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COMPARISON OF VARIOUS CRITERIA OF PLAYING PERFORMANCE IN BASKETBALL

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Abstract

To establish the performance of a basketball player in a game is rather difficult and unreliable. It depends on many factors from which some can be established objectively and recorded as basketball statistics so that the playing efficiency of a player can be determined. The other factors can be established only subjectively and therefore playing success can thus be adequately evaluated only by competent experts.

The sample of subjects included 43 young female basketball players (age 15 to 17) who participated in the final tournament of the Cadet Championship of Slovenia in the season 1994/95. The sample of variables included 6 weighted and 6 non-weighted indexes of playing efficiency and 5 marks of playing success which were established by 5 independent evaluators according to certain criteria

We can establish that the weighted and non-weighted indexes of playing efficiency have, with respect to the extremely high interrelation, practically the same subject of measurement so that non-weighted indexes obviously also express a fairly real mark of playing performance. For this reason, the application and calculation of the weighted indexes was almost meaningless in our case because instead of them the non-weighted indexes could have been used as a criterion of playing efficiency as well.

We can also find out that the indexes of the playing efficiency used in the research are a quite successful measure of efficiency of a player in a game. Absolute indexes obviously carry some more information as they are in a better correlation with the mark of performance than are the relative ones. In establishing the playing efficiency we thus recommend for further use above all the index of absolute efficiency of a player in a match. Provided that the playing performance is evaluated by adequate experts, the mark of playing performance (success) probably still remains that criterion which is the most relevant one and which conveys the most information.

Key words: basketball, criteria of playing performance, comparison, girls aged 15 to 17

Zusammenfassung

Vergleich unterschiedlicher Leistungskriterien im Basketball

Es ist sehr schwer die Leistung der Basketballspieler in einem Spiel zuverlässig festzustellen. Sie hängt von mehreren Faktoren ab, von denen einige sächlich festzustellen und als Spielstatistik zu verzeichnen sind und aus betreffender Statistik ist die Leistung durchaus herzuleiten. Die anderen Faktoren sind nur die persönliche Einschätzung, so dass die Spielleistung entsprechend nur von den Fachleuten eingestuft werden kann.

Das Muster umfasste 43 junge Basketballspielerinnen im Alter von 15 bis 17, die an einem Endwettbewerb der slowenischen Jugendliga im Jahre 1994./95. teilnahmen. Das Musterbeispiel schloss 6 ponderierte und 6 unponderierte Leistungindexe, sowohl fünf Leistungsurteile von fünf unabhängigen Urteile gemäss bestimmten Kriterien ein.

Es ist festzustellen, dass sowohl ponderierte als auch unponderierte Leistungindexe hinsichtlich dem ausgesprochenen Verhältnis zueinander eigentlich den gleichen Leistungspunkt haben, so dass auch unponderierte Indexe ziemlich genaues Leistungsurteil aufweisen. Daher blieb die Anwendung und Bearbeitung von ponderierten Indexe fast bedeutungslos, weil sie zum Leistungsurteil durchaus durch die unponderierten Indexe ersetzt werden konnte.

Wir dürfen auch behaupten, dass die angewendete Leistungsindexe im Spiel ein großes Ausmaß an Spielerleistung im Spiel zeigen. Die absoluten Indexe bringen einige Daten mehr bei, weil sie in einem festeren Verhältnis zu Leistungsurteil als die relativen stehen. Daher empfehlen wir in der zukünftlichen Beurteilung von der Spielleistung den Index der absoluten Spielerleistung im Spiel. Unter der Voraussetzung, dass die Spielleistung durch Fachleute beurteilt wird, bleibt das Leistungsurteil das relevanteste, am meisten zeigende Kriterium.

Schlüsselwörter: Basketball, Leistungskriterium, Vergleich, Mädchen, 15-17 jährig

Introduction

To establish the performance of a basketball player in a game is rather difficult and unreliable. Concerned is an involved and complex issue in which numerous basketball experts and researchers have been involved with more or less success for a long time. The performance of a basketball player in a game depends on many factors from which some can be established objectively and recorded so that the playing (competition) efficiency of a player can be calculated. The performance of an individual player

also depends on the actions which indirectly affect the performance of a team: on how a player co-operates with his team-mates (is well co-ordinated with them), and how he fulfils the tasks given by the coach. These performance factors can be established only subjectively and therefore the playing performance can thus be adequately evaluated only by competent professionals.

In establishing the playing (competition) efficiency of a player in a game we are helped by recording the concluding actions on the offense and defense (e.g. the number of scored points, rebounds, turnovers and steals, assists...). Despite the fact that the scored points are an important factor in establishing the performance of a player in a game, it is by far not the only one and the most important one. Regretably, such a conviction is still present in Slovenia in the non-professional and "quasi" professional public.

On the basis of the parameters of basketball statistics it is possible to calculate various indexes according to certain formulas, and on the basis of these indexes the playing efficiency can be determined for individual players or for the entire team. At the Faculty of Sport in Ljubljana we are developing a computer program by means of which it will be possible to objectively establish the performance of a player in a match in a relatively fast and simple manner.

The playing efficiency

Dežman (1992) speaks about different types of efficiency indexes and also gives formulas according to which the said indexes can be calculated. Thus we know the index of absolute efficiency of a player on the offense and defense, and the index of efficiency of a player in a match by which we establish the overall efficiency of a player, i.e. the efficiency on offense and defense together. All the mentioned indexes can be absolute, in which case we do not take into account the time of playing (minutes), or relative, in which case the efficiency of playing depends also on the time of playing (minutes).

Types of efficiency indexes (according to Dežman, 1992):

Index of absolute efficiency of a player on offense (ANA)

It is calculated by adding up the number of scored points (KOŠI) and the number of assists (A).

$$ANA = KOŠI + A$$

Index of absolute efficiency of a player on the defense (AOB)

It is calculated by adding up the offensive rebounds (SN), defensive rebounds (SO), steals (D), and blocked (B) shots.

$$AOB = SN + SO + D + B$$

Index of absolute efficiency of a player on a game (AIG)

It is calculated by adding up the indexes of absolute efficiency on offense (ANA) and on defense (AOB).

$$AIG = ANA + AOB$$

Index of relative efficiency of a player on offense (RNA)

It is calculated by dividing the index of absolute efficiency on offense (ANA) by the value obtained when the number of turnovers (IZG) is added to the mentioned index (ANA).

$$RNA = \frac{ANA}{(ANA + IZG)}$$

Index of relative efficiency of a player on the defense (ROB)

It is calculated so that we divide the index of the absolute efficiency of a player on the defense (AOB) by the value which is obtained in such a way that we multiply the quotient between the number of points against (points scored by the opposing team) (KOŠIN) and 200 (the number of minutes per game) by the time of playing (minutes) of the respective player in a game (ČAS) and add to the thus obtained result the index of absolute efficiency of the player on the defense (AOB).

$$ROB = \frac{AOB}{AOB + \frac{KOŠIN}{200} \cdot ČAS}$$

Index of relative efficiency of a player in a match (RIG)

It is calculated by adding up the indexes of relative efficiency on the offense (RNA) and the defense (ROB).

$$RIG = RNA + ROB$$

For our requirements we calculated the absolute and relative indexes of efficiency on the defense and on offense for all those players who played at least 5 minutes in each game.

Influence of the quality of the opponent on the efficiency of players

The quality of players of the opposing team has also a large influence on the efficiency of the own players in a game. Therefore, the efficiency of a player in matches against different opponents is difficult to compare. We can help ourselves so that the efficiency

of a player in a match is multiplied by the coefficient of the quality of the opposing team.

In competition systems in which every team plays against all the other teams, the coefficient of the quality of a team is obtained by dividing the number of the points (games won) attained in the competition by the number of all the possible points (games won).

$$k\ 1 = \text{attained points/possible points}$$

In other competition systems, the coefficients of the quality of a team are calculated by dividing the number of the participating teams by the product of the rank of the team in the competition multiplied by 10.

$$k1 = N/(\text{rank} * 10)$$

The real efficiency of a player in a competition, i.e. the weighted indexes of efficiency, are calculated by multiplying the indexes of the efficiency of a player in a match by the coefficient of the quality of the opposing team.

The playing success

The concluding offensive actions are, of course, not the only ones according to which the performance of a player can be established. We cannot determine objectively or record all the parameters which affect the playing performance. The performance of an individual player depends also on the actions which indirectly affect the performance of a team, on how the player co-operates with his team-mates (is well co-ordinated with them), and on how he fulfils the tasks given by the coach. These factors of performance can be established only subjectively and therefore the playing performance can be established only by a competent expert. The evaluation performed by an expert who is a real professional and knows every detail of the basketball game can tell us even more than the objectively calculated efficiency.

For a "subjective" evaluation of playing success some other conditions must also be fulfilled. Above all we need an adequate number of evaluators who must be, as already said, adequately professionally trained. A sufficient number of evaluators also allows us to establish the reliability and validity of the evaluation. An evaluation of playing success is carried out according to certain criteria (Erčulj, 1996).

Methods

The sample of subjects included 43 young female basketball players who, with their teams, participated in the final tournament of the best four teams of the Cadet Championship of Slovenia in the season 1994/95. In the further analysis we, however, included only 25 players who met the following conditions:

- that they were born in 1978, 1979, or 1980;
- that they were healthy and without injuries to the locomotor system at the time of competition;
- that they had played in at least two matches;
- that their time of playing (minutes) was on average at least 5 minutes per game.

The sample of variables included all variables by means of which the playing efficiency and success of the players could be established.

The efficiency of playing of an individual player in a match was established objectively so that we calculated the indexes of the playing efficiency for all players. The parameters necessary to calculate the indexes (concluding offensive and defensive actions) were obtained so that we recorded the concluding parameters of playing in all games. These statistical data were recorded for an individual team by a statistician and his assistant.

The actual, playing success of the young female basketball players was established by "subjective" evaluations of playing performance. In our case, the playing success of the young female basketball players was established by five independent evaluators, i.e. basketball experts who evaluated the performances of the players according to certain criteria (Erčulj, 1996) with marks from 1 to 5.

The data were processed at the Institute for Kinesiology at the Faculty of Sport in Ljubljana on a VAX/VMS computer of the University Computer Centre in Ljubljana. In processing the data, a statistical programme package SPSS was used. Statistical programme Kwikstat 3.3 and Statistica 4.5 were also used intended for work on personal computers.

The playing efficiency and success of the players was established during the final tournament of the National Championship for Cadets, in the gym hall KK Ježica in Ljubljana on the 1st and 2nd April, 1995. The competition took place as a one-stage, single-circuit competition system where each team played against the remaining three teams.

Results and discussion

Reliability of evaluation of playing success

With respect to the high values of the coefficients of reliability which exceed 0.93 (alpha = 0.931, Lambda6 = 0.940), we can establish a high degree of reliability of the evaluation. This confirms the fact that the selection of the evaluators was good as they were obviously good basketball experts.

The structure of the marks assigned to the playing success was determined by factor analysis. In this analysis we isolated one latent dimension (the main component) which explains 80.6% of the variance of the system which points to a high degree of the validity and homogeneity of the evaluation. The

projections on the isolated factor are high as they amount from 0.85 to 0.95.

Table 1 Initial statistics of factor analysis

Factor	Eigen-value	% of variance
1	**4,032**	**80,6**
2	0,446	8,9
3	0,240	4,8
4	0,173	3,5
5	0,108	2,2

Table 2 Factor matrix and communalities for the isolated factor

	Projections on the factor	Communality
Evaluator 1	0,953	0,909
Evaluator 2	0,851	0,725
Evaluator 3	0,908	0,825
Evaluator 4	0,899	0,809
Evaluator 5	0,874	0,765

Doubtless, the first main component carries the largest possible amount of information about the playing success. We are of the opinion that with respect to the obtained percentage, the first main component defines the criterion variables well - the evaluators who were evaluating the playing performance. A high percentage of variance and only one isolated main component (factor) mean that the used criterion variables are a good measuring instrument and that they evaluate well the subject of measurement. High values of the projections of individual evaluators on the isolated factor mean high connection between the individual evaluators with the common subject of measurement or evaluation and a high degree of validity of the evaluators in evaluating the playing performance. The coefficients of the connection of individual evaluators with the subject of evaluation also represent a kind of value which allows us to rank the evaluators according to the quality of their evaluation.

Let us state for the sake of comparison that the mentioned results show the reliability or validity of the evaluation of the playing success which is at the level or even slightly above the level of some previous researches dealing with similar issues (Pavlovič, 1973, Dežman, 1974).

Taking into account the above findings, we may conclude that the evaluation of the evaluators who evaluated the playing performance was very reliable, and that they had a common subject of measurement or evaluation, which points to the fact that they accomplished their task well.

Comparison of various criteria of playing success or efficiency

First we calculated the average values of the indexes of efficiency for the entire competition for all those players who on average played at least 5 minutes per match. These values were obtained in such a way that we added up the indexes of efficiency in the individual matches and divided the sum by the number of the matches played (See Table 3).

Table 3 Average values of indexes of efficiency and playing time in the entire competition

No.	POS	ANA	AOB	RNA	ROB	AIG	RIG	MIN
1	P	16	9,7	0,76	0,53	25,7	1,29	31
2	P	14	5,3	0,75	0,39	19,3	1,15	30
3	I	5,5	4	0,5	0,36	9,5	0,86	13,7
4	I	8	7,3	0,71	0,44	15,3	1,15	32,7
5	I	1,7	5,7	0,42	0,48	7,3	0,9	24
6	I	30;3	14	0,85	0,54	44,3	1,39	38,3
7	P	29,7	9,3	0,9	0,41	39	1,38	38
8	P	8,3	5,3	0,61	0,43	13,7	1,05	23,7
9	I	5	11	0,67	0,55	16	1,23	32,1
10	P	2,5	1,5	0,31	0,35	4	0,66	7,3
11	I	13,3	8,7	0,76	0,46	22	1,21	37,7
12	P	5	4,3	0,66	0,42	9,3	1,08	17,3
13	I	14,3	11	0,86	0,55	25,3	1,41	31,3
14	I	11	8	0,69	0,36	19	1,05	35
15	I	5,5	2	0,55	0,2	7,5	0,75	11,7
16	P	6,7	7	0,52	0,31	13,7	0,82	37
17	P	25,7	7	0,87	0,32	32,7	1,19	35,3
18	P	11	7,7	0,69	0,4	18,7	1,09	27
19	P	5	3,3	0,79	0,2	8,3	0,68	28,3
20	I	2,5	2	0,42	0,34	4,5	0,75	23
21	P	13	3,3	0,69	0,21	16,3	0,9	39
22	I	15	4,7	0,86	0,26	19,7	1,13	40
23	I	7,3	6	0,95	0,3	13,3	1,25	40
24	I	6	8,7	0,76	0,4	14,7	1,16	39
25	I	27,3	14,7	0,94	0,58	42	1,52	33,3

Further, we weighted the efficiency of the individual players in a match by the coefficient of quality of the opposing team, thus obtaining the real efficiency of the respective player in a match; then we calculated the average of the weighted indexes for the individual player per game. In this way we obtained the weighted indexes of the efficiency of the players for the entire competition (See Table 4).

Table 4 Weighted indexes (P) of playing efficiency in the entire competition (average values of weighted indexes per game).

No.	POS	P ANA	P AOB	P RNA	P ROB	P AIG	P RIG
1	P	10,7	6,5	0,51	0,35	17,1	0,86
2	P	9,3	3,5	0,50	0,26	12,9	0,77
3	I	3,7	2,7	0,33	0,24	6,3	0,57
4	I	5,3	4,9	0,47	0,29	10,2	0,77
5	I	1,1	3,8	0,28	0,32	4,8	0,60
6	I	20,2	9,3	0,57	0,36	29,5	0,93
7	P	21,5	6,7	0,65	0,29	28,2	1,00
8	P	6,0	3,8	0,44	0,31	9,4	0,76
9	I	3,6	7,9	0,48	0,40	11,6	0,89
10	P	1,8	1,1	0,22	0,25	2,9	0,48
11	I	9,6	6,3	0,55	0,33	15,9	0,87
12	P	3,6	3,1	0,48	0,30	6,7	0,78
13	I	10,3	8,0	0,62	0,40	18,3	1,02
14	I	8,6	6,2	0,54	0,28	14,8	0,82
15	I	4,3	1,6	0,43	0,16	5,8	0,58
16	P	5,2	5,4	0,40	0,24	10,7	0,63
17	P	20,0	5,4	0,68	0,25	25,4	0,93
18	P	8,6	6,0	0,54	0,31	14,5	0,85
19	P	3,9	2,6	0,61	0,16	6,5	0,53
20	I	1,9	1,6	0,33	0,26	3,5	0,58
21	P	10,8	2,7	0,57	0,17	13,6	0,7
22	I	12,5	3,9	0,72	0,22	16,4	0,94
23	I	6,1	5	0,79	0,25	11,1	1,04
24	I	5	7,2	0,63	0,33	12,2	0,97
25	I	22,8	12,3	0,78	0,48	35	1,27

Legend:

POS- playing position (P - perimeter players, I - inside players)

ANA- index of absolute efficiency of a player in offense

AOB- Index of absolute efficiency of a player in defense

RNA- Index of relative efficiency of a player in offense

ROB- Index of relative efficiency of a player in defense

AIG- absolute index of playing efficiency

RIG- relative index of playing efficiency

MIN- average time of playing per game (minutes)

The real, playing performance of young female basketball players was also evaluated by assigning average marks of playing success. After the competition, the mark of playing success in the entire competition was calculated for each player. It was obtained by dividing the sum of all the marks by the number of games played (See Table 5).

Table 5 Values of the marks of playing success for the entire competition of every single evaluator (OC1, ..., OC5) and average values (XA).

No.	POS	OC1	OC2	OC3	OC4	OC5	$\bar{X}A$
1	P	4	3,8	4	3,3	3,8	3,78
2	P	4,3	4	4	3,6	2,8	3,74
3	I	2,7	3	3	3	2	2,74
4	I	3,3	3	3	3,3	2,5	3,02
5	I	2,7	3	3	2	1,5	2,44
6	I	4,3	4	4,7	4,5	4,3	4,36
7	P	4,5	3,7	3,7	4,3	4,6	4,16
8	P	3,3	2,8	2,7	3	2,5	2,86
9	I	3,5	3	3,7	3,7	2,7	3,32
10	P	3	2,5	2	3	3	2,7
11	I	3,5	3	2,7	3,2	3	3,08
12	P	2	2,5	2,5	2,5	2,5	2,4
13	I	3,7	3	3,3	3	3,8	3,36
14	I	2,8	3,3	2	2,7	3	2,76
15	I	1,5	2,5	2	2,5	2	2,1
16	P	2,8	3,3	2,5	2,7	2,3	2,72
17	P	3,3	3,3	3,3	3	3,3	3,26
18	P	2,8	2,7	2,7	2,7	3	2,78
19	P	2	2,7	2,3	2,7	2	2,34
20	I	2	2,5	1,5	2,2	2	2,04
21	P	2,7	2,8	2,3	2,7	2,3	2,56
22	I	3,3	2,7	3,3	3,7	3,3	3,26
23	I	2,3	3	2,7	2	2,3	2,46
24	I	2,2	3	2	2,8	1,7	2,34
25	I	4	3,8	3,8	4,3	4,3	4,04

*Table 6 Correlation between various criteria of success or efficiency of playing**

	AIG	RIG	OCENA	PAIG	PRIG
AIG	1,00				
RIG	0,83 (0,82)	1,00			
OCENA	0,88 (0,87)	0,77 (0,76)	1,00		
PAIG	0,99 (0,98)	0,81 (0,82)	0,83 (0,80)	1,00	
PRIG	0,77 (0,75)	0,94 (0,91)	0,62 (0,58)	0,81 (0,81)	1,00

Legend:

AIG-absolute index of playing efficiency

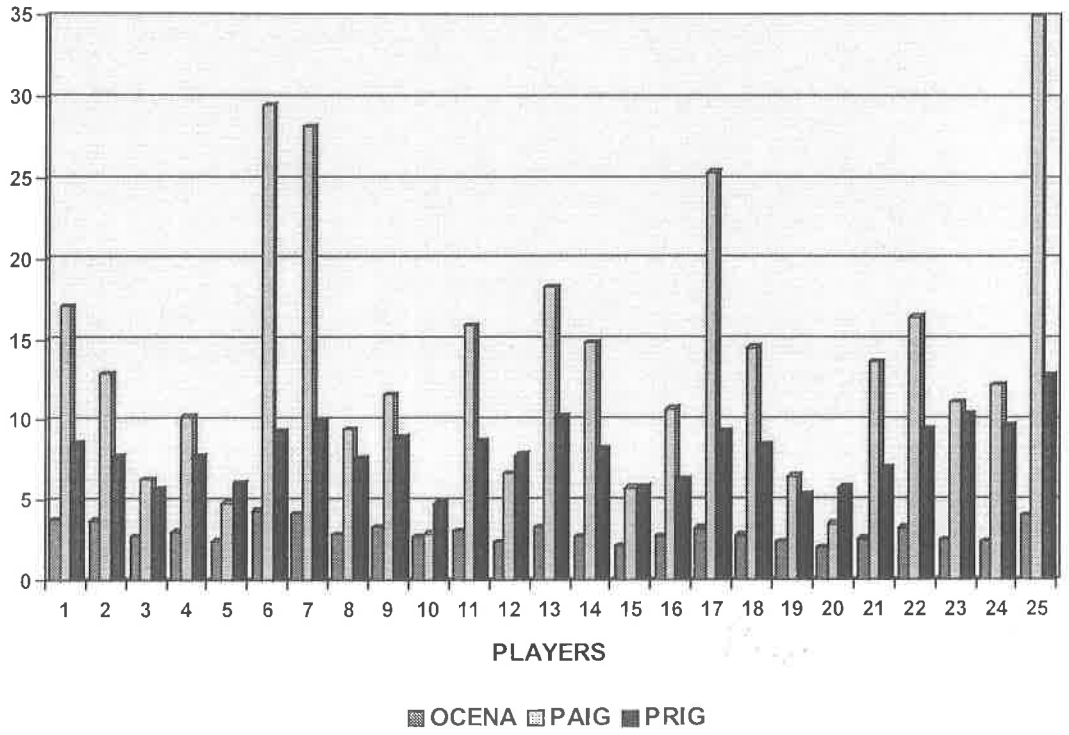
RIG -relative index of playing efficiency

OCENA-mark of playing performance (success)

PAIG -weighted absolute index of playing efficiency

PRIG -weighted relative index of playing efficiency

*The table gives the values of the Pearson correlation coefficient and the values of the Spearman rank-order correlation (in brackets)



Graphic representation 1 Comparison of the values of criterion variables for the subjects of the entire sample

From Table 6, a high correlation between various criteria of success and efficiency can be seen as all the correlations are statistically significant (p.01).

From both the weighted indexes of efficiency, the index of absolute efficiency which is in greater correlation with the mark of the playing success obviously carries more information. The explanation is probably that better players usually have more "minutes" in a game and are also assigned better marks. However, in the absolute indexes, the time of playing does not affect the efficiency of a player.

As regards the relationship between the weighted and non-weighted indexes of the playing efficiency, we can establish that weighted and non-weighted indexes have, with respect to the extremely high interrelation, practically the same subject of measurement so that the non-weighted indexes obviously also express a fairly real mark of playing performance. For this reason, the application and calculation of weighted indexes was almost meaningless in our case as instead of them non-weighted indexes could have been used as a criterion of playing efficiency as well. Should this finding be confirmed in the future researches too, the application of weighted indexes of playing efficiency could be dispensed with in the future.

It can thus be established that the indexes of playing efficiency used in the research are a quite successful measure of efficiency of a player in a game. Absolute indexes obviously carry some more information as they are in a better correlation with the mark of performance than are the relative ones. In establishing the playing efficiency we thus recommend for further use above all the index of absolute efficiency of a player in a match. Provided that the playing performance is evaluated by adequate experts, the mark of playing performance (success) probably still remains that criterion which is the most relevant one and which conveys the most information.

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