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The Effects of Differential Learning and Traditional Learning Trainings on Technical Development of Football Players

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Abstract

There are several different methods of learning motor skills, like traditional (linear) and differential (nonlinear) learning training. The traditional motor learning approach proposes that learners improve a skill just by repeating it. According to the teaching principles, exercises are selected along continua from easy to hard and from simple to complex. The differential learning approach is mainly characterized by taking advantage, for the purpose of learning, of fluctuations that occur, without movement repetitions and without corrections during the skill acquisition process. The purpose of this study is to examine the effects of differential and traditional training on technical development of 15-year-old football players who have been continuing football education. Twelve (12) football players who were 15 years old from the youth football team (Under 15) of Istanbul Kavacik Club were tested voluntarily in this study. In this study, the Mor-Christian soccer passing test, German Football Association agility/dribbling test, and feet-juggling test were applied on the football field with synthetic grass of the Istanbul Kavacik Sports Club in 2016. The Mann-Whitney U test for paired comparison of the groups and the Wilcoxon test for the comparison of pre- and post-tests of the groups were used for statistical analyses. In conclusion, the findings suggest that the results of the technique tests for groups offer no clear evidence for the superiority of the differential learning approach in comparison to the classical training approach. However, participants of the Differential Group (DG) were able to improve their performance in all tests and techniques compared to those of the Classical Group (CG). These findings may be useful for trainers and physical education teachers in the selection process of players and in preparing football training programs.

Keywords: differential learning, football, motor skill, training program, learning theory, football test

1. Introduction

There are several different methods of learning motor skills, like traditional (linear) and differential (nonlinear) learning training. In motor learning literature, variability of practice is believed to be an effective method producing successful learning, retention and transfer of learned motor skills (Lee and Simon, 2004; Shoenfelt, et al., 2002).

The classical (traditional) motor learning approach proposes that learners improve a skill just by repeating it. According to the teaching principles, exercises are selected along continua from easy to hard and from simple to complex.

A learning theory that opposes the repetition of movement based on an ideal movement pattern is the differential learning approach proposed by Schöllhorn. Differential learning utilizes the fluctuations in human motor behaviour to induce a self-organising process in the learner that takes advantage of individual movement and learning characteristics. Differential learning is a representative of variable practice. Once these exercises have been chosen for an intervention program, every exercise is repeated several times. One method to include variability in teaching is differential learning involving maximum variability between single repetitions (Schöllhorn 1999; Schöllhorn et al., 2010; Schöllhorn, Beckmann & Davids, 2010).

The differential learning approach is mainly characterized by taking advantage, for the purpose of learning, of fluctuations that occur, without movement repetitions and without corrections during the skill acquisition process (Schöllhorn et al., 2009). This approach can be considered as highly nonlinear because of learners' constantly performing the whole complex movement with permanently changing stochastic perturbations.

Traditional learning approaches are typically based on a linear understanding of causality where the same cause leads to the same effect. The differential learning approach takes advantage of fluctuations in a complex system by increasing them through 'no repetition' and 'constantly changing movement tasks' which add stochastic perturbations (Schöllhorn, Hegen & Davids, 2012).

In the differential learning approach, the fluctuations in the learner's subsystems themselves are exploited during learning, because they have the potential to destabilize the whole system. This destabilization process can lead to an instability that has the advantage of requiring less energy in order to achieve a new stable state of organization for the learner. By amplifying these observed fluctuations, the system is additionally confronted with the potential limits of possible performance solutions. Consequently, a self-organizing process is initiated and exploited that forces the system to instigate a new coordination strategy which typically results in the emergence of more effective or more stable movement patterns. These amplified fluctuations tend to increase fluctuations in other anatomical areas of the body and lead to a highly nonlinear adaptation process. Several experiments have shown higher skill acquisition rates for the differential learning approach in comparison to traditional linear approaches and, most intriguingly, display even better performance improvements in the retention phase of learning (Wagner and Müller, 2008; Schöllhorn, 1999)

The purpose of this study is to examine the effects of differential and traditional training on technical development of 15-year-old football players who have been continuing football education.

2. Method

Twelve (12) football players who were 15 years old from the youth football team (Under 15) of Istanbul Kavacik Club were tested voluntarily in this study. In this study, the Mor-Christian soccer passing test, German Football Association agility/dribbling test, and feet-juggling test were applied on the football field with synthetic grass of the Istanbul Kavacik Sports Club in 2016.

A pre-test was followed by a four-week training intervention. Both groups performed exercises as differential and traditional/classical learning training for four weeks, within the normal club training program, and the training intervention consisted of twelve sessions (three per week). In all twelve sessions 9 exercises for the target-passing technique, 9 exercises for the dribbling with the ball technique, and 9 exercises for the feet-juggling technique were performed. Each intervention lasted about 20 minutes. In summary, each participant performed a total of 108 exercises for each technique.

The Classical Group (CG) trained according to the classical training approach oriented on ideal movement archetypes for target-passing, dribbling with the ball, and feet-juggling movements. The techniques were trained in a blocked order: target-passing, dribbling with the ball, and feet-juggling techniques.

Methodological sequences of exercises on target-passing, dribbling with the ball, and feet-juggling with numerous repetitions and error corrections were conducted. For example; criteria for the optimum performance of the target-passing movement included the position of the standing leg, orientation of the head, amplitude of the kicking leg, sequence of the maximum velocity in the limbs of the kicking leg, stiffness of the kicking leg at ball contact and arm movements during the approach and during the passing movement.

The Differential Group (DG) trained according to the differential learning approach, performing target-passing, dribbling with the ball, and feet-juggling techniques with blocked order in one training session.

The core idea of the differential training group was to increase the fluctuations of techniques in order to make the athletes more stable against disturbances and in order to provide the athletes with the possibility to seek and explore functional movement patterns. The fluctuations were increased by infinite variations in each technique as well as by avoiding movement repetitions and by providing no corrective feedback. Movement variations were characterized by variations in the standing leg, in the kicking leg, in the arms, in the trunk, in the head and the ball, referring to the angles, the angular velocity and the rhythm of each joint movement. To exemplify: the standing leg had to be placed well before the ball, well behind it, or well to the side of the ball; the knee joint in one shot had to be stiff, while in the other it was kept very flexible or alternating between stiffness and flexibility after each shot (Schöllhorn, Hegen & Davids, 2012)

2.1 Statistical Analysis

Descriptive statistics are presented as arithmetic means, standard deviations, and minimums and maximums. The Mann-Whitney U test for paired comparison of the groups and the Wilcoxon test for the comparison of pre- and post-tests of the groups were used. A result was considered to be significant if p was less than 0.05.

3. Results

The pre-test analyses of juggling, passing, agility and dribbling measurements of the traditional and differential training groups in the study are displayed in Table1.

Table 1. Mann-Whitney U analysis of pre-test feet-juggling, passing, agility and dribbling measurements of the traditional and differential training groups

		X	SD	U	p
Juggling	Traditional	52.00	12.50	13.500	0.470
	Differential	51.83	4.40		
Passing	Traditional	5.50	2.34	11.500	0.287
	Differential	4.33	1.03		
Agility	Traditional	8.13	0.52	14.000	0.520
	Differential	8.30	0.70		
Dribbling	Traditional	11.57	0.71	16.000	0.748
	Differential	11.63	0.69		

There were no statistically significant differences between any pre-test values of the traditional and differential groups ($p>0.05$).

Table 2. Wilcoxon analysis of pre-test and post-test feet-juggling, passing, agility and dribbling measurements of the traditional training group

		X	SD	Z	p
Juggling	Pre-test	52.00	12.50	-0.527	0.598
	Post-test	51.00	12.50		
Passing	Pre-test	5.50	2.34	-0.422	0.673
	Post-test	4.83	1.32		
Agility	Pre-test	8.13	0.52	-1.572	0.116
	Post-test	7.75	0.46		
Dribbling	Pre-test	11.57	0.71	-1.363	0.173
	Post-test	11.14	0.67		

Table 2 shows the pre-test and post-test analysis of juggling, passing, agility and dribbling measurements of the traditional training group.

A significant difference was not found in juggling, passing, agility or dribbling performances between the pre-and post-test in the traditional training group ($p>0.05$).

Table 3. Wilcoxon analysis of pre-test and post-test feet-juggling, passing, agility and dribbling measurements of the differential training group

		X	SD	Z	p
Juggling	Pre-test	51.83	4.40	-0.314	0,753
	Post-test	52.83	10.79		
Passing	Pre-test	4.33	1.03	-0.552	0.581
	Post-test	4.66	1.63		
Agility	Pre-test	8.30	0.70	-2.201	0.028*
	Post-test	7.74	0.34		
Dribbling	Pre-test	11.63	0.69	-1,153	0.249
	Post-test	11.12	1.09		

* $p<0.05$

The pre-test and post-test analysis of the measurements of the differential training groups can be seen in Table 3. There was a statistically significant difference in agility performance ($Z=-2.201$; $p<0.05$) between the pre-and post-test in the differential learning group.

Table 4. Mann-Whitney U analysis of post-test feet-juggling, passing, agility and dribbling measurements of the traditional and differential training groups

		X	SD	U	p
Juggling	Traditional	51.00	12.50	13.500	0.470
	Differential	52.83	10.79		
Passing	Traditional	4.83	1.32	16.500	0.805
	Differential	4.66	1.63		
Agility	Traditional	7.75	0.46	17.500	0.936
	Differential	7.74	0.34		
Dribbling	Traditional	11.14	0.67	17.000	0.873
	Differential	11.12	1.09		

The post-test analysis of juggling, passing, agility and dribbling measurements of the traditional and differential training groups in the study are displayed in Table 4.

There were no statistically significant differences between any post-test values of the traditional and differential groups ($p>0.05$).

4. Discussion and Conclusion

In this study, a nonlinear training approach to teaching three football techniques in contrast to a classical teaching methodology was investigated. About 70% of the club players (12) were able to complete their participation in all test and intervention events. The small number of participants could give the study the character of a pilot study for youth football players.

Differential and traditional trainings three times a week for four weeks produced no significant difference in development of players' football techniques. There were no statistically significant differences between performances in tests in differential and traditional groups ($p>0.05$).

However, participants of DG were able to improve their performance in all tests and techniques compared to CG. In most cases an increase during the acquisition phase is followed by a decrease. There may not be a difference due to the fact that the players had completed the phase of basic technical training.

Schöllhorn et al. (2012), considering the results of football technique tests in their study, offer clear evidence for the superiority of the differential learning approach in comparison to the classical training approach.

In the majority of cases, the differential learning approach resulted in better skill acquisition and better learning rates in participants (Wagner and Müller, 2008; Schöllhorn et al., 2009). Several studies have demonstrated increased learning rates using a variable practice approach compared to a repetitive practice approach (Schöllhorn et.al., 2012); Schöllhorn, Michelbrink, Welminski & Davids, 2009).

According to Henz et al's (2016) study on contralateral activation after Differential Learning (DL), results indicate that DL stimulates the motor system in an extensive way that is not induced by repetitional training. The EEG results indicate that the DL approach activates working memory and attentional processes that contribute essentially to increased motor learning rates compared to repetitive learning.

A significant advantage is reported for the differential learning group in comparison to the traditional learning group in soccer and hurdle sprint training (Schöllhorn et al., 2006), and in shot put (Beckmann and Schöllhorn, 2003).

On the other hand, in Savelsbergh et al's (2010) study, differential learning was compared to traditional learning in the acquisition of a new task: speed skating. Although there were no significant differences between the traditional and differential groups, the differential learning group showed the most improvement in performance.

In conclusion, the findings suggest that the results of the technique tests for groups offer no clear no evidence for the superiority of the differential learning approach in comparison to the classical training approach.

Further research is required for determining the optimum number of differences that would be functional during training. In addition, these results need to be verified with other and larger samples.

These findings may be useful for trainers and physical education teachers in the selection process of players and in preparing football training programs.

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