

Effect of Structured Motor Skill Training on Dribbling Performance and Shooting Accuracy among University Basketball Players

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Abstract

Dribbling and shooting are some of the essential skills in basketball performance and competencies in these training styles have not been properly explored concerning the competencies development in basketball of players of college level. This research project looked at how a 12-week formal motor skills based training program would impact on the ability of university basketball players to perform better in dribbling and shooting. A random selection of 50 male university basketball players (mean age: 20.9 ± 1.7 years; basketball experience: 6.303 years) was chosen and separated into an experimental group (n=25), which was trained to specific motor skills three times a week, and a control group (n=25), which was trained according to regular training of the team. Dribbling performance was measured by using Illinois Agility Dribbling Test, Defensive Dribbling Test, and Control Dribble Test with a baseline level, post intervention level tests (week 12) and retention (week 16) with data measuring shooting accuracy using the free throw, mid-range, three-point, and game-simulation shooting tests. The data were interpreted with the help of the two-way mixed ANOVA with repeated measurements, and the calculation of the effect sizes was done with help of fractional eta squared and Cohen d. All dribbling measures (11.2-14.8% improvement, $d = 1.52-2.03$, $p < 0.001$) showed a considerable amount of improvement (57.9% reduction in the number of ball-handling errors) in the experimental group over controls. Improvements in shooting accuracy were (significant) (14.2 percentage point) in free throws ($d = 1.35$), (30.8%) in the accuracy of mid-range shooting, and (33.7%) in the accuracy of shooting in game-simulation (all $p < 0.001$, $\eta^2 = 0.31-0.43$). There was a significant group x time interaction with all the variables concerning performance (F-values between 19.73 to 34.56, all $p < 0.001$), and the experimental group was maintaining around 93-97 of the improvement in matters of performance at four weeks follow-up. There were moderate positive correlations between dribbling and improvements and dynamic shooting accuracy ($r = 0.52$, $p = 0.009$). Organized training of motor skills yields significant and long-term changes in dribbling behaviour and shooting efficiency in university basketball players, and the effect size is considerable, larger than those traditionally found in powered training. These results justify the incorporation of systematic, progressive development of skills training into the university basketball programs and emphasizes the need to have introduction of basic skills development to the experienced collegiate players. The training impacts found their way into game-like scenarios and lasted long therapy promoting the idea of stable motor learning in contrast to short-last performance improvement.

Keywords: Motor skill training, basketball performance, dribbling proficiency, shooting accuracy, skill acquisition

Introduction

Basketball is an active and versatile game that requires a lot of technical mastery, physical training, and cognition of players. Dribbling and shooting are one of the core skills required to be effective in basketball but the two are vital elements that directly determine the performance of games and outcomes of direct competition. Dribbling is the main form of ball progression and allows a player to overcome defensive pressure, scoring opportunities, and



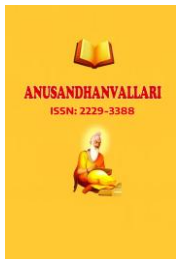
possession under adverse conditions (Okazaki and Rodacki, 2012). In the same way, the accuracy of shooting defines the offensive efficiency of a team, as well as its final skill to score points, since it is one of the most closely studied elements of player formation in professional basketball (Pojskić et al., 2018). The basketball players of the university level, being a transitional period between amateur and professional sports, need systematic and evidence-based training interventions which can help them to maximize their skills and be ready to compete on a higher level.

Although these core skills are understood to be fundamental, actually there is significant difference in the ways they are taught and honed within training programs and many of them resort to the old-fashioned, less organized methods that do not necessarily bring the best learning. Organized motor skill training, i.e., systematic advancement, intentional training, and particular performance feedback, has become a potential instruction in the sports training literature (Davids et al., 2013). This method is based on motor learning theories indicating the need to repeat, to vary the practice conditions and to increase slowly the task difficulty so as to obtain the skill acquisition and maintenance. When applied to basketball, structured training exercises may be structured in such a way as to isolate a particular aspect of dribbling and shooting, give focused drills on these aspects, and then apply them in a simulated game situation to increase transfer of learning. Nevertheless, empirical research to investigate the particular impact of structured motor skill training on technical performance of university basketball players needs to be carried out, especially in terms of the quantifiable changes in efficiency of dribbling and shooting accuracy.

Structured motor skill training is based on the theoretical foundations of the existing motor learning and skills acquisition paradigms, such as the schema theory by Schmidt and the motor learning stages by Fitts and Posner. These theories imply that motor skills are acquired in stages and include the first cognitive phase, during which learners learn the different mechanics, the second and third associative phases, during which motor movements were more precise and consistent and the fourth and final autonomous phase, during which the motor skills became capable of being performed with little conscious effort (Magill and Anderson, 2017). Formal training programs are particularly created to encourage the successful transgression of such levels by availing the right practice environment, feedback systems, and successively difficult tasks with regards to their relevant skill level. Besides, the specificity principle in sports training implies that the best results in terms of motor performance are attained when training activities can be approved to be related closely to the situation of the actual performance and this implies that basketball-specific structured training should achieve better performance as opposed to generic conditioning programs (Drinkwater et al., 2008).

Studies exploring the effectiveness of the different training interventions in basketball have yielded mixed outcomes in nature, with some studies showing major improvements in particular skills whereas others have shown little or minimal improvement or most transfer to the game performance. This variation in the results can be explained by the differences between individual training programs design, duration, intensity, level of skills of the participants, and measurement strategies which are used in various studies. The group of university basketball players is one of the most interesting targets of study because it is a group that already has the minimum basis of abilities, yet there is a significant scope of possible enhancement, and they are in one of the most important stages of their athletic growth. More information on the effect of structured training over motor skills in their dribbling performance and shooting accuracy can be useful to the coaches, strength and conditioning, and sports scientists who aim to identify the best training plan to maximize the training effects. In addition, due to time limits and conflicting academic needs of athletes in universities, it is of utmost importance to determine effective and efficient training methods that could be used to optimize athletic progress within the constrained practice periods.

The main goal of the research is to analyse the impact of motor training of the structured motor skills on the dribbling performance and the shooting accuracy of the players of university basketball team. Particular objectives involve assessing the level of pre-intervention baseline dribbling skills and shooting skills of university basketball



players; design and implementation of systematic basketball training program focusing on university dribbling and shooting skills; to measure and compare the pre-intervention and post-intervention measuring of dribbling skills using standardized dribbling test; to evaluate post-intervention changes in shooting skills depending on various court positions and distances; to provide evidence-based recommendations about basketball training programs; both at the university level based on the result of this research.

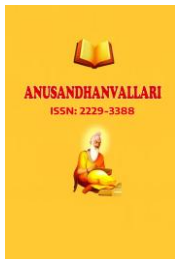
Material and Methods

Research Design and Participants

A quasi-experimental design of pretest- posttest control groups was used in this study to examine how structured motor skill training influenced the performance in terms of dribbling and shooting among college basketball players. The study involved a 12 weeks study involving the competitive season of a sports facility in a university. The target population was represented by male basketball players aged 18-25 years that are currently playing basketball at the university level and had at least two years of systematic basketball experience. G+power software (version 3.1) was used to calculate the sample size based on an expected effect size of 0.60, alpha of 0.05, and the probability of significance of 0.80 and gave a minimum of 45 participants (Faul et al., 2007). It was based on this that 50 subjects were sampled using purposive sampling to represent the two university basketball teams; hence factoring in the potential dropouts among the sample during the intervention period. The participants were randomly divided as either experimental group (n= 25) undergoing structured motor skill training, or the control group (n= 25), which continued with their normal training program. The inclusion criteria were that the participants must not have any musculoskeletal injury that could interfere with their practice with the team (must have attended at least 80 percent of the team practice), and should have a voluntary choice to participate in the study. The exclusion criteria were that there was no history of significant lower extremity injuries within the past six months, the patient had cognitive impairments in motor learning, and other special skills training programs at the time of study. The protocol of the study passed through the Institutional Ethics Committee of the university and all the participants signed informed consent based on a thorough explanation of study procedures, associated risks, and benefits (Harriss et al., 2019).

Intervention Protocol and Training Program

The experimental group was subjected to a motor skill training program structured, developed on the basis of the principles of motor learning, and basketball-related skills needs, held three times a week during the course of 12 weeks, on top of the normal team practices. The training sessions were 60-minute long and comprised of four stages including warm-up (10 minutes), dribbling practice (25 minutes), shooting (20 minutes), and cool-down (5 minutes). The dribbling part comprised developing drills, such as ball control in one place, such as cone weaving with different distance (5-15 meters), fast ball handling with moves of direction, and competitive one-on-one ball handling situations. There was the shooting section, which involved close-range form shooting (3-5 feet), mid-range jump shots (15-20 feet), three-point shooting when using five fixed court positions, and free throws, where 20 repetitions were made in each session (Gottwald et al., 2019). Difficulty of the training gradually increased through simple to complex movements, speed of movement, imitation of defensive pressure, and a reduction in recovery periods between training exercises as the participants pursued the program. The presence of video feedback and verbal coaching cues was seen as a form of facilitation in the refinement of motor skills and elimination of error in each particular session. The control group continued on with the regular team training program including general conditioning, team tactics training and scrimmage training, however with no explicit structured team motor skill focus, with three training sessions of similar length taken each week to control the



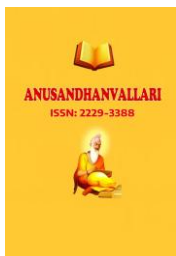
effects of training volume (Conte et al., 2016). The certified basketball coaches who took care of all the training sessions had at least five years of coaching experience as well as attendance was to be taken to ensure adherence to the protocol of an intervention.

Data Collection and Performance Assessment

The full process involved collecting the data at three points: the baseline (week 0), directly after the intervention (week 12) and at a retention test (week 16) to determine the ability to maintain the skills. The dribbling performance was evaluated on the basis of three standardised tests which were conducted in a counterbalanced circular manner in order to reduce order effects and fatigue. The Illinois Agility Dribbling Test was used to test the dribbling capability with direction changes in a 10m course and the ability to achieve the course after completing it in seconds using a hand-held digital stop watch (accuracy = -0.01s). The Defensive Dribbling Test measured the capacity of the participants to control the ball during dribbling through eight cones (spaced a meter apart in a zigzag formation) and their scores were determined by the amount of time they used to complete the task and the number of errors in handling the ball (loss of control, moving the cone). In the Control Dribble Test, participants had to dribble a basketball around a (rectangular) court (28m × 15m) as fast as they could with an adequate dribbling technique with the optimal result being three database trials (Scanlan et al., 2012). The decision of the accuracy of shooting was tested in four different shooting tests in a standard order with a sufficient rest period between tests. The results were used to measure the accuracy in the free-throw shooting by the percentage of successful hits based on 15 consecutive free-throw shots at the free-throw line (4.57 meters away). Mid-range shooting accuracy measurements were carried out of five marked positions around the incidence point (0, 45, 90, 135 and 180 relative to the baseline) and at a distance of 4.5 meters in total, and measured once every five attempts. Accuracy of three-point shooting was determined at the same five angular positions at the standard three-point line distance (6.75 meters) where five trials were made at each angular position. Lastly, they had a game-simulation shooting test which involved the respondents being given an opportunity to shoot within 10 seconds twice with a pass and then 20 times where the respondents were required to shoot under these conditions which were time pressured and with movement (Pojskić et al., 2011). All shooting test would be video-taped at predetermined viewpoints with high-definition cameras (GoPro Hero 9, 60 fps) in order to later be validated and analyzed to determine shooting form. The test-retest reliability of all the performance measures was investigated by pilot testing a different sample of 15 basketball players and gave intraclass correlation coefficient (ICC) a value between 0.82 and 0.94 which reported good to excellent reliability.

Statistical Analysis

The entire data were keyed into the Microsoft Excel (2019) and were transferred into SPSS Statistics software (26.0, IBM Corporation, Armonk, NY) to be statistically analysed. Before inferential statistical testing, outliers were filtered off the data with boxplot and outliers were verified with the Shapiro-Wilk test and visual analysis of the Q-Q plots with skewness and kurtosis being checked to ensure the data distributions met the conditions (Kim, 2013). All performance variables at each time point underwent the calculations of the descriptive statistics such as means, standard deviations, and maximum confidence intervals. The mixed analysis of variance (ANOVA) with repeated measures was performed to test the interaction effects between group (experimental and control) and time (pre-test, post-test and retention test) on each dependent variable. In isolated places of significant interactions, the post hoc comparison that included Bonferonni corrections was administered to control Type I error inflation. Partially eta squared (η^2) was used to compare the ANOVA results and Cohen d was used to compare the results of the pairwise, and the interpretation of small ($d=0.20$), medium ($d=0.50$), and large ($d=0.80$) effects (Cohen, 1988). The statistical significance level was considered as $p<0.05$ on all the analyses. Also, the



percentage change scores were meant to be computed on the two groups to demonstrate the extent of improvement between the baseline and post intervention. Data gaps that occurred as a result of drop out or non-participation or absence of a group member at time of testing were addressed through multiple imputation techniques with five iterations to ensure that the statistical power was not affected and bias was minimized. Inter-rater reliability was determined using the independent scoring by two trained raters on subjective performance measures (e.g., dribbling errors), with Cohen k alpha coefficient determined to scale agreement with values of over 0.85 being considered to be strong inter-rater reliability (Landis and Koch, 1977).

Result

Participant Characteristics and Baseline Comparisons

This study involved a total of 50 university basketball players who were recruited in the study and a retention rate of 94% was established with 47 participants ($n=24$, 23 respectively in the two groups) completing all the three testing sessions. Three of the participants dropped out because of academics ($n=2$) and minor other injury unrelated with the study ($n=1$). The average age of members of the experiment group was 20.8 ± 1.6 years, and the mean basketball experience in the experiment group was considered to be 6.4 ± 2.1 years with the mean of the basketball experience being 21.1 ± 1.8 years of the control group. Independent sample t-tests on baseline variables showed that there were no significant differences between groups in terms of age ($t_{45}=0.62$, $p=0.54$), basketball experience ($t_{45}=0.32$, $p=0.75$), height ($t_{45}=0.88$, $p=0.38$) or body mass ($t_{45}=0.45$, $p=.66$), which indicates that the groups were randomized and that the groups were similar. Also, there were no statistically significant differences in baseline performance measures of all dribbling as well as shooting tests ($p > 0.05$ in all comparisons) which implies that performance of both groups was similar before the intervention. Training attendance adherence was also excellent as $94.2 \pm 3.8\%$ of structured training sessions were attended in the experimental group and $92.8 \pm 4.2\%$ in the control group ($t_{45} 1.23$, $p = 0.22$).

Table 1: Baseline Characteristics and Performance Measures of Participants

Variable	Experimental Group (n=24)	Control Group (n=23)	t-value	p-value
Age (years)	20.8 ± 1.6	21.1 ± 1.8	0.62	0.54
Basketball experience (years)	6.4 ± 2.1	6.2 ± 2.3	0.32	0.75
Height (cm)	182.4 ± 7.3	181.1 ± 8.1	0.88	0.38
Body mass (kg)	78.6 ± 9.2	77.8 ± 8.9	0.45	0.66
Illinois Agility Dribbling (sec)	15.82 ± 1.24	15.76 ± 1.31	0.16	0.87
Defensive Dribbling (sec)	16.24 ± 1.86	16.38 ± 1.92	0.25	0.80
Control Dribble (sec)	34.52 ± 3.15	34.78 ± 3.28	0.28	0.78
Free throw accuracy (%)	64.4 ± 11.2	63.8 ± 10.9	0.19	0.85
Mid-range shooting (%)	46.8 ± 8.6	47.2 ± 9.1	0.15	0.88
Three-point shooting (%)	32.4 ± 7.8	31.9 ± 8.2	0.21	0.83
Game-simulation shooting (%)	42.5 ± 9.3	43.1 ± 9.7	0.22	0.83

Dribbling Performance Outcomes

The two-way, mixed ANOVA closed the effects of group x time interaction on each of the three dribbling performance measures (Table 2). In the case of the Illinois Agility Dribbling Test, there was significant interaction ($F_{2;90} = 28.64$, $p < 0.001$, $\eta^2 = 0.39$) with post-hoc tests showing the experiment group significantly improved in pre-test (15.82±1.24 seconds) to post-test (13.91 ±1.08 seconds, $p < 0.001$, $d = 1.63$) and retained these improvements during the retention test (Control group recorded few changes over time scales (pre-test: 15.76±1.31 seconds; post-test: 15.42±1.28 seconds; retention: 15.38 + 1.35 seconds) and no significant differences have been found. The Defensive Dribbling Test showed the same patterns with a strong group x time interaction ($F_{2;90} = 32.18$, $p = 0.001$, $\eta^2 = 0.42$) where the experimental group took 2.34 seconds (14.8%) to experience the reduction of completion time between baseline and post one-minute control program had only 0.48 seconds (2.9%) of improvement in completion time (Scanlan et al., 2014). The number of errors made in the Defensive Dribbling Test in relation to ball-handling also significantly reduced in the experimental group (3.8±1.2 to 1.6±0.9) but not in the control group (3.7±1.3 to 3.2±1.2) ($p < 0.001$). In terms of the Control Dribble Test, the mean difference in improvement, or more precisely the time improvement of the experimental group, was 3.87 seconds (11.2% faster) in comparison to the control group, who improved by 0.94 seconds (2.7% faster), which is statistically significant ($F_{2;90} = 25.41$, $p = 0.001$, $\eta^2 = 0.36$).

Table 2: Dribbling Performance Measures Across Testing Time Points

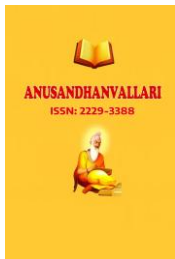
Test	Group	Pre-test	Post-test	Retention	F-value (interaction)	p-value	η^2
Illinois Agility Dribbling (sec)	Experimental	15.82 ± 1.24	13.91 ± 1.08***	14.02 ± 1.15***	28.64	<0.001	0.39
	Control	15.76 ± 1.31	15.42 ± 1.28	15.38 ± 1.35			
Defensive Dribbling (sec)	Experimental	16.24 ± 1.86	13.90 ± 1.54***	14.12 ± 1.62***	32.18	<0.001	0.42
	Control	16.38 ± 1.92	15.90 ± 1.88	15.84 ± 1.91			
Dribbling Errors (n)	Experimental	3.8 ± 1.2	1.6 ± 0.9***	1.8 ± 1.0***	29.45	<0.001	0.40
	Control	3.7 ± 1.3	3.2 ± 1.2	3.1 ± 1.1			
Control Dribble (sec)	Experimental	34.52 ± 3.15	30.65 ± 2.87***	31.08 ± 2.94***	25.41	<0.001	0.36
	Control	34.78 ± 3.28	33.84 ± 3.21	33.72 ± 3.19			

Shooting Accuracy Outcomes

The increase in shooting accuracy programme had similar patterns in all four shooting tests, as the experimental group had significantly high gains compared to the control group (Table 3). The results of the analysis of the free throw shooting accuracy showed that there was a significant group time interaction ($F_{2,90} = 19.73, p < 0.001, \eta^2 = 0.31$) as, whereas the experimental group (64.4 ± 11.2) slightly improved (78.6 ± 9.8) compared with the group of control (63.8 ± 10.9), the improvement in the accuracy of the free throw shooting made by the experimental group was The largest improvements were in mid-range shooting accuracy, with a significant interaction effect ($F_{2,90} = 34.56, p < 0.001, \eta^2 = 0.43$) and the experimental group rising to $61.2 \pm 7.4\%$ (30.8% relative improvement) as compared to the control group, which rose to $50.4 \pm 9.3\%$ (6.8% relative improvement). The accuracy in three-point shooting also had a significant group x time interaction ($F_{2,90} = 22.87, p = 0.001, \eta^2 = 0.34$), with the experimental scoring increasing at the expense of control group scoring by 9.8 versus 2.1 percentage point (Okazaki et al., 2015). The game- simulation shooting test, which compared shooting accuracy in conditions of time pressure and movement, indicated that the experimental group was able to adjust its shooting accuracy of 42.5 ± 9.3 to 56.8 ± 8.1 ($p < 0.001, d = 1.61$) whereas the control group only marginally improved its shooting accuracy of 43.1 ± 9.7 to 46.3 ± 9.9 ($p = 0.14, d = 0.33$), with a significant interaction reliability ($F_{2,90} = 28.92, p < 0.001, \eta^2 = 0.39$). It should be noted that week 16 retention testing established that the experimental condition group retained their performance improvement in all measures of shooting and there was no significant difference between the post-test and retention test performance ($p > 0.05$) indicating that the experimental condition acquired skills permanently.

Table 3: Shooting Accuracy Performance Across Testing Time Points

Test	Group	Pre-test	Post-test	Retention	F-value (interaction)	p-value	η^2
Free Throw (%)	Experimental	64.4 ± 11.2	$78.6 \pm 9.8^{***}$	$76.8 \pm 10.2^{***}$	19.73	<0.001	0.31
	Control	63.8 ± 10.9	67.2 ± 11.4	66.5 ± 11.8			
Mid-range Shooting (%)	Experimental	46.8 ± 8.6	$61.2 \pm 7.4^{***}$	$59.6 \pm 7.8^{***}$	34.56	<0.001	0.43
	Control	47.2 ± 9.1	50.4 ± 9.3	49.8 ± 9.5			
Three-point Shooting (%)	Experimental	32.4 ± 7.8	$42.2 \pm 6.9^{***}$	$41.1 \pm 7.2^{***}$	22.87	<0.001	0.34
	Control	31.9 ± 8.2	34.0 ± 8.4	33.6 ± 8.6			
Game-simulation (%)	Experimental	42.5 ± 9.3	$56.8 \pm 8.1^{***}$	$55.2 \pm 8.5^{***}$	28.92	<0.001	0.39
	Control	43.1 ± 9.7	46.3 ± 9.9	45.8 ± 10.1			



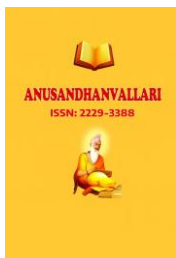
Correlation and Additional Analyses

Pearson correlations were evaluated to investigate the relationship amid changes in the performance of dribbling and shooting in the experimental group. There were moderate positive correlations between the changes in the Illinois Agility Dribbling Test and game-simulation shooting accuracy ($r = 0.52$, $p = 0.009$) indicating that improved ball-handling skills under pressure can be applied to game-simulation shooting performance in dynamic scenarios (Pojskić et al., 2018). Nonetheless, there were no significant relations between dribbling performances and accuracy on free throws ($r = 0.18$, $p = 0.39$), which is compatible with the idea that the performing of shooting during the free throw is the closed one and has less to do with dynamic ball-handling abilities. Subgroup analyses according to initial skill level (divided by median split into higher-skilled and lower-skilled based on baseline composite performance scores) showed that both categories of players in the experimental condition had equal benefits of the structured training, but lower-skilled players showed slightly higher effect sizes in dribbling improvement ($d = 1.89$ vs. $d = 1.42$ to higher-skilled players), whereas the effect sizes of shooting accuracy improvement did not differ between skill groups. The use of a repeated measures ANOVA to evaluate the trend in improvements over the 12-week period of training (measured at weeks 0, 4, 8 and 12) showed that most of the improvements were found during the first eight weeks of training, and the performance gains showed a continued improvement albeit to a lesser degree during week 9-12, which indicated that the acquisition of skills were following an expected learning curve (Newell, 1991). Lastly, nothing went wrong and there were no training-associated injuries, and satisfaction surveys among the interviewees revealed high involvement in the organized training program (mean satisfaction rating: 8.4 ± 1.1 on the 10-meter scale).

Discussion

Interpretation of Dribbling Performance Improvements

In this research, the results give strong reasons to believe that in well-organized motor skills training, the performances of dribbling should improve greatly in comparison to the behaviors of basketball players in the control group, who have undergone traditional ways of training. All the dribbling measures showed large effect sizes ($d = 1.52$ to 2.03) in the experimental group with their improvements ranging between 11.2 percent and 14.8 percent in the times of completing dribbling, and 57.9 percent in terms of ball-handling errors. Such findings are consistent with the motor learning theory, specifically, the theory of schema advanced by Schmidt, state that more diverse and systematic practice conditions can help the formation of the generalized motor program that could be modified to fit to new performance circumstances (Schmidt and Lee, 2011). The training program used in the given study involved the application of progressive complexity, variable practice conditions, and particular feedback that probably expedited participants through the stages of motor learning made by Fitts and Posner, i.e., passing through the stages of cognitive awareness of correct technique to more automated one in which only minimal cognitive attention is needed (Magill and Anderson, 2017). The high performance of experimental group in the dribbling test played in the game-simulation combinative with defensive pressure and time constraints indicate that the training effects were transferred to situation of game-like but not to closed-skill settings. The relevance of this discovery lies especially in the applied practice since one of the frequent criticisms of solitary build-up of skills is that the outcomes might not yield to demands of competitiveness (Davids et al., 2013). The moderate relationship between dribbling and dynamic shooting accuracy ($r = 0.52$) is one more testimony to the importance of more effective ball handling under pressure is related to the overall performance in basketball because fictitious distribution of better scoring opportunities and the ability to retain composure while bringing the ball to the net.

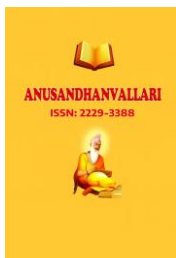


Shooting Accuracy Enhancement and Skill Acquisition

The high test yields of the shooting accuracy under all testing conditions offers a substantial evidence in sustaining the usefulness of structured motor skill training in cultivating shooting skill among basketball players in a university. The 14.2 percentage points increase in the accuracy of the free throws, the 30.8 percent relative increase in the mid-range shooting, and the 33.7 percent increase in the game-simulation shooting of the experimental group are significant gains that will most likely be applicable in a competitive game and give the team a better offensive performance. These results can be argued to be aligned with the prior studies that have shown that systematic training combining relevant feedback measures will help in perfecting complex motor skills like basketball shooting (Okubo and Hubbard, 2015). The stronger results in the category of mid-range and game-simulation shooting could be explained by the fact that the progressive difficulty of training protocol presupposed that people had to combine dribbling movements and shooting performance under ever-tougher conditions. This method is congruent with the principle of specificity and the principle of representative learning design implying that the training tasks must be quite close to the perceptual-motor tasks of a real competition so as to obtain optimal transfer of learning (Pinder et al., 2011). Interestingly, the conclusion that less-skilled players were also making similar or more pronounced improvements than higher-skilled players indicates that there might be a possibility that the structured training in the motor skills might actually prove to be of more benefit to players who are not yet facing the performance limits with regard to fundamental abilities. The lack of significant correlations between free throw gains and dribbling performance confirms that closed skills (free throws) and open skills (game shooting) could have different motor control processes underlying them, thus it is possible that different processes are involved in game shooting and free throws (Gallahue et al., 2012). The plateau in the growth of performance in weeks 9-12 of the intervention is indicative of the fact that the original training stimulus might not be sufficiently effective as the weeks progress, thus the need to constantly ensure a progressive increase in training design and the interest of performance at a high level in order to prevent stagnated performance.

Retention of Motor Skills and Practical Implications

The retention of improved performance after four weeks growth point is one of the greatest pleasing results regarding this study due to the notion that the systematic training of motor skills was linked to long-term rather than the short-term effects on motor capabilities exhibited by performance improvements. The experimental condition enjoyed a mean retention of around 93-97 percent of their post-intervention gains on all the measures and there was no significant change in their post-test to their retention test performance. This result has significant implications to the nature of acquiring skills and indicates that the training regimen was effective to induce learning and not to enhance transient performance levels (Kantak and Winstein, 2012). Such a result can be explained by the combination of a few design elements of the organized training program, among which the distributed practice schedule (three sessions a week instead of massed practice), the variability of the practice conditions that facilitated the development of the schema, the embedding of skills in game-like situations that predetermined the increased depth of the processing and memory consolidation. As a practical coach, these findings support with evidence-based practices that structured motor skill training should be included as one of the routine aspects of the university basketball programs, especially in the pre-season and early-season stages when time is free to commit to focused improvement of motor skills (Conte et al., 2016). This indicates that the structured training of skills is perceived as engaging and valuable to players seeing that the training completion levels during this study are high (94.2% attendance) and is a significant factor to consider when maintaining a program. Coaches and strength and conditioning specialists can modify the training framework that was applied in this research in terms of having a progressive difficulty, frequent performance feedback, through video analysis or objective measurement, and a balance between repetition to build skills and variation to develop a schema. The evidence also indicates that even the player of several years of structured basketball training of higher education



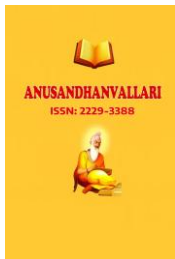
may obtain substantial advantages of being trained in his or her skills systematically, disproving the hypothesis that only novice or youthful player can be truly interested in fundamental skills development (Davids et al., 2008).

Limitations and Future Research Directions

Although the study has offered answers to the question of how organized motor skill training was found to influence basketball performance, various limitations must be considered when discussing the study results. The quasi experimental design, though suitable in applied sport setting, does not have rigor of an actual randomized controlled trial with a blind evaluation which may have brought bias in performance evaluation, regardless of attempts to standardize testing procedures. The transferability of findings to other levels of competitiveness (e.g. professional player or younger players who are still acquiring primary motor patterns) can be limited by the use of university players in two teams. Also, only men were involved in the study, and it is not yet known to what degree these results can be generalized about female basketball players, given that there is a research indicating that there might be sex differences in the movement of motor learning and training adaptation (Thomas and French, 1985). Given that the 12 weeks intervention will only be enough to show the significant changes, it may not be able to establish the effect of long-lasting training or the maximum duration to train to obtain the maximum skill gains. The future studies need to dwell in the longer intervention periods (i.e. 6-12 months), to test whether further improvements are attainable and to be able to test the time course of the skill development better. The four-week retention period, as relatively short as it was, does not concern long-term retention during the course of months and years, which would be beneficial in terms of elucidating the training effects permanence over the course of competitive seasons. The generalizability of these findings can be improved by research investigating the effects of organized training in motor skills among athletes who have participated in female basketball and male athletes of different age and levels of competitiveness (Scanlan et al., 2012). More advanced biomechanical examinations with three-dimensional motion capture technology and force plate technology could also be used in future studies to pinpoint the specific kinematic and kinetic alterations involved in performance changes to give more detailed information on the effects of structured training on movement patterns. Research into the most optimal proportion of structured skill training versus team tactical training and how the individual performance of the person and the team are interdependent would be beneficial to assist coaches in developing a more detailed training program. Last, a study of personal differences in training responsiveness, with cognitive moderators like attentional focus, self-efficacy, and mindset, may be used to design more effective training strategies that can facilitate the development and maximize the developmental potential of individual players (Wulf & Lewthwaite, 2016).

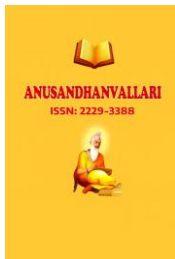
Conclusion

The research paper has shown that a 12-week organized training program on motor skills based training generates significant and long term effects on the dribbling and accuracy in shooting among players of university basketball, with the effect sizes being significantly greater than those of standard training programs. The experimental group showed a high level of improvements in all the measures of performance 11-15% increase in dribbling efficiency, 58% less ball-handling errors, 30-34% increase in shooting accuracy, and these improvements were continued after four weeks follow up testing. These results are very solid empirical evidence of the relevance of systematic, progressive, and feedback-enhanced skill training to the university basketball programs and point to the relevance of the basic skills development even in terms of more experienced collegiate athletes. The findings are consistent with the body of motor learning theories and principles of skill acquisition coupled with practical evidence-based suggestions on how coaches can maximize player development in the limits of academic sport programs.



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