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EVALUATION OF THE EXPERT SYSTEM »KISS 1.2 KOŠŽ1 EKSPERT« ON PLAYERS OF THE SLOVENIAN CADET NATIONAL FEMALE BASKETBALL TEAM

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PREVERJANJE VELJAVNOSTI EKSPERTNEGA SISTEMA »KISS 1.2 KOŠŽ1 EKSPERT« NA VZORCU ŽENSKE KADETSKE KOŠARKARSKE REPREZENTANCE SLOVENIJE

ABSTRACT

The model of the expert system of potential performance was evaluated on a sample of twelve female basketball players of the Slovene National Cadet Team. A battery of twentyfive morphological and fourteen motor tests was carried out immediately before the players' departure for the European Championships which enabled us to establish the effect of the present moment state of preparedness on the playing performance and efficiency of the players.

In order to establish the relationship between manifest (predictive) variables and the criterion (playing performance and efficiency), the expert system »KISS 1.2 KOŠŽ1 EKSPERT« was used.

The estimate (assessment) of playing performance is in statistically significant correlation with the expert evaluation of potential performance on the highest (ultimate) level of performance tree (0.57), and with expert evaluation of potential performance on the level of morphological dimensions (0.59). The correlation between playing efficiency and expert estimate of potential performance is just under the limit of statistical significance.

With guards and forwards the amount of correlation between different criteria of success and expert evaluation of potential performance does not differ significantly. The values range from 0.43 to 0.69, but due to the very small number of subjects, are not statistically significant.

Key words: basketball, women, cadets, motorics, morphology, expert system, validation

IZVLEČEK

Na vzorcu dvanajstih košarkaric slovenske kadetske reprezentance, smo ovrednotili model ekspertnega sistema potencialne uspešnosti. Igralke smo, neposredno pred odhodom na evropsko prvenstvo, izmerili z baterijo petindvajsetih morfoloških in štirinajstih motoričnih testov. Na ta način smo ugotavljali kako trenutna pripravljenost igralk vpliva na njihovo igralno uspešnost in učinkovitost.

Za ugotavljanje povezanosti sistema manifestnih (prediktorskih) spremenljivk s kriterijem (igralno uspešnostjo in učinkovitostjo) smo uporabili ekspertni sistem »KISS 1.2 KOŠŽ1 EKSPERT«.

Ocena uspešnosti igranja je v statistično značilni povezavi z ekspertno oceno potencialne uspešnosti na najvišjem (končnem) nivoju drevesa uspešnosti (0,57) in z ekspertno oceno potencialne uspešnosti na nivoju morfoloških razsežnosti (0,59). Povezanost med igralno učinkovitostjo in ekspertno oceno potencialne uspešnosti je malo pod mejo statistične značilnosti.

Pri branilkah in krilnih igralkah so rezultati povezanosti med različnimi kriteriji uspešnosti in ekspertno oceno potencialne uspešnosti dokaj izenačeni. Vrednosti se gibljejo med 0,43 in 0,69, vendar zaradi zelo majhnega števila merjenk niso statistično značilne. Povezanost spremenljivk morfološkega in motoričnega prostora s kriteriji upešnosti je pri branilkah dokaj uravnotežena, pri krilnih igralkah pa so morfološke razsežnosti v večji povezanosti s kriteriji igralne uspešnosti in učinkovitosti.

Ključne besede: košarka, kadetinje, reprezentanca, morfologija, motorika, ekspertni sistem, veljavnost

INTRODUCTION

Basketball is a polystructural complex sport (13). It is a rather complicated and complex team ball game of which cyclic and acyclic moving structures as well as contrary interests of the opponent teams are characteristic.

The performance of a basketball team or individual male or female players depends on a great number of factors having different effects on playing performance. Most of the factors that have effect on the achievement i. e. performance in play (game) are more or less related to each other, they can complement, compensate or exclude each other. Individual contribution is not directly measurable, the result (achievement) does not depend solely on the performance of individual players but also on the cooperation of the players which can be direct or indirect (playing tactics in offense and in defense) as well as on the play of opponent players. Players create and adapt their movements with regard to the playing situation, thus also intuition plays an important role.

Owing to unpredictability, great possibility of compensation and multidimensionality, research work in basketball is very complicated and also less reliable.

Because of the above, investigating the theory of performance in basketball demands a systematic approach. The system of playing performance of a player (basketball team) can only function if it comprises all the essential elements of the system and their relationships (15).

Theoretical knowledge of the factors on which playing performance is dependent is one of the basic conditions necessary for a proper and successful training process in basketball. In this way only a coach-kinesiologist is able to conduct and control training process and to achieve rationality so indispensable for top performance in modern sport.

Playing performance is to a high degree affected by motor and morphological dimensions (2, 3, 9) therefore in this study major emphasis will be laid upon the investigation of this segment of the psychosomatic status.

The use of artificial intelligence in research has increased recently. Also kinesiological science has enriched its methodology by using the methods, techniques and tools of artificial intelligence (17).

Expert systems also belong to computer programs of artificial intelligence. Expert systems behave similarly to an expert in a particular field, their basic characteristic being the ability to explain the solution. A computer helps to collect and arrange a segment of our knowledge and to employ this knowledge in a consequent, systematic and transparent way (16).

Expert systems are being more and more and with increasing success used in the investigation of the theory of sport performance. The method applied to research complex systems combines computer capacities with the experts' knowledge in the field of sport. A basketball player or a basketball team can also be defined as a (very) complex system (14).

Expert systems as a rule consist of three modules (11, 16, 17):

1.Knowledge base
It is based on the sports science findings on the preparation of athletes. In it the knowledge consists of generally approved facts and heuristics (expert rules of inference and decision making). The performance model must be designed so that it can give answers to the following questions:

- on which factors, abilities and characteristics the result (achievement) depends
- how significant each of the factors is and what its relative share in the result is
- what the relationships between single factors are.

The quality of the expert system is to the highest degree dependent on the amount and quality of the knowledge base.

2. Mechanisms of Inference
It enables active application of the knowledge from the knowledge base for problem solving. It gives answers to the user's questions and explains them. It determines the sequence of steps for the problem solution.

3. User's (communication) Interface
It takes care of comfortable communication between the user and the system and allons the user the insight into the process of problem solving directed by the mechanism of inference.

The first to begin the investigation of potential and competitive (playing) performance in basketball (by means of different models of expert sytems), was Dežman (4, 5, 6, 7). He also composed a simplified and generalized model of the tree of potential performance of a basketball player (7).

Individual factors (dimensions) have different effects on the playing performance, therefore their contribution i. e. weights are determined by decision making rules. Decision making rules are of qualitative character and are determined by an expert. They illustrate the relationship between the elements of the performance model. The experts expresses the equation of specification according to his own conception and arbitrary judgement (17).

By determining normalizers the level of single dimensions is evaluated on the tree of performance with values 1 to 5. Normalizers are of quantitative character and are used to set limits to the results in single variables. Decision making rules and normalizers can be determined for all types of basketball players.

On the basis of information obtained from literature and so far existing studies in this field (4, 5, 6, 10, 11, 17) and of expert knowledge, decisional making rules (weight) were determined in motor and morphological space of the psychosomatic status of the young female basketball players (9). Decision making rules were made for each playing position. The reduced model of the expert system of potential performance was named »KISS 1.2 KOŠŽMOT1 EKSPERT«.

Potential performance in the motor ability space was defined by 14 tests, by means of which conditional abilities, technical knowledge and coordination abilities were measured. Among conditional abilities are included power, velocity and endurance, technical knowledge and coordination abilities are determined with movements without and with a ball.

Morphological space was defined by tests measuring external geometrical dimensions (longitudinal, transversal and voluminosity dimensions) and internal geometrical dimensions (fat tissue).

The purpose of the evaluation of the model of expert system described is to obtain as objective information as possible on the state of preparedness of the young female basketball players and thus as objective as possible prognostic assessment of their competitive performance. This is also one of basic issues in the training process in basketball and in sport in general.

METHODS

The sample was comprised of 12 players of the Slovene National Cadet Female Basketball Team preparing for the participation at the European Championship, 1995. In further analysis 11 players with sufficient playing time during the competition were included if they met the following criteria:
- that they were born in the years 1978, 1979 or 1980
- that they were measured with all tests
- that they were in good health and free of injures of locomotion apparatus during measurement and competition.

With regard to their playing positions and roles in play, the selected sample was divided into two subsamples: outside players or guards (n=5) were separated from the players whose playing position is nearer to the basket i. e. inside players or forwards (n=6). This division was done by the coaches of the team.

The sample of (independent) variables of potential performance comprised the tests applied in the model of tree of expert system of prognostic performance, i. e. the tests measuring those motor and morphological dimensions with the highest degree of impact on playing performance of young basketball players (see Tables 2 and 3). Very good measuring characteristics of these tests have allready been proven several times (1, 2, 9). Detailed description of the tests was given by Erčulj (9).

The sample of dependant variables was comprised of variables estimating playing (competitive) performance and efficiency:
- Playing performance of the young players was assessed subjectively: the coach and his assistant evaluated the player's performance with the values from 1 to 5. Global playing performance, i. e. total performance of the player in offense and defense was assessed according to the criteria by Erčulj (9).
- The efficiency of the individual player in the game was stated objectively by the calculation of efficiency indexes (5). The parameters necessary for the calculation of indexes (concluding offensive and defensive actions) were obtained from official game statistics.

The measurements were carried out at the premises of the Faculty of Sport immediately before the departure to the European Cadet Championship which enabled us to establish the effect of the state of preparedness on the players' competitive performance. Competitive performance was assessed at the European Cadet Championship held in August 1995 at Cetniewo (Poland).

The data was processed at the Institute of Kinesiology at the Faculty of Sport in Ljubljana, on

the VAX/VMS computer of the University Computing Center in Ljubljana. Statistical program package SPSS was used. The expert system was made by the help of computer program KISS (version 1.2 E) which was made for the needs of Basketball Information System by Leskošek B. (12).

The model of the expert system (KISS 1.2 KOŠŽ1 EKSPERT) and descriptive statistics procedures were used for data processing. The correlation between final estimates of potential and competitive model of performance were obtained by means of Pearson correlation coefficients.

RESULTS

The procedures described were primarily used to measure playing performance and efficiency for the players with a sufficient amount of playing time at the championship. Table 1 shows the results of playing performance and efficiency for above mentioned players.

Table 1: Playing performance and efficiency of the players at the European Cadet Championship 1995.

PL	PP	CEPP	AIPE	RIPE	GAMES	PTIME
1	G	3	7.75	0.88	4	12.9
2	F	2	3.00	0.69	3	4.0
3	G	2	9.86	0.94	7	26.9
4	F	3	5.60	0.98	5	13.8
5	F	4	16.71	1.13	7	38.1
6	F	2	3.86	0.73	7	13.1
7	F	3	3.20	0.81	5	9.8
8	G	3	18.86	1.18	7	34.6
9	G	2	14.71	1.05	7	26.1
10	F	1	8.14	0.92	7	16.8
11	G	1	0	0	2	3.4

Legend:
PL - player
PP - playing position
CEPP - coach's evaluation of playing performance
AIPE - absolute index of playing efficiency at the competition
RIPE - relative index of playing efficiency at the competition
GAMES - number of played games at the tournament
PTIME - average playing time on the game (minutes)

With the use of the expert system »KISS 1.2 KOŠŽ1 EKSPERT« and by means of a computer programme (KISS 1.2) the potential performance was computed for each of the players. Decision making rules and normalizers were used to evaluate the level of individual dimensions of potential performance. Table 2 shows expert evaluations of potential performance on the three highest levels of the performance decision tree.

Table 2: Expert evaluations of potential performance of the cadet national team players on the three highest levels of the performance tree.

PL	PP	FINAL	MORPH	MOTOR
1	G	2.7	1.8	3.3
2	F	2.7	2.6	2.8
3	G	3.8	3.9	3.7
4	F	3.3	2.5	4.1
5	F	3.1	4.0	2.2
6	F	3.0	2.2	3.8
7	F	2.7	3.2	2.2
8	G	3.3	3.6	3.1
9	G	2.8	2.8	2.8
10	F	3.2	3.3	3.1
11	G	2.6	2.6	2.6

Legend:
FINAL - expert evaluations of potential performance on the highest level (final level of the performance tree)
MORPH - expert evaluations of potential performance on the highest level of morphological dimensions
MOTOR - expert evaluations of potential performance on the highest level of motor dimensions

The validity of the results of the used expert system was established with the amount of correlation between criteria variables (variables of playing performance and efficiency – CEPP, AIPE, RIPE) and the variables of potential performance on the three highest levels of the performance tree (FINAL, MORPH, MOTOR).

Tables 4 show the results of validity of the used expert system also for the sub-samples of guards and forwards.

DISCUSSION

If the sample of players is regarded as a whole, the correlation between potential estimate of performance on the highest level (FINAL) and the playing performance (CEPP) is statistically significant. The criteria of objectively established playing efficiency (AIPE, RIPE) are in relatively high correlation with the final estimate of potential performance (FINAL) but the values of correlation coefficients are not statisti-

Table 3: Correlation between the criteria variables and the variables of potential performance on the three highest levels of the performance tree.

	CEPP	AIPE	RIPE	GAMES	PTIME	FINAL	MORPH	MOTOR
CEPP	1.00							
AIPE	**0.81**	1.00						
RIPE	**0.83**	**0.79**	1.,00					
GAMES	**0.67**	**0.70**	**0.77**	1.00				
PTIME	**0.87**	**0.95**	**0.76**	**0.78**	1.00			
FINAL	**0.57**	**0.43**	**0.52**	**0.64**	**0.58**	1.00		
MORPH	**0.59**	**0.58**	**0.41**	**0.54**	**0.70**	**0.60**	1.00	
MOTOR	**0.04**	**-0.11**	**0.15**	**0.20**	**-0.07**	**0.55**	**-0.33**	1.00

*statisticaly significant (P<0.05) are values, higher than 0.57 (marked with emphasised print)

Table 4: Correlation between the criteria variables and the variables of potential performance on the three highest levels of the performance tree for guards (G) and forwards (F) separately.

	CEPPS	AIPE	RIPE	GAMES	PTIME	FINAL	MORPH	MOTOR
CEPP	1.00							
AIPE	**0.89(G)** **0.86(F)**	1.00						
RIPE	**0.93(G)** **0.88(F)**	**0.92(G)** **0.88(F)**	1.00					
GAMES	**0.99(G)** 0.29(F)	**0.89(G)** 0.56(F)	**0.89(G)** 0.50(F)	1.00				
PTIME	**0.96(G)** **0.86(F)**	**0.95(G)** **0.97(F)**	**0.89(G)** **0.87(F)**	**0.96(G)** 0.67(F)	1.00			
FINAL	0.68(G) 0.47(F)	0.43(G) 0.47(F)	0.50(G) 0.67(F)	0.69(G) 0.58(F)	0.69(G) 0.48(F)	1.00		
MORPH	0.61(G) 0.58(F)	0.46(G) **0.81(F)**	0.34(G) 0.72(F)	0.66(G) 0.36(F)	0.70(G) **0.76(F)**	**0.88(G)** 0.08(F)	1.00	
MOTOR	0.52(G) -0.18(F)	0.25(G) -0.38(F)	0.53(G) -0.17(F)	0.48(G) 0.07(F)	0.43(G) -0.32(F)	0.79(G) 0.57(F)	0.39(G) **-0.77(F)**	1.00

* statisticaly significant (P<0.05): guards - 0.81, forwards - 0.75.

cally significant. Rather interesting is the fact that the correlation between mean playing time (PTIME) and expert estimate of potential performance is significant (0.64). It can thus be concluded that the players with higher estimates of potential performance have a higher amount of playing time compared with those with lower estimates of potential performance. Playing time is thus a kind of criterion of playing performance since better players as a rule have a higher amount of playing time than less successful players, and vice versa.

Among dimensions on the highest level only the correlation between playing performance and morphological characteristics is statistically significant, the correlation between motor dimensions and playing performance of the National Team players is, due to extremely low values of correlation coefficients, practically negligible. This probably does not mean that morphological dimensions could have greater influence on players' performance than motor dimensions. It can neither be concluded that the players' motor dimensions are less developed. It is possible that the players do not differ significantly in motor dimensions and that morphological dimensions are responsible for differentiation. These relationships undoubtedly demand further investigation. These findings are only valid for the selected sample of players, as the sample, although of high quality, is too small and does not permit generalization.

Coefficients of correlation between different criteria of performance and the final estimate of potential performance are rather the same with both sub-samples and range from 0.43 to 0.69. As the sample of five (5) and six (6) players is too small, they are not significant.

The correlation between potential performance of guards and forwards and the amount of playing time is relatively high (0.69 and 0.48) and is a good indicator of playing performance, i. e. of the rank of a player, but not statistically significant.

If the correlation between morphological and motor dimensions and playing performance is considered separately it is found to be rather similar with guards. With forwards the correlation between morphological dimensions and performance criteria is much higher.

In spite of this a relatively high degree of correlation between the model of potential performance of the players and their playing performance and efficiency can be established. With regard to the fact that in this investigation a reduced model of expert system was applied and only a part of psychosomatic status of the players was involved, a relatively high level of predictive value of expert system was established on the sample of the National Female Cadet Basketball Team.

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