

Biomechanical establishment of optimal program models for practice of optimal program models for practice of elements in soccer

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The aim of this research was to determined optimal program model for practice in soccer. By using the algorithm Alprobi is determined the biomechanical characteristics of 21 soccer elements, and then is determined biomechanical similarity of whole system, force of biomechanical connection of one skill with other and neighbouring biomechanical similarity.

The most optimal model for practicing in soccer is the first with coefficient 0,65. The coefficient of biomechanical similarity of whole system of elements is 0,44. That means the elements from soccer have more expressive heterogeneous biomechanical structure. The highest coefficient of biomechanical similarity with others is present in kick with the top of the foot (.56), passing with the external part of the foot (.52), kick with the upper part of the foot (.52), leading with the upper part of the foot (.53). It shows the central place in the learning process in sports techniques.

Key words: Biomechanics, soccer, Alprobi, optimal program model.

INTRODUCTION

The primary goal of a qualitative biomechanical analysis is to improve technique while purpose of qualitative anatomical analysis is to determine the predominant muscular activity during specific phase of a performance. Knowing the biomechanical characteristics of the elements from the football game it may be established the degree of appropriate muscular groups in the performing of the movement partly for each element. In order to form new motor skills having this in mind pedagogical principles more often is enforced need for more rational approach at their forming. Because of that, the order of the elements which are training should be of such kind to permit more efficient transfer in the learning process. From the former knowledge it can be see that certain mechanisms on the central nervous system, are responsible for the control of the motor manifestations with the same biomechanical structure, while for motor manifestations with other biomechanical structure are responsible other mechanisms. From that reason it is need more rational approach at training of elements of soccer to provide the most efficient transfer in the learning process and to have in mind the pedagogical principles. This is equally important for the class of physical education as well as during the training process in sports clubs.

The subject of this research is studying of the biomechanical and motor structure of the dynamics stereotypes of elements from sports game soccer, which are most learned on the class of physical education and during the training process in the sports clubs, and the optimal learning order on the same. Primary aim of this research is to establish the biomechanical optimality at certain elements of soccer.

Concrete aims of the research are:

- to establish biomechanical similarity between the elements,
- to establish the degree of the biomechanical homogeneity of the elements,
- to establish the next biomechanical similarity,
- to establish similarity of one element with all the other,
- to establish the central roll and the meaning of the elements in the learning process.

EXPOSITION METHODS OF WORK

During the planning of this research we started from the object and the aims which is from the start conditioned the variables should cover the researching area. There were analyzed 21 elements from sport game soccer represented in learning process in Macedonian basic schools as well as in the training process in the sport clubs.

The analyzed elements are: 1. passing with the internal part of the foot (PIF), 2. passing with the external part of the foot (PEF), 3. kicking with the upper-internal part of the foot (KUIF), 4. kicking with the upper part of the foot (KUF), 5. kicking with the upperexternal part of the foot (KUEF), 6. volley kick in sagittal plane (VKSP), 7. volley kick in horizontal plane (VKHP), 8. kicking with the top of the foot (KTF), 9. kicking with the heel (KH), 10. kicking with the forehead of the head (KFH), 11. kicking with crown of the head (KCH), 12. kicking with the head in jump (KHJ), 13. leading with the upper part of the foot (LUF), 14. receiving with the internal part of the foot (RIF), 15. receiving with the upper part of the foot (RUF), 16. receiving with the thigh (RT), 17. receiving with the chest (RC), 18. caching low balls with banding of the body (CLBBB), 19. catching high balls (CHB), 20. boxing ball with the one hand (BBOH), 21. boxing ball with two hands (BBTH).

Total were defined 82 biomechanical variables and as a starting point for further analyses it was established initially binary matrix. The biomechanical variables are classified in several groups. The first group of variables is intent to describing the aim of realization on the entity it is own. The second group of variables defines the starting and the finishing positions of all sports elements. The third group variables are intent to describe the functional-anatomic structure and the forth group the mechanical structure of analyzed sport elements.

The sample of the soccer elements is analyzed with the methods of qualitative biomechanical analysis and the results are given in binary matrix with symbols 1 and 0, where in horizontal are placed the elements from football and in vertical the variables⁶.

The received facts with the biomechanical analyses on the elements are estimated with more mathematical operation defined with the algorithm ALPROBI. First of all is formed starting binary matrix with basic biomechanical characteristics on the movements. From this matrix we got symmetrical matrix on standardized measures on the biomechanical similarity and are determined all the rest parameters for biomechanical structure on the model. The first parameter gives information about the coefficient on the biomechanical similarity on the whole system. This coefficient which is standardized from 0-1 points the degree of homogeneity of the elements. The second parameter is intent for establishing the neighbor biomechanical similarity on the elements. This coefficient is significant for establishing on the degree on the optimality for the learning process. The third parameter points on the connection of the element with all the others. With this coefficient is established the primary meaning on certain elements in the whole system, the central part on certain elements in the learning process. For the purpose of the research three different theoretical models of learning were established, presented at table 1.

⁶ The example of the biomechanical variables and the binary matrix are not shown and they are at the authors.

Table 1

Theoretical models of soccer sport elements learning order

MODEL 1	MODEL 2	MODEL 3
1. passing with the internal part of the foot (PIF)	2. passing with the external part of the foot (PEF)	5. kicking with the upper-external part of the foot (KUEF)
2. passing with the external part of the foot (PEF)	1. passing with the internal part of the foot (PIF)	9. kicking with the heel (KH)
3. kicking with the upper-internal part of the foot (KUIF)	5. kicking with the upper-external part of the foot (KUEF)	13. leading with the upper part of the foot (LUF)
4. kicking with the upper part of the foot (KUF)	4. kicking with the upper part of the foot (KUF)	20. boxing ball with the one hand (BBOH)
5. kicking with the upper-external part of the foot (KUEF)	3. kicking with the upper-internal part of the foot (KUIF)	16. receiving with the thigh (RT)
6. volley kick in sagittal plane (VKSP)	7. volley kick in horizontal plane (VKHP)	12. kicking with the head in jump (KHJ)
7. volley kick in horizontal plane (VKHP)	6. volley kick in sagittal plane (VKSP)	8. kicking with the top of the foot (KTF)
8. kicking with the top of the foot (KTF)	9. kicking with the heel (KH)	4. kicking with the upper part of the foot (KUF)
9. kicking with the heel (KH)	8. kicking with the top of the foot (KTF)	18. catching low balls with banding of body (CLBBB)
10. kicking with the forehead (KFH)	12. kicking with the head in jump (KHJ)	11. kicking with crown of the head (KCH)
11. kicking with crown of the head (KCH)	11. kicking with crown of the head (KCH)	21. boxing ball with two hands (BBTH)
12. kicking with the head in jump (KHJ)	10. kicking with the forehead (KFH)	1. passing with the internal part of the foot (PIF)
13. leading with the upper part of the foot (LUF)	13. leading with the upper part of the foot (LUF)	3. kicking with the upper-internal part of the foot (KUIF)
14. receiving with the internal part of the foot (RIF)	16. receiving with the thigh (RT)	15. receiving with the upper part of the foot (RUF)
15. receiving with the upper part of the foot (RUF)	15. receiving with the upper part of the foot (RUF)	6. volley kick in sagittal plane (VKSP)
16. receiving with the thigh (RT)	14. receiving with the internal part of the foot (RIF)	14. receiving with the internal part of the foot (RIF)
17. receiving with the chest (RC)	17. receiving with the chest (RC)	2. passing with the external part of the foot (PEF)
18. catching low balls with banding of body (CLBBB)	19. catching high balls (CHB)	7. volley kick in horizontal plane (VKHP)
19. catching high balls (CHB)	18. catching low balls with banding of body (CLBBB)	19. catching high balls (CHB)
20. boxing ball with the one hand (BBOH)	21. boxing ball with two hands (BBTH)	11. kicking with crown of the head (KCH)
21. boxing ball with two hands (BBTH)	20. boxing ball with the one hand (BBOH)	3. kicking with the upper-internal part of the foot (KUIF)

RESULTS AND DISCUSSION

According to results from the research at the sports game football it could be concluded that the biggest biomechanical similarity it is found between the elements kick with the upper part of the foot and kick with upper-external part of the foot. Some smaller similarity is appearing between kick with upper-internal part of the foot and kick with upper-external part of the foot which is 91%, volley kick in sagittal plane and kick with the top of the foot which is 88%, as well as between the elements kick with the upper part of the foot and kick with the top of the foot with 88%. Smaller biomechanical similarity it is noticed between the elements volley kick in horizontal plain and receiving high balls which is 10% as between volley kick in sagittal plane and receiving high balls with 10%. Coefficient on the biomechanical similarity of all sports elements in all three models is 0.44. That means the elements from soccer have more expressive heterogeneous biomechanical structure. From didactical aspect this fact points that in the learning process it can not be expected effective transfer between some elements. Coefficient on the next biomechanical similarity at the all elements given in determinate order in the first model is 0.65 in the second 0.62 while in the third 0.43. This fact says that the order of learning on the sports elements from soccer according to the first model is most optimal. An upon the strength values on the biomechanical connection of one element with all the rest in the model, it may be concluded that central place in the learning process in sports techniques in soccer have elements: kick with the top of the foot (.56), passing with the external part of the foot (.52), kick with the upper part of the foot (.52), leading with the upper part of the foot (.53).

Table 2. Standardized measured of the biomechanical similarity between football elements, coefficient of strength relationship on one element with all the rest (in the main diagonal), coefficient on biomechanical similarity on the whole system on elements (KBSWS) and the coefficient on next biomechanical similarity of all elements (KNBSWS).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	(.50)																				
2	.826	(.52)																			
3	.711	.667	(.48)																		
4	.546	.592	.774	(.52)						KBSWS = .44				KNBSWS = .65 (first model)							
5	.667	.756	.909*	.791	(.41)									KNBSWS = .62 (second model)							
6	.546	.592	.774	1.00*	.791	(.51)								KNBSWS = .43 (third model)							
7	.455	.410	.651	.714	.651	.714	(.41)														
8	.667	.711	.682	.884	.727	.884	.651	(.56)													
9	.606	.606	.477	.537	.477	.537	.342	.667	(.50)												
10	.202	.202	.310	.423	.310	.423	.318	.362	.434	(.35)											
11	.253	.303	.207	.318	.259	.318	.212	.362	.434	.647	(.35)										
12	.319	.319	.419	.429	.419	.429	.476	.372	.342	.582	.370	(.36)									
13	.718	.765	.538	.651	.587	.651	.551	.783	.564	.223	.334	.350	(.53)								
14	.728	.592	.512	.381	.419	.381	.238	.512	.683	.212	.265	.238	.551	(.46)							
15	.578	.622	.409	.512	.455	.512	.326	.636	.620	.207	.310	.233	.685	.744	(.49)						
16	.590	.639	.402	.514	.452	.514	.257	.653	.738	.286	.400	.206	.595	.772	.854	(.50)					
17	.287	.287	.147	.200	.147	.200	.150	.293	.462	.501	.556	.250	.316	.451	.440	.541	(.34)				
18	.239	.239	.196	.200	.196	.200	.150	.147	.257	.501	.445	.350	.263	.350	.342	.324	.632	(.31)			
19	.335	.335	.147	.100	.147	.100	.100	.245	.410	.390	.390	.250	.368	.451	.440	.433	.632	.790	(.34)		
20	.431	.478	.391	.401	.440	.401	.401	.489	.359	.278	.278	.401	.526	.350	.391	.379	.158	.211	.316	(.40)	
21	.420	.466	.381	.390	.429	.390	.439	.477	.350	.271	.271	.488	.513	.342	.381	.369	.154	.257	.359	.827	(.40)

CONCLUSION

On upon the results form the biomechanical analysis of elements from the sports game soccer and the coefficient received with data estimated it could be concluded that:

- Knowing the biomechanical characteristics of the elements form the soccer game it may be established the degree of the involved muscles groups in the performing of the movements partly for each element.

- The first model on the order of the training of the elements from soccer is the most optimal according to the criterion on the next similarity on the group analyzed elements. This kind of model is expected to give the most effective transfer in the training process in sports clubs and in the classes of physical education.

In order to confirm this optimal model is necessary to conduct experimental research in practice.

LITERATURE

[1] Ацески, А. (2009). Проценка на нивото на развој на основната моторна вештина од локомоторен вид трчање преку синтетички пристап. Наука & Спорт, год. 1, бр. 1.

[2] Ацески, А. (2009). Биомеханички статус на основните моторни вештини застапени во курикулумите по физичко и здравствено образование за деца на возраст од три до десет години. Магистерски труд. Скопје: Факултет за физичка култура.

[3] Aceski, A., Naumovski, M., Petrov, L. (2005). Utvdavane na optimalen model za obucavane na tehnicските elementi ot sportnata igra basketbol. Sport&nauka. Izvanredni broj 4. Veliko Trnovo.

[4] Ацески, А., Туфекчиевски, А. (2006). Утврдување на оптимални модели за обучување на елементите од кошарка, одбојка, фудбал и ракомет според биомеханичката сличност. Стручно-научен собир "Пелистер 2006".

[5] Анастасовски, И. (1999). Утврдување на оптимален модел за обучување на елементите од кошарка кај учениците од петтите одделенија. Магистерски труд. Скопје: Факултет за физичка култура.

[6] Анастасовски, И. (2001). Утврдување на оптимални модели за обучување на елементите од спортските игри кошарка, ракомет, одбојка и фудбал, опфатени во наставните планови за основното образование. Докторска дисертација, Скопје: Факултет за физичка култура.

[7] Анастасовски, И., Поповски, А. (2004). Утврдување на оптимална модел за учење на елементите од кошарка според биомеханичката структура опфатени во наставниот план и програм за основното образование. Физичка култура. Скопје, бр. 1, 1007-110.

[8] Аргироски, А., Ацески, А., Туфекчиевски, А. (2008). Биомеханичка оптималност на методиката на учење на елементи од "А" тежина на вратило. Стручно-научен собир, Пелистер 2008.

[9] Клиначаров, И. (2001). Оптимална методска поставеност и реализација на наставата по предметот физичко и здравствено образовани во основното образование во Република Македонија. Докторска дисертација, Скопје: Факултет за физичка култура.

Knudson V. D., Morrison S. C.: Qualitative analysis of human movement, second edition, Human kinetics, 2002.

[10] McGinnis, P., M. (2005). Biomechanics of sport and exercise 2nd edition. Human Kinetics, USA.

[11] Туфекчиевски, А., Ацески, А. (2009). Биомеханика. Второ проширено и дополнето издание. Факултет за физичка култура. Скопје.

[12] Туфекчиевски, А. (2000). Биомеханика на човековиот локомоторен систем. Де Гама – Скопје.

[13] Туфекчиевски, А. (1991). Практикум по биомеханика. Скопје.

[14] Туфекчиевски, А. (2003). Биомеханика. Скопје: Факултет за физичка култура.

[15] Туфекчиевски, А., Јанковски, Љ., Трниниќ, С., Ристовски, Д. (1988). АЛПРОБИ – алгоритам и програм за утврдување на оптималноста на мрежести биомеханички модели за учење на моторните стереотипови. Годишен зборник на Факултетот за физичка култура, Скопје.

[16] Туфекчиевски, А. (1988). Биомеханичка структура на динамичките стереотипови во физичката култура. Докторска дисертација, Скопје: Факултет за физичка култура.

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The report has been reviewed.