Table 2 reports the mean creativity scores in for each constraint group.

Table 2. Creativity Scores by Constraint Group

Constraint Group	n	Mean Novelty	Mean Effectiveness	Mean Wholeness	Mean TCS
ICG	13	3.846	3.654	3.615	11.115
OCG	13	3.731	4.308	4.231	12.269
CCG	13	1.577	1.1644	1.1065	5.538

Post hoc Dunn's (1964) pairwise comparisons were conducted to address Research Questions 2 and 3. Results revealed statistically significant differences in Total Creativity Scores (TCS) between both the Input Constraint Group and the Constraint-Free Control Group, $\chi^2(2) = 14.577$, $p < .001$, and the Output Constraint Group and the Constraint-Free Control Group, $\chi^2(2) = 17.615$, $p < .001$ (Table 6) . Significant differences were also observed across all subcomponents of creativity: novelty (Table 3), effectiveness (Table 4), and wholeness (Table 5) . As such, the null hypotheses for both Research Questions 2 and 3 were rejected. These findings indicate that both input and output constraints significantly improved the creative performance of Generation Z pre-service teachers compared to no constraints.

Effect size calculations using Cohen's η^2 further support these findings, with large effects observed for both groups: the Output Constraint Group showed effect sizes of .427 (novelty), .399 (effectiveness), .534 (wholeness), and .484 (TCS), while the Intput Constraint Group showed comparably large effects across the same domains. These results suggest that designed constraints meaningfully enhance creativity in this population.

Table 3. Dunn's Pairwise Comparison Post Hoc Test for Novelty

Samples	Dunn's Test Statistic	Std. Error	Std. Test Statistic	Sig.
ICG-CCG	16.077	4.381	3.670	<.001
OCG-CCG	16.577	4.381	3.784	<.001
ICG-OCG	-.500	4.381	-.114	.909

Table 4. Dunn's Pairwise Comparison Post Hoc Test for Effectiveness

Samples	Dunn's Test Statistic	Std. Error	Std. Test Statistic	Sig.
ICG-CCG	10.269	4.349	2.361	.018
OCG-CCG	16.269	4.349	3.741	<.001
ICG-OCG	-6.000	4.349	-1.380	.168

Table 5. Dunn's Pairwise Comparison Post Hoc Test for Wholeness

Samples	Dunn's Test Statistic	Std. Error	Std. Test Statistic	Sig.
ICG-CCG	13.808	4.384	3.149	.005
OCG-CCG	18.615	4.384	4.246	<.001
ICG-OCG	-4.808	4.384	-1.097	.818

Table 6. Dunn's Pairwise Comparison Post Hoc Test for Total Creativity (TCS)

Samples	Dunn's Test Statistic	Std. Error	Std. Test Statistic	Sig.
ICG-CCG	14.555	4.428	3.292	<.001
OCG-CCG	16.577	4.428	3.979	<.001
ICG-OCG	-.500	4.428	-.686	.493

Discussion

The purpose of this study was to examine the effects of intentionally designed constraints—specifically input and output constraints—on the creative performance of Generation Z pre-service teachers (GZ-PSTs). Guided by the Constraint-Based Model of Creativity (C-BMN) (Stokes, 2009), this study sought to determine how structured limitations affect creativity in a population of future educators raised in standardized, public education systems. All participants were

publicly educated and enrolled in a teacher preparation program with a common curricular pathway, offering a highly relevant context for examining how structured tasks might promote creativity in a generation often critiqued for risk-aversion and preference for guided learning.

Statistically significant differences were found between both constraint groups and the constraint-free control group across all measured dimensions of creativity—novelty, effectiveness, wholeness, and Total Creativity Score (TCS). These results offer strong support for the underlying hypotheses and reinforce prior research on the positive impact of designed constraints in creative performance (Hinchman, 2022; Hinchman et al., 2023). The control group consistently scored lowest on each sub-component, highlighting a critical concern about the absence of constraints. When no constraints were applied, GZ-PSTS produced a significantly less creative caption. These findings reveal that GZ learners may struggle with open-ended prompts or unstructured tasks but may thrive under designed conditions that guide them toward completion.

This is consistent with Roskes' (2015) work on motivation schemas, which suggests that success-driven individuals often benefit from structured environments. Both input and output constraints may provide GZ-PSTs with the scaffolding needed to organize their thinking and activate divergent ideas within a focused space. The findings of the present study also align with Tan et al. (2023), who demonstrated that targeted instruction enhances critical and creative thinking in learners, particularly in online or self-regulated settings. In this case, designed constraints acted as a form of targeted cognitive structure that amplified the creative engagement of participants.

This study contributes to the growing body of research on how Generation Z pre-service teachers—especially those educated in highly structured public-school systems—can cultivate creativity within similarly structured educational environments. The results both validate the C-BMN overall usage but also emphasizes that GZ-PSTS may require specific conditions and limitations (like designed constraints) to maximize their creative potential. The very low creativity scores in the absence of such supports underscore the risks of assuming that creativity will emerge naturally in teacher preparation programs without instructional design strategies that incorporate constraint.

This work adds to a growing consensus among scholars that creativity can flourish under conditions of structured uncertainty, particularly when learners are taught how to identify and work within constraints (Tromp & Baer, 2022). In line with Taylor (2019), who explored the deliberate teaching of creativity in higher education, this study suggests that constraint-based tasks can be taught as a strategic pedagogical method—particularly for populations trained under rigid curricula. These findings advocate for the integration of constraint-based instruction into educator preparation programs to better support creativity development in novice teachers, especially as they transition into classrooms governed by highly structured standards and assessments.

Implications

The findings of this study hold significant implications for educator preparation programs (EPPs) seeking to foster creativity in Generation Z pre-service teachers, particularly those who have been educated in traditional, standards-based public-school systems. The consistently low creativity scores among participants in the constraint-free group underscore a crucial insight: creativity does not automatically emerge in the absence of structure. Rather, intentionally designed constraints—whether encouraging students to "use what you got" (input constraints) or specifying "this is what it looks like" (output constraints)—serve as productive cognitive scaffolds that help preservice teachers access deeper levels of originality, clarity, and contextual integration in problem-solving tasks.

Given how structured the K-12 learning environment can be with prescribed curricula and strict regulated observation cycles, it is essential that pre-service teachers are equipped with skills to innovate from within. One implication of this study is the importance of explicitly training pre-service teachers to recognize, apply, and design constraint-based strategies to maximize creative potential within structured environments. Learning how to think inside the curricular box through constraints, pre-service teachers can redesign existing lesson limitations to develop imaginative new learning experience for their future students.

Educator preparation programs should consider embedding constraint-based creativity training into professional courses, fieldwork reflections, lesson design, and instructional planning modules. For example, pre-service teachers could be taught to design tasks with intentional output limits (e.g., word count, media type, fixed usage) or input constraints (e.g., predefined vocabulary, mandatory resources, or fixed thematic lenses). Such strategies can be directly applied to teaching highly structured curricula, enabling pre-service teachers to move from procedural compliance to creative transformation within rigid systems.

Future Research

Building on the findings of this study, future research should explore the intersection of cognitive load theory and designed constraints in higher education learning environments. While the current results support the use of constraints to enhance creativity among Generation Z pre-service teachers, it remains unclear how these constraints interact with learners' cognitive processing capacities. Investigating how different types of constraints (e.g., input vs. output) affect working memory, task complexity, and mental effort could provide valuable insight into optimizing instructional design in teacher education. This line of research may also clarify which constraint formats best support deep learning and creativity without overwhelming learners, particularly in high-stakes or content-dense coursework. Such work would further refine the application of constraint-based pedagogy in preparing future educators for innovation within structured curricular systems.

Conclusions

The study highlights the value of integrating constraint-based strategies in educator preparation, especially for Generation Z learners who have experienced highly structured, test-driven K–12 environments. Embedding such strategies

may empower pre-service teachers to think creatively within standardized curricular frameworks.

Conflicts of Interest

The author declare that no conflicts of interest exist..

References

Weïck, N., & Shaughnessy, M. (2024). Standardized testing and effective instruction : Teacher perceptions on how high stakes testing affects instructional practive. *International Journal of Educational Spectrum*. https://doi.org/10.47806/ijesacademic.1358791

Fodor, M., & Jaeckel, K. (2018). What does it take to have a successful career through the eyes of generation Z-based on the results of a primary qualitative research. *International Journal on Lifelong Education and Leadership, 4*(1), 1-7.

Fraser, M., & Hawley, M. (2023). The pernicious predictability of state-mandated tests of academic achievement in the United States. *Education Sciences, 14*(2), 129.

Nicholas, & Arlene, J. (2020). *Preferred Learning Methods of Generation Z.* https://digitalcommons.salve.edu/cgi/viewcontent.cgi?article=1075&context=fac_staff_pub

Stokes, P. D. (2009). Using constraints to create novelty: A case study. *Psychology of Aesthetics, Creativity, and the Arts, 3*(3), 174-180. doi:https://doi.org/10.1037/a0014970

Roskes, M. (2015). Constraints that help or hinder creative performance: A motivational approach. *Creativity & Innovation Management, 24*(2), 197-206. https://doi.org/10.1111/caim.12086

Tromp, C., & Baer, J. (2022). Creativity from Constraints: Theory and Applications to Education. *Thinking Skills and Creativity.* https://doi.org/10.1016/j.tsc.2022.101184

Hinchman, T. (2022). Closed Captioned: Designed Constraints Impact on Millennial Preservice Teachers' Creativity. *In Multidisciplinary Perspectives on Diversity and Equity in a Virtual World* (pp. 185-212). IGI Global.

Hinchman, T., Taylor, C. D., Lange, E. J., & Meachum, M.(2023). Purposeful Practice: Constraints and Temperament Impact on Physical Performance of Collegiate Division II Soccer Athletes. *Sport Journal*.

McLaughlin, V., & Berlinghoff, D. (2022). Designing EPPs Aligned with CEC's 2020 Initial Practice-Based K-12 Standards. *Journal of Special Education Preparation, 2*(3), 6-18.

Stokes, P. D. (2006). *Creativity From constraints: The psychology of breakthrough.* New York: Springer Publishing Company.

Stokes, P. D. (2001). Variations on Guilford's creative abilities. *Creativity Research Journal, 13*(3-4), 277-283. https://doi.org/10.1207/S15326934CRJ1334_05

Stokes, P. D. (2014). Thinking inside the box: Creativity, constraints, and the colossal portraits of Chuck Close. *The Journal of Creative Behavior, 48*(4), 276-289. https://doi.org/10.1002/jocb.52

Damadzic, A., Winchester, C., Medeiros, K., & Griffith, J. (2022). [Re]thinking outside the box: A meta-analysis of constraints and creative performance. *Journal of Organizational Behavior.* https://doi.org/10.1002/job.2655

Hatchuel, A., & Chen, M. K. (2017). Creativity under strong constraints: The hidden influence of design models. *European Review, 25*(2), 194-207.

Haught-Tromp, C. (2017). The green eggs and ham hypothesis: How constraints facilitate creativity. *Psychology of Aesthetics, Creativity & the Arts, 11*(1), 10-17. https://doi.org/10.1037%2Faca0000061

Stokes, P. D. (2013). The effects of constraints in a mathematics classroom. *Journal of Mathematics Education at Teachers College, 4*(2), 25-31. Retrieved from https://jmetc.columbia.edu/

Rosso, B. D. (2014). Creativity and constraints: Exploring the role of constraints in the creative processes of research and development teams. *Organization Studies, 35*(4), 551-585. https://doi.org/10.1177/0170840613517600

Cromwell, J. R. (2024). How combinations of constraint affect creativity: A new typology of creative problem solving in organizations. *Organizational Psychology Review, 14*(1), 3–24. https://doi.org/10.1177/20413866231202031

Adrian, K., & Sahrani, R. (2021). Relationship Between Fear of Missing Out (FoMO) and Problematic Smartphone Use (PSU) in Generation Z with Stress as a Moderator. *International Conference on Economics, Business, Social, and Humanities (ICEBSH 2021),* Jakarta, Indonesia. https://doi.org/10.2991/assehr.k.210805.152

Gölogluu Demir, C., & Kaplan Keles, Ö. (2021). The Impact of High-Stakes Testing on the Teaching and Learning Processes of Mathematics. J*ournal of Pedagogical Research, 5*(2), 119-137.

Erenli, K. (2016). Generation I (mmersion)–how to meet learner expectations of tomorrow. *International Journal of Advanced Corporate Learning, 9*(1), 19-25. Retrieved from https://www.learntechlib.org/p/173486/

Hosek, A. M., & Titsworth, S. (2016). Scripting knowledge and experiences for millennial students. *Communication Education, 65*(3), 357-359. https://doi.org/10.1080/03634523.2016.1177844

Miller, A. C., & Mills, B. (2019). 'If They Don't Care, I Don't Care': Millennial and Generation Z Students and the Impact of Faculty Caring. *Journal of the Scholarship of Teaching and Learning, 19*(4), 78-89.

Leedy, P. D., Ormrod, J. E., & Johnson, L. R. (2019). *Practical research: Planning and design.* New York: Pearson Education.

Henriksen, D., Mishra, P., & Mehta, R. (2015). Novel, effective, whole: Toward a NEW framework for evaluations of creative products. *Journal of Technology and Teacher Education, 23*(3), 455-478. Retrieved from https://www.learntechlib.org/p/151574/

Ayre, C., & Scally, A. J. (2014). Critical values for Lawshe's content validity ratio: Revisiting the original methods of calculation. *Measurement and Evaluation in Counseling and Development, 47*(1), 79–86.

IBM Corp. (2024). *IBM SPSS Statistics for Windows* (Version 29.0.2.0) [Computer software]. Armonk, NY: IBM Corp.

Tan, A. J. Y., Davies, J. L., Nicolson, R. I., & Karaminis, T. (2023). Learning critical thinking skills online: Can precision teaching help? *Educational Technology Research and Development, 71*(3), 1275–1296. https://doi.org/10.1007/s11423-023-10227-y

Taylor, A. (2019). There Is No 'E' in 'Constraints': Teaching Creativity in Higher Education Screen Production. *The Palgrave Handbook of Screen Production.* https://doi.org/10.1007/978-3-030-21744-0_31

APPENDIX A: Caption Problem Spaces

OCG Problem Space

Provide an original caption to the following cartoon in **exactly seven** words. You can use any words that you wish to caption this cartoon.

Word #1 Word #2 Word #3 Word #4 Word #5 Word #6 Word #7

CCG Problem Space

Provide an original caption to the following cartoon.

ICG Problem Space

Provide an original caption to the following cartoon. You will need to use at least one concrete noun from the left column and one concrete verb from the right column. Please note that you are allowed to modify the words to meet the needs of your caption (e.g. change tense).

Noun List:

1. Cancer
2. Elevator
3. Hurricane
4. Jacket
5. Kool-Aid
6. Murder
7. Nail
8. Screw
9. Shirt
10. Stairway
11. Sunshine
12. Tango
13. Titanic
14. Window
15. Wrench

Verb List:

1. Answer
2. Ask
3. Cry
4. Demand
5. Inquire
6. Interrupt
7. Mutter
8. Observe
9. Reason
10. Rejoin
11. Remark
12. Repeat
13. Reply
14. Return
15. Suggest

Малі зсуви — великі здобутки: переосмислення креативності у добу підзвітності

Тімоті Гінчман[1ABCDE]

Університет Джорджії Саутерн

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 9 с., 6 табл., 3 рис., 32 джерела.

Мета. У дослідженні вивчався вплив цілеспрямовано сконструйованих обмежень на креативність представників покоління Z — студентів педагогічних спеціальностей (GZ-PSTs), що навчаються у державній програмі підготовки педагогів (EPP). Спираючись на Модель новизни на основі обмежень Стокс (Constraint-Based Model of Novelty, C-BMN; 2009), перевіряли, чи здатні обмеження на вході («використай те, що маєш») та на виході («ось як це має виглядати») підсилювати творче розв'язання проблем, зокрема в контексті створення підпису до візуального стимулу.

Матеріали та методи. Застосовано квазіекспериментальний дизайн з нееквівалентними групами та лише підсумковим тестуванням; використано вибірку зручності з 39 GZ-PSTs, яких випадково розподілили на три групи, які мали: обмеження на вході, обмеження на виході та відсутність обмежень (контроль). Усі учасники виконували однакове творче завдання — створити підпис до карикатурного зображення. Оцінювання підписів здійснювалося за валідованою рубрикою NEW (Henriksen та ін., 2015), що вимірює новизну, ефективність, цілісність та загальний показник креативності (TCS). Двоє підготовлених викладачів незалежно оцінювали відповіді. Для перевірки міжгрупових відмінностей застосовано критерій Крускала—Уолліса та пост-хок аналіз Данна (1964), а міжекспертну узгодженість підтверджено коефіцієнтом каппа Коена.

Результати. Виявлено статистично значущі відмінності за всіма вимірами креативності: найнижчі бали отримала група без обмежень (TCS M = 5,54), найвищі — група з обмеженням на виході (TCS M = 12,27). Розміри ефекту були від середніх

до великих. Отримані результати підтверджують припущення, що продумано спроєктовані обмеження можуть слугувати ефективною опорою для творчого мислення майбутніх учителів.

Висновки. Дослідження підкреслює цінність інтеграції стратегій на основі обмежень у програми підготовки педагогів, особливо для покоління Z, яке навчалося у високоструктурованому, орієнтованому на тести середовищі K–12. Вбудовування таких стратегій може надати майбутнім учителям змогу мислити творчо в межах стандартизованих курикульних рамок.

Ключові слова: студенти-педагоги покоління Z, креативність, спроєктовані обмеження, підготовка педагогів, рамка C-BMN.

Information about the Authors

Hinchman Timothy: thinchman@georgiasouthern.edu; https://orcid.org/0009-0007-9316-6438; Georgia Southern University, College of Education, Department of Elementary and Special Education, 1332 Southern Dr, Statesboro, GA 30458.

Cite this article as: Hinchman, T. (2025). Small Shifts, Big Gains: Rethinking Creativity in the Age of Accountability. *Journal of Learning Theory and Methodology, 6*(2), 71-79. https://doi.org/10.17309/jltm.2025.6.2.02

Received: 15.07.2025. Accepted: 16.08.2025. Published: 30.08.2025

This work is licensed under a Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0)

Journal of Learning Theory and Methodology
Журнал теорії та методології навчання

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

Original Scientific Article

Development of Speed Abilities of Players of the Age Category U-15 During the Macrocycle in Futsal

Leonid Zaitsev[1ABCD], Maksym Mishyn[1ACD] and Serhii Lebediev[1AD]

[1]Kharkiv State Academy of Physical Culture

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

DOI: 10.17309/jltm.2025.6.2.03

Abstract

Objectives. To substantiate the construction of the process of development of speed abilities of players of the U-15 age category in futsal throughout the macrocycle.

Materials and Methods. The study involved 15 U-15 players, representatives of the Municipal Institution «Children's and Youth Sports School» of the Bogodukhov City Council (Kharkiv Region), participants of the Ukrainian Futsal Championship (U-15) of the 2024-2025 season. The study was conducted in accordance with the ethical principles of the "Helsinki Declaration". Participation in them was voluntary, about which the athletes signed consent. To solve the tasks of the study, a set of research methods was used: analysis of scientific and methodological literature; pedagogical observation; pedagogical testing; methods of mathematical statistics.

Results. Analysis of the dynamics of the development of speed abilities of U-15 age category futsal players during the macrocycle revealed that statistically significant increase in the result is observed only in the preparatory period ($t=11.42$, $p<0,001$). During the competitive period, statistically significant differences between the test results were not revealed ($t=0.83$, $p>0.05$; $t=1.97$; $p>0,05$), however, negative dynamics are observed at the end ($t= -1.00$; $p>0.05$).

Conclusions. Futsal puts forward specific requirements for the physical training of players, in particular, for the development of speed abilities and their ability to react instantly in conditions of frequent changes in the game situation. The conducted analysis of the dynamics of the development of speed abilities of players showed that a reliable improvement in indicators occurs only in the preparatory period, and in connection with the long competitive period, there is a stabilization of average indicators, however, some players have shown negative dynamics. In this regard, the construction of the training process for the development of speed abilities should be based on scientifically sound methods that take into account the age characteristics of players, the specifics and nature of the competitive load in futsal.

Keywords: training process, training means, physical qualities, preparatory period, competitive period, load.

Introduction

Futsal is one of the fastest growing sports. Futsal's popularity is currently associated not only with the high emotional intensity of the game, but also with the simplicity of the rules and minimal requirements for the courts (Petrenko & Petrenko, 2021). In addition, regular futsal classes have a comprehensive impact on young athletes, contribute to an increase in the level of motor activity, improve the functional capabilities of players and have a positive effect on physical development (Strykalenko et al., 2024).

At the same time, in order to improve the organizational and methodological support for the process of training young futsal players, it is necessary to use scientifically based approaches (Strykalenko et al., 2021; Strykalenko et al., 2022). This requires searching for modern scientific and innovative methods for constructing training activities in various periods of the annual training cycle (Kostenko, 2023) and the use of modern means and methods of teaching specific technical and tactical actions (Sadiq, 2021).

It is worth noting that for a more effective training process in futsal, the issues of developing priority physical qualities that are most inherent in this particular type of football are acute (Vons et al., 2020), since the physical fitness of young players affects the formation of moral and volitional qualities (Patriychuk & Ivanyshyn, 2024; Sekulic et al., 2021; Spyrou et al., 2020).

However, scientific research and practical recommendations for improving the physical fitness of players are mainly related to classic football. However, as far as scientific devel-

© Zaitsev, L., Mishyn, M., & Lebediev, S., 2025.

JLTM
LLC OVS

Corresponding Author: Maksym Mishyn,
e-mail: mishyn.m@khdafk.com

opments in the construction of the process of physical training of young athletes in futsal, and especially the development of speed abilities, are concerned, they are only fragmentary.

Taking into account all of the above, the construction of the process of developing the speed abilities of young futsal players during the macrocycle and its justification, based on the study of the dynamics of indicators, is relevant and determines the theoretical and practical significance.

Materials and Methods

Study Participants

The study involved 15 U-15 players, representatives of the Municipal Institution «Children's and Youth Sports School» of the Bogodukhov City Council (Kharkiv Oblast), participants of the Ukrainian Futsal Championship (U-15) of the 2024-2025 season. The study was conducted in accordance with the ethical principles of the «Declaration of Helsinki». Participation was voluntary, to which the athletes signed consent.

Study Organization

For players in the U-15 age category, a macrocycle structure and content for developing speed abilities have been developed, and the timing of control testing has been determined (Figure 1).

The analysis of the dynamics of speed abilities development was carried out on the basis of comparison of the results of control tests using the «15 m sprint» test, conducted on the 1st week of the preparatory period and on the 2nd, 7th, 16th and 22nd weeks of the competitive period.

To develop the speed abilities of futsal players of the U-15 age category, a wide range of running exercises was used during the macrocycle. In the preparatory part of the lesson, special running exercises were used: running with a high hip lift; throwing the heels back; jogging; running with side steps; jumping run; running on straight legs; running with small steps. At the beginning of the main part of the lesson, the following means were used: running from a high start for a distance of 10 to 50 m; starts in different positions; relay running; running downhill; high-intensity running for short segments with weights; jumping run for 20-40 m. In addition, futsal-specific means were used to increase speed potential, including: fast dribbling of the ball for 20-30 m; jumping exercises with the ball; changing the direction of movement at high speed. The means involved were used within the framework of two methods: repeated and serial. The training load was mostly selected individually and included repeating one exercise from 6 to 10 times, and the rest pause between repetitions of the exercises lasted until the body's performance was restored, at which high-quality performance of the exercise was possible and lasted from 60 to 180 seconds.

Statistical Analysis

To process the research results, statistical data processing methods were used using Microsoft Excel software, which made it possible to observe the dynamics of data and their percentage ratio. To compare the obtained test results, an even two-sample Student's t-test was used for average values. When evaluating statistical hypotheses, we proceeded from a 5% probability level, which ensures the necessary accuracy in pedagogical research. Paired two-sample for averages.

Results

To determine the dynamics of the development of speed abilities of futsal players of the U-15 age category during the macrocycle, 5 control tests were conducted, of which 1 at the beginning of the preparatory period, 2-5 during the competitive period (Table 1, Figure 1).

The first test (15 m sprint) was conducted on the first week of the preparatory period to determine the current state of the athletes. The average result was 2.61 s, and the average deviation was 0.11 s. The players' results were within the range: min = 2.85 s, max = 2.44, and the difference between the results was 0.41 s.

The second test was conducted on the second week of the competition period, two weeks before the first round of the competition. The average result of the players was 2.52 ± 0.11 s, with the best result of 2.39 and the worst 2.77 s.

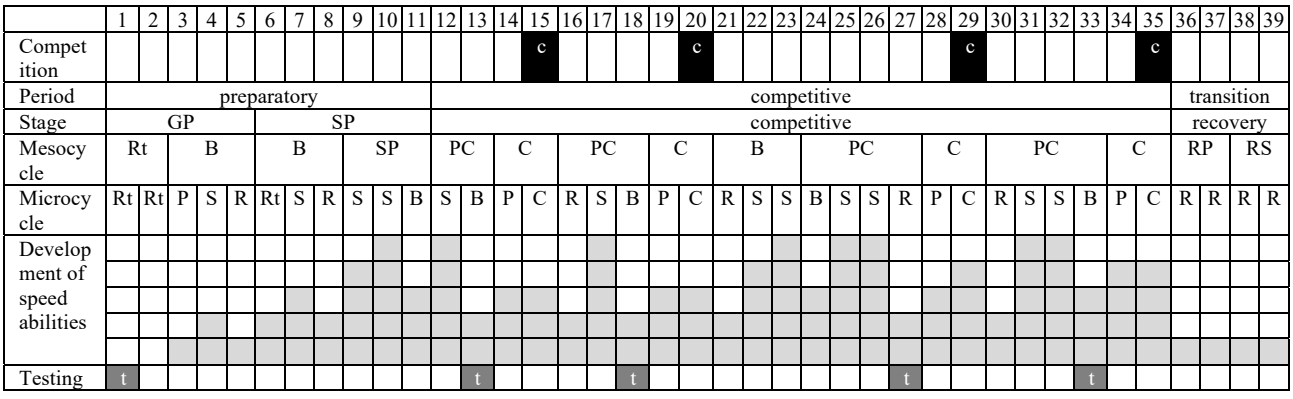

Fig. 1. Load distribution for the development of speed abilities of futsal players of the U-15 age category in the structure of the macrocycle. Note: Period: P – preparatory; C – competitive; TR – transitional. Stage: GP – generally preparatory; SP – special preparatory; C – competitive; R – recovery. Mesocycles: Rt – retracting; B – basic; SP – special preparatory; PC – pre-competition, C – competition; RP – recovery and preparatory; RS – recovery and supportive. Microcycles: Rt – retracting; S – shock (developmental) ; P– preliminary; C – competition; R – recovery

Table 1. Results of 15m sprint testing during a macrocycle of U-15 futsal players, (n=15)

№	1 testing, 1 week preparatory period, s	2 testing, 2 week competition period, s	Difference 1-2, s	3 testing, 7 week competition period, s	Difference 2-3, s	4 testing, 16 week competition period, s	Difference 3-4, s	5 testing, 22 weeks competitive period, s	Difference 4-5, s
1	2 .63	2 .57	0 .06	2 .53	0 .04	2 .56	-0 .03	2 .55	0 .01
2	2 .51	2 .45	0 .06	2 .41	0 .04	2 .40	0 .01	2 .42	-0 .02
3	2 .44	2 .39	0 .05	2 .40	-0 .01	2 .37	0 .03	2 .38	-0 .01
4	2 .57	2 .45	0 .12	2 .49	-0 .04	2 .46	0 .03	2 .45	0 .01
5	2 .64	2 .54	0 .10	2 .53	0 .01	2 .52	0 .01	2 .52	0 .00
6	2 .73	2 .59	0 .14	2 .62	-0 .03	2 .53	0 .09	2 .55	-0 .02
7	2 .85	2 .74	0 .11	2 .72	0 .02	2 .72	0 .00	2 .70	0 .02
8	2 .61	2 .52	0 .09	2 .54	-0 .02	2 .53	0 .01	2 .55	-0 .02
9	2 .59	2 .51	0 .08	2 .55	-0 .04	2 .52	0 .03	2 .53	-0 .01
10	2 .47	2 .40	0 .07	2 .43	-0 .03	2 .41	0 .02	2 .39	0 .02
11	2 .58	2 .49	0 .09	2 .44	0 .05	2 .43	0 .01	2 .45	-0 .02
12	2 .66	2 .54	0 .12	2 .49	0 .05	2 .50	-0 .01	2 .50	0 .00
13	2 .54	2 .41	0 .13	2 .39	0 .02	2 .38	0 .01	2 .42	-0 .04
14	2 .81	2 .77	0 .04	2 .72	0 .05	2 .70	0 .02	2 .68	0 .02
15	2 .59	2 .47	0 .12	2 .47	0 .00	2 .49	-0 .02	2 .50	-0 .01
$\overline{x}$	2 .61	2 .52	0 .09	2 .52	0 .00	2 .50	0 .02	2 .51	-0 .01

All players showed positive dynamics of the result increase, fluctuating between 0.05 and 0.14 s.

The third test was conducted on the 7th week of the competition period, two weeks before the second round of the competition. The average result was 2.52 ± 0.10 s. The best result remained at 2.39 s, and the worst improved to 2.72 s. At the same time, positive dynamics of test results were observed only in 8 players and ranged from 0,01 to 0,05. Neutral dynamics were detected in 1 player and negative dynamics were detected in 6 players, which ranged from - 0.01 to - 0.04.

The fourth test was conducted on the 16th week of the competition period, two weeks before participation in the third round of the Ukrainian Futsal Championship. The average result of the players improved to 2.50 ± 0.10 s, but 3 athletes demonstrated negative dynamics of the observed (- 0.01 – - 0.03 s), and 1 – neutral.

The fifth test was conducted on the 22nd week of the competitive period, two weeks before participation in the fourth (final) round of the competition. Despite the improvement of max=2.38 s and min=2.70 s results, there is a deterioration in the average result – 2.51 ± 0.09 s. Compared to the previous test, negative dynamics are observed in 8 players.

The analysis of the dynamics of the test results made it possible to determine the statistical difference in the indicators (Table 2).

The study of the dynamics of the average result of the players was conducted using an even two-sample Student's criterion for average values. It was found that during the preparatory period there was a statistically significant increase in speed abilities (t=11.42, p<0.001), which on average amounted to 0.09 s. This can be explained by the effectiveness of the adaptation processes that took place in the first period of the macrocycle. Analysis of the dynamics of the development of speed abilities during the competitive period did not reveal statistically significant differences between the average indicators (t=0.83, p>0.05; t=1.97; p>0.05; t= -1.00; p>0.05). This can be explained by the stabilization of results in the second period of the macrocycle. At the same time, the negative dynamics of results in some players may be associated with the accumulation of fatigue, insufficient individual load and other factors, which requires further research.

Table 2. Analysis of the dynamics of 15 m sprint performance during the macrocycle of U-15 futsal players, (n=15).

Testing	$\overline{x} \pm \sigma$	t	p
1	2.61 ± 0.11	11.42	<0.001
2	2.52 ± 0.11		
2	2.52 ± 0.11	0.83	>0.05
3	2.52 ± 0.10		
3	2.52 ± 0.10	1.97	>0.05
4	2.50 ± 0.10		
4	2.50 ± 0.10	-1.00	>0.05
5	2.51 ± 0.09		

Discussion

This study assumed that futsal is a speed-strength sport and puts forward specific requirements for the development of players' motor skills, in particular, speed abilities. This requires the formation of a proprietary futsal concept for the development of motor skills, which should currently become a priority area of research for both theorists and practitioners.

The conducted research confirms that the high dynamism of futsal is due to the nature of competitive activity, which involves multiple accelerations, instant start from a place, quick inclusion in the rivalry and the performance of explosive actions with the ball. The obtained results are consistent with the findings of foreign researchers Santa Cruz et al. (2015), who define the main physical qualities that are of priority importance for futsal. These include starting speed, distance speed, speed endurance and explosive power. It is these components of physical training that determine the player's ability to quickly adapt to a variable game situation, ensure effective movement around the court and the implementation of technical and tactical actions at a high pace.

At the same time, for the development of effective training programs, it is key to determine the nature of the competitive load in futsal. Thus, according to Horbenko & Kohanetz (2012), during the performance of such game actions as sprints, accelerations, returns to the defense zone and sprint-brake movements, players are predominantly in conditions of submaximal and maximum intensity (HR ≥ 180 bpm), and the total volume of such actions is 600-800 m per match with 260-300 s of active playing time. Such intensity of the load indicates the need for targeted development of speed qualities, the ability to react quickly and effectively recover between episodes of high activity.

Summarizing the results of testing futsal players aged 20 to 30 years, playing in the Extra League of Ukraine, domestic experts Strikalenko, Shalar & Guzar (2020) determined the dynamics of the level of physical fitness. Thus, the increase in the result in the test "15 m sprint" during the preliminary period is 19.60%. At the same time, our research has revealed that for players of the U-15 age category, the dynamics of indicators in a similar test during the preparatory period, which lasted 11 weeks, is significantly lower. The average increase in the indicator was 3.52% and ranged from 1.42% to 5.13%.

In addition, as noted by Stasiuk (2013), a long competitive period in futsal requires the use of various training process tools to maintain optimal athletic form. In the structure of each competitive mesocycle, in addition to competitive and recovery microcycles, those aimed at maintaining the physical and functional fitness of players should also be used and play an important role in maintaining the stability of physical form, allowing athletes to maintain a high level of readiness and include tools that promote effective functioning. This is confirmed by our study. Thus, during the 24-week competitive period, it was possible to maintain a sufficient level of development of the players' speed abilities (the average result of the «15 m sprint» test was: Week 2 – 2.52 s; Week 7 – 2.52 s; Week 16 – 2.50 s; Week 22 – 2.51 s). This was facilitated by the use of exercises that contributed to: maintaining explosive speed; improving reaction and adaptability to changes in the game situation; developing movement speed and team interaction; increasing coordination and leg strength; improving the frequency of movements and ball control; maintaining explosive power and start speed; developing coordination and maneuverability.

The use of these tools is consistent with the research of foreign experts (Kassiano et al., 2019), who consider the development of speed, explosive and anaerobic strength of the lower limbs to be an important aspect of the training process for young futsal players. But as the authors note, the selection of training exercises should take into account: the development of fast attacks; improvement of positional attacks; control and possession of the ball at high speeds; improvement of speed technical and tactical actions in martial arts.

The introduction of specialized methods will improve the efficiency of the training process and adapt the physical training of players to the specific requirements of futsal.

Conclusions

Futsal puts forward specific requirements for the physical training of players, in particular, for the development of speed abilities and their ability to react instantly in conditions of frequent changes in the game situation.

The conducted analysis of the dynamics of the development of speed abilities of players showed that a reliable improvement in indicators occurs only in the preparatory period, and in connection with the long competitive period, there is a stabilization of average indicators, however, some players have shown negative dynamics.

The construction of the training process for the development of speed abilities should be based on scientifically sound methods that take into account the age characteristics of players, the specifics and nature of the competitive load in futsal.

Conflict of Interest

All authors have read and approved the final version of the manuscript, and they declare no conflicts of interest.

References

Petrenko, Yulia & Petrenko, Yuri. (2021). Modern information and communication technologies in the organization and holding of matches of the Kharkiv region of futsal. *Scientific and methodological bases of use of information technologies in the field of physical culture and sports,* 5, 106-113.

Strykalenko, E.A., Shalar, O.G. & Baranovskaya, Yu.V. (2024). Differences in the physical fitness of players in football and futsal. *XXIV International scientific and practical conference "Modern Scientific Challenges are the Driving Force of the Development of Scientific Research"* (May 22-24, 2024), Bruges, Belgium: International Scientific Unity, 191-195. ISBN 978-617-8427-16-0.

Strykalenko,Y., Huzar, V., Shalar, O., Voloshynov, S., Homenko, V. & Svirida, V. (2021). Physical fitness assessment of young football players using an integrated approach. *Journal of Physical Education and Sport, 21*(1), 360-366. https://doi.org/10.7752/jpes.2021.01034

Strykalenko, Evgeniy, Cherepovska, Hanna & Shalar, Oleg. (2022). Eatures of building the training processof young futsalists. *Theory, methodology and practice of learning, 1*(92), 62-73. https://doi.org/10.54662/veresen.1.2022.05

Kostenko, M. (2023). Organization of the educational and training progress at the initial stage of beach soccer. *Scientific journal National Pedagogical Dragomanov University, 3K*(162), 201-206. https://doi.org/10.31392/NPU-nc.series15.2023.3K(162).41

Sadiq, S.J. (2021). The effects of tactical sequences on game scenarios in the development of skilful and tactical performances for futsal players. *J Hum Sport Exerc, 16*(3proc), 1340-1350. https://doi.org/10.14198/jhse.2021.16.Proc3.49

Vons, O.Z., Dmitrov, R.V. & Ivanyshyn, Yu.I. (2024). The impact of futsal classes on the physical fitness of young men 15-16 years. *Problems and prospects for the development of sports games and collections in higher education institutions,* 66-70.

Patriychuk, Anna & Ivanyshyn, Irina. (2024). The aim is to characterize the psychomotor performance of young futsal players at the stage of preliminary basic training. *Newsletter of Precarpathian University. Physical culture,* 43, 82-88. https://doi.org/10.15330/fcult.43.82-88

Sekulic, D., Pojskic, H., Zeljko, I., Pehar, M., Modric, T., Versic, S. & Novak, D. (2021). Physiological and Anthropometric Determinants of Performance Levels in Professional Futsal. *Front. Psychol,* 11, 621763, 1-14. https://doi.org/10.3389/fpsyg.2020.621763

Spyrou, K., Freitas, T.T., Marín-Cascales, E. & Alcaraz, P.E. (2020). Physical and physiological match-play demands and player characteristics in futsal: a systematic review. *Front. Psychol,* 11, 569897. https://doi.org/10.3389/fpsyg.2020.569897

Santa Cruz, R.A.R., Baganha, R.J., Da Rocha, G.L., De Oliveira, M.A., Pellegrinotti, I.L., Verlengia, R. & Lopes, C.R. (2015). Training with sprints and reduced games for speed performance in futsal. *Revista Brasileira De Futsal E Futebol, 7*(24), 214-220. ISSN 1984-4956

Horbenko, M. & Kohanetz, P. (2012). Features of physical fitness of athletes for the realization of various tactical tasks in futsal. *Physical culture, sports and health of the nation / Collection of scientific works,* 14, 24-29. ISSN 2071-5285.

Strikalenko, E., Shalar, O. & Guzar, V. (2020). Efficiency of building the training process of futsalists of FC Prodeksim in the preparatory period. *Sportyvni Ihry, 2*(16), 44-57. https://doi.org/10.15391/si.2020-2.05

Stasiuk, I.I. (2013). Construction training process of highly skilled players in mini-football for competition period. *Pedagogics, psychology, medical-biological problems of physical training and sports,* 8, 99-106. https://doi.org/10.6084/m9.figshare.750451

Kassiano, Witalo, Andrade, Ana, Denise, De Jesus, Karla, Lima, Antônio, Barroso, Simim, Mário, Antônio, Medeiros, Araripe, Alexandre Igor & Assumpção Cláudio de Oliveira. (2019). Neuromuscular parameters and anaerobic power of U-20 futsal players. *Journal of Human Sport and Exercise, 14*(1), 207-214. https://doi.org/10.14198/jhse.2019.141.17

Розвиток швидкісних здібностей гравців вікової категорії u-15 протягом макроциклу в футзалі

Леонід Зайцев[1ABCD], Максим Мішин[1ACD], Сергій Лебедєв[1AD]

[1]Харківська державна академія фізичної культури

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 2 табл., 1 рис., 15 джерел.

Мета дослідження – обґрунтувати побудову процесу розвитку швидкісних здібностей гравців вікової категорії U-15 у футзалі протягом макроциклу.

Матеріали і методи. У дослідженні брали участь 15 гравців категорії U-15, представники Комунальної установи «Дитячо-юнацька спортивна школа» Богодухівської міської ради (Харківська область), учасники Чемпіонату України з футзалу (U-15) сезону 2024-2025 рр. Середні вік гравців складав 14,8 років. Дослідження проводилось відповідно до етичних принципів «Гельсінської Декларації». Участь в них відбувалось на добровільних засадах, про що спортсмени підписали згоду. Для вирішення поставлених завдань дослідження роботи застосовувався комплекс методів досліджень: аналіз науково-методичної літератури; педагогічне спостереження; педагогічне тестування; методи математичної статистики.

Результати. Аналіз динаміки розвитку швидкісних здібностей гравців вікової категорії U-15 у футзалі протягом макроциклу виявив, що статистично достовірний приріст результату спостерігається лише у підготовчому періоді ($t=11,42$, $p<0,001$). Протягом змагального періоду статистично достовірних відмінностей між результатами тестування на виявлено ($t=0,83$, $p>0,05$; $t=1,97$; $p>0,05$), разом з тим наприкінці спостерігається негативна динаміка ($t= -1,00$; $p>0,05$).

Висновки. Футзал висуває специфічні вимоги до фізичної підготовки гравців, зокрема до розвитку швидкісних здібностей та їх здатності до миттєвих реакцій в умовах частої зміни ігрової ситуації. Проведений аналіз динаміки розвитку швидкісних здібностей гравців виявив, що достовірне покращення показників відбувається лише в підготовчому періоду, а у зв'язку з тривалим змагальним періодом відбувається стабілізація середніх показників, проте у деяких гравців виявлено негативну динаміку. У зв'язку з цим, побудова тренувального процесу щодо розвитку швидкісних здібностей повинна

базуватися на науково обґрунтованих методиках, що враховують вікові особливості гравців, специфіку та характер змагального навантаження в футзалі.

Ключові слова: тренувальний процес, засоби підготовки, фізичні якості, підготовчий період, змагальний період, навантаження.

Information about the Authors:

Zaitsev, Leonid: zaitsev.z00117@gmail.com, https://orcid.org/0009-0005-3131-3629; Department of Football and Hockey, Kharkiv State Academy of Physical Culture, Klochkivska St., 99, Kharkiv, 61022, Ukraine.

Mishyn, Maksym: mishyn.m@khdafk.com, https://orcid.org/0000-0002-8908-6861; Department of Olympic and Prґofessional Sport, Kharkiv State Academy of Physical Culture, Klochkivska St., 99, Kharkiv, 61022, Ukraine.

Lebediev, Serhii: serjlebedev1988@gmail.com, https://orcid.org/0000-0002-8452-8800; Department of Football and Hockey, Kharkiv State Academy of Physical Culture, Klochkivska St., 99, Kharkiv, 61022, Ukraine.

Cite this article as: Zaitsev, L., Mishyn, M., & Lebediev, S. (2025). Development of Speed Abilities of Players of the Age Category U-15 During the Macrocycle in Futsal. *Journal of Learning Theory and Methodology, 6*(2), 80-85. https://doi.org/10.17309/jltm.2025.6.2.03

Received: 15.07.2025. Accepted: 16.08.2025. Published: 30.08.2025

This work is licensed under a Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0)

Journal of Learning Theory and Methodology
Журнал теорії та методології навчання

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

Original Scientific Article

Improving the Level of Physical Preparedness of Female Cadets During Studying at a Specialized Higher Military Educational Institutions

Oksana Blavt[1ACD], Gennadii Iedynak[2BCDE] and Tetiana Liudovyk[3,4 BCD]

[1]Lviv Polytechnic National University
[2]Kamianets-Podilskyi National Ivan Ohiienko University
[3]Hetman Petro Sahaidachny National Army Academy
[4]Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies of Lviv

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

DOI: 10.17309/jltm.2025.6.2.04

Abstract

Objectives. The purpose of the study was to evaluate the effectiveness of an experimental physical education program designed to optimize the development of physical fitness in female cadets – future officers during their final year of study at a specialized military higher education institution.

Material and Methods. Fifty-four female cadets (mean age at baseline: 17.4 ± 0.2 years) participated in the pedagogical experiment. The participants were assigned to an experimental group (EG) and a control group (KG), both beginning their fourth year of study at the Hetman Petro Sahaidachnyi National Army Academy. The research design included the implementation of an experimental physical education program in the EG, while the KG followed the standard curriculum. General scientific methods (analysis and systematization), pedagogical testing, a forming pedagogical experiment, and methods of mathematical statistics were used. Physical fitness was assessed using standard tests for strength, speed, power, flexibility, and endurance, as well as indicators of special physical preparedness.

Results. Analysis showed that in the KG, only aerobic endurance improved significantly over the academic year, as evidenced by the 12-minute run performance. In contrast, the EG demonstrated statistically significant improvement in all indicators of general physical fitness. Regarding special physical preparedness, four indicators in the EG were significantly higher at the end of the experiment compared with the KG, while no such advantages were observed in the KG.

Conclusions. The experimental program used to organize and implement the content of physical education proved effective in enhancing all studied indicators of physical fitness in female cadets – future officers. The improvements observed in the EG confirm the positive impact of the structured and targeted measures incorporated into the experimental program throughout the academic year.

Keywords: female cadets, future officers, physical education, physical fitness, physical preparedness.

Introduction

The activity of a military officer at the present stage is marked by increasing demands and challenges due to the prolonged military aggression of russia against Ukraine. In this context, the modernization of methods, approaches, and strategies to ensure a high level of competence among future officers during their professional training becomes particularly important (Khotin, 2022).

It is essential to note that physical education continues to hold a leading position in this educational process (Sliusarchuk, V., & Iedynak, 2023). Its implementation enables the achievement of a high level of preparedness among military personnel and future officers for performing their professional duties and operational tasks (Klymovych et al., 2020; Jamro et al., 2021).

According to the Ministry of Defence of Ukraine (mod.gov.ua), as of January 1, 2025, over 70,000 women are serving in the Armed Forces of Ukraine, and this number continues to grow. Therefore, the scientific problem, supported by the practical realities of professional military service, concerning the training of women for military service in general and future female officers for fulfilling their professional duties in particular, gains special relevance. This includes the use of forms, means, and methods of physical education during

© Blavt, O., Iedynak, G., & Liudovyk, T., 2025.

JLTM
LLC OVS

Corresponding Author: Oksana Blavt,
e-mail: oksanablavt@ukr.net

their training in specialized higher military educational institutions (Sliusarchuk et al., 2022).

Achieving a high level of individual military-professional mastery in the modern soldier is largely determined by the development and implementation of the organizational principles and content of physical education (Duncan, 2016; Melnykov et al., 2018; Oderov et al., 2022).

Considering the necessity of solving the tasks defined by the theory and practice of modern warfare, and the urgent need to strengthen national defense capacity during prolonged war, it is essential to improve the organization and content of physical education in specialized institutions of higher military education. This aims to achieve the maximum possible positive outcomes in enhancing the professional preparedness of women – future officers.

Analysis of recent research and publications. Physical preparedness as a fundamental quality required for military personnel has been the focus of numerous studies (Haddock et al., 2016; Ojanen et al., 2018; Iedynak et al., 2020; Rebryna et al., 2022; Yahodzinskyi et al., 2022; Vaara et al., 2023). Other works (Aandstad et al., 2020; Smith et al., 2022; Oja & Piksööt, 2023; Coge et al., 2024) have emphasized the importance of physical preparedness for developing the physical condition of future officers.

In studies by Petrachkov et al. (2024), Vantarakis et al. (2022), Banakh, Iedynak, & Blavt, (2025) and Pietiläinen et al. (2024), the role of physical preparedness in enhancing psycho-emotional resilience and developing key physical abilities is highlighted. Scholars argue (Oliver et al., 2017; Vasiliki, 2021; Sliusarchuk et al., 2021) that all aspects of military tasks can be successfully performed on the basis of high-quality physical preparedness.

Various aspects of special physical preparedness in future female officers are examined in the studies of Grier et al. (2015); Knapik, Sharp, & Steelman (2017); Schram et al. (2022); Slyusarchuk (2020), and Sliusarchuk et al. (2022). Some authors focus specifically on the impact of specialized training programs for female military personnel (Santtila et al., 2022), as well as strategies for improving both physical (Schram et al., 2022) and physiological readiness (Jamro et al., 2021; Sliusarchuk et al., 2022).

International sources highlight the existence of several key approaches to organizing physical education in NATO armies. One approach involves joint training of men and women (Aandstad et al., 2012; Santtila et al., 2022), while another provides distinct organizational conditions, means, and methods tailored specifically for women (Greeves, 2015; Chassé et al., 2019). In particular, works by Grier et al. (2015), Nindl (2015), and Zurek et al. (2022) explore individualized physical training programs using various types of physical activity for female officers in NATO forces.

Researchers (Haddock et al., 2016; Slyusarchuk, 2020) acknowledge the lack of studies aimed at modernizing physical education for future female officers in specialized military educational institutions. This modernization is especially necessary in light of growing demands for their physical preparedness, and it requires appropriate methods and means to maximize both general and special physical preparedness. Data on the actual indicators and dynamics of physical preparedness among future female officers remain scarce, which hinders the evaluation of the current approach to organizing and implementing physical education, as well as the formation of appropriate physical activity content during their training.

The purpose of the study is to determine the effectiveness of an experimental approach to organizing and implementing the content of physical education for female cadets during their training at a specialized higher military educational institute.

Materials and Methods

Research methods

The research methodology employed a set of appropriate research methods, including general scientific methods such as analysis and systematization, as well as pedagogical experiments, pedagogical testing, and methods of mathematical statistics.

The pedagogical testing method involved the use of a battery of tests, each of which met the existing metrological requirements (Thomas et al., 2022). Testing was conducted in the first and last months of training, using tests that allowed for the assessment of the development of basic motor skills.

The motor characteristics were motor qualities that were considered physical fitness at all stages of the study. At the same time, general physical preparedness combined a set of motor qualities, which were assessed using the following tests: speed – 30 m sprint from a high start, absolute hand muscle strength (dynamometry of the dominant hand), explosive strength of the lower limb muscles (standing long jump), mobility in the lumbar spine (forward bend while sitting), coordination in cyclic locomotion (4x9 m shuttle run), aerobic endurance (12-minute run for maximum distance), static strength endurance (pull-ups on bent arms, bent at the elbow joints).

Special physical preparedness was studied using a battery of tests that allowed assessing the state of strength endurance development in a dynamic mode (exercise #7 – a complex strength exercise). The exercise consists of two parts: the first is bending and unbending the torso, the second is bending and unbending the arms from a lying position. The exercise is performed on any flat surface for one minute without interruption), speed (anaerobic) endurance (exercise #10 – 100 m run), coordination («exercise #10a – 10x10 m shuttle run) and aerobic-anaerobic endurance (exercise #14 – 1000 m run). All tests used were in line with recommendations in scientific literature (Duncan, 2016; Pichugin et al, 2011; US Army, 2022).

Study Participants

Fifty-four girls participated in the experiment; at the start of the experiment, the average age of the sample was 17.4 ± 0.2 years. All participants in the study sample were divided into experimental (EG) and control (KG) groups, which began their final year (4th year) of study at the Hetman Petro Sahaidachny National Army Academy.

The study was planned and carried out following the principles of bioethics set forth by the World Medical Association (WMA-2013) in the Helsinki Declaration «Ethical Principles of Medical Research Involving Humans» and UN-

ESCO in the «General Declaration on Bioethics and Human Rights».

Research Organization

To obtain objective data on the effectiveness of the author's development, a pedagogical experiment was conducted. The formative experiment was carried out over the course of one academic year. In the EG, an experimental physical education program was tested, while in the KG, traditional organizations, content, and methods of physical activity implementation in the process of physical education in a higher military educational institutions, were used.

The subject of the study of women – future officers – was the quantitative values of motor characteristics. In particular, these values were established at the beginning and end of the academic year, and then compared within the year of study. An increase, decrease, or maintenance of a certain characteristic under study was determined.

The results of the study were based on empirical data obtained at the beginning and end of a one-year formative experiment in research groups of female future officers who were pursuing specialized higher education during their first and fourth years of study at a higher military educational institutions.

Statistical Analysis

Using adequate methods of mathematical statistics, the mean, standard deviation, mean error, asymmetry, excess, and Student's t-test were determined for each characteristic under study. The following probability levels were used to indicate statistical significance: 0.05; 0.01; 0.001 (Dawson, 2019).

Mathematical statistics methods were used to process, analyze, and interpret the experimental data using SPSS Version 22.0 (IBM Corporation).

Results

In organizing physical education for female future officers during their professional training at specialized higher education institutions, it was taken into account that the duration of physical education in various forms should not exceed the duration specified in the current working program for this academic discipline, which is approved at certain higher military educational institutions (Working program of the academic discipline, 2020). According to the provisions of the «Instructions on physical training in the system of the Ministry of Defense of Ukraine» (Ministry of Defense of Ukraine, 2021): the planning of this pedagogical process should ensure the implementation of physical training programs taking into account training (combat) tasks, the even distribution of physical training activities throughout the week, month, and year, and provide for a specified number of hours for physical training classes.

The distinctive features of the experimental physical education program are the determination of its structure by a set of factors, namely external (the optimality of the content of physical education for the maximum possible promotion of physical fitness, the adequacy of physical fitness assessment standards to the capabilities of modern girls, taking into account individual characteristics during the implementation of physical education classes and other forms of physical activity in a specialized higher education institution, the presence of a conscious and responsible attitude towards the fulfillment of requirements regulated by professional activity; monthly complication of the content of basic movements and exercises for the development of functional abilities and motor qualities, adequate distribution of all specified forms of physical activity in the daily and weekly routine of girls; taking into account the structural features of each form of such activity; effective organization of girls' activities in each of these forms; practical ensuring of the integrity of physical education.

The results of the use of the experimental development by female cadets – future officers during the last year of study in higher military educational institutions– showed certain features of changes in the values of the studied indicators.

General Physical Preparedness. At the beginning of the experiment, the values of the studied indicators in the EG and the CG were practically identical, indicating their homogeneity. Moreover, it was noted that individual values for all indicators followed a normal distribution, which allowed for the appropriate use of mathematical and statistical methods in comparative analysis.

Based on these considerations, the analysis of the obtained data revealed that in the control group over the academic year, only one physical preparedness indicator changed to a statistically significant degree. This was aerobic endurance, which improved by 6% based on the results of the 12-minute run for maximum distance ($t=5.35$; $p<0.001$) (Table 1). Additionally, it was observed that changes in the remaining indicators reflected the following trends: the development of two motor qualities – absolute muscular strength and flexibility – remained at the same level, albeit with a negative trend. The decline amounted to 2.2% based on the handgrip dynamometry of the dominant hand ($t=1.02$; $p>0.05$), and 3.6% based on the sit-and-reach flexibility test ($t=1.54$; $p>0.05$).

As for the development of other studied motor qualities, there was a significant decrease in indicator values. Specifically, static muscular endurance declined by 18.7%, speed qualities by 3.9%, explosive power of the lower limbs by 3.5% ($p<0.001$), and coordination in cyclic locomotions by 2.4% ($p<0.01$).

In the EG, the implementation of the experimental intervention led to a completely different outcome. Over the course of the academic year, all assessed indicators of general physical preparedness showed significant improvement. The greatest increase was observed in static muscular endurance, which improved by 55.3% ($t=8.95$; $p<0.001$). The smallest, yet still statistically significant improvement, was recorded in speed qualities, which increased by 2.9% ($t=2.2$; $p<0.05$).

Another confirmation of the effectiveness of the experimental intervention and its advantage over the traditional approach to physical education for women – future officers – was the final assessment of indicators in the study groups at the end of the experiment. In all cases, significantly better values of general physical preparedness indicators were recorded in the EG.

Special Physical Preparedness. At the beginning of the experiment, the values of the studied indicators in both the

Table 1. Changes in indicators of general physical preparedness of female cadets (N-54)

Indicator	Group	At beginning		t between EG and CG	At the end		Change value ($X_1 - X_2$)		t	t between EG and CG
		X_1	m_1		X_2	m2	in absolute values	y, %		
30 m sprint from a high start, s	CG	7.48	0.07	0.09	7.78	0.05	0.3	- 3.9	3.49***	7.29***
	EG	7.49	0.08		7.27	0.06	- 0.22	2.9	2.2*	
Dynamometry of the dominant hand , kg	CG	27.9	0.41	0.45	27.3	0.43	- 0.6	- 2.2	1.02	5.49***
	EG	28.2	0.52		31.2	0.57	3.0	10.6	3.9***	
Standing long jump, cm	CG	188.4	1.27	0.33	182.1	1.31	- 6.3	- 5.1	3.46***	2.2*
	EG	187.7	1.72		197.3	1.74	9.6	3.5	3.92***	
Forward leansitting, cm	CG	17.4	0.28	0.79	16.8	0.37	- 0.6	- 3.6	1.54	3.49**
	EG	16.9	0.57		19.5	0.68	2.6	15.4	3.26**	
4×9 m shuttle run	CG	11.59	0.07	0.57	11.88	0.06	0.29	- 2.4	3.11**	11.0***
	EG	11.61	0.09		10.5	0.11	- 1.11	9.6	7.82***	
12-minute run for maximum distance	CG	2021.7	18.25	0.51	2151.1	15.85	129.4	6.4	5.35***	7.36***
	EG	2007.3	21.32		2354.8	22.7	347.5	17.3	11.2***	
Pull-ups on bent arms, bent at the elbow joints, c	CG	15.68	0.48	0.04	13.21	0.5	- 2.47	- 18.7	3.58***	11.8***
	EG	15.71	0.52		24.4	0.82	8.69	55.3	8.95***	

Table 2. Changes in indicators of special physical preparedness of female cadets (N-54)

Indicator	Group	At beginning		t between EG and CG	At the end		Change value ($X_1 - X_2$)		t	t between EG and CG
		X_1	m_1		X_2	m_2	in absolute values	y, %		
Exercise #7	КГ-4	33.68	0.43	0.84	33.11	0.41	- 0.57	- 7.2	0.97	10.9***
A complex strength exercise, n	ЕГ-4	34.21	0.46		42.31	0.39	8.1	23.7	13.5***	
Exercise #10	КГ-4	16.04	0.08	0.18	15.75	0.08	- 0.29	1.8	2.57*	5.82***
100 m run, s	ЕГ-4	16.02	0.08		15.11	0.08	- 0.91	5.7	8.27***	
Exercise #10a	КГ-4	35.67	0.22	1.03	35.45	0.25	- 0.22	0.6	0.67	8.16***
10x10 m shuttle run, s	ЕГ-4	36.01	0.25		34.12	0.31	- 1.89	5.2	4.73***	
Exercise #14	КГ-4	254.5	2.56	1.61	244.5	2.42	- 10.0	3.9	2.84**	4.56***
1000 m run, s	ЕГ-4	260.7	2.87		227.8	2.75	- 32.9	12.6	8.29***	

Note: The value of t-critical for related samples at n=24: at the level of p <0.05 – 2.064, at the level of p <0.01 – 2.797, at the level of p <0.001 – 3.745; at n=108 – respectively 1.984; 2.626; 3.391; marked "*" – p <0.05; "**" – p <0.01; "***" – p <0.001

EG and the CG were compared. It was found that all indicators showed virtually no differences between the groups, as evidenced by the t-test values, which ranged from 0.18 to 1.61 (Table 2).

An analysis of the data obtained at the end of the pedagogical experiment in the EG confirmed changes across all studied indicators. In every case, the changes were positive, with gains ranging from 5.2% to 23.7%. The greatest improvement was observed in dynamic muscular endurance, assessed based on the results of Exercise #7, which increased by 23.7% (p<0.001). A high level of improvement was also recorded in aerobic-anaerobic endurance, with a gain of 12.6% (p<0.001). Smaller, yet statistically significant improvements were noted in speed endurance (5.7%), measured by Exercise #10, and in coordinative endurance (5.2%), assessed by Exercise #10a (p<0.001).

The presented data differed significantly from those obtained in the CG. This was particularly evident in the indicators of dynamic muscular endurance (Exercise #7) and coordinative endurance (Exercise #10a), the development of which remained at the previously achieved level. In the former, a negative trend was observed, with a 7.2% decrease in performance (t = 0.97; p > 0.05), while in the latter, a slight positive trend was recorded, with a 0.6% increase (t = 0.67; p > 0.05).

As for the other studied indicators, the changes demonstrated modest but notable improvements: speed endurance increased by 1.8% (t = 2.57; p < 0.05), and aerobic-anaerobic endurance by 3.9% (t = 2.84; p < 0.01).

Analyzing the data from the perspective of how many indicators had higher final values in one group compared to the other, the results showed the following: in the EG, there were four such indicators, while in the CG, there were none.

Thus, the results obtained using both assessment criteria confirmed a greater improvement in special physical preparedness among women in the EG compared to those in the CG.

Discussion

Scientific research on the modernization of the content of physical preparedness for future officers is driven by its

critical role in shaping their professional readiness amid prolonged combat operations. This aligns with a number of recent scientific studies (Marić et al., 2013; Vantarakis et al., 2022; Bahas, Nikolaienko, & Hlivinska, 2025). Physical preparedness is recognized as one of the defining components of a young officer's readiness for high-quality professional service (Klymovych et al., 2020; Oliver et al., 2017; Vasiliki, 2021).

The conducted experiment expands the existing body of knowledge regarding the role of physical preparedness in shaping general combat readiness (Ojanen et al., 2018; Haddock et al., 2016; Jamro et al., 2022; Vaara et al., 2022). We support the scholarly view that this can be achieved through adherence to modern physical activity guidelines (Haddock et al., 2016; Smith et al., 2022; Oja, & Piksööt, 2023), adapting female military physical training to the contemporary demands of warfare (Greeves, 2015), and incorporating various forms of physical activity (Iedynak et al., 2020; Rebryna et al., 2022; Yahodzinskyi et al., 2022).

The obtained results are attributed to a combination of factors. One of the main factors is the effectiveness of all physical education activities developed and implemented within the framework of the experimental program for female cadets undergoing training in specialized higher military institutions. This conclusion is partially supported by the findings of other researchers (Greeves, 2015; Nindl, 2015; Santtila et al., 2015; Coge et al., 2024), which emphasize that optimal individualized training programs – empirically validated – provide effective preparation, including for women in military service.

This is also consistent with scientific perspectives (Aandstad et al., 2020; Melnykov et al., 2018; Coge et al., 2024) highlighting the need for ongoing monitoring of physical preparedness parameters throughout training in specialized military educational institutions.

Our study confirms the effectiveness of specially developed training programs for female military personnel, which can influence adaptation to training during military service (Jamro et al., 2021; Santtila et al., 2022) and improvement in physical condition (Grier et al., 2015). It also supports the formulation of physical preparedness programs based on women's military specialization as a key criterion for determining training direction (Nindl, 2015), within specific areas of military activity, considering sex-specific characteristics and physical attributes (Coge et al., 2024), as well as the defined structure of changes in general physical preparedness among female cadets (Sliusarchuk et al., 2022).

Moreover, it highlights the importance of adjusting training curricula based on gender differences (Bustamante-Sánchez, Nikolaidis, & Clemente-Suárez, 2022; Zurek et al., 2022), and accounting for the dependency between combat readiness and the level of physical preparedness (Jamro et al., 2022; Oderov et al., 2022).

Conclusions

Physical education remains one of the key factors determining the high level of professional preparedness of young officers upon graduation from military academies, as well as the maintenance of this level throughout their professional careers. At present, there is insufficient data on the dynamics of general and specialized physical preparedness indicators among female cadets – future officers – during their studies at higher military educational institutions.

The current approach to organizing and implementing physical education programs for female cadets – future officers promotes the development of only certain motor qualities, while others show only a positive trend without significant improvement. The implementation of an experimental framework for organizing, structuring, and delivering physical activity content over the course of one academic year enabled female cadets to achieve results that significantly improved all examined physical preparedness indicators. Comparative analysis between corresponding experimental groups confirmed statistically significant differences.

These outcomes are attributed to the effectiveness of the measures proposed by the experimental program, which were implemented within the military academy's physical education system for female cadets. The obtained findings should be considered in the planning and execution of physical education programs in higher military educational institutions, as they contribute to enhancing the overall efficiency in achieving the intended objectives.

Conflict of interest

If the authors have any conflicts of interest to declare.

References

Khotin, Y. (2022). Specificities of physical training of future officers-borderliners of ukraine (before and after the start of the war). *Scientific Innovations and Advanced Technologies*. https://doi.org/10.52058/2786-5274-2022-10(12)-453-462. [in Ukrainian]

Sliusarchuk, V., & Iedynak, G. (2023). The Dependence of Physical Fitness on the Functional Capabilities of Girls During Education at the Military Academy. *J of Learning Theory and Methodology, 4*(1), 33-38. https://doi.org/10.17309/jltm.2023.4.05

Klymovych, V., Oderov, A., Romanchuk, S., Korchagin, M., Zolochevskyi, V., Fedak, S., Gura, I., Nebozhuk, O., Lashta, V., & Romanchuk, V. (2020). Correlation of Physical Fitness and Professional Military Training of Servicemen. *Sport Mont, 18*(2), 79-82. https://doi.org/10.26773/smj.200612

Jamro, D., Zurek, G., Lachowicz, M., & Lenart, D. (2021). Influence of Physical Fitness and Attention Level on Academic Achievements of Female and Male Military Academy Cadets in Poland. *Healthcare (Basel), 24, 9*(10), 1261. https://doi.org/10.3390/healthcare9101261

Ministry of Defense. Available at: https://mod.gov.ua/

Sliusarchuk, V., Iedynak, G., Blavt, O., Chaplinskyi, R., Galamanzhuk, L., Stasyuk, V., & Klius, O. (2022). The Structure of General Physical Fitness of Girls – Future Officers During Training at the Military Academy. *Physical Education Theory and Methodology, 22*(1), 28-35. https://doi.org/10.17309/tmfv.2022.1.04

Duncan, A. G. (2016). *The military education of junior officers in the Edwardian Army.* Birmingham: History Department College of Arts and Law University.

Melnykov, A., Iedynak, G., Galamandjuk, L., Blavt, O., Duditska, O., Koryagin, V., Balatska, L., & Mazur, V. (2018). Factors that influence change in cadets' physical preparation during the first half of study at the military academy. *J of Physical Education and Sport, 18*(2), 781-786. https://doi.org/10.7752/jpes.2018.02115

Oderov, A., Kuznetsov, M., Romanchuk, S., Pohrebniak, D., Indyka, S., & Bielikova, N. (2022). Analysis of the level of physical fitness of cadets of the Military College ofSergeants of the National Academy of Land Forces in Lviv at the primary stage. Sport i Turystyka. *Środkowoeuropejskie Czasopismo Naukowe, 5*(1), 93-102. http://dx.doi.org/10.16926/sit.2022.01.05

Haddock, C. K., Poston, W. S., Heinrich, K. M., Jahnke, S. A., & Jitnarin, N. (2016).The Benefits of High-Intensity Functional Training Fitness Programs for Military Personnel. Mil Med, 181(11), e1508-e1514. https://doi.org/10.7205/MILMED-D-15-00503

Ojanen, T., Häkkinen, K., Vasankari, T., & Kyröläinen, H. (2018). Changes in Physical Performance During 21 d of Military Field Training in Warfighters. *Mil Med, 1;183*(5-6), 174-e181. https://doi.org/10.1093/milmed/usx049

Iedynak, G., Romanchuk, S., Sliusarchuk, V., Mazur, V., Matsuk, L., Kljus, O., Bozhyk, M., Oderov, A., Klymovych, V., Lototskiy, I., & Ovcharuk, I. (2020). The Effect of Training in Military Pentathlon on the Physiological Characteristics of Academy Cadets. *Sport Mont, 18*(3), 95-99. https://doi.org/10.26773/smj.201007

Rebryna, A., Kytrar, V., Koshel, A., Petrovych, O., Bondar, T., Bosniuk, P., Stasiuk, R., Serhiienko, V., Tkachenko, I., Kisiliuk, O., & Khlibovych, I. (2022). Dynamics of cadets' physical fitness in the process of arm wrestling. *International Journal of Human Movement and Sports Sciences, 10*(3), 361-370. https://doi.org/10.13189/saj.2022.100301

Yahodzinskyi, V., Khlibovych, I., Babaiev, Yu., Mykhniuk, O., Barkovskyi, D., Rodionov, M., Zimnikov, O. (2022). Health-improving effect of engagement in different types of motor activities for cadets of higher military educational institutions. *Acta Balneologica, 5*(171), 484-489. https://doi.org/10.36740/ABAL202205119

Vaara, J. P., Pihlainen, K., Rusila, J., Ojanen, T., & Kyröläinen, H. (2023). Physical fitness and anthropometrics in Finnish soldiers during their early career: prospective changes during a 3-year follow-up. *BMJ Mil Health., 169*(2), 116-121. https://doi.org/10.1136/bmjmilitary-2020-001571

Aandstad, A., Sandberg, F., Hageberg, R., & Kolle, E. (2020). Change in anthropometrics and physical fitness in Norwegian cadets during 3 years of military academy education. *Military medicine, 185*(7-8), e1112-e1119. https://doi.org 10.1093/milmed/usz470

Smith, C., Doma, K., Heilbronn, B., & Leicht, A. (2022). Effect of Exercise Training Programs on Physical Fitness Domains in Military Personnel: A Systematic Review and Meta-Analysis. *Mil Med, 25, 187*(9-10), 1065-1073. https://doi.org/10.1093/milmed/usac040

Oja, L., & Piksööt, J. (2023). The Influence of Previous Lifestyle on Occupational Physical Fitness in the Context of Military Service. *Int J Environ Res Public Health, 19, 20*(3), 1860. https://doi.org/10.3390/ijerph20031860

Coge, M., Neiva, H. P., Pereira, A., Faíl, L., Ribeiro, B., & Esteves, D. (2024). Effects of 34 Weeks of Military Service on Body Composition and Physical Fitness in Military Cadets of Angola. *Journal of Functional Morphology and Kinesiology, 9*(3), 111. https://doi.org/10.3390/jfmk9030111

Petrachkov, O. V., Kyslenko, D. P., Mykhaylov, V. V., Shostak, R., & Polyvaniuk, V. (2024). Motivation of military specialists to engage physical training during the legal regime of martial law. *Journal of Physical Education and Sport, 24*(6), 165, 1457-1464, https://doi.org/10.7752/jpes.2024.06165

Vantarakis, A., Vezos, N., Karakatsanis, K., Grivas, G., Oikonomou, T., Argyratou, A. D., Vantarakis, S. A., & Kalligeros, S. (2022). The Effects of Exercise During a 10-Week Basic Military Training Program on the Physical Fitness and the Body Composition of the Greek Naval Cadets. *Mil Med, 29, 187*(11-12), e1396-e1402. https://doi.org/10.1093/milmed/usab146

Banakh, V., Iedynak, G., & Blavt, O. (2025). Effectiveness of Different Models of Physical Activity in Improving the Physiological Characteristics of Girls Studying at University. *Journal of Learning Theory and Methodology, 6*(1), 33-41. https://doi.org/10.17309/jltm.2025.6.1.04

Pietiläinen, E., Parkkola, K., Vasankari, T., Santtila, M., Luukkaala, T., & Kyröläinen, H. (2024). Physical activity, physical fitness and cardiometabolic health among Finnish military workers. B*MJ Military Health, Published Online First:* 05 July. https://doi.org/10.1136/military-2024-002800

Oliver, J. M, Stone, J. D., Holt, C., Jenke, S. C., Jagim, A. R., & Jones, M. T. (2017). The Effect of Physical Readiness Training on Reserve Officers' Training Corps Freshmen Cadets. *Mil Med, 182*(11), e1981-e1986. https://doi.org/10.7205/MILMED-D-17-00079

Vasiliki, K. (2021). The Competency of the Military Fitness Training Leaders in the Hellenic Army Journal of Military and Veterans' Health. *Journal of Military and Veterans' Health, 22*(3). https://doi-ds.org/doilink/11.2021-32772174

Sliusarchuk, V., Iedynak, G., Galamanzhuk, L., Blavt, O., Balatska, L., Zoriy, Y., Nakonechnyi, I., Marchuk, D., Dotsyuk, L., & Moldovan, A. (2021). Physiological characteristics of cadet girls while studying at the military academy. *J of Physical Education and Sport, 21*(5), 3094-3101. https://doi.org/10.7752/jpes.2021.s5411

Grier, T., Canham-Chervak, M., Anderson, M. K., Bushman, T. T., & Jones, B. H. (2015). The effects of cross-training on fitness and injury in women. *US Army Med Dep J.* Apr-Jun, 33-41.

Knapik, J. J., Sharp, M. A., & Steelman, R. A. (2017). Secular Trends in the Physical Fitness of United States Army Recruits on Entry to Service, 1975-2013. *J Strength Cond Res, 31*(7), 2030-2052. https://doi.org/10.1519/JSC.0000000000001928

Schram, B., Canetti, E., Orr, R., & Pope, R. (2022). Risk factors for injuries in female soldiers: a systematic review. *BMC Sports Sci Med Rehabil., 29, 14*(1), 54. https://doi.org/10.1186/s13102-022-00443-z

Slyusarchuk, V. (2020). General physical fitness of girls – future officers at the stages of training in military academies. *Bulletin of Kamyanets-Podilsky National University named after Ivan Ogienko. Series: Physical education, sports and human health,* 19, 54-60. https://doi.org/10.32626/2309-8082.2020-19.54-6 [in Ukrainian]

Santtila, M., Pihlainen, K., Vaara, J., Tokola, K., & Kyröläinen, H. (2022). Changes in physical fitness and anthropometrics differ between female and male recruits during the Finnish military service. *BMJ Mil Health, 168*(5), 337-342. https://doi.org/10.1136/bmjmilitary-2020-001513

Aandstad, A., Hageberg, R., Saether, Ø., & Nilsen, R. O. (2012). Change in anthropometrics and aerobic fitness in Air Force cadets during 3 years of academy studies. *Aviat Space Environ Med, 83*(1), 35-41. https://doi.org/10.3357/asem.3069.2012

Greeves, J. P. (2015). Physiological Implications, Performance Assessment and Risk Mitigation Strategies of Women in Combat-Centric Occupations. *J Strength Cond Res, 29*(l),11, S94-100. https://doi.org/10.1519/JSC.0000000000001116

Chassé, E., Tingelstad, H. C., Needham-Beck, S. C., & Reilly, T. (2019). Factors affecting performance on an Army urban operation casualty evacuation for male and female soldiers. *Military Medicine,* pii: usz075. https://doi.org/10.1093/milmed/usz075

Nindl, B. C. (2015). Physical Training Strategies for Military Women's Performance Optimization in Combat-Centric Occupations. *J Strength Cond Res, 29*(11), S101-6. https://doi.org/10.1519/JSC.0000000000001089.

Zurek, G., Lenart, D., Lachowicz, M., Zebrowski, K., & Jamro, D. (2022). Factors Influencing the Executive Functions of Male and Female Cadets. *Int J Environ Res Public Health, 19, 19*(24), 17043. https://doi.org/10.3390/ijerph192417043

Thomas, J. R., Martin, P., Etnier, J. L., & Silverman, S. J. (2022). *Research methods in physical activity.* 6 th ed. Champaign, IL: Human Kinetics.

Pichugin, M. F., Hryban, G. P., Romanchuk, V. M., Romanchuk, S. V., & Boyarchuk, O. M. (2011). *Physical education of military personnel: teaching aids.* Zhytomyr: ZhVI NAU. [in Ukrainian]

US Army (2022). *Army Combat Fitness Test.* – URL: https://www.army.mil/acft/

Dawson, A. (2019). *Research Methods and Statistics in Physical Education.* Published by ED-Tech Press.

Working program of the academic discipline. *Theory and organization of physical training of troops* (for training cadets of the Ivan Chernyakhovsky National University of Defense of Ukraine) (2020). Kyiv. URL: https://nuou.org.ua/assets/ documents/rpnd-teo-org-fpv-23.pdf [in Ukrainian]

Instructions on physical training in the system of the Ministry of Defense of Ukraine (2021). Ministry of Defense of Ukraine. Available at: 2_ВКП-7-007201.02-ІНС-3-ФІЗ-ПІДГ-В-СИСТ-МОУ.pdf [in Ukrainian]

Marić, L., Krsmanović, B., Mraović, T., Gogić, A., Sente, J., & Smajić, M. (2013). The effectiveness of physical education of the Military Academy cadets during a 4-year study. *Vojnosanit Pregl, 70*(1), 16-20. https://doi.org/10.2298/vsp1301016m

Bahas, O., Nikolayenko, K., & Hlivinska, L. (2025). The influence and importance of physical education of border guard cadets during the war. *Scientific notes. Series "Psychological and pedagogical sciences" (Nizhyn State University named after Mykola Gogol),* (4), 146-151. https://doi.org/10.31654/2663-4902-2024-PP-4-146-151 [in Ukrainian]

Santtila, M., Pihlainen, K., Viskari, J., & Kyröläinen, H. (2015). Optimal Physical Training During Military Basic Training Period. *J Strength Cond Res, 1*(11), S154-7. https://doi.org/10.1519/JSC.0000000000001035

Vaara, J.P., Groeller, H., Drain, J., Kyröläinen, H., Pihlainen, K., Ojanen, T., Connaboy, C., Santtila, M., Agostinelli, P., Nindl, B.C. (2022). Physical training considerations for optimizing performance in essential military tasks. *Eur J Sport Sci, 22*(1), 43-57. https://doi.org/10.1080/17461391.2021.1930193

Bustamante-Sánchez, Á., Nikolaidis, P. T., & Clemente-Suárez, V. J. (2022). Body composition of female air force personnel: a comparative study of aircrew, airplane, and helicopter pilots. *International journal of environmental research and public health, 19*(14), 8640. https://www.mdpi.com/1660-4601/19/14/8640

Jamro, D., Zurek, G., Lachowicz, M., Lenart, D., & Dulni, M. (2022). Alternating Attention and Physical Fitness in Relation to the Level of Combat Training. *Healthcare (Basel), 27, 10*(2), 241. https://doi.org/10.3390/healthcare10020241

Підвищення рівня фізичної підготовленості курсанток під час навчання у спеціалізованому військовому закладі вищої освіти

Оксана Блавт[1ACD], Геннадій Єдинак[2BCDE], Тетяна Людовик[3,4BCD]

[1]Національний університет «Львівський політехніка»
[2]Кам'янець-Подільський національний університет імені Івана Огієнка
[3]Національна академія сухопутних військ імені гетьмана Петра Сагайдачного
[4]Львівський національний університет ветеринарної медицини та біотехнологій імені С. З. Ґжицького

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 2 табл., 15 джерел.

Мета дослідження полягала у визначення ефективності експериментального підходу до організації та реалізації змісту фізичного виховання курсанток – майбутніх офіцерів під час навчання у спеціалізованому військовому закладі вищої освіти.

Матеріал та методи. В експерименті взяли участь 54 курсантки, вік у вибірці становив 17,4 ± 0,2 років. Усі учасники досліджуваної вибірки було розподілено на експериментальну та контрольну групи, які розпочали останній рік навчання (4 курс) у спеціалізованому військовому закладі вищої освіти. Методологія дослідження передбачала використання комплексу адекватних методів дослідження, зокрема, загальнонаукових, а саме аналізу, систематизації, а також педагогічного експерименту, педагогічного тестування, методів математичної статистики. Метод педагогічного тестування передбачав використання батареї тестів.

Результати. Результати використання експериментальної розробки курсантками – майбутніми офіцерами протягом останнього року навчання у спеціалізованому військовому закладі вищої освіти засвідчили певні особливості зміни значень досліджуваних показників. На початку експерименту значення досліджуваних показників у ЕГ та КГ були практично однаковими, що свідчило про їхню однорідність.

Згідно аналізу одержаних даних щодо загальної фізичної підготовленості, встановлено, що у КГ протягом навчального року на статистично значущу величину змінилися значення тільки одного показника. Таким була аеробна витривалість дівчат, а її поліпшення за результатом 12-хвилинного бігу на максимальну відстань. У ЕГ реалізація експериментального чинника призвела до суттєвого поліпшення усіх досліджуваних показників загальної фізичної підготовленості. Аналізуючи дані спеціальної фізичної підготовленості з позиції кількості показників, значення яких наприкінці експерименту в одній групі були вищими, аніж у іншій, засвідчили таке. У ЕГ таких показників було 4, тоді як у КГ– жодного.

Висновки. Використання експериментальної розробки до організації, формування й реалізації змісту фізичного виховання у спеціалізованому військовому закладі вищої освіти забезпечує курсанткам – майбутнім офіцерам досягнення результатів, що сприяло суттєвому поліпшенню всіх досліджуваних показників фізичної підготовленості, які при порівнянні у відповідних дослідних групах засвідчують розбіжність на статистично значущу величину. Одержаний результат пов'язували з ефективністю передбачених експериментальною розробкою заходів, що були зреалізовані у спеціалізованому військовому закладі вищої освіти під час фізичного виховання курсанток – майбутніх офіцерів.

Ключові слова: курсантки, майбутні офіцери, фізичне виховання, фізична підготовленість, фізична підготовка.

Information about the Authors:

Blavt Oksana: oksanablavt@ukr.net; https://orcid.org/0000-0001-5526-9339; Department of PE, Lviv Polytechnic National University, Bandera St., 12, Lviv, 79013, Ukraine.

Iedynak Gennadii: yedinak.g.a@gmail.com; https://orcid.org/0000-0002-6865-0099; Kamianets-Podilskyi National Ivan Ohiienko Universit, Department of Theories and Methods of Physical Education; 32301, Kamianets-Podilskyi, Ohiienko Street, 62, Ukraine

Liudovyk Tetiana: tluidovyk@gmail.com; https://orcid.org/0000-0002-2407-0447; Hetman Petro Sahaidachny National Army Academy, 79012, Lviv, Heroes of Maidan Street, 32, Ukraine.

Department of PE, sports and health Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies of Lviv; St. Pekarska, 50 Lviv, 79010, Ukraine.

Cite this article as: Blavt, O., Iedynak, G., & Liudovyk, T. (2025). Improving the Level of Physical Preparedness of Female Cadets During Studying at A Specialized Higher Military Educational Institutions. *Journal of Learning Theory and Methodology, 6*(2), 86-93. https://doi.org/10.17309/jltm.2025.6.2.04

Received: 15.07.2025. Accepted: 16.08.2025. Published: 30.08.2025

This work is licensed under a Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0)

Journal of Learning Theory and Methodology
Журнал теорії та методології навчання

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

Original Scientific Article

Enhancing Locomotor Skills Through Team-Based Games with Creative Media in Elementary Physical Education Classes

Ananda Alfath[1ABCDE], Meirizal Usra[1ACD] and Wahyu Indra Bayu[1ACDE]

[1]Universitas Sriwijaya

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

DOI: 10.17309/jltm.2025.6.2.05

Abstract

Background. Locomotor movement is a fundamental component of motor development in early elementary school. However, low student engagement and limited Physical Education, Sports, and Health (PJOK) learning facilities often restrict the effective development of locomotor skills.

Objectives. This study aimed to evaluate the effectiveness of creative media-based team games in improving locomotor skills among second-grade elementary school students.

Material and Methods. The research used a Classroom Action Research (CAR) design implemented over two cycles, each consisting of two actions. The participants were 28 students of class 2B from SD Negeri 02 Indralaya Utara. Data collection included observation, interviews, documentation, and the Test of Gross Motor Development-2 (TGMD-2).

Results. The intervention led to a notable improvement in locomotor performance. The students' average score increased from 29.89 (62.27%) at baseline to 44.46 (92.63%) at the end of Cycle 2, indicating substantial progress following the implementation of creative media-based team games.

Conclusions. Creative media-based team games are effective in enhancing locomotor skills and fostering an engaging, active learning environment. The findings provide practical guidance for teachers in designing evidence-based instructional strategies to support locomotor development in early elementary education.

Keywords: locomotor skills, physical education, creative media, team games, motor development, classroom action research.

Introduction

Education plays a crucial role in human life because it contributes directly to developing individual potential and quality. In the Indonesian education system, Physical Education, Sports, and Health (PJOK) holds an equal position with other subjects in achieving national education goals. PJOK emphasizes movement-based learning through physical activities, games, and sports to enhance students' physical, mental, and emotional development (Shidiq et al., 2022). Central to this process are basic movement skills—locomotor, non-locomotor, and manipulative—that form the foundation for students' physical abilities (Muzakki & Saputra, 2020). Among these, locomotor movements such as walking, running, and jumping are essential for supporting physical competence and quality of life (Simahate & Munip, 2020; Bednarczuk et al., 2025).

Despite their importance, many elementary students still show low locomotor skills, which can hinder both learning and daily activities. Locomotor competence is closely linked to lower limb strength, speed, balance, and self-confidence (Gråstén et al., 2022). Observations at SD Negeri 02 Indralaya Utara revealed that some students lacked interest in PJOK motor skills lessons, reflecting low motor proficiency. This issue may stem from factors such as limited facilities, unpleasant learning experiences, or difficulties in understanding material. Yet, motor skill development is vital because strong motor abilities support sensory functions and cognitive growth, thereby influencing students' motivation and learning outcomes.

Improving locomotor skills requires supportive external factors, including appropriate facilities, creative media, and effective teacher–student interaction (Saleh & Ramdhani, 2020; Nur et al., 2018; Zain & Putra, 2020). Teachers' professional competence and managerial skills also play a significant role in creating engaging learning environments (Ellis et al., 2023). One promising strategy is the use of educational games, which not only strengthen psychomotor skills but also integrate cognitive and affective aspects (Anggraini,

© Alfath, A., Usra, M., & Bayu, W. I., 2025.

JLTM
LLC OVS

Corresponding Author: Wahyu Indra Bayu,
e-mail: wahyu.indra@fkip.unsri.ac.id

2021; Agung, 2021). Recent studies confirm the effectiveness of play-based learning and media in improving locomotor skills (Musampa, 2022; Syahbani et al., 2024; Arlini et al., 2024). However, these studies primarily focused on individual practice and used limited media, leaving gaps in the implementation of more varied and collaborative approaches.

Previous studies on improving locomotor skills in elementary students have largely emphasized individual practice and relied on limited types of learning media. While these approaches demonstrated positive outcomes, they do not fully address the need for collaborative, engaging, and varied game-based models that reflect the social and interactive nature of elementary school learning. Therefore, this study aims to design and implement an innovative creative media-based team game model in PJOK as an alternative solution to enhance locomotor skills. The study specifically seeks to analyze the current condition of students' locomotor skills, to develop a creative team game model that integrates diverse learning media suited to elementary school characteristics, and to examine the practicality and potential effectiveness of the model in PJOK learning. Accordingly, the research is guided by the following questions: (1) what is the current condition of elementary school students' locomotor skills in PJOK learning, (2) how can a creative media-based team game model be designed to suit the characteristics and needs of elementary students, and (3) to what extent is the developed model practical and potentially effective in improving students' locomotor skills?

Materials and Methods

This study employed a Classroom Action Research (CAR) approach, conducted systematically in cycles. Each cycle consisted of four stages: planning, implementation, observation, and reflection, carried out once a week. The CAR approach was expected to contribute to improving the quality of PJOK learning, particularly in developing students' locomotor skills.

The research was conducted at SD Negeri 02 Indralaya Utara, Ogan Ilir Regency, South Sumatra. The classroom action research was implemented over a period of several weeks, with one cycle carried out each week.

The subjects of this study were 28 students from grade 2B, consisting of 14 boys and 14 girls, aged 6 to 8 years old.

The selection of subjects was based on initial observation results, which indicated that the students' locomotor skills were still relatively low. Thus, the entire class was included as research participants.

Data were collected using a test technique to measure students' locomotor skills through the Test of Gross Motor Development-2 (TGMD-2), which focuses on locomotor skills such as running, galloping, hopping, leaping, horizontal jumping, and sliding. The TGMD-2 instrument has been shown to possess high validity and reliability, indicating consistency and accuracy in measurement (Apriyani et al., 2018). Assessments were carried out using a checklist-based scoring sheet, where each student was given two trials for each skill. A score of 1 was given if the skill criterion was achieved, and a score of 0 if it was not.

The collected data were analyzed using a quantitative approach. Raw scores from each locomotor skill test were converted into standard scores based on TGMD-2 guidelines and categorized according to the established descriptive classification. Furthermore, the mean scores and percentages were calculated for each cycle to evaluate the improvement in students' locomotor skills.

Results

This study aimed to improve the locomotor skills of grade 2B students at SD Negeri 02 Indralaya Utara through the implementation of group games supported by creative media in Physical Education (PE). Data were collected from 28 students through a series of tests and observations across each action cycle.

Table 1. Initial Test Results

Initial Data	Raw Score	Mean	Percentage (%)
Total	837	29.89	62.27

Based on Table 1, the total raw score obtained by the students was 837, with a mean score of 29.89 or 62.27%. These results indicate that the students' locomotor ability was still at a low level.

Table 2. Cycle 1 Action 1 Results

C1A1	Raw Score	Mean	Percentage (%)
Total	955	34.11	71.06

In Cycle 1 Action 1, the raw score increased to 955, with a mean of 34.11 or 71.06%. This shows an improvement of 118 points from the baseline, with a mean increase of 4.22 or 8.79%.

Table 3. Cycle 1 Action 2 Results

C1A2	Raw Score	Mean	Percentage (%)
Total	1,065	38.04	79.25

In Cycle 1 Action 2, the raw score rose to 1,065, with a mean score of 38.04 or 79.25%. This indicates an improvement of 110 points, with a mean increase of 3.93 or 8.13%. The students began to demonstrate better understanding and became more accustomed to locomotor concepts and practices.

Table 4. Cycle 2 Action 1 Results

C2A1	Raw Score	Mean	Percentage (%)
Total	1,165	41.61	86.69

In Cycle 2 Action 1, the raw score further increased to 1,165, with a mean score of 41.61 or 86.69%. This shows an improvement of 100 points compared to the previous cycle, with a mean increase of 3.57 or 7.44%.

Table 5. Cycle 2 Action 2 Results

C2A2	Raw Score	Mean	Percentage (%)
Total	1,245	44.46	92.63

In Cycle 2 Action 2, the raw score reached 1,245, with a mean of 44.46 or 92.63%. This represents an improvement of 80 points, with a mean increase of 2.85 or 5.94%.

Overall, the findings demonstrate significant improvement in each cycle. From the baseline mean score of 29.89 (62.27%), the students' scores increased to 44.46 (92.63%)

by the end of Cycle 2 Action 2. These results indicate that the implementation of group games supported by creative media was effective in enhancing the locomotor skills of grade 2B students at SD Negeri 02 Indralaya Utara.

Discussion

Based on the findings of this study, several factors were identified as contributing to the low level of locomotor skills among grade 2B students at SD Negeri 02 Indralaya Utara. The main problems included a lack of understanding of basic movement concepts, limited awareness of the importance of physical activity, and low interest in physical education. In fact, physical education plays a crucial role in enhancing students' overall quality of life—physically, mentally, and emotionally (Salim et al., 2023; Firdaus & Nurrochmah, 2021; Adji & Wibowo, 2023). Initial data showed that the average locomotor skill score of students was still low, reaching only 29.89 or 62.27%. This situation was further worsened by inadequate facilities, less engaging teaching methods, and low learning motivation, as confirmed by previous studies (Fauzan et al., 2022).

Through the implementation of creative media and game-based learning strategies, students' locomotor skills improved significantly in each cycle. In cycle 1 action 1, the average score increased to 34.11 (71.06%) after the use of creative media, which made the learning process more effective (Erwansyah & Ferianto, 2016; Muslim, 2021). The improvement continued in cycle 1 action 2, with the average score rising to 38.04 (79.25%), where the application of games successfully enhanced motivation and provided enjoyable motor stimulation (Mudzakir, 2020; Zenith et al., 2020).

In cycle 2 action 1, the average score further increased to 41.61 (88.69%) through the implementation of the group-based "Locomotor Circuit" game model, which encouraged students' coordination, cooperation, and interaction (Waluyo et al., 2024; Sudarmono, 2016; Rani et al., 2025). The highest improvement was observed in cycle 2 action 2, with the average score reaching 44.46 (92.63%) after the circuit was enhanced with more challenging variations of stations and obstacles. This finding demonstrates the effectiveness of consistent and structured practice in improving locomotor competence (Chen et al., 2024; Liu et al., 2025).

Overall, the study results indicate that the application of group games integrated with creative media in physical education effectively improved students' locomotor skills, motivation, teamwork, and provided enjoyable learning experiences. Students became more active, confident, and cooperative throughout the learning process. Nevertheless, this study was limited to a single class, and therefore, its findings cannot be generalized to a broader population. Future studies are recommended to involve larger and more diverse samples to obtain more representative results.

Conclusions

Based on the results obtained through several cycles, this study concludes that the implementation of group games supported by creative media in physical education effectively improves the locomotor skills of grade 2B students at SD Negeri 02 Indralaya Utara. The findings show a consistent increase in average locomotor skill scores across cycles, supported by step-by-step treatments and observations. Beyond locomotor development, this approach also enhanced students' creativity, learning enthusiasm, self-confidence, active participation, and teamwork during the learning process.

Thus, this model can serve as an effective alternative to address the low locomotor ability of elementary school students while improving the overall quality of physical education. These results highlight the importance of competent PE teachers and confirm that game-based learning tailored to students' characteristics provides enjoyable and meaningful experiences that foster holistic development—physically, mentally, and emotionally.

Conflict of interest

The authors declare no conflicts of interest.

References

Shidiq, A.A. P., Cahayani, P.M., Waluyo, & Iwandana, D.T. (2022). Tingkat Kreativitas Guru dalam Mengatasi Keterbatasan Prasarana Sarana Pembelajaran PJOK. *Gelanggang Olahraga: Jurnal Pendidikan Jasmani Dan Olahraga (JPJO), 6*(1), 27-35. https://doi.org/10.31539/jpjo.v6i1.4480

Muzakki, A., & Saputra, S.Y. (2020). Hubungan Antara Body Mass Index dengan Physical Fitness Pada Mahasiswa PGSD. *Jurnal Pemikiran Dan Pengembangan Sekolah Dasar (JP2SD), 8*(1), 88-95. https://doi.org/10.22219/jp2sd.v8i1.12414

Simahate, S., & Munip, A. (2020). Latihan Gerak Lokomotor Sebagai Upaya Mengembangkan Motorik Kasar Anak Down Syndrome. *ThufuLA: Jurnal Inovasi Pendidikan Guru Raudhatul Athfal, 9*(2), 236-248. https://doi.org/10.21043/thufula.v8i2.7656

Bednarczuk, G., Bandura, W., Rutkowska, I., & Starczewski, M. (2025). Balance Level and Fundamental Motor Skills of Youth with Visual Impairments: Pilot Study. *Journal of clinical medicine, 14*(10), 3483. https://doi.org/10.3390/jcm14103483

Gråstén, A., Huhtiniemi, M., & Jaakkola, T. (2022). School-Aged Children's Actual Motor Competence and Perceived Physical Competence: A 3-Year Follow-up. *Medicine & Science in Sport and Exercise, 54*(6), 1020-1027. https://doi.org/10.1249/mss.0000000000002870

Saleh, M.S., & Ramdhani, S. (2020). Survei Sarana Dan Prasarana Pendidikan Jasmani Dan Tingkat Kesegaran Jasmani Siswa Kelas VIII SMP PGRI Barembeng Kabupaten Gowa. *Journal Coaching Education Sports, 1*(1), 51-64. https://doi.org/10.31599/jces.v1i1.86

Nur, H.W., Nirwandi, & Asmi, A. (2018). Hubungan Sarana Prasarana Olahraga Terhadap Minat Siswa Dalam Pelaksanaan Pembelajaran Pendidikan Jasmani Olahraga Dan Kesehatan Di Sma N 1 Batipuah Kabupaten Tanah Datar. *Jurnal Menssana, 3*(2), 93-102. https://doi.org/10.24036/jm.v3i2.82

Zain, M.S., & Putra, D.S. (2020). Analisis Lingkungan Belajar, Metode Mengajar, Kurikulum Fisika, Relasi Guru Dengan Siswa, Dan Disiplin Sekolah. *Jurnal Pendidikan Fisika, 8*(1), 30-41.

Ellis, R., Mahaly, S., & Papalia, I. (2023). *Peningkatan Kapasitas Guru Melalui Pembelajaran Kompotensi Sosial Emosional Di SMP Al Hilal Haya.* German Für Gesellschaft (J-Gefüge), 2(2), 120-127.

Anggraini, Y. (2021). Analisis Persiapan Guru dalam Pembelajaran Matematika di Sekolah Dasar. *Jurnal Basicedu, 5*(4), 2415-2422. https://doi.org/10.55904/educenter.v1i5.171

Agung, L. (2021). Menggunakan Permainan Tradisional Gedrik Dalam Meningkatkan Hasil Belajar Gerak Lokomotor Siswa Kelas 2 Sd Islam Siti Hajar Kota Madiun. *Jurnal Buana Pedagogi Olahraga, 1*(1), 12-21. https://doi.org/10.36456/jbpo.v1i1.5192

Musampa, R. (2022). Peningkatan Hasil Belajar Gerak Lokomotor melalui Alat Bantu Pembelajaran Sederhana. *Kalam Cendekia: Jurnal Ilmiah Kependidikan, 10*(2), 246-251.

Syahbani, N., Prianto, A., Agustina, & Ahadiah (2024). Upaya Peningkatan Hasil Belajar Gerak Lokomotor Melalui Pendekatan Bermain Pada Siswa Kelas IV MIN 1 Muaro Jambi. *Journal of Indonesian Professional Teacher : JIPT, 1*(2), 1-11.

Arlini, Sujarwo, & Novitasari, E. F. (2024) Model Pembelajaran Gerak Dasar Lokomotor Berbasis Permainan Kartu Gambar Pada Siswa Kelas 2 Sekolah Dasar. *JPJA: Jurnal Pendidikan Jasmani dan Adaptif, 1*(7), 8-16

Salim, M.A., Priambodo, A., & W, A.R. (2023). Upaya Meningkatkan Minat Belajar PJOK Peserta Didik Menggunakan Pendekatan Etnopedagogi. *Journal on Education, 06*(01), 5605-5614.

Firdaus, M.A., & Nurrochmah, S. (2021). Survei Keterampilan Gerak Dasar Lokomotor, Nonlokomotor, dan Manipulatif Siswa Putri Kelas VII. *Sport Science and Health, 3*(5), 235-253. https://doi.org/10.17977/um062v3i52021p235-253

Adji, B.S., & Wibowo, S. (2023). Peningkatan Hasil Belajar Gerak Dasar Lokomotor Pada Siswa Sekolah Dasar Melalui Modifikasi Permainan Tic Tac Toe. *Jurnal Ilmiah STOK Bina Guna Medan, 11*(2), 141-152.

Fauzan, K.T., Marlina, R., & Syafei, M.M. (2022). Tingkat Motivasi Belajar Siswa Putri terhadap Pembelajaran Penjas Kelas VII SMPN 1 Kutawaluya. *Jurnal Ilmiah Wahana Pendidikan, 8*(November), 64-73.

Erwansyah, A.A., & Ferianto, B. (2016). Pengaruh Permainan Lompat Kardus terhadap Hasil Belajar Lompat Jauh Gaya Menggantung dalam Pembelajaran PJOK. *Jurnal Pendidikan Olahraga Dan Kesehatan, 04*(02), 355-362.

Muslim, A. (2021). Penggunaan Media Pembelajaran Terhadap Keberhasilan Mapel PJOK pada Kelas IV SD Negeri 01 Banjarsari. *Jurnal Kualita Pendidikan, 2*(3), 187-191. https://doi.org/10.51651/jkp.v2i3.143

Mudzakir, D.O. (2020). Pengaruh Permainan Olahraga Tradisional Terhadap Motivasi Belajar Dalam Pembelajaran Penjas Di Sekolah Dasar. *Jurnal Pendidikan Jasmani Kesehatan Dan Rekreasi, 10*(1), 44-49. https://doi.org/10.35194/jm.v10i1.941

Zenith, D., Hanim, Z., & Sjamsir, H. (2020). Efektivitas Permainan Tradisional Dalam Pengembangan Keterampilan Gerak Manipulatif Anak Usia 4-5 Tahun dI PAUD Arsa Muda Desa Loa Raya. *Jurnal Pendidikan Dan Pengajaran, 4*(2), 143-160.

Waluyo, Nugroho, D., Putro, BN, Syaifullah, R., Mukholid, A., Sabarini, SS, & Liskustyawati, H. (2024). Mengoptimalkan Hasil Pembelajaran Gerak Dasar Lokomotor Melalui Model Bermain "Sirkuit Gerak" Untuk Siswa Kelas 3. *Jurnal Ilmu Keolahragaan, 15*(4), 549-558. https://doi.org/10.21009/GJIK.154.12

Sudarmono, M. (2016). Pengembangan Model Permainan Basketball and Football Combination Untuk Pembelajaran Penjasorkes Siswa Sekolah Dasar. *Journal of Physical Education Health and Sport, 3*(1), 7-14.

Rani, C., Pratiwi, D.E., Hidayat, Y.A., Humaira, S.S., & Suyono, S. (2025). Keberhasilan Praktik Bermain pada Pembelajaran Penjas di SD Negeri 105287 dalam Menciptakan Pembelajaran yang Aktif dan Kreatif. *ALACRITY : Journal of Education, 5*(1), 75-84. https://doi.org/10.52121/alacrity.v5i1.538

Chen, D., Zhao, G., Fu, J., Shun, S., Su, L., He, Z., Chen, R., Jiang, T., Hu, X., Li, Y., & Shen, F. (2024). Effects of structured and unstructured interventions on fundamental motor skills in preschool children: a meta-analysis. *Frontiers in public health,* 12, 1345566. https://doi.org/10.3389/fpubh.2024.1345566

Liu, B., Yan, Y., Jia, J., & Liu, Y. (2025) Can active play replace skill-oriented physical education in enhancing fundamental movement skills among preschool children? A systematic review and meta-analysis. *BMC Public Health,* 25, 1399. https://doi.org/10.1186/s12889-025-22398-9

Покращення локомоторних навичок учнів початкової школи через командні ігри з використанням креативних медіа на уроках фізичної культури

Ананда Альфат[1ABCDE], Меїрізал Усра[1ACD], Вах'ю Індра Баю[1ACDE]

[1]Університет Шрівіджая

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 5 с., 5 табл., 28 джерел.

Історія питання. Локомоторні рухи є фундаментальним компонентом моторного розвитку дітей молодшого шкільного віку. Проте низька зацікавленість учнів та обмежені можливості для проведення занять з фізичної культури, спорту і здоров'я (PJOK) часто ускладнюють формування цих навичок.

Метою дослідження було оцінити ефективність використання командних ігор на основі креативних медіа для покращення локомоторних навичок учнів початкової школи.

Матеріали і методи. У дослідженні застосовано дизайн педагогічного дослідження у формі класно-урочного експерименту (Classroom Action Research, CAR), реалізований у двох циклах, кожен з яких складався з двох дій. У вибірку увійшли 28 учнів класу 2B SD Negeri 02 Indralaya Utara. Збір даних здійснювали за допомогою спостережень, інтерв'ю, аналізу документації та тесту TGMD-2 (Test of Gross Motor Development-2).

Результати. Запроваджена методика забезпечила суттєве покращення локомоторних навичок. Середній показник підвищився з 29.89 (62.27%) на початку дослідження до 44.46 (92.63%) наприкінці другого циклу, що свідчить про високу результативність командних ігор на основі креативних медіа.

Висновки. Використання командних ігор із застосуванням креативних медіа є ефективним засобом розвитку локомоторних навичок і створює більш зацікавлене та активне навчальне середовище. Отримані результати можуть слугувати практичними рекомендаціями для вчителів щодо розробки доказових стратегій навчання моторному розвитку в початковій школі.

Ключові слова: локомоторні навички, фізична культура, креативні медіа, командні ігри, моторний розвиток, класно-урочне дослідження.

Information about the Authors:

Alfath, Ananda: anandaalfath28@gmail.com; Department of Physical Education and Health, Faculty of Teacher Training and Education, Sriwijaya University, Palembang – Prabumulih KM 32 Street, indralaya, Ogan Ilir, South Sumatra, Indonesia.

Usra, Meirizal: meirizalusra@fkip.unsri.ac.id; https://orcid.org/0000-0003-0598-3416; Department of Sport Education, Faculty of Teacher Training and Education, Sriwijaya University, Srijaya Negara Street, Bukit Besar, Palembang, South Sumatra, 30139, Indonesia.

Bayu, Wahyu Indra: wahyu.indra@fkip.unsri.ac.id; https://orcid.org/0000-0002-0650-8783; Department of Sport Education, Faculty of Teacher Training and Education, Sriwijaya University, Srijaya Negara Street, Bukit Besar, Palembang, South Sumatra, 30139, Indonesia.

Cite this article as: Alfath, A., Usra, M., & Bayu, W. I. (2025). Enhancing Locomotor Skills Through Team-Based Games with Creative Media in Elementary Physical Education Classes. *Journal of Learning Theory and Methodology, 6*(2), 94-98. https://doi.org/10.17309/jltm.2025.6.2.05

Received: 15.07.2025. Accepted: 16.08.2025. Published: 30.08.2025

This work is licensed under a Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0)

ISSN 2708-7581 (Online)
ISSN-L 2708-7573

JLTM

Journal of Learning Theory and Methodology

Scientific journal

August 2025
Volume 6
Number 2

Відповідальний за випуск О. М. Худолій
Комп'ютерна верстка М. О. Худолій
Коректор Є. Б. Бланк

Зареєстровано в Національній раді України з питань телебачення і мовлення:
рішення No 1751 від 23.05.2024 р., протокол No 16, оприлюднено 23 травня 2024 р., ідентифікатор медіа – R40-04690
https://webportal.nrada.gov.ua/wp-content/uploads/2024/05/R-2024-01751.pdf
Засновник і видавець — ТОВ «ОВС».
Адреса редакції: https://www.ltmjournal.com.Тел.: (067) 578-40-08. E-mail: editor-in-chief@ltmjournal.com
Підписано до друку 28.08.2025. Формат 60×84 1/8. Електронне видання. Гарнітура Таймс. PDF формат.
Ум. друк. арк. 6,989. Обл.-вид. арк.7,25. Вид. № 02-2025. Зам. № 56. Тираж 300 прим. Ціна договірна.
ТОВ «ОВС» Україна, 61003 Харків, пл. Конституції, 18, к. 11.
Свідоцтво Держкомінформу України Серія ДК № 331 від 08.02.2001 р.