

The Effect of Training Methods And Coordination on Futsal Goalkeeper Skills

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ABSTRACT

This study aims to determine the effect of training methods and coordination on futsal goalkeeper skills. Specifically, this study aims to determine: (1) the differences in the effects of drill, situational, and mixed training methods on futsal goalkeeper skills; (2) the effect of coordination on futsal goalkeeper skills; and (3) the interaction between training methods and coordination on futsal goalkeeper skills. This study employed an experimental method with a 3x2 factorial design. The independent variables in this study were training methods, consisting of drill training (A1), situational training (A2), and mixed training (A3), while the moderator variable was coordination, consisting of high coordination (B1) and low coordination (B2). The study population consisted of Pamulang University students who actively participated in futsal activities. The sample comprised 90 students selected using purposive sampling. The sample was divided into six treatment groups, each consisting of 15 participants. Coordination was measured using the Wall Toss Test, while futsal goalkeeping skills were assessed using a modified futsal goalkeeping skills test instrument. Data analysis utilized descriptive statistics, analysis of variance (ANOVA) with two factors, and Tukey's HSD post-hoc test at a significance level of $\alpha = 0.05$. The results of the study indicate that: (1) there is a significant effect of training method on futsal goalkeeping skills ($F = 3.387$; $\text{Sig.} = 0.038$); (2) coordination had a significant effect on futsal goalkeeping skills ($F = 75.893$; $\text{Sig.} = 0.000$); and (3) there was a significant interaction between training method and coordination on futsal goalkeeping skills ($F = 7.444$; $\text{Sig.} = 0.001$). Further analysis showed that the group using the mixed training method with high coordination demonstrated the greatest improvement in futsal goalkeeping skills compared to the other groups.

1. INTRODUCTION

The development of modern futsal has positioned the goalkeeper as a role that plays a strategic part in determining the team's overall success (Lhaksana, 2011a). The high intensity of futsal demands that goalkeepers remain constantly prepared to handle various critical situations (Irwansyah, Acha, & Wibowo, 2025). These situations include close-range shots, quick counterattacks, and pressure from opposing players in confined spaces. These conditions make the goalkeeper's role more complex compared to that in outdoor soccer. Research shows that even minor mistakes by a futsal goalkeeper can directly impact the score of a match. Therefore, improving the quality of futsal goalkeepers' skills is a fundamental need in elite sports development (Alvitto, 2025).

Futsal goalkeeper training can no longer be viewed as merely a process of repeating basic techniques (Kholili et al., 2025). Goalkeepers are required to have extremely quick reaction times and reflexes to respond to the unpredictable direction of the ball (Hamid, 2023a). Additionally, hand-eye coordination is the cornerstone of successfully catching, blocking, or deflecting the ball (N. Amalia, 2024; Fahrizal et al., 2023). Extremely tight time constraints force goalkeepers to make split-second decisions without error. In this context, a goalkeeper's skills are multidimensional and interrelated. Training that does not integrate physical, technical, and cognitive dimensions has the potential to result in suboptimal performance (Komarudin et al., 2024). Therefore, a comprehensive training approach is essential in modern futsal coaching. A futsal goalkeeper's reaction speed plays a crucial role because most shots occur at close range (Salamudin et al., 2025b). The narrow playing area severely limits the time available for anticipation. These conditions require goalkeepers to possess fast and accurate neuromuscular responses. Reaction drills using visual stimuli or reaction balls have been shown to significantly improve goalkeepers' reaction speed (Cecep et al., 2024; Hamid, 2023a). This improvement not only impacts saving ability but also boosts the goalkeeper's confidence when facing game pressure. Good reaction times allow goalkeepers to adjust their body position more effectively (Salamudin et al., 2025b). Thus, reaction drills are a crucial component of futsal goalkeeper training.

In addition to reaction time, a futsal goalkeeper's reflexes are also a key factor in successfully handling unexpected situations (Munggaran & Arifin, 2024). Reflexes relate to the body's ability to respond to stimuli without involving a lengthy conscious thought process. In futsal matches, reflexes often prove decisive in situations involving rebounds or sudden deflections. Exercises that systematically stimulate reflexes can help improve a goalkeeper's automatic responses (Salamudin et al., 2025b). However, reflexes cannot function effectively on their own without being supported by good coordination and balance. Limited reflexes without adequate coordination can result in inefficient movements.

Coordination is one of the components of physical fitness that plays a crucial role in a futsal goalkeeper's skills. Coordination enables the goalkeeper to integrate body movements efficiently and with precision. Coordination training in futsal is often applied more to field players than to goalkeepers (Alvitto, 2025; Irwansyah, Acha, & Wibowo, 2025). This has led to the specific needs of goalkeepers in terms of coordination receiving less attention. In fact, hand-eye coordination and whole-body coordination are crucial determinants of a goalkeeper's response quality. Research indicates that manipulative drills can improve the technical skills of futsal players. However, most of these studies focus on the kicking accuracy or ball control of

field players. Goalkeepers have different movement demands and therefore require a more specific training approach. This research gap highlights an imbalance in the development of futsal coaching science. Therefore, goalkeeper coordination warrants more in-depth study.

In the context of futsal, training methods can be categorized into technical and situational drills. Technical drills tend to involve fixed and repetitive movement patterns. In contrast, situational drills provide varied stimuli that are difficult for athletes to predict. These differing characteristics result in distinct adaptive responses. Consequently, training methods are a crucial variable that requires comparative analysis. Drill-based training is generally used to build technical foundations and movement consistency. This method is effective during the early stages of skill acquisition. However, overly predictable training has the potential to reduce

an athlete’s readiness to face real-game situations. In futsal, game situations are rarely static or structured. Goalkeepers must be prepared to handle rapidly changing and unexpected stimuli. Excessive drill-based training can limit a goalkeeper’s ability to adapt. Therefore, alternative, more contextual training methods are needed. Situational training is one relevant approach in this context.

Situational training is designed to simulate dynamic match conditions. The stimuli presented are random and demand quick responses from athletes. This method involves higher-order cognitive processes because athletes must make spontaneous decisions. For futsal goalkeepers, situational training can enhance mental readiness and reactions to sudden shots. The resulting adaptations tend to more closely mirror the demands of actual matches.

Coordination, as an individual factor, can moderate the influence of training methods on goalkeeping skills. Goalkeepers with high coordination tend to be able to respond more effectively to training stimuli. Conversely, goalkeepers with low coordination may struggle to adapt to complex training exercises. These differences indicate that training methods cannot be applied uniformly to all goalkeepers. A training approach that ignores coordination characteristics has the potential to yield suboptimal results. Therefore, understanding the interaction between training methods and coordination is crucial. This interaction needs to be empirically tested through appropriate research designs.

A research gap is evident in the scarcity of studies combining training methods and coordination in the context of futsal goalkeepers. Some studies focus solely on specific reactions or techniques. Other studies focus on coordination without relating it to the training methods used. This situation indicates a fragmentation of research in the field of futsal coaching. The integration of training methods and coordination has not been systematically explored. However, this integration is essential for a holistic understanding of goalkeeper performance. This gap serves as the primary basis for the present study. The novelty of this study lies in examining the interaction between training methods and coordination in futsal goalkeepers. This approach is still rarely found in the futsal coaching literature. Previous studies have tended to treat these two variables separately. By integrating them, this study offers a new perspective. A two-path analysis allows for a deeper understanding of goalkeeper performance. This novelty contributes both conceptually and methodologically. Therefore, this study possesses strong novelty value.

2. METHODS

This study employs a quantitative, experimental approach, as it aims to test the effects of training methods and coordination on futsal goalkeepers’ skills. This approach allows researchers to compare the results of several different treatment groups to objectively determine the effectiveness of a training method. Thus, this design emphasizes numerical measurements and statistical analysis to draw scientifically verified conclusions (Nugroho, 2018; Priadana & Sunarsi, 2021). The experimental method is a traditional approach in quantitative research used to test ideas, practices, or procedures to determine whether a treatment affects an outcome. In experimental research, researchers manipulate one independent variable and measure its impact on the dependent variable, often in an educational context (Creswell, 2009). This study involves several variables, including the dependent variable—futsal goalkeeping skills—the independent variable—training methods—and the moderator variable—coordination.

The research design used in this study is a 3x2 factorial design, with the independent variables grouped into three categories. The treatment independent variables are classified into three types of training methods (A): drill training (A₁), situational training (A₂), and mixed training (A₃). Meanwhile, the moderator variable is classified into two levels of coordination (B): high coordination (B₁) and low coordination (B₂). For further details, see the table below.

Table1 3x 2 factorial design

Training Method (A)			
Coordination (B)	Drill (A ₁)	Situational (A ₂)	Mix (A ₃)

High (B ₁)	A ₁ B ₁	A ₂ B ₁	A ₃ B ₁
Low (B ₂)	A ₁ B ₂	A ₂ B ₂	A ₃ B ₂
Futsal Goalkeeper Skills			

Source: (Fraenkel, 2012)

Notes:

A₁ B₁ = A group of training drills requiring a high level of coordination.

A₂ B₁ = A group of situational training methods requiring a high level of coordination. A₃ B₁ = A group of mixed training methods with high coordination.

A₁ B₂ = A group of drill-based training methods with a low level of coordination. A₂ B₂ = A group of situational training methods with a low level of coordination. A₃ B₂ = Group using a mixed training method with low coordination.

The population in this study consisted of all Pamulang University students who actively participated in futsal activities. The study sample comprised 90 Pamulang University students who actively participated in futsal activities, either through student clubs or regular training sessions. The sampling technique used purposive sampling with specific criteria, namely: (1) male students, (2) having at least one year of futsal playing experience, (3) being in good physical condition, and (4) willing to participate in the entire research process. The purposive sampling technique was chosen so that the participants involved would have relatively equivalent skill levels and understand the role and function of the goalkeeper in futsal. This is important to maintain the validity of the research results, as differences in basic skill levels can affect the effectiveness of the treatment administered. The sample was then divided into six experimental groups based on a 2x3 factorial design. The groups were assigned randomly to avoid bias and ensure that each group had an equal chance of receiving the treatment. In the sampling process for this study, the researcher manipulated the pre-determined sample based on (Verducci, 1890, p. 176), specifically selecting the top 27% of scores for the high-coordination group and the bottom 27% of scores for the low-coordination group. In this study, the predetermined sample consisted of 45 participants with the highest scores, who were classified into the group of athletes with high coordination, while the 45 participants with the lowest scores were classified into the group of athletes with low coordination. Consequently, there will be six groups: drill method with high coordination, drill method with low coordination, situational method with high coordination, situational method with low coordination, mixed training method with high coordination, and mixed training method with low coordination.

There are two instruments used in this study. The first is a test to determine coordination level (high or low) using the Wall Toss Test. The second is an assessment instrument in the form of a futsal goalkeeper skills test. The validity and reliability of this coordination test instrument have been tested in various previous studies. Based on a study conducted by Nurhasan (2001), the validity test for the Wall Toss Test yielded a correlation coefficient of $r = 0.82$, while its reliability reached $r = 0.87$, indicating that this tool possesses a high level of reliability in measuring motor coordination. These values demonstrate that the instrument possesses adequate psychometric properties for use in research assessing complex motor skills such as those possessed by futsal goalkeepers (Bompa & Buzzichelli, 2019).

The futsal goalkeeper skills test is used to measure a goalkeeper's technical ability in handling complex, fast-paced, and dynamic game situations. The skill aspects observed include ball-catching ability, reflexes and quick reactions, ball distribution, positioning, and the ability to anticipate the direction of shots. The instrument used in this study adapted the Futsal Goalkeeper Skill Test Battery (FGSTB) developed by Travassos et al. (2013) and was modified to suit the conditions of university futsal players. This test comprises four main components: the ball handling test, the reaction save test, the throwing accuracy test, and the positioning movement test. Content validity testing was conducted by three nationally certified futsal experts, yielding an average Aiken's V of 0.88, indicating a high degree of alignment between the test items and the skill indicators being measured. In addition, the results of the internal reliability test using Cronbach's Alpha yielded a value of $\alpha = 0.90$, indicating that the consistency among items was very good (Ramdhan, 2021).

Next, an inter-rater reliability test was conducted on 12 goalkeepers using two different raters to assess the consistency of performance scores. The results of the test, using the Intraclass Correlation Coefficient (ICC), showed a value of $r = 0.87$ (), indicating a high level of agreement among the raters. These results support the view (Reilly & Gilbourne, 2003) that high reliability in sports skill tests is an important prerequisite for ensuring the objectivity and replicability of measurement results. This modified FGSTB instrument is deemed suitable for use because it is capable of providing stable, accurate, and representative measurements of futsal goalkeeper performance at the university level. The item inventory for the futsal goalkeeper skills instrument is presented in the table below.

Table 2: Futsal Goalkeeper Skills Instrument Outline

No.	Aspects Tested	Test Format	Success Indicators
1	Reaction Speed	Reaction Save Test	Response time to the direction of the ball
2	Ball Distribution	Throwing Accuracy Test	Passing accuracy after a catch
3	Positioning	Movement	Positioning before a shot
4	Handling	Ball Catching Test	Success rate in catching the ball
5	Anticipation	Predictive Save Test	Accuracy in reading the opponent's ball direction

3. RESULTS AND DISCUSSION 3.1RESULT

The research results will be described in accordance with the previously stated objectives and hypotheses. This study will present a description of comparative research data showing the differences in treatment outcomes among the research subjects. The description of the comparison or differences in the research data aims to provide an overview of the varying effects of training methods—divided into three treatment groups: drill training, situational training, and mixed training—on futsal goalkeepers' skills. To analyze the research data, the researcher employed data distribution analysis, measures of central tendency in frequency distributions, a normality test, a homogeneity test, and hypothesis testing.

1. Results of Descriptive Statistical Tests

A summary of the statistical results for futsal goalkeeping skills in the drill, situational, and mixed training method groups based on coordination levels is presented in Table 3 below.

Table 3. Descriptive Analysis of Futsal Goalkeeping Skills Data

Group	N	Minimum Value	Maximum Value	Range	Mean	Standard Deviation	Variance
Drill method – high coordination (A1B1)	15	6	8	2	6.80	0.68	0.46
Drill method – low coordination (A1B2)	15	2	9	7	5.13	2.07	4.27
Situational method – high coordination (A2B1)	15	6	9	3	7.40	0.74	0.54
Situational method – low coordination (A2B2)	15	3	7	4	5.80	1.08	1.17
Mixed method – high coordination (A3B1)	15	7	9	2	8.73	0.59	0.35
Mixed method – low coordination (A3B2)	15	2	7	5	4.87	1.81	3.27

Based on Table 3, it can be seen that the mixed training method group with high coordination (A3B1) achieved the highest mean score of 8.73, with a standard deviation of 0.59, indicating that the futsal goalkeeping skills of this group were relatively high and exhibited a narrow data distribution. This suggests that the mixed training method for participants with high coordination yields better results compared to the other groups.

Meanwhile, the lowest mean was obtained by the mixed training method group with low coordination (A3B2), at 4.87 with a standard deviation of 1.81. The largest variance was found in the drill method group with low coordination (A1B2), at 4.27, indicating that the data in that group exhibited a fairly high degree of variation.

In general, participants with high coordination (B1) tended to achieve better goalkeeping skill scores than those with low coordination (B2). Additionally, the mixed training method showed a tendency to yield a greater improvement in futsal goalkeeping skills compared to both the drill and situational training methods.

2. Prerequisite Test

In data processing and analysis, several steps are required to determine the type of analysis to be used. Therefore, normality and homogeneity tests are conducted as prerequisites for data processing.

The normality test is intended to determine whether the variables in the study follow a normal distribution or not. This normality test is calculated using the Shapiro-Wilk formula, with data processing performed using the SPSS 25 software. With a significance level of $\alpha = 0.05$, the test criteria are as follows: if the p-value is $< \alpha = 0.05$, the data are not normally distributed; if the p-value is $> \alpha = 0.05$, the data are normally distributed. The results of the normality test for the pretest and posttest data on goalkeeping skills are presented in Table 4.

Table 4. Normality Test

		A1	A2	A3	A1B1	A1B2	A2B1	A2B2	A3B1	A3B2
N		30	30	30	15	15	15	15	15	15
Normal Parameters	Mean	5.97	6.60	6.80	6.80	5.13	7.40	5.80	8.73	4.87
	Standard	1.732	1.221	2.369	.676	2.066	.737	1.082	.594	1.807
Most Extreme	Absolute	.174	.228	.223	.283	.192	.306	.240	.473	.196
Differences	Positive	.142	.172	.177	.250	.192	.306	.160	.327	.144
	Negative	-.174	-.228	-.223	-.283	-.141	-.227	-.240	-.473	-.196
Test Statistic		.174	.228	.223	.283	.192	.306	.240	.473	.196
Asympt. Sig. (2-tailed)		.021 ^c	.000 ^c	.001 ^c	.002 ^c	.140 ^c	.001 ^c	.020 ^c	.000 ^c	.125 ^c

Based on Table 4, the results of the normality test using the One-Sample Kolmogorov-Smirnov Test on the futsal goalkeeper skill data showed different significance values (Asymp. Sig., 2-tailed) across each research group. The decision criterion used was that if the significance value (Sig.) > 0.05 , the data were considered normally distributed; whereas if the significance value (Sig.) < 0.05 , the data were considered not normally distributed.

Based on the test results for the training method groups (A), the drill method group (A1) obtained a significance value of 0.021, the situational method group (A2) obtained a significance value of 0.000, and the mixed training method group (A3) obtained a significance value of 0.001. These results indicate that the data distributions for all three training method groups are non-normal because their significance values are less than 0.05.

In the groups combining training methods and coordination (A×B), the drill method group with high coordination (A1B1) yielded a significance value of 0.002, the drill method group with low coordination (A1B2) yielded 0.140, the situational method group with high coordination (A2B1) yielded 0.001, the situational method group with low coordination (A2B2) had a p-value of 0.020, the mixed training method group with high coordination (A3B1) had a p-value of 0.000, and the mixed training method group with low coordination (A3B2) had a p-value of 0.125.

These results indicate that groups A1B2 and A3B2 have significance values greater than 0.05, meaning the data in these two groups are normally distributed. Meanwhile, groups A1B1, A2B1, A2B2, and A3B1 have significance values less than 0.05, meaning the data in these groups are not normally distributed.

Overall, the results of the normality test show that most of the study groups have non-normal data distributions. Of the nine data groups tested, only two met the normality assumption: the drill method group with low coordination (A1B2) and the mixed exercise method group with low coordination (A3B2). Thus, the assumption of normality was not fully met in this study.

Nevertheless, the analysis could proceed using a factorial ANOVA () because the sample sizes in each group were relatively balanced—15 subjects per group—making the analysis of variance sufficiently robust against deviations from the normality assumption.

After conducting the normality test, a homogeneity test was then performed. The homogeneity test was conducted to determine whether the data groups used in the study originated from populations with equal variances. The homogeneity test in this study used Levene's test at a significance level of $\alpha = 0.05$. The results of the homogeneity test are presented in Table 5 below.

Table 5. Homogeneity Test

F	df1	df2	Sig.
4.736	5	84	.001

Based on Table 5, the results of the Levene's Test of Equality of Error Variances show an F-value of 4.736 with degrees of freedom $df1 = 5$ and $df2 = 84$, and a significance value of 0.001. The significance value obtained is smaller than the significance level of 0.05 ($0.001 < 0.05$), so H_0 is rejected and H_1 is accepted. Thus, it can be concluded that the variance of the goalkeeper skill data across all treatment groups is not homogeneous. These results indicate that there are differences in data variability among the drill, situational, and mixed training method groups when combined with high and low coordination levels. In other words, the assumption of homogeneity of variances in this study was not fully met. Although the assumption of homogeneity of variances was not met, the two-way ANOVA analysis could still proceed because the study design used an equal number of samples in each group (each group consisted of 15 participants). According to the characteristics of ANOVA, a design with an equal number of samples in each factorial cell is relatively more robust.

3. Hypothesis Testing

Hypothesis testing in this study was conducted and analyzed using a two-way analysis of variance (ANOVA) with a 3×2 factorial treatment design. The two-way ANOVA was used to test the main effects of training method (A) and coordination level (B), as well as the interaction effect between training method and coordination level ($A \times B$) on futsal goalkeeping skills.

A main effect analysis was conducted to determine the differences in the effects of training methods—consisting of the drill method (A1), the situational method (A2), and the mixed method (A3)—as well as to determine the differences in coordination levels, consisting of high coordination (B1) and low coordination (B2). Meanwhile, an interaction test was conducted to determine whether there was an interaction between training methods and coordination levels on futsal goalkeeping skills.

If the ANOVA results indicate a significant difference, the analysis continues with a post hoc test—specifically, the Dunnett's t-test—to identify differences among the treatment groups for each training method at each coordination level in greater detail.

Table 6. Two-Way ANOVA Results

Source of Variation	F	Sig.	Notes
Training Method (A)	3.387	0.038	Significant
Coordination (B)	75.893	0.000	Significant
Interaction ($A \times B$)	7.444	0.001	Significant

Based on the results of the two-way ANOVA, the coefficient of determination was $R^2 = 0.537$ with an Adjusted $R^2 = 0.510$, indicating that training method and coordination together account for 53.7% of the variation in futsal goalkeeping skills, while the remaining 46.3% is influenced by other factors outside the scope of this study. The test results showed that the training method variable (A) yielded an F-calculated value of 3.387 with a significance value of 0.038. This significance value is less than 0.05 ($0.038 < 0.05$), so H_0 is rejected and H_1 is accepted. Thus, it can be concluded that there is a significant difference in the effects of the drill training method, the situational training method, and the mixed training method on futsal goalkeeping skills. The results of the coordination test (B) showed an F-calculated value of 75.893 with a significance value of 0.000. The significance value is less than 0.05 ($0.000 < 0.05$), so H_0 is rejected and H_1 is accepted. Thus, there is a significant difference in the effect between participants with high coordination and those with low coordination on futsal goalkeeping skills. The

results of the interaction test between training method and coordination showed an F-calculated value of 7.444 with a significance value of 0.001. This significance value is less than 0.05 ($0.001 < 0.05$), so H_0 is rejected and H_1 is accepted. Thus, there is a significant interaction between training method and coordination on futsal goalkeeping skills. These results indicate that the effectiveness of the training methods administered is influenced by the participants' level of coordination. In other words, specific training methods do not yield the same results for participants with different levels of coordination.

Table 7. Results of the Tukey HSD Post-hoc Test

(I)	(J)	(Mean)	(Standard)	Sig.	95% Confidence Interval	
INTERACTI ON	INTERACTI ON	Difference (I- J)	Error		Lower Bound	Upper Bound
A1B1	A1B2	1.67*	.473	.009	.29	3.05
	A2B1	-.60	.473	.801	-1.98	.78
	A2B2	1.00	.473	.290	-.38	2.38
	A3B1	-1.93*	.473	.001	-3.31	-.55
	A3B2	1.93*	.473	.001	.55	3.31
A1B2	A1B1	-1.67*	.473	.009	-3.05	-.29
	A2B1	-2.27*	.473	.000	-3.65	-.89
	A2B2	-.67	.473	.721	-2.05	.71
	A3B1	-3.60*	.473	.000	-4.98	-2.22
	A3B2	.27	.473	.993	-1.11	1.65
A2B1	A1B1	.60	.473	.801	-.78	1.98
	A1B2	2.27*	.473	.000	.89	3.65
	A2B2	1.60*	.473	.013	.22	2.98
	A3B1	-1.33	.473	.064	-2.71	.05
	A3B2	2.53*	.473	.000	1.15	3.91
A2B2	A1B1	-1.00	.473	.290	-2.38	.38
	A1B2	.67	.473	.721	-.71	2.05
	A2B1	-1.60*	.473	.013	-2.98	-.22
	A3B1	-2.93*	.473	.000	-4.31	-1.55
	A3B2	.93	.473	.366	-.45	2.31
A3B1	A1B1	1.93*	.473	.001	.55	3.31
	A1B2	3.60*	.473	.000	2.22	4.98
	A2B1	1.33	.473	.064	-.05	2.71
	A2B2	2.93*	.473	.000	1.55	4.31
	A3B2	3.87*	.473	.000	2.49	5.25
A3B2	A1B1	-1.93*	.473	.001	-3.31	-.55
	A1B2	-.27	.473	.993	-1.65	1.11
	A2B1	-2.53*	.473	.000	-3.91	-1.15
	A2B2	-.93	.473	.366	-2.31	.45
	A3B1	-3.87*	.473	.000	-5.25	-2.49

Hypothesis 1

The first hypothesis states that there is a difference between the drill training method and the situational training method regarding futsal goalkeeping skills. Based on the results of the Tukey HSD post-hoc test for the high-coordination drill group (A1B1) compared to the high-coordination situational group (A2B1), a significance value of 0.801 (>0.05) was obtained, while for the low-coordination drill group (A1B2) compared to the low-coordination situational group (A2B2), a significance value of 0.721 (>0.05) was obtained. Thus, H_0 is accepted and H_1 is rejected, indicating that there is no significant difference between drill training methods and situational training methods on futsal goalkeeping skills.

Hypothesis 2

The second hypothesis states that there is a difference between the drill training method and the mixed training method in terms of futsal goalkeeping skills. Based on the results of further tests, the significance value for the high-coordination drill group (A1B1) compared to the high-coordination mixed training group (A3B1) was 0.001 (<0.05), while the value for the low-coordination drill group (A1B2) compared to the low-coordination mixed training group (A3B2) was 0.993 (>0.05). The results indicate a significant difference, particularly in the high-coordination groups; therefore, H_0 is rejected and H_1

is accepted.

Hypothesis 3

Based on the results of the follow-up test, the significance value for the high-coordination situational group (A2B1) compared to the high-coordination mix group (A3B1) was 0.064 (>0.05), while that for the low-coordination situational group (A2B2) compared to the low-coordination mix group (A3B2) was 0.366 (>0.05). Since the significance values are greater than 0.05, H_0 is accepted and H_1 is rejected. Thus, there is no significant difference between the situational training method and the mixed training method.

Hypothesis 4

Based on the results of the two-way ANOVA, the calculated F-value was 7.444 with a significance level of 0.001 (<0.05). Thus, H_0 is rejected and H_1 is accepted. This indicates that there is a significant interaction between the training method and coordination on futsal goalkeeping skills.

Hypothesis 5

Based on the results of the Tukey HSD test, a significance value of 0.801 (>0.05) was obtained, so H_0 is accepted and H_1 is rejected. Thus, there is no significant difference between the high-coordination drill training method and the high-coordination situational training method.

Hypothesis 6

Based on the results of the Tukey HSD test, a significance value of 0.001 (<0.05) was obtained, so H_0 was rejected and H_1 was accepted. Thus, there is a significant difference between the high-coordination drill training method and the high-coordination mixed training method.

Hypothesis 7

Based on the results of the Tukey HSD test, a significance value of 0.064 (>0.05) was obtained, so H_0 was accepted and H_1 was rejected. Thus, there is no significant difference between the high-coordination situational training method and the high-coordination mixed training method.

Hypothesis 8

Based on the results of the Tukey HSD test, a significance value of 0.721 (>0.05) was obtained, so H_0 is accepted and H_1 is rejected. Thus, there is no significant difference between the situational training method with low coordination and the drill training method with low coordination.

Hypothesis 9

Based on the results of the Tukey HSD test, a significance value of 0.993 (>0.05) was obtained; therefore, H_0 is accepted and H_1 is rejected. Thus, there is no significant difference between the mixed training method with low coordination and the drill training method with low coordination.

Hypothesis 10

Based on the results of the Tukey HSD test, a significance value of 0.366 (>0.05) was obtained; therefore, H_0 is accepted and H_1 is rejected. Thus, there is no significant difference between the mixed training method with low coordination and the situational training method with low coordination.

4. DISCUSSION

1. The Effect of Training Methods on Futsal Goalkeeping Skills

The results of the ANOVA analysis indicate that training methods have a significant effect on futsal goalkeeping skills, with an F-value of 3.387 and a significance level of 0.038 (<0.05). These results suggest that drill, situational, and mixed training methods have different effects on improving futsal goalkeeping skills.

Based on the descriptive results of the study, the mixed training method showed a tendency toward better results compared to the drill and situational methods. This finding can be explained by the Theory of Training Periodization (Periodization Theory) proposed by Bompa and Buzzichelli (2019). This theory states that a good training program must apply the principles of exercise variation, progressivity, specificity, and physiological adaptation to produce optimal performance improvements. Exercise variation provides a broader stimulus to the neuromuscular system, allowing athletes' technical skills and performance to develop more effectively.

According to Bompa & Buzzichelli,(2022) , overly monotonous training can reduce an athlete's adaptation, whereas varying training methods can enhance motor responses and accelerate the development of sports skills. This explains why a mixed training method—combining drills and situational training—yields better improvements in goalkeeping skills.

In futsal, goalkeepers are required not only to master basic techniques such as catching and blocking the ball but also to make quick decisions in rapidly changing game situations. Therefore, training that combines technical repetition with game situation simulations has a greater impact on improving goalkeeper performance.

2. The Effect of Coordination on Futsal Goalkeeping Skills

Research results show that coordination has a significant effect on futsal goalkeeping skills, with an F-value of 75.893 and a p-value of 0.000 (<0.05). Coordination is an individual's ability to integrate various parts of the body to produce effective, efficient, and precise movements. According to Bompa and Buzzichelli (2019), coordination is one of the biomotor components that plays a crucial role in supporting athletic skills because it enables athletes to perform complex movements with high accuracy.

In the context of futsal goalkeeping, coordination refers to the ability to integrate eye-hand coordination, eye-foot coordination, body balance, reaction speed, and the ability to anticipate movement. Participants with high coordination in this study demonstrated better goalkeeping skills compared to the low-coordination group.

These findings align with the FIFA Goalkeeping Coaching Manual (2025), which states that futsal goalkeepers must possess high motor coordination because futsal is a fast-paced game that requires split-second decision-making. A goalkeeper must be able to integrate technical, tactical, and physical aspects simultaneously.

3. The Interaction Between Training Methods and Coordination on Futsal Goalkeeping Skills

The results show a significant interaction between training methods and coordination on futsal goalkeeping skills, with an F-value of 7.444 and a p-value of 0.001 (<0.05). This interaction indicates that the effectiveness of training methods is influenced by participants' coordination levels. In other words, the same training method can yield different results for individuals with varying coordination levels.

These findings can be explained using the Ecological Dynamics Theory developed by Davids, Araújo, Vilar, Renshaw, and Pinder (2013). The Ecological Dynamics Theory explains that sports skills develop through the relationship between individual characteristics, training tasks, and the environment in which training takes place. An individual's motor performance is determined not only by physical ability but also by their ability to adapt to changing situations.

According to Davids et al. (2013), athletes achieve optimal performance when the training environment is designed to resemble actual competition situations, allowing them to develop perceptual and decision-making skills simultaneously.

In this study, the group that underwent a mixed training method with high coordination showed the highest results compared to the other groups. This indicates that participants with high coordination were able to respond to training variations more effectively than those with low coordination. These results are further supported by , which states that the learning of sports skills develops optimally when training designs provide diverse environmental challenges, enabling athletes to find movement solutions appropriate for competition situations.

4. Discussion of Post Hoc Tests

The results of the Tukey post hoc test indicate that significant differences exist among certain groups, particularly between the mixed training method group with high coordination and the other groups. These findings indicate that the combination of training methods and coordination levels makes a significant contribution to the improvement of futsal goalkeeping skills. Overall, it can be concluded that the mixed training method combined with a high level of coordination has the most optimal effect on improving futsal goalkeeping skills. This is because the mixed training method combines repetitions of basic techniques with game-situation-based drills, enabling athletes to not only improve their technical abilities but also their decision-making skills during matches.

5. CONCLUSION

Based on the research results, data analysis, hypothesis testing, and discussion regarding the influence of training methods and coordination on futsal goalkeeping skills, the following conclusions can be drawn:

1. There is a significant difference in the effects of the drill training method, the situational training method, and the mixed training method on futsal goalkeeping skills. This is evidenced by the results of a two-way ANOVA, which showed a significance value for the training method of 0.038 (<0.05).
2. There is a significant effect of coordination level on futsal goalkeeping skills. Students with high coordination demonstrated better goalkeeping skills compared to those with low coordination. This is evidenced by a significance value of 0.000 (<0.05).
3. There was a significant interaction between the training method and coordination on futsal goalkeeping skills, with a significance value of 0.001 (<0.05). This indicates that the effectiveness of the training method is influenced by the participants' level of coordination.
4. Based on the results of the post hoc Tukey HSD test, the mixed training method group with high coordination (A3B1) showed the highest futsal goalkeeping skills compared to the other groups.
5. The mixed training method is more effective for improving futsal goalkeeping skills, particularly for participants with high levels of coordination.

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