TRANSFORMATION EFFECT OF PHYSICAL ACTIVITY PROGRAMMING MODEL ON THE MOTOR ABILITIES OF PRESCHOOL CHILDREN

Abstract
The aim of the study was to examine the effects of the nine-month program of physical activity-oriented models on the motor status of children aged 6-7 years. A hypothetical research framework is based on the assumption that a specific programming model of physical activity, based upon social and constructionist approach, for a period of nine months will bring positive transformation effects on motor skills of preschool children.

The survey was conducted on a sample of 128 children aged (MEAN±SD) 6.23 ± 0.88 years, who were not included in additional sports programs. The sample was divided into two sub-samples, experimental (N = 61) and control group (N = 67). The set of 12 motor tests was applied to test six hypothetic motor factors. Children included in experimental and control groups were subjected to nine months long physical activities programme five times per a week. Each organizational form of physical education for experimental group was 30% longer than the identical forms of physical activities planned by regular curriculum in kindergarten. Program design of experimental group was based on the premises of social constructionist approach, which represented the basis for differentiated physical activities. Significant difference in developmental level of motor abilities was assessed by multivariate (MANOVA repeated measures) and univariate analysis of variance (ANOVA repeated measures).

Results of multivariate analysis of variance (MANOVA repeated measures) revealed significant difference (F=37.14, p=0.03, η²=0.64) in the developmental level of children’s motor skills between control and experimental groups. Univariate analysis revealed statistically significant differences (p ≤ 0.05) in variables of force, explosive strength, repetitive strength, speed and speed elements, in favour of experimental group.

Developmental level of motor abilities of children included in the experimental treatment significantly differs from the level of achieved motor abilities of preschool children included in regular physical education curriculum.

Key words: GAME / POLYGONS / POWER / SPEED / COORDINATION / FLEXIBILITY / ACCURACY
INTRODUCTION

National curriculum of preschool education defines the concept of physical education in kindergartens and enables practitioners to be creative and independent in physical education programme making (The Program Basis, 2006). Motor learning conception, motor programmes, contextual interference, motor knowledge classification, structure and level of development of motor abilities, anatomic and physiological characteristics of children represent indicators of contemporary approach to physical activities and general motor potential at certain age (Gallahue & Donnelly, 2003; Prskalo & Babin, 2006; Schmidt, & Wrisberg, 2008; Bala, 2010; Pišot, & Planinšec, 2010). Processes of diagnostics, prediction, evaluation and self-evaluation of achieved results are used in pedagogic work due to modern technology. Educational effects depend on frequency of physical activities in kindergarten, as well as on technology of pedagogic process which is reflected in choice and adequate application of methodological principles, methods and tools of organizational work. The basic problem of physical education organization with children aged from 6-7 is reflected in the question: How should physical activities be structured, i.e. which algorithm should be used for physical activities programming and evaluation of the effect of programming activities on children’s anthropological status? Examination of research studies that deal with physical education at an early childhood, as well as of the studies that deal with the problems of children sports (Koprivica, 2002; Metikoš, et al. 2003; Bompa, 2005; Issurin, 2009; Perić, 2007; Zaciorski, & Kram er, 2009; Jevtić, Radojević, Juhas, & Ropret 2011) leads us to the conclusion that numerous authors suggest general (gross) physical activities programmes of low intensity (training sequences) and of dynamic character based on natural forms of movement and modalities of their combinations for children aged from six to ten, whereas the emphasis is placed upon the development of wide scope of motor knowledge, abilities and skills. The aim of this research paper is based upon examination of achievement strategy of nine-month long program of physical activity-oriented models on the motor status of children aged 6-7 years based upon the premises of social constructivism. A hypothetical research framework is based on the assumption that a specific programming model of physical activity for a period of nine months will bring positive transformation effects on motor skills of preschool children (Kundrat, 1979; Krstulović, Maleš, Žuvela, Erceg, & Miletić, 2010; Privitello, Caput-Jogunica, Gulan, & Boschi, 2007; Giagazoglou, Karagianni, Sidiropoulou, & Salonikidis, 2008; Živčić, Trajkovski-Višić, & Sentderdi, 2008).

METHOD

Participants

The sample was excluded from the population of preschool children (6.23 decimal years, 0.88 standard deviation, 6.41 median) who are not included in additional sports programmes and early sports specialization. The sample included 128 preschool children, 57 boys (N=57) and 71 girls (N=71) who attend kindergarten “Pčelica” in Sremska Mitrovica and it does not represent the random sample. The sample was divided into two sub-samples, consisted of an experimental (N = 61) and control group (N = 67).

Variables

Motor battery test based on reduced model of Kurelić, Momirović, Stojanović, Šturm, Radojević, & Viskić-Štalec (1975) was applied, and modified for little children (Perić, 1991; Popović, et al., 2007; Kostić, et al., 2009; Bala, 2010). Battery test for motor abilities assessment consisted of following measuring instruments:

1. For force definition
   • hanging pull-ups MHP (Kurelić, et al., 1975).
2. For strength definition
   • long distance jump from a standstill position MLDJSP (Kurelić, et al., 1975),
   • torsolifting in 60 s MTL60 (Kurelić. et al.,1975).
3. For coordination definition
   • backward polygon MBP (Bala,1999),
   • running and rolling MRR (Kostić. et al., 2009),
slalom with three medicine balls M3MBS (Kurelić, et al., 1975).

4. For speed definition
   • hand tapping MHT (Kurelić, et al., 1975),
   • 10 metres run M10MR (Kurelić, et al., 1975),
   • 20 metres run M20MR (Kurelić, et al., 1975).

5. For flexibility definition
   • forward bend on the bench MFBB (Kurelić, et al., 1975).

6. For accuracy definition
   • hoop throwing on the stand MHTNS (Perić, 1991)
   • ball rolling beneath the chair MBRBC (Perić, 1991).

Experimental protocol

Children included in experimental and control groups were subjected to nine months long physical activities programme five times per a week. Program-design of experimental group was based on differentiated physical activity content and duration of an average 30% of time longer for each organizational form of physical education in kindergarten curriculum. Organizational forms of physical activities within the structural design of experimental group programme were weekly planned as follows:

• 10-15 min of morning physical activities five times per a week
• 40-45 min. of guided physical activities two times per a week
• 10-15 min of recreational break five times per a week

Programming model of experimental group was based on curriculum based contextual motor learning and teaching and children development comprehension as “development of an identity according to transformation of participation in community” (Pavlovska, 1998; Rogoff, 2000; Krnjaja, 2008). Experimental curriculum, designed as a contextually applied practice was based upon thematic planning, i.e. on five important postulates, regard to the author’s opinion:

• Globalization – child is completely engaged in investigation, exercising and object classification
• Personalization – each child has its own developmental path, tempo and rhythm, sensitive developmental periods. The child creates its experiences by integration of new stimuli in its previous knowledge.
• Actualization – dynamic interaction of a child with its physical and social surrounding creates quality experience
• Individualization – preschool teacher develops intervention strategy based on observation and on aforementioned three principles.
• Harmonization – pedagogic work, as the result of aforementioned principles provides help and support to child’s personal dynamics which strives to unity and harmony.

Thematic units were formed according to diagnostics of developmental level of motor status and children’s actual interests and needs, whereas monostructural and polystructural complexes of both programmed and unprogrammed motor movement forms (with and without requisites) aimed at explosive and repetetive strength, coordination, flexibility and balance, specific physical exercises for postural status (with and without requisites) and basic technical elements of sports games (volleyball, basketball, football, handball) made programming contents (Table 1). Activities applied in this program were divided into seven program units: EMG – elementar motor games; TES – toning exercises set; SG – sports games; SG – sports gymnastics; SA – snow activities; AD – athletics disciplines; CMAP – complex movement activities polygon. Initial measurement defined further procedures in planning of daily and weekly activities which were determined by developmental capacities of preschool children during experimental treatment.
<table>
<thead>
<tr>
<th>Thematic units</th>
<th>Physical activities program for experimental group</th>
</tr>
</thead>
</table>
| **Traffic**   | EMG- fundamental motor movements (catch me if you can – moving in traffic – games within limited space (speed limit, traffic signs, pedestrians, vehicles), different means of transportation  
TES with a requisit (bowling pin)  
SG – guiding, throwing, kicking a ball during the games “traffic light”, “my crossroads”, “pedestrian crossing”, “safety in traffic” - “magic bus”, riding a bicycle, scooter, rollers, skateboard  
Pantomimegame, “rhythm speech”, “table labirint” |
| **Planet Earth** | EMG- fundamental motor movements, “scientists and dinosaurs”, “star wars”, “ninja turtles’ land”  
TES with a requisit (ball)  
SG-handball, mini basketball (trip around the world), dancing coreography accompanied by music, school within solar system, Super Spies cartoon dramatization |
| **Circus**    | EMG- movement activities for stimulation and improvement of walking and running (accompanied by rhythm), jumping, symbolic play, “moving target”, bowling pin knocking down, walking over different surfaces and in different ways, hitting from the standing position, high jump and long jump  
TES-with a requisit (hoop)  
SG- tennis (using only hands, without a tennis racquet), dribbling in pairs typical for handball, basketball and football  
SG – elements of acrobatics  
Game with buttons, “table football” |
| **Winter**    | EMG- movement activities for improvement of static and dynamic balance in the snow, “invisible rope”, “ship on the waves”  
TESwith requisits (tennis ball)  
AHC-relay games, sleigh riding, ice-skating, symbolic and creative games (snow paths making, snow figures making, stick drawing), CMAPin the snow  
„brain storming”, “motor puzzles” |
| **Me and my body** | EMG- “imitator”; “Watch out, here comes the frog, bear, snake...”  
TES with requisit (medicine ball)  
Be acquainted with your body (body scheme), lateralization, space relations (with and without the requisits), SG – galactic football, SG – elements of acrobatics, hanging pull-ups, medicine ball throwing, lateral split, agility exercices, yoga positions |
| **Cartoons**  | EMG - „Wizard”, „Ninja warriors”- techniques for jumping improvement (pogo, star, rocket, jumping from one leg to another, jump with both legs, from elevated surface) and combination with basic motor knowledge (climbing, crawling, pulling thorough, skipping, lifting, carrying, pushing, pulling...)  
TES with a requisit (strip)  
SG-Handball, basketball and football flipper, alternating relay, relay thorough the tunnel  
“Baybladers” cartoon dramatization |
| **Easter**    | EMG- „moving images”, „mirror”, „easter eggs”  
TES with requisits (hoop, skipping rope)  
AD- 5, 10, 20, 30 ann 60 metres run with and without requisits, Circle training of joy (six stations) – Easter customs and symbols are placed at each station and correct answer is demanded  
Memory games in small groups – spring landscape |
| **Olympic Games** | EMG- movement activities for improvement of the techniques of running, jumping, throwing  
TES with requisuit (skipping rope )  
Small Olympic Games – 20m run, long jump with running takeoff , CMAP in one lane, 200g ball throwing, 1kg medicine ball throwing, high jump, 600m walking and running  
Number playroom, “Numbers and letters” |
| **World around Us** | EMG-catch me if you can – forest and domestic animals, rope games, shadow games, “dog and the master”  
TES with requisit (strip, ball)  
Competitive games with drama elements, “clay pigeons”, “moving targets”, riding a bicycle, scooter, rollers, skateboard  
Letter playroom |

**Legend:**  
EMG – elementar motor games; TES – toning exercies set; SG – sports games; SA – snow activities; AD – athletics disciplines; CMAP – complex movement activities polygon.
Control group realized regular physical activities planned in kindergarten curriculum and pedagogic contents during less flexible time limit set by Preschool Education Programme Basis in the following way:

- 10-15 min of *morning physical activities* five times per week
- 25-30 min. of *guided physical activities* two times per week
- 5-10 min of *recreational break* five times per week

Significant difference in developmental level of motor abilities was assessed by multivariate (MANOVA- repeated measure) and univariate analysis of variance (ANOVA- repeated measure).

**RESULTS**

The results of MANOVA- repeated measure (F=1.81; p=0.69, eta square =0.02) revealed there was no quantitative difference in applied system of assessed motor abilities between control and experimental groups at initial measuring. (Table 2).

### Table 2. Multivariate differences between motor abilities of experimental and control group at initial measurement

<table>
<thead>
<tr>
<th>Wilk's Lambda</th>
<th>F</th>
<th>Effect df</th>
<th>p</th>
<th>eta</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.831</td>
<td>1.81</td>
<td>12</td>
<td>0.69</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Univariate variance analysis (Table 3), arithmetic mean analysis (MEAN) and analysis of standard deviation (SD) and difference significance tests between the examinees in control and experimental groups according to univariate variance analysis, revealed there was no statistically significant difference of assessed motor abilities between control and experimental group at initial measuring, sugesting on the relative homogenity of the sample.

### Table 3. Univariate differences between motor abilities of experimental and control group at initial measurement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental group</th>
<th>Control group</th>
<th>F (1.94)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLDJSP(cm)</td>
<td>116.2</td>
<td>113.00</td>
<td>0.40</td>
<td>0.528</td>
</tr>
<tr>
<td>MHP(0.1 s)</td>
<td>86.3</td>
<td>7.91</td>
<td>2.31</td>
<td>0.133</td>
</tr>
<tr>
<td>MTL60(freq.)</td>
<td>9.02</td>
<td>8.42</td>
<td>0.24</td>
<td>0.628</td>
</tr>
<tr>
<td>MBP(0.1 s)</td>
<td>297.66</td>
<td>292.1</td>
<td>0.09</td>
<td>0.769</td>
</tr>
<tr>
<td>MRR(0.1 s)</td>
<td>324.1</td>
<td>318.9</td>
<td>0.84</td>
<td>0.395</td>
</tr>
<tr>
<td>M3MBS(0.1 s)</td>
<td>361.9</td>
<td>356.3</td>
<td>1.25</td>
<td>0.404</td>
</tr>
<tr>
<td>MHT(freq.)</td>
<td>10.06</td>
<td>9.66</td>
<td>1.51</td>
<td>0.223</td>
</tr>
<tr>
<td>M10MR(0.1 s)</td>
<td>36.4</td>
<td>33.13</td>
<td>0.74</td>
<td>0.851</td>
</tr>
<tr>
<td>M20MR(0.1 s)</td>
<td>69.2</td>
<td>70.12</td>
<td>0.31</td>
<td>0.578</td>
</tr>
<tr>
<td>MFBB (cm)</td>
<td>31.06</td>
<td>31.53</td>
<td>0.70</td>
<td>0.404</td>
</tr>
<tr>
<td>MHTNS (freq.)</td>
<td>0.79</td>
<td>0.57</td>
<td>0.43</td>
<td>0.715</td>
</tr>
<tr>
<td>MBRBC(freq.)</td>
<td>1.42</td>
<td>1.65</td>
<td>0.18</td>
<td>0.654</td>
</tr>
</tbody>
</table>
The analysis of potential differences between experimental and control groups at final measurement was done by multivariate analysis of covariance (MANOVA - repeated measure) (Table 4) according to the results of their differences at initial measuring, whereas its aim was to define the effect of applied experimental programme. It can be stated that Wilk’s Lambda is 0.009, F test is 436.35, which shows statistical significance at the level of p=0.003. Partial eta square explains 67% of variance, which shows significant difference between mean values of the groups.

Table 4. Multivariate differences between motor abilities of experimental and control groups at final measurement (MANOVA – repeated measure)

<table>
<thead>
<tr>
<th>Wilk’s Lambda</th>
<th>F</th>
<th>Effect df</th>
<th>p</th>
<th>eta</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.009</td>
<td>436.35</td>
<td>12</td>
<td>0.001</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Single univariate differences between the groups in motor tests were defined by univariate analysis of covariance for repeated measure (ANOVA – repeated measure) (Table 5)

Table 5. Univariate differences between motor abilities of experimental and control groups at final measurement with difference neutralization at initial measurement (ANOVA – repeated measure)

<table>
<thead>
<tr>
<th>Variable</th>
<th>AMC - E group</th>
<th>SD</th>
<th>AMC - C group</th>
<th>SD</th>
<th>F (1.53)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLDJSP (cm)</td>
<td>132.12</td>
<td>19.3</td>
<td>121.42</td>
<td>18</td>
<td>59.63</td>
<td>0.01</td>
</tr>
<tr>
<td>MHP (0.1 s)</td>
<td>137.1</td>
<td>116.5</td>
<td>96.2</td>
<td>104.7</td>
<td>13.83</td>
<td>0.01</td>
</tr>
<tr>
<td>MTL60 (freq.)</td>
<td>13.14</td>
<td>8.7</td>
<td>8.76</td>
<td>9.3</td>
<td>74.59</td>
<td>0.01</td>
</tr>
<tr>
<td>MBP (0.1 s)</td>
<td>249.4</td>
<td>45.7</td>
<td>272.9</td>
<td>99.7</td>
<td>16.25</td>
<td>0.05</td>
</tr>
<tr>
<td>MRR (0.1 s)</td>
<td>289.16</td>
<td>73.4</td>
<td>338.12</td>
<td>152.6</td>
<td>18.45</td>
<td>0.05</td>
</tr>
<tr>
<td>M3MBS (0.1 s)</td>
<td>264.9</td>
<td>53.4</td>
<td>294.1</td>
<td>76.9</td>
<td>21.13</td>
<td>0.03</td>
</tr>
<tr>
<td>MHT(freq.)</td>
<td>15.47</td>
<td>3.6</td>
<td>13.04</td>
<td>7.4</td>
<td>69.16</td>
<td>0.01</td>
</tr>
<tr>
<td>M10MR (0.1 s)</td>
<td>29.3</td>
<td>3.7</td>
<td>32.1</td>
<td>5.2</td>
<td>17.84</td>
<td>0.04</td>
</tr>
<tr>
<td>M2OMR(0.1 s)</td>
<td>6.2</td>
<td>5.3</td>
<td>6.7</td>
<td>6.1</td>
<td>43.71</td>
<td>0.01</td>
</tr>
<tr>
<td>MFBB (cm)</td>
<td>35.43</td>
<td>3.1</td>
<td>32.21</td>
<td>6.7</td>
<td>22.78</td>
<td>0.05</td>
</tr>
<tr>
<td>MHTNS (freq.)</td>
<td>0.87</td>
<td>0.82</td>
<td>0.65</td>
<td>0.59</td>
<td>0.26</td>
<td>0.92</td>
</tr>
<tr>
<td>MBRBC(freq.)</td>
<td>1.56</td>
<td>0.24</td>
<td>1.32</td>
<td>0.31</td>
<td>0.32</td>
<td>0.87</td>
</tr>
</tbody>
</table>

Statistically significant difference for assessed motor abilities between the groups was observed at significance level p ≤ 0.05 at ten analyzed variables; there weren't differences at the tests for assessment of accuracy – MHTNC and MBRBC.
DISCUSSION

Experimental program suggested in this paper is based upon Piaget structuralist theory and kindergarten curriculum is comprehended as developmentally suitable practice, but it also linked actual context of growing up, cultural and social patterns of behaviour of preschool child with educational sequences and motor learning, whereas physical activity is understood as an act of knowledge gathering and world comprehension, not being the goal in itself, but the basis for integral development of child’s personality (Bokan, 1999; Kukolj, 2006).

Everyday physical activities of middle and high intensity during 60 min, planned according to children developmental possibilities have positive influence on normal growth and development, as well as on active life style development (Gallahue, & Donnelly, 2003; Faigenbaum, et al., 2010). Aforementioned authors recommend physical activity models to be implemented 60 min daily or 30 min two times a day and they should be based on motor games, running, jumping and turning. Recent studies of transformational effects of physical activities on motor abilities have been mostly based on the samples of examinees who achieved relatively stable phase of motor abilities development. Longitudinal studies on the sample of preschool children which include more experimental groups have been rare. Most of the studies about the effects of one experimental model of motor programme on motor status of children (Stanković, 1976; Čanović, 1990; Giagazoglou, et al., 2008; Stanković, Nurkić, Lolić, & Bratić, 2009; Savičević, 2010) defined positive effects of experimental treatment on motor abilities of preschool children. The analysis of results of studies which observed early selection, transformational programmes of judo (Drid, Obadov, & Bratić, 2006), developmental gymnastics (Popović, & Radanović, 2010; Madić, & Popović, 2007: Kostić, et al, 2009), football (Molnar, et al., 2009), athletics (Maleš, & Žuvela, 2009) show statistically significant and better results of children included in early specialization at certain segments of motor space in comparison to children who were not engaged in any form of physical or sports activity. Both research approaches have mutual interpretative platform (Krnjaja, 2008) which labels them as researches with previously defined plan and programme, with the same educational contents for all examinees in the research.

The results of this study show that effects of differentiated programming model based on everyday physical activity as well as on evaluation and self-evaluation of physical activities on daily basis bring educational contents closer to group and individual developmental needs of children. Evaluation of suggested nine-months long programme shows that 30% longer period of time for each physical activity planned in curriculum causes statistically significant results which refer to all aspects of strength, speed, coordination and flexibility. This program did not show statistical significance at the results of the tests of accuracy, which opens the question of possibility of additional check of metrical characteristics of these two measuring instruments.

CONCLUSION

The results of this research paper show that preschool teachers should be re-educated so that they could apply implicit pedagogies to integral and contextual approach to children teaching and learning. Thematic planning does not represent solution of equation with multiple unknown variables, but the possible way of recognition and influence of individual approach on further group development in kindergarten. The research paper is based on basic postulates of dynamic interaction theory, i.e. the statement that movement organization represents the result of the learner, environemnt and complexity of motor task (Schmidt, & Lee, 2005). The results of the research show that greater volume (scope and intensity), differentiated educational programmes and more efficient and effective use of time planned for physical activities realization cause higher developmental level of motor abilities of preschool children. Prognostic validity of suggested programming concept of physical education in kindergartens represents starting level of exploring strategy of physical education in kindergartens. General conclusion of research paper is that curriculum as contextually suitable practice, as well as 30% longer period of time
devoted to each organizational form of physical activities of children who were not engaged in additional sports activities and early sports specialization, have positive influence on positive trend of motor abilities development of preschool children.

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