RELATIONS BETWEEN BASKETBALL SKILLS AND CERTAIN COGNITIVE ABILITIES OF JUNIOR BASKETBALL PLAYERS

Abstract
The aim of this study was to explore the relations i.e. connection between basketball skills and certain cognitive abilities of individual junior players. The research was conducted on a sample of 80 players, the best juniors of Serbia, aged 17 to 18 years. Basketball skills were assessed with 15 tests, which covered most basketball activities: shooting, passing, dribbling, playing without a ball in attack and defense play. Cognitive abilities of junior basketball players were evaluated with five tests: Domino D48 test (test of general intelligence), and four test of cognitive abilities perceptive factor abilities: S1,P1, F1 and F2. Canonical analysis was applied. The canonical analysis results indicate that the two areas are related (canonical correlation coefficient R = .727 i.e. determination coefficient R² = .529), but only the first factor is significant and it carries 53% of the explained variance. The cognitive abilities variables that have the largest projection on the first factor and that contribute most to relation between these two areas are perceptual identification (PF1), perceptual analysis and logical conclusion (PF2) and visual spatialization (PS1), while the variables of basketball skills are: direction change in dribbling (PSD), throwing the ball with two hands technique from chest (BL2RG), drive to the basket for 30 s (PNK30), dynamic shooting for 30 s DS30, reverse movement for 30 s (PK30), dribbling slalom (SD) and precision shooting (PULK).

Keywords: BASKETBALL SKILLS / COGNITIVE ABILITIES / JUNIORS

INTRODUCTION

All human skills include coordination of perception and action, i.e. of movement, motion. Different types of skills have different stressing of the need for perceptual processes, cognitive decisions and motor control (Holding, 1989). Basketball skills are a specific form of movement that can be defined as rational and efficient execution of certain movements, with and without the ball, which are in the domain rules of the game, and aimed at solving tactical tasks in the game (Karalejic & Jakovljevic, 2001). They presume a very large number of different movement forms and based on biomechanical parameters are usually classified into five groups: attitudes and movements, jumping, kicking, dribbling, and adding (Hay, 1978). Great wealth of basketball skills sets a challenge for coaches because the basketball players...
who have a greater repertoire of basketball skills or who perform them better, are more successful in the game (Jakovljevic, 1996, 1997). Therefore, in the basketball practice much attention is dedicated to learning and development of basketball skills, especially in working with the young people. Acquiring of basketball skills is the same as any other motor learning, which represents relatively permanent changes in the performance of certain motor structure as a result of training or previous experience. In the process of learning, the first level is usually denoted as proprioceptive one, and it is accountable for the initial organization of information of different sensory modalities, while the second is marked as a perceptual level, at which sensory modalities are organized and differ to the extent that they can be grouped and recognized as the modalities that have a connection with previous experience. The next level is usually named a conceptual because perceptions are categorized and generally organized resulting into a certain that represents a general group of motor tasks, e.g. jumps where the goal of jump can be quite different. The last level is cognitive one, and it involves organization and reduction of necessary information for a specific action, it demonstrates knowledge on what a movement means and under what circumstances it is usually produced. In great number of studies, carried out with general population, the correlation of the following motor skills has been established: coordination, speed of execution of complex motor tasks and balance, with a general and perceptive factor of cognitive abilities (Ismail, 1976, 1976b, 1976c and 1976d; Kane, 1984; Kurelić, Momirović, Mraković & Sturm, 1979; Mejovšek, 1977, 1979), as well as in researches on a sample of students of the Faculty of Physical Education (Bala, 1981) and with athletes (Angyán, Téczely, Zalay & Karsai, 2003; Kuleš, Maric, 1989). Similar results were obtained in researches on a sample of basketball players. Thus (Becker, 1981) emphasizes the importance of perception, attention and ability of concentration for players’ performing skills. Zhang (1989) found that agility in operational thinking and speed of perception are two very important factors in the development of basketball skills. Some researches show that the basketball players who differ in the level of basketball skills, are also different in cognitive and visual abilities (Kioumourtzoglou, Derri, Tzetis & Theodorakis, 1998; Millslagle, 2002). Isaacs (1981) showed a correlation between players’ perceptive abilities and their efficiency in the performance of free throws. Mental skills play an important role in the process of development of basketball skills (Sandeford & Shoenfelt, 2001; Vernacchia, 1993), and therefore rank among players’ fundamental skills (Brown & Burke, 2003).

With reference to the results of the aforesaid available studies, the aim of this study was to assess basketball skills and certain cognitive abilities of the best Serbian junior players, and to establish their correlation.

### METHOD

#### Sample of subjects

The research was conducted with 80 players - junior, members of the most successful clubs in Serbia. All participants were aged 17 to 18. Each subject has previously been in a program of systematic and organized basketball training and competition for at least five years.

#### The sample of variables and instruments.

**Basketball skills** were evaluated by using 15 tests of basketball skills, which are present in the literature and used in previous studies. Nine variables were obtained by using the tests recommended by Lehmann (1981):

- Turning the ball around the trunk for 30 s - OLT30,
- Turning the ball around the entire body for 30 s - OLCT30,
- Eights in standing dribbling 30 s - ODM30,
- Direction change in dribbling - PSD,
- Dribbling slalom - SD,
- Shot under the basket for 30 s - ŠK30,
- Drive to the basket for 30 s - PNK30,
- Moving in defensive position for 30 s - KOS30
- Reverse movement for 30 s - PK30.

Two variables were obtained using tests recommended by Blašković, Milanovic & Matkovic, (1982):

- Precision shooting - PULK
- Throwing the ball with two hands technique from chest - BL2RG.
Two variables of passing were assessed by the tests presented by Barou and McGee (1975):

- standing pass at a target with two hands - DLM2R
- ball passing at a target with one hand - DLM1R.

The variables assessing shooting in basketball were evaluated by tests presented by Karalejic and Jakovljevic (1998):

- Dynamic shooting for 30 s - DŠ30
- Shooting from 5 external positions for 50 s - Š5SP50.

The variables from the area of cognitive abilities were obtained by application of five tests for cognitive abilities assessment. Domino test - D48 (constructed by Anstey, adapted version of Matic and Momirović) was administered for evaluation of general intelligence (variable general intelligence - OID). Variable visual spatialization - PS1 was obtained based on the results of tests for understanding of spatial relations S1, battery SVPN1, Reuchlina and Valine, adapted by Matic, Kovacevic and Wolff (according to Peric, 1994), while implementation of the test of geometrical differences P1, also obtained from the battery SVPN1, resulted in variable of perceptual differentiation and logical conclusion - PP1. The variable perceptual identification - PF1 was obtained by applying the test figural identification F1, author Bukvic (according to Peric, 1994) and the variable perceptual analysis and logical conclusion - PF2 was obtained by applying the test of squares decomposition F2, authors Bukvić and Štajnberger (according to Peric, 1994). The applied tests were often used to assess cognitive abilities in sports, as well as with basketball population in our country (Bačanac 2001; Jakovljevic 1996, 2003a, 2003b; Karalejic & Jakovljevic, 2008).

**Data processing**

Standard descriptive statistics was applied for data processing. The following was calculated: arithmetic mean (Mean), standard deviation (SD) and minimum (Min) and maximum (max) values. Establishing of relation, connection between the area of cognitive abilities and basketball skills has been done by using canonical analysis. Statistical program STATISTICS 5.0. was used for data processing.

**RESULTS AND DISCUSSION**

Table 1 displays the descriptive parameters of all the variables. Values of arithmetic means of the cognitive ability variables are approximately equal to the values obtained in testing again of junior players in the earlier period (Jakovljevic, 1996, 2003; Karalejic & Jakovljevic, 2008), and of the population of junior athletes in sports games (Bačanac, 2001). There are few available reference data about the results of the applied tests of basketball skills, so these data can be added to the database in order to compare talented young basketball players of junior age. Some tests, applied in this study, were used in young basketball players aged 12, 13 and 14 (Karalejic & Jakovljevic, 2008), and compared to them, juniors, as it was expected, achieved better results.

**Table 1.** Descriptive parameters of all variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OID</td>
<td>30.68</td>
<td>5.15</td>
<td>18</td>
<td>42</td>
</tr>
<tr>
<td>PS1</td>
<td>21.01</td>
<td>4.51</td>
<td>11</td>
<td>29</td>
</tr>
<tr>
<td>PP1</td>
<td>18.21</td>
<td>3.19</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>PF1</td>
<td>22.93</td>
<td>4.90</td>
<td>14</td>
<td>34</td>
</tr>
<tr>
<td>PF2</td>
<td>16.97</td>
<td>3.95</td>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>OLT30</td>
<td>45.65</td>
<td>3.66</td>
<td>38</td>
<td>55</td>
</tr>
</tbody>
</table>
Results of the canonical analysis (R = .727) indicate that there is a significant correlation of these two areas (p = 0.018). In relation to five variables in the area of cognitive abilities, five canonical roots were extracted. The results of Chi-square test are shown in Table 2. It can be seen that only the first canonical root is significant, it carries the greatest proportion of the variance (R² = .529) and is taken for interpretation.

### Table 2. Chi-square test with successive roots removed

<table>
<thead>
<tr>
<th>Removed roots</th>
<th>R</th>
<th>R²</th>
<th>Chi-sqr.</th>
<th>p</th>
<th>Lambda Prime</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>.727</td>
<td>.529</td>
<td>102.668</td>
<td>.018</td>
<td>.256</td>
</tr>
<tr>
<td>1</td>
<td>.475</td>
<td>.226</td>
<td>45.685</td>
<td>.835</td>
<td>.546</td>
</tr>
<tr>
<td>2</td>
<td>.386</td>
<td>.149</td>
<td>26.341</td>
<td>.939</td>
<td>.705</td>
</tr>
<tr>
<td>3</td>
<td>.345</td>
<td>.119</td>
<td>14.112</td>
<td>.944</td>
<td>.829</td>
</tr>
<tr>
<td>4</td>
<td>.240</td>
<td>.057</td>
<td>4.509</td>
<td>.952</td>
<td>.942</td>
</tr>
</tbody>
</table>

Tables 3 and 4 show the factor structure of the first canonical root in the area of cognitive ability and basketball skills. From Table 3 it can be seen that the high projections to the first root are present in the following variables of a variable: Throwing the ball with two hands technique from chest - BL2RG, Drive to the basket for 30 s - PNK30, Direction change in dribbling - PSD, Dynamic shooting for 30 s - DS30, Reverse movement for 30 s - PK30, Precision shooting - PULK, Dribbling slalom - SD. Negative distinction appears related to the measuring units in which the results are expressed in certain variables.

Table 4 displays the projection results of cognitive abilities variables to the first canonical root. Variables of perceptual identification - PF1, perceptual analysis and logical conclusion - PF2 and visual spatialization - PS1 have very high projections to the first root.
Table 3. Projections of variables of basketball skills to the first root

<table>
<thead>
<tr>
<th>Variables</th>
<th>Roots 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLT30</td>
<td>0.346</td>
</tr>
<tr>
<td>OLCT30</td>
<td>0.160</td>
</tr>
<tr>
<td>ODM30</td>
<td>0.154</td>
</tr>
<tr>
<td>PSD</td>
<td>-0.622</td>
</tr>
<tr>
<td>SD</td>
<td>-0.479</td>
</tr>
<tr>
<td>BL2RG</td>
<td>0.677</td>
</tr>
<tr>
<td>DLM2R</td>
<td>0.283</td>
</tr>
<tr>
<td>DLM1R</td>
<td>0.382</td>
</tr>
<tr>
<td>ŠK30</td>
<td>0.390</td>
</tr>
<tr>
<td>PNK30</td>
<td>0.650</td>
</tr>
<tr>
<td>PULK</td>
<td>0.493</td>
</tr>
<tr>
<td>DŠ30</td>
<td>0.553</td>
</tr>
<tr>
<td>Š5SP50</td>
<td>0.387</td>
</tr>
<tr>
<td>KOS30</td>
<td>0.338</td>
</tr>
<tr>
<td>PK30</td>
<td>0.506</td>
</tr>
</tbody>
</table>

Table 4. Projections of variables of cognitive abilities to the first root

<table>
<thead>
<tr>
<th>Variables</th>
<th>Roots 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>OID</td>
<td>0.377</td>
</tr>
<tr>
<td>PS1</td>
<td>0.691</td>
</tr>
<tr>
<td>PP1</td>
<td>0.425</td>
</tr>
<tr>
<td>PF1</td>
<td>0.900</td>
</tr>
<tr>
<td>PF2</td>
<td>0.873</td>
</tr>
</tbody>
</table>

The relation between the first canonical factors from the system of basketball skills variables and cognitive abilities variables shows that subjects who have achieved better results in basketball skills variables achieved better results in cognitive ability variables: PF1, PF2 and PS1. High correlation of variables can be seen in Figure 1 which shows the projection of variables from both sets to the first root.

In order to interpret the obtained correlation of these two areas it is necessary to know the structure of the applied tests. The tests providing the variables of basketball skills that have high projections on the first root, impose for the subjects great requirements in explosive strength (BL2RG), agility (PNK30, PSD, DŠ30, PK30, and SD) and precision (PNK30, DŠ30 and PULK). This indicates that these tests do not evaluate only technique, but to some extent, also explosive power, agility and precision, as well as anaerobic abilities since test lasted between 7 and 30 seconds. In dribbling tests performing (variables PSD and SD) the subjects were supposed to move as quickly as possible, but simultaneously taking care on the prescribed performing way of the assigned activity, i.e. on tasks to be solved in a particular test. These tests require good control of the ball, good ruling of ball. Passing test (variable BL2RG), besides the passing technique, a very important factor is the explosive power of arms and shoulder girdle, while agility and precision play important role in shooting tests. Tasks in these tests have certain coordination complexity, given the demands of speed and accuracy of performance.

On the other hand tests of cognitive abilities providing the variables PF1, PF2 and PS1 place the tasks based on fast solving (time for work is limited and short) of perceptual and spatial tasks. In a short period, the subject has perceive the connection and find a solution, like he should act quickly in most tasks of basketball skills.

Connections of results in basketball skills tests with the results of three tests of cognitive abilities are supported by previous studies in general popu-
lation where correlation was found between coordination, speed of performance of complex motor tasks and explosive power with cognitive abilities perceptive factor (Ismail, 1976a, 1976b, 1976c and 1976d; Kane, 1984; Kurelić, et al. 1979; Mejovšek, 1977, 1979), as well as by research on a sample of basketball players which emphasizes the importance of perceptive abilities in development of basketball skills (Zhang, 1989), the researches which show that basketball players who differ in the level of basketball skills, also differ in cognitive and visual abilities (Kioumourtzoglou, et al. 1998; Millslagle, 2002), as well as the research of Isaacs (1981) which showed a correlation between perceptive abilities of basketball players and their accuracy in the performance of free throws.

The results obtained in this study and other similar studies (Kioumourtzoglou et al., 1998; Millslagle, 2002; Zhang, 1989) indicate that in basketball training, training of basketball skills it is necessary to use as much as possible various perceptual stimuli, i.e. to use the exercises with less or more stimuli which require rapid motor solutions. These exercises should be coordinated with age and general characteristics of basketball players. In addition, these results imply that in the process of young players selection care should be taken about certain cognitive abilities, especially if you take into account research which showed that these skills significantly affect the overall successfulness of players (Bacanac, 2001; Jakovljevic, 1996, 2003; Karalejic & Jakovljevic, 2008; Kioumourtzoglou et al., 1998).

CONCLUSION

With the sample of 80 high quality players – juniors, individual basketball skills (15 variables) and certain cognitive abilities (5 variables), as well as canonical correlation between the two variable sets were analyzed.

Compared to few available data on these skills and abilities, these data can be included in the database for comparison of talented basketball players of the same age.

The study established significant correlation between these two areas, with only the first canonical root being the separated as significant. Their correlation was mostly contributed, from the area of basketball skills, by variables: Throwing the ball with two hands technique from chest - BL2RG, Drive to the basket for 30 s - PNK30, Direction change in dribbling - PSD, Dynamic shooting for 30 s - DŠ30, Reverse movement for 30 s - PK30, Precision shooting - PULK, Dribbling slalom - SD, and from the area of cognitive ability variables: Perceptual identification - PF1, Perceptual analysis and logical conclusion - PF2 and Visual spatialization - PS1.

The correlation of these two areas is based on basketball skills that require agility and precision, and ability of fast perception. This refers to: the ability of simultaneous eduction of spatial relations, speed of shape perception and ability of manipulation in perceptual space, as well as visualization and fine differentiation and conclusion on perceptive material. This indicates the need to include, in basketball skills training, exercises that will stimulate the development of these perceptive cognitive abilities. These are exercises that contain a great number of perceptual stimuli and require solving of certain assignments in the shortest possible period. The obtained correlation of these two areas emphasize the importance of cognitive skills in the process of basketball players’ selection as well as in the process of learning and improvement of development of basketball skills.
REFERENCES


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