GENDER-BASED PROGRESSION AND ACQUISITION OF GYMNASTIC SKILLS IN PHYSICAL EDUCATION

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ABSTRACT

Gender differences in acquiring and retaining gymnastic skills in first graders were studied. Forty-four (44) girls and thirty-two (32) boys (mean age 6.5 years) participated as the experimental group. They were included in the 35-week-long program based on four gymnastic skills. Their performance was measured in three acquisition and two retention phases. The results showed that the girls performed better than the boys. The independent sample t-test showed significant gender differences in the majority of measurements. ANOVA for the retention phases revealed a positive learning transfer only in case of the candlestick element for the boys and in case of the cartwheel element for the girls. The differences found are not considered as a disturbing factor for the coeducational teaching method but just as the guidelines for the PE teachers when making their curricula more appropriate and individually approached.

Key words: coeducational teaching, curriculum, motor learning, retention

INTRODUCTION

The quality of learning process in gymnastics directly depends on the active involvement of learner. Two interrelated factors which influence the acquisition of gymnastic skills refer to skill difficulty and learner’s ability. Learners who practice effectively demonstrate superior improvements in
skills. Practice is an imperative in gymnastics, as a wide range of new skills are mastered according to the following principle: the acquisition of complex motor skills after mastering simple motor skills. When the level of task difficulty is not compatible with the current level of learner’s skills, practice becomes futile and unsuccessful (Goldenberg & Gerney, 1990; Silverman, 1993).

Motor learning has three distinct stages: verbal-cognitive, motor, and autonomous (Schmidt & Wrisberg, 2000). The effectiveness of motor reactions is defined by the relations between motor information and the level of abilities and properties that act interactively but differently in various stages of advancement (Miletić, Katić, & Maleš, 2004). Thus, the aim of learning is to acquire a skill at the highest possible level, which is defined as the autonomous stage. The motor stage is the error detecting stage. The performance of acquired skills can be most precisely evaluated in the motor stage of learning when errors are obvious most. The quality of movements should be also constantly focused at this stage. The feedback should be, thus, positive and encouraging, as well as individualized. Serious problems must be targeted and strategies devised to help the student effectively perform gymnastic skills. According to Bandura’s social learning theory (1977), learners symbolically code a desired behavior; the coded behavior is later used in the performance. Therefore, it is necessary to measure the retention of knowledge, after the process of learning, to provide information about motor skills that have or have not been mastered (Schmidt & Lee, 2005), as theories of motor learning emphasize the positive transfer of simple skills onto the later acquisition of complex skills (Burton & Miller, 1998).

Gender-based programming in PE, until the age of eleven, is considered inappropriate and unnecessary, and can also indicate an unequal division of boys and girls in the society. Shared exercising should be socially approved and should become an important, active factor in creating the healthy and respected social environment. The biggest challenge for the teacher is, thus, to offer the PE curriculum that is equally appropriate for boys and girls, also taking into account varieties and interests in pupils with different abilities and knowledge.

Although male and female gymnastics differ in the number of apparatus and training forms, they are identical in terms of learning basic skills and teaching principles. Beginning gymnastics includes motor skills which, according to Schmidt and Wrisberg (2000), belong to discrete and closed skills. A motor action of gymnastics skills is mainly short and well-defined from the beginning to the end and it includes moving and/or rotating body parts or the whole body around one or more axis. Such
exercising develops the most relevant motor abilities and affects children’s proper growth and development. All skills can be vertically and horizontally progressed in terms of their performance. This progression enables the continuous acquisition of new skills through a large number of teaching procedures (Živčić, Breslauer & Stibilj–Batinić, 2008), as well as the adjustment of learning dynamics to individual characteristics and abilities.

Gender differences in basic motor skills favoring boys have been identified (Aponte, French & Sherrill, 1990; Krebs, 2000). Boys show significantly better results than girls in object manipulation skills (Malina & Bouchard, 1991; Ulrich, 2000). Mazzardo (2008) states that the main reason for the existence of significant differences between them is the fact that boys, in general, choose activities which develop manipulative, but also loco-motor skills (basketball, handball, soccer), while girls mostly choose to participate in the activities that have a great potential for developing loco-motor skills (gymnastics, swimming, dancing).

The aim of this research was to determine possible gender differences in the acquisition and retention of gymnastic motor skills among the first grade pupils. We analyzed gender differences in performing four gymnastic skills (candlestick, bridge, forward roll, cartwheel). The results from five measurement points, obtained during the learning process and after it, have been analyzed.

METHODS

The study was carried out on 44 girls and 32 boys (7 ± 0.5 years old) who attended the first grade of elementary school. The male students averaged 126.9 cm in height and 26.7 kg in weight, while the female students averaged 125.9 cm in height and 26.7 kg in weight. The average BMI value among the boys was 16.54 and the average BMI value among the girls was 16.16. The BMI values we found are comparable to those found in literature (Miletić et al., 2004). They, thus, represent this population well. In order to test the experimental program benefits, a group of 16 girls and 10 boys, who attended regular PE classes (35 weeks), was chosen as a control group. The group averaged 126.1 cm in height and 25.7 kg in weight.

Information about children’s organized physical activity was gathered with the use of questionnaire (Mazzardo, 2008) which indicates activity participation in one year. From the total sample of 102 first grade pupils, 34.1% were involved in some sort of organized activity: soccer (7.9%), twirling (7.9%), gymnastics (6.6%), tennis (3.9%), swimming (2.6%), karate (2.6%) and taekwondo (2.6%). Thus, 65.9% of the pupils were not
involved in such activities. The overall average time regarding the participation in a physical activity was 152 minutes per week. In addition, a measure of inactivity revealed that the average time regarding sedentary activities was 1224 minutes per week.

Prior to the study, administration approval was obtained and parents were informed. Also, the Ethical Committee of the Faculty of Kinesiology – the University of Split and the School Board confirmed that this research complied with ethical principles considering scientific research with human subjects.

The experimental program was realized throughout 35 weeks (23 treatment weeks, 7 retention weeks, and 5 assessment weeks). Boys and girls practiced together three times per week, for 45 minutes, during the PE class taught by the same teacher. In the period of 10 months, children had 105 classes. The control group attended regular PE classes (according to the elementary school curriculum). The experimental treatment differed from the control one by the number of applied gymnastic skills.

The study included initial, transitive, final, and retention phases. Performance in the first three phases was assessed during the learning process, while the retention level performance was assessed after the learning process and treatment itself. The performance quality was assessed five times in total, as follows: 1st assessment - initial point (beginning of the learning process); 2nd assessment - transitive point (three months after the beginning of learning process); 3rd assessment - final point (six months after the beginning of learning process); 4th assessment - first retention point (one week after finishing the learning process); 5th assessment - second retention point (seven weeks after finishing the learning process). In order to assess the level of knowledge in the above mentioned points as precisely as possible, every pupil’s performance of the four gymnastic skills was video-recorded. To avoid any subjective assessment, three independent judges were included in this evaluation. They were instructed on the required criteria for performing gymnastic skills, based on the Likert type scale.

The performance assessment criteria in case of the four gymnastic motor skills were adjusted to the PE curriculum. The Likert type scale was used as follows: (5) performance without any technical and/or aesthetic mistakes; (4) performance with small technical and/or aesthetic mistakes; (3) performance with medium technical and/or aesthetic mistakes; (2) performance with large technical and/or aesthetic mistakes; (1) no performance at all.

Correct candlestick performance referred to a position in which the subject stands on the back of his/her shoulders with his/her feet pointed towards the ceiling, while his/her arms push the floor to enable support and
balance. *Bridge* needed to be performed in an arched position with feet and hands on the floor, but with abdomen towards the ceiling. A movement in which the body is rolled forward, by putting the head on the ground and swinging the legs over the head, was considered as correct *forward roll* performance. The most difficult element – *cartwheel* – was correctly performed when the subject moved sideways in a straight line, placing the hand of the same side on the ground followed by the other hand, as the legs are passed over the body and then down as the hands and body come up to a standing up position.

All the included gymnastic skills showed normal distributions according to Kolmogorov-Smirnov test. The data were analyzed with the use of STATISTICA for Windows 7.0 package and the level of statistical significance was set at $p<0.05$. To establish whether the judges were objective or not, ICC Coefficients were calculated for every gymnastic skill in all five measurements. The means for each group in each point were obtained. To determine performance differences in the last three points, ANOVA with repeated time measures was used, along with the post-hoc Tukey test for specific differences. Finally, t-test for independent variables was used to determine differences between the groups in every measuring session.

**RESULTS**

To determine the objectivity of judges, we used the intra-class correlation coefficient (ICC). The data in Table 1 refer to the ICC coefficients for each element and for each measuring point. Their values range from 0.88 to 0.97, depending on the element. The results show the highest reliability in the most complex element – *cartwheel*.

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Table 1. Intra-Class Correlation Coefficients in first (E1), second (E2), third (E3), fourth (E4), and fifth (E5) evaluation for each element
Results covering initial, transitive, final, and retention phases for all the three groups of subjects are presented in Figures 1 to 4. They show the dynamics of learning process which indicates some positive knowledge progress in each specific gymnastic skill, based only on the transitive stages. Focusing only on the initial phase, the means show a similar performance level for each group, although some small differences do exist. In phase two (transitive point) and, particularly, in phase three (final point), the differences are bigger in most of the elements; especially when compared to the control group. The present finding indicates the quality of experimental program.

Observing the static elements, namely candlestick and bridge, it is clear that the control group performed them better than the male group during the second measuring. However, it is not the case when the dynamic elements are concerned. Phase three reveals the true effect of experimental program, when both girls and boys performed the elements better than the control group.

Mean retention scores are presented in Figures 1 to 4. The control group was not measured in terms of the retention points as they did not participate in the experimental treatment. Generally speaking, the means show a decreased performance level in the first retention point for every gymnastic skill. However, it is important to note that the quality of performance in the second retention point is higher than in the initial point for both groups, which proves that the learning process was successful. Concerning the second retention point, compared to the first one, a small decrease has been recorded in all elements.

The analysis of variance (ANOVA) for repeated measures was applied to determine the differences in performance in the last three points. The results are presented in Table 2.

Table 2. ANOVA for repeated measures related to last three points with post-hoc Tukey test between third and fourth (3-4), third and fifth (3-5) and fourth and fifth (4-5) measurement for male and female participants

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Figure 1-4. Acquisition of four skills throughout five learning stages and differences between three groups (\(^a\) significant differences between Boys and Girls, \(^b\) significant differences between Boys and Control, \(^c\) significant differences between Girls and Control).
The results showed statistically significant differences between the final point and the retention points for the majority of elements, excluding candlestick for boys (0.06) and cartwheel for girls (0.37). Post-hoc Tukey test revealed specific differences. Significant differences were found between the final and the first retention point, as well as between the final and the second retention point. The analysis of differences between the two retention points revealed no significant differences, indicating consistent performance.

Looking back at Figures 1 to 4, we can notice that the girls performed better than the boys in case of each gymnastic skill. Such a difference was not initially observed, except in the forward roll element. Then, in the second measuring phase, significant gender-related differences in two (candlestick and cartwheel) of the four elements suggest that girls learn some elements faster than boys. The same test was conducted in two retention points and the results showed significant differences between male and female participants in both sessions for every element, except the candlestick one. Also, according to the results in Table 2, the boys remained at the same level of knowledge in case of candlestick, while the girls did the same in the cartwheel element. Differences among the last three points showed the same results in the boys as it did in the girls.

**DISCUSSION AND CONCLUSION**

Measuring individual performance in order to assess the efficiency of learning process in the gymnastics curriculum is a complex issue. The necessary components of the experimental design included the stages of information processing important during the learning process and the forms of extrinsic feedback available to learners. This feedback was an important motivational factor in all the three groups trained by the same teacher. The significant differences between the control group and the experimental groups in point two and point three, in particular, confirm that the adjusted PE program is more efficient than the regular one which supports the previous research (Babin, Bavčević, Prskalo, 2010). It can be also noticed that the control group is more competent when performing the static elements in the same learning stage. However, more complex and dynamic elements pose a problem for the regular group.

According to motor learning theories, it is extremely important that a learned skill is retained over time after a period without any practice. Learning gymnastic skills, as discrete and closed knowledge types, depends
on the processes used in motor learning. Changes that take place in the central nervous system become permanent and stable as a part of student’s increased capacity for skilled performance. The present study suggests that memorizing such skills could be gender specific in seven-year-old pupils. More precisely, according to the obtained retention measures for *candlestick*, the frequency of exercising was sufficient only for boys, in case of candlestick, while the frequency of exercising was sufficient only for girls in case of *cartwheel*. *Candlestick* is a static element, easy to perform, especially for girls with better flexibility, while *cartwheel* is a more complex, dynamic element, difficult to learn. Yet, the level of *cartwheel* performance remains the highest in the retention phases. Therefore, task complexity and performance level reached in the motor stage of learning could not be quite good predictors for memorizing discrete, closed skills. When some task is more complex, pupils learn by memory more, which is a better learning strategy. This might be useful as a basis for developing more active, complex, and integrated motor learning strategies. When acquiring gymnastic skills, girls learn faster and reach a higher level of performance than boys, thereby, inducing a better memorizing process. The basic patterns of artistic gymnastics are energetic, dynamic and expressive, which provides students with some unique movement experience.

Insufficient frequency of exercising disables learners to retain a high level of performance over time without any practice. According to the presented data, the frequency of practicing *bridge*, *forward roll* and *cartwheel* should be increased in the PE curriculum for boys, while the frequency of practicing *candlestick*, *bridge* and *forward roll* should be increased in the PE curriculum for girls. Surely, teachers need to design such a curriculum that allows students to actively acquire the knowledge and completely participate in every course. Williams, Davids, Burwitz and Williams (1992) pointed out that the role of memory must be considered as important in order to understand how people deal with available information. In the present study, the authors tried to calculate an optimal amount of practice for seven-year-old children to learn basic gymnastic skills. The practice provided was found to be sufficient in reaching the required performance level in the acquisition phase of motor learning. However, such was not the case in the memorization of skills over time after practicing/learning in the retention phases. Clearly, the autonomous stage of learning was not reached and student’s performance was still at the higher level of motor stage.

PE has been recognized as an activity primarily reserved for the male population (Solomon et al., 2003), with activities that can be divided into those preferred by boys (basketball, handball, soccer) and those preferred
by girls (gymnastics, dance, swimming) (Mazzardo, 2008). The present study confirmed the fact that students’ preferences were in accordance with their competencies, when gymnastic skills are concerned, and that girls learn such skills faster than boys.

As existing differences can be eliminated by adjusting the frequency of exercising that is required for certain skills, the authors advocate shared classes (boys and girls together). Gymnastic elements are irreplaceable contents that incorporate fundamental and specialized movement structures and have an overall impact on the anthropological status of children (Delaš, Babin & Katić, 2007; Delaš, Zagorac & Katić, 2008), so they should play a more important role in the PE curriculum, especially in the lower elementary school classes. To design the curriculum successfully, teachers must explore the current research for new findings; recognize specific problems that students have when learning new and complex skills; respect gender-based differences; encourage students to participate in physical activities more often by implementing various sports and sport disciplines in the PE curriculum.

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DINAMIKA UČENJA I IZVOĐENJA GIMNASTIČKIH ELEMENATA U TJELESNOJ I ZDRAVSTVENOJ KULTURI – RAZLIKE PO SPOLU

SAŽETAK

Istraživane su razlike po spolu u dinamici učenja i retenciji gimnastičkih znanja na uzorku učenika prvog razreda osnovne škole. Eksperimentalnu grupu činile su 44 učenice i 32 učenika koji su sudjelovali u tretmanu u trajanju od 35 tjedana, a koji je uključivao i četiri gimnastička znanja. Izvođenje tih znanja procjenjivano je u 3 faze učenja i 2 retencijske faze. Govoreći o usvajanju gimnastičkih znanja, rezultati su ukazali na bolje izvođenje djevojčica za razliku od dječaka. T test za nezavisne uzorke potvrdio je značajnu razliku između spolova u većini točaka provjeravanja. Rezultati ANOVA testa za retencijske točke provjeravanja ukazali su na pozitivan transfer učenja samo za element stava na lopaticama kod dječaka i premeta strance kod djevojčica. Pronađene razlike između spolova ne smatraju se remetećim faktorom za postojanje zajedničke metode poučavanja za oba spola, već primarno služe kao smjernice profesorima tjelesne i zdravstvene kulture za prilagođavanje nastavnog kurikula kako bi bio što prikladniji i usmjereniji na individualni pristup.

Ključne riječi: zajednička metoda poučavanja, kurikulum, motoričko učenje, retencija

UVOD

Kvaliteta procesa učenja gimnastičkih znanja izravno ovisi o aktivnom sudjelovanju onoga koji uči. Postoje dva međusobno povezana čimbenika koji utječu na kvalitetu procesa učenja takvih znanja: zahtjevnost vještine i sposobnost ispitanika. Pri tome veći napredak u gimnastičkim znanjima postižu oni ispitanici koji vježbaju učinkovito, obzirom da je uvježbavanje imperativ u sportu kao što je gimnastika. Veliki broj novih gimnastičkih znanja savladava se sljedeći specifični metodički princip: usvajanje složenih motoričkih znanja nakon savladavanja jednostavnijih
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znanja. Kada razina zahtjevnosti određenog znanja nije u skladu s trenutnim sposobnostima i znanjima onoga tko uči, vježba postaje neuspješna i uzaludna (Goldenberg i Gerney, 1990; Silverman, 1993).


Planiranje i programiranje u tjelesnoj i zdravstvenoj kulturi odvojeno za djevojčice i djecake do 11 godina smatra se neprimjerenim i nepotrebnim i može ukazivati na nejednaku podjelu dječaka i djevojčica u društvu. Zajedničko vježbanje djevojčica i dječaka treba biti društveno prihvaćeno i postati važan i aktivan čimbenik u oblikovanju zdrave i cijenjene socijalne okoline. Najveći izazov za profesore tjelesne i zdravstvene kulture stoga je konstruirati takav program koji će biti jednako primjeren djeci oba spola i uvažavati različitosti i interese učenika i učenica različitih sposobnosti i znanja.

Iako se muška i ženska sportska gimnastika razlikuju po broju sprava i načinu treniranja, radi se o sportovima koji se temelje na jednakim principima učenja bazičnih znanja, kao i metodičkim principima podučavanja. Gimnastika za početnike uključuje motorička znanja koja, prema Schmidt i Wrisberg (2000), pripadaju kategoriji diskretnih i zatvorenih znanja. Motorička akcija gimnastičkih znanja uglavnom je kratka i dobro definirana od početka do kraja izvođenja te uključuje pomicanje i/ili rotaciju dijelova tijela ili cijelog tijela oko jedne ili više osi. Takav način vježbanja razvija najvažnije motoričke sposobnosti i utječe na pravilan rast i razvoj
djece. Svako gimnastičko znanje ima opciju vertikalne ili horizontalne progresije u izvedbi koja omogućava kontinuirano učenje novih vještina putem velikog broja metodičkih principa (Živčić, Breslauer & Stibilj–Batinić, 2008), kao i prilagodbu dinamike procesa učenja prema individualnim osobinama i sposobnostima.


Cilj ovog istraživanja bio je utvrditi moguće razlike po spolu u usvajanju i zadržavanju naučenih gimnastičkih znanja kod učenika prvog razreda. Analizirale su se razlike među djevojčicama i dječacima u kvaliteti izvođenja četiri gimnastička znanja (svijeta, most, kolut naprijed i zvijezda). Prikupljeni su rezultati pet točaka provjeravanja provedenih tokom i nakon procesa učenja.

**METODE RADA**

Uzorak ispitanika sačinjavale su 44 djevojčice i 32 dječaka (7 ± 0.5 godina) polaznika prvog razreda osnovne škole. Dječaci su u prosjeku bili visoki 126.9 cm i imali masu od 26.7 kg, dok su djevojčice u prosjeku bile visoke 125.9 cm i imale 26.7 kg. Vrijednost indeksa tjelesne mase (BMI) kod dječaka iznosila je 16.54, dok je vrijednost istog indeksa kod djevojčica bila 16.16. Ovakve vrijednosti indeksa tjelesne mase slične su vrijednostima u literaturi (Miletić et al., 2004). Prema tome, uzorak ispitanika reprezentativna je slika ove populacije. Kontrolna grupa, koja se sastojala od 16 djevojčica i 10 dječaka koji su prisustvovali isključivo satima tjedna, uvedena je kako bi se provjerila kvaliteta eksperimentalnog tretmana. Ova je grupa djece u prosjeku bila visoka 126.1 cm, tjelesne mase 25.7 kg.

Informacije o organiziranom kineziološkom aktivitetu djece prikupljene su upitnikom (Mazzardo, 2008) koji registrira sudjelovanje u aktivnosti u jednoj godini. Od ukupnog uzorka od 102 učenika, 34.1% djece bilo je uključeno u neki oblik organizirane kineziološke aktivnosti: nogomet (7.9%), twirling (7.9%), gimnastika (6.6%), tenis (3.9%), plivanje (2.6%),...
karate (2.6%) i taekwondo (2.6%). 65.9% djece nije bilo uključeno u takve aktivnosti. Djeca su u prosjeku sudjelovala u kineziološkim aktivnostima u ukupnom obimu od 152 minute tjedno. Nadalje, mjera tjelesnog neaktiviteta pokazala je kako djeca u prosjeku provedu 1224 minute tjedno u sedentarnim aktivnostima.

Prije početka samog istraživanja dobivena su potrebna ovlaštenja i roditelji su informirani. Također, Etički odbor Kineziološkog fakulteta Sveučilišta u Splitu i školsko vijeće odobrili su provedbu istraživanja te potvrdili kako je ono u skladu s etičkim načelima znanstvenih istraživanja koja uključuju ljudske subjekte.

Eksperimentalni tretman organiziran je kroz 35 tjedana (23 tjedna tretmana, 7 tjedana retencijskog razdoblja i 5 tjedana procjene izvedbe). Dječaci i djevojčice vježbali su zajedno 3 puta tjedno po 45 minuta pod vodstvom istog trenera. U 10 mjeseci tretmana djeca su imala 105 sati vježbanja. Kontrolna grupa sudjelovala je u regularnim satovima tjelesne i zdravstvene kulture (prema planu i programu prvog razreda osnovne škole). Eksperimentalni tretman razlikovao se od regularnog prema broju primijenjenih gimnastičkih znanja.

Istraživanje je uključivalo inicijalnu, tranzitivnu, finalnu i retencijske faze. Inicijalna, tranzitivna i finalna razina izvedbe procjenjivane su tokom procesa učenja, dok su retencijske razine izvedbe procjenjivane nakon prestanka procesa učenja i samog tretmana. Sveukupno, kvaliteta izvedbe znanja procjenjivana je pet puta: 1 – inicijalna točka (na početku procesa učenja), 2 – tranzitivna točka (3 mjesec nakon početka procesa učenja), 3 – finalna točka (6 mjeseci nakon početka procesa učenja), 4 – prva retencijska točka (1 tjedan nakon završetka procesa učenja), 5 - druga retencijska točka (7 tjedana nakon završetka procesa učenja). Kako bi procjena znanja u svim točkama provjeravanja bila što točnija, izvedba ispitanika kod sva četiri znanja snimljena je videokamerom. Da bi se izbjegla subjektivnost procjene, izvedbu znanja ocjenjivala su tri nezavisna suca koji su bili upoznati s predviđenim kriterijima svakog pojedinog znanja prema Likertovoj skali ocjenjivanja.

Kriteriji za procjenu izvedbe četiri gimnastička motorička znanja su konstruirani na način da budu prikladni za ocjenjivanje u tjelesnoj i zdravstvenoj kulturi. Likertova skala korištena je na sljedeći način: (5) izvedba bez tehničkih i/ili estetskih pogrešaka; (4) izvedba s malim tehničkim i/ili estetskim pogreškama; (3) izvedba sa srednjim tehničkim i/ili estetskim pogreškama; (2) izvedba s velikim tehničkim i/ili estetskim pogreškama; (1) nemogućnost izvedbe znanja.

Pravilna izvedba elementa svijeća podrazumijevala je stav na lopaticama sa stopalima usmjerenim prema stropu dok ruke pritišću tlo kako...
bi osigurale ravnotežu. Most je element u kojem su stopala i dlanovi na podu, izveden u lučnom položaju s trupom okrenutim prema strupu. Element u kojem se tijelo kotrlja prema naprijed na tlo i pritom noge presuđe preko glave označavao je *kolut naprijed*. Pravilna izvedba najtežeg elementa – *zvijezde* – označavala je postraničnu kretinju u ravnoj liniji, postavljajući ruke jednu po jednu na tlo, raznožni prolazak preko linije trupa, postavljanje nogu na tlo i podizanje ruku s tla u stojeći položaj.

Prema Kolmogorov-Smirnov testu normaliteta distribucije sva primijenjena gimnastička znanja imala su normalne distribucije. Podaci su analizirani programom STATISTICA Windows 7.0, a prag značajnosti postavljen je na p<0.05. Za procjenu objektivnosti sudaca za svako su gimnastičko znanje izračunati ICC koeficijenti u svih pet točaka provjeravanja. Izračunate su aritmetičke sredine za sve grupe ispitanika u svim točkama provjeravanja. Za utvrđivanje razlika u izvedbi u zadnje tri točke provjeravanja primijenjena je ANOVA za ponovljena mjerenja, kao i post-hoc Tukey test za utvrđivanje specifičnih razlika. Konačno, t testom za nezavisne varijable utvrđene su razlike među grupama ispitanika u pojedinačnim točkama provjeravanja.

**REZULTATI**

Za utvrđivanje objektivnosti sudaca korišten je koeficijent međučestične povezanosti (ICC). Izračunati koeficijenti prikazani su u Tablici 1 za svaki od primijenjenih elemenata i u svim točkama provjeravanja. Vrijednosti koeficijenata kreću se od 0.88 do 0.97, ovisno o elementu. Najveća objektivnost sudaca zabilježena je u elementu *zvijezda*, koji se smatra najkompleksnijim elementom od primijenjenih.

Tablica 1.

Podatci koji predstavljaju rezultate u inicijalnom, tranzitivnoj, finalnoj i retencijskim točkama provjeravanja za sve tri grupe ispitanika prikazani su u Grafovim od 1 do 4. U njima je prikazana dinamika procesa učenja koja ukazuje na pozitivnu progresiju razine znanja svih specifičnih gimnastičkih vještina, gledajući tranzitivne faze procesa učenja. Promatrajući samo inicijalnu točku provjeravanja, vrijednosti aritmetičkih sredina ukazuju na sličnu razinu izvedbe kod sve tri skupine ispitanika, iako postoje minimalne razlike. U drugoj fazi procesa učenja (tranzitivna točka), a
pogotovo u trećoj (finalna točka), spomenute razlike postaju sve izraženije u većini elemenata. Ovo se posebno odnosi na kontrolnu grupu ispitanika. Ovakav rezultat ukazuje na kvalitetu eksperimentalnog programa.

Kada promatramo statičke elemente, točnije svijeću i most, očito je kako je kontrolna grupa ispitanika elemente izvodila bolje od dječaka u drugoj točki provjeravanja. Međutim, to nije slučaj i kod težih, dinamičkih elemenata. Treća faza ukazala je na pravi učinak eksperimentalnog tretmana gdje su i djevojčice i dječaci elemente izvodili bolje od kontrolne skupine ispitanika.

Aritmetičke sredine rezultata u retencijskim fazama također su prikazane u Grafovima od 1 do 4. Iz razloga što nisu sudjelovali u eksperimentalnom tretmanu, razina znanja kontrolne grupe nije ni procjenjivana u retencijskim točkama provjeravanja. Generalno, vrijednosti aritmetičkih sredina ukazuju na smanjenje razine izvođenja u prvoj retencijskoj točki za sva gymnastička znanja. Međutim, važno je napomenuti kako je kvaliteta izvođenja elemenata u drugoj retencijskoj točki veća nego u inicijalnoj točki provjeravanja za obje grupe, što je dokaz uspješnog procesa učenja. Promatrajući drugu retencijsku točku u odnosu na prvu, zabilježen je mali pad u razini izvođenja kod svih elemenata.

Graf 1.-4.

Primijenjena je ANOVA za ponovljena mjerenja kako bi se utvrdile razlike u izvedbi ispitanika u zadnje tri točke provjeravanja. Rezultati su prikazani u Tablici 2.

Tablica 2.

Zabilježene su statistički značajne razlike između finalne i retencijskih točaka provjeravanja za većinu elemenata, osim za element svijeća kod dječaka (0.06) i zvijezda kod djevojčica (0.37). Pomoću post-hoc Tukey testa otkrivena su specifične razlike između mjerenja. Značajne su razlike pronađene između finalne i prve retencijske točke, kao i između finalne i druge retencijske točke provjeravanja, dok analiza razlika između dviju retencijskih točaka nije bila statistički značajna, što je ukazalo na dosljednost u izvedbi elemenata.

Ponovno analizirajući grafove od 1 do 4 primjećujemo kako djevojčice imaju veću razinu izvođenja svih gymnastičkih znanja od dječaka. U inicijalnom mjerenju, međutim, nisu zabilježene takve razlike, osim u elementu koluta naprijed. Nadalje, značajne razlike među spolovima u drugoj točki provjeravanja kod dva (svijeća i zvijezda) od četiri elementa.
ukazuju kako djevojčice neke elemente usvajaju brže od dječaka. Analizom dvije retencijske točke provjeravanja, uočavamo značajne razlike među spolovima u oba provjeravanja i kod svih gimnastičkih elemenata osim kod elementa svijeća. Također, prema rezultatima Tablice 2, dječaci su zadržali razinu znanja elementa svijeća, dok su djevojčice na istoj razini izvodile element zvijezda. Rezultati u zadnje tri točke provjeravanja pokazali su iste razlike i kod dječaka i kod djevojčica.

**RASPRAVA I ZAKLJUČAK**

Mjerenja razine izvođenja znanja s ciljem procjene učinkovitosti procesa učenja u gimnastici možemo smatrati vrlo kompleksnim. Komponente koje su bile potrebne u eksperimentalnom tretmanu uključivale su faze obrade informacija važne za proces učenja, kao i oblike vanjskih povratnih informacija koje su dostupne onima koji uče. Takve povratne informacije bile su važan motivacijski čimbenik za sve tri grupe ispitanika koje su bile pod vodstvom istog trenera. Pronađene značajne razlike između kontrolne i eksperimentalnih grupa u drugoj, i posebice trećoj točki provjeravanja, dokaz su kako je eksperimentalni plan i program tjelesne i zdravstvene kulture učinkovitiji od redovnog plana i programa što je potvrda prethodnih istraživanja (Babin, Bavčević, Prskalo, 2010). Također je primjetno kako kontrolna grupa ispitanika ostvaruje puno bolje rezultate u statičkim elementima od eksperimentalne grupe u istoj fazi učenja. Međutim, složenija i dinamičnija gimnastička znanja predstavljaju problem za skupinu ispitanika koji su pohađali satove tjelesne i zdravstvene kulture po redovnom programu.

Vodeći se teorijama motoričkog učenja, vrlo je važno da naučena vještina bude zadržana i nakon određenog razdoblja bez vježbanja. Učenje gimnastičkih vještina, kao diskretnih i zatvorenih vrsta znanja, ovisi o procesima koji se koriste u motoričkom učenju. Promjene koje se događaju su na razini centralnog živčanog sustava, postaju trajne i stabilne te prate povećanje razine izvedbe određene vještine. Ova studija sugerira kako bi pamćenje takvih vještina kod sedmogodišnjih djece moglo biti specifično ovisno o spolju. Točnije, prema rezultatima retencijskog mjerenja kod elemenata svijeća, primijenjena frekvencija uvježbavanja bila je dovoljna samo kod skupine dječaka, dok je kod elemenata zvijezda frekvencija uvježbavanja bila dovoljna samo kod djevojčica. Ovo je moguće objasniti činjenicom da je svijeća jednostavan statički element, pogotovo za djevojčice koje dokazano imaju veću fleksibilnost od dječaka. S druge strane, zvijezda je kompleksniji, dinamičan element koji je vrlo zahtjevan za učenje.
Pa ipak, razina izvedbe zvijezde ne opada u retencijskim fazama. Stoga je moguće zaključiti kako složenost zadataka i razina izvedbe u motoričkoj fazi učenja nisu dovoljno dobri prediktori za memoriранje diskretnih, zatvorenih znanja i vještina. Što je zadatak složeniji to ispitanici više uče prema memori, što je bolja i trajnija strategija učenja. Ova pretpostavka mogla bi biti korisna kao baza za razvoj aktivnijih, složenijih i integrativnih strategija motoričkog učenja. Prilikom učenja gimnastičkih znanja, djevojčice usvajaju brže i postižu veću razinu izvedbe od dječaka čime pridonose boljim procesima memoriранja. Osnovne kretnje sportske gimnastike obilježava eneričnost, dinamičnost i izražajnost, što učenicima pruža jedinstveno iskustvo pokreta.

Nedovoljna frekencija uvježbavanja određene vještine ili znanja onemogućava učeniku zadržavanje visoke zadržavanje tokom vremena bez vježbanja. Prema dobivenim rezultatima, potrebno je povećati frekvenciju ponavljanja znanja most, kolot naprijeđ i zvijezda kod dječaka, te frekvenciju ponavljanja znanja svijeća, most i kolot naprijeđ u planu i programu djevojčica. Svakako, zadatak je učitelja osmisliti takav kurikulum koji će omogućiti djeci akcivan proces učenja i puno sudjelovanje u svakoj nastavnoj jedinici. Williams, A., Davids, Burwitz & Williams, J. (1992) ističu važnu ulogu pamćenja u razumijevanju fenomena interpretacije dostupnih informacija. U ovom istraživanju autoori su pokušali predvidjeti optimalnu količinu vježbanja za sedmogodišnju djecu, a u cilju učenja osnovnih gimnastičkih znanja. Primijenjena količina vježbanja smatra se dovoljna za postizanje željene razine izvedbe u aktivnim fazama procesa učenja. Dakako, ta količina nije bila dovoljna za potpuno memoriранje znanja nakon prestanka procesa učenja u retencijskim fazama. Očito je kako ispitanici nisu dostigli automatizacijsku fazu učenja već se njihova razina znanja može okarakterizirati višom razinom motoričke faze učenja.

Tjelesna i zdravstvena kultura prepoznata je primarno kao aktivnost muške populacije (Solomon et al., 2003) u kojoj se aktivnosti mogu podijeliti na one koje preferiraju dječaci (košarka, rukomet i nogomet) i na one koje preferiraju djevojčice (gimnastika, ples i plivanje) (Mazzardo, 2008). Ovo istraživanje potvrđuje činjenice kako su preferencije ispitanika u skladu s njihovim kompetencijama, kada su u pitanju gimnastička znanja, te da djevojčice takva znanja uče brže od dječaka.

Zbog činjenice da se postoje razlike među spolovima mogu riješiti ondešavanjem frekvencije uvježbavanja određenih znanja, autori zagovaraju zajednički plan i program tjelesne i zdravstvene kulture za djevojčice i dječake. Također, gimnastički elementi su nezamjenjivi sadržaji koji se sastoje od bazičnih i specifičnih kretnih struktura i imaju svestrani utjecaj na antropološki status djece (Delaš, Babin & Katić, 2007; Delaš, Zagorac & Katić,
2008), te bi trebali igrati važniju ulogu u kurikulumu tjelesne i zdravstvene kulture, pogotovo u prvim razredima osnovne škole. Kako bi planovi i programi tjelesne i zdravstvene kulture bili uspješni, učitelji bi trebali: analizirati trenutne znanstvene spoznaje; prepoznati specifične probleme učenika prilikom učenja novih i složenih znanja; poštivati razlike među spolovima; i ohrabrivati učenike na veće sudjelovanje u kineziološkim aktivnostima putem uvođenja novih sportova i disciplina u plan i program tjelesne i zdravstvene kulture.