# THE EFFECT OF DIFFERENT TEACHING SYSTEMS IN LEARNING RHYTHMIC GYMNASTICS APPARATUS MOTOR SKILLS

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***Abstract***

*The purpose of this study was to examine which of the two teaching systems, the Current Teaching System (CTS) and the Serial Organization System (SOS), is more effective in the learning rhythmic gymnastics skills in this novice (basic) level of students. The sample that consisted of 84 novices female students of physical education of Athens, aged 18-20 years old (19.02±0.77) who volunteered to participate in this study separated in two groups ($n_1$=39, $n_2$=43). At first, a pre test wad done to ascertain the initial level of performance and a post test after the end of practice in order to assess the effectiveness of these two teaching methods. All the experimental skills were evaluated by two teachers of University who were also official judges in the sport of Rhythmic Gymnastics. All participants took place in a nine weeks intervention program, 2 times per week for 90 minutes in each session (teaching unit). According to the results, although there was not a group effect in the pre test in each apparatus ($p>.05$), in the post test there was significant group effect in the total number of examined skills ($p<.05$). Further, there was a significant group effect between the two measurements in the total number of skills in each apparatus of ribbon ($p<.05$), rope and clubs ($p<.001$). Furthermore, it has to be stressed that the SOS had higher scores in the majority of examined skills in post test. Conclusively, SOS is more effective than CTS in case of learning Rhythmic Gymnastics skills according to the position of body and apparatus, especially in these cases where the parameters of implementation of exercise are not altered.*

***Keywords:*** *Rhythmic Gymnastics- motor skills- learning.*

## INTRODUCTION

Rhythmic Gymnastics (RG) is a sport that requires increased coordination of body movements and apparatus. In this particular sport gymnasts during training period must execute a great number of motor skills in order to structure their competitive routines, and this is the reason that they perform rhythmic skills, which are characterized by a change of body position and/or locomotion of apparatus (Aparo and her colleagues, 1999). This condition was verified by Karpenko and her colleagues that proposed the utilization of two apparatus for the improvement of performance in a weekly training schedule (Karpenko et al, 2005). On the contrary, other studies support the utilization of even four apparatus in the main part of an instructive-training course (Gaverdovskij et al, 1984; Lisitskaja et al, 1985). However, in RG as a main unit of our educational program, educators pursue the teaching of

more than one of these skills during a session, taking into consideration various factors, as the level and the number of participators, and the duration and the distribution of time of practice. Based on these factors, it is obvious that the method that is used in teaching (total - partial) depends mainly on the type of skills (Wightman & Lintern, 1985) while the type of exercise (selected - random) depends mainly on the characteristics of the skill, the characteristics of the practitioner and the evaluation of learning (Magill & Hall, 1990). A number of studies reported in the planning of practising motor skills, with participants repeating a number of repetitions of the same movement in one session or between several sessions support the superiority of random versus grouped practice (Lee & Magill, 1983; Shea & Kohl, 1990; 1991; Shea, Kohl, & Indermill, 1990). In addition, the way of organizing one practice unit (session) is related to the contextual interference that constitutes the number of various skills that are practiced in the session. Many studies report that the increase of elements that are practiced simultaneously and thus complicating the conditions during one session, results in the better recall of information on the instructing skill after a great amount of time (Bating 1972; Bating 1979; Goode & Magill, 1986). Related literature, according to the contextual interference effect, is referred mainly to laboratory conditions (Del Ray, 1982; 1989; Gabriel, Hall and Lee, 1989; Lee and Magill, 1983; Shea & Morgan, 1979; Wulf & Lee, 1993). Further, there is evidence that random practice surpasses considerably the method of grouped practice in the retention of motor skills (French, Rink and Werner, 1990; Goode, & Magill, 1986; Hall, Domingues and Cavazos, 1994; Wrisberg and Liu, 1991). Goode and Magill (1986) used three different types of service in badminton revealed that group followed random practice and serial practice achieved higher levels of maintenance and transfer of learning contrary to the group that followed grouped practice. This is also well documented by Bortoli and his colleagues that apply a similar method during practice in volley ball skills (Bortoli et al, 1992). Similar results are reported also by Wrisberg and Liu (1991) who examined in real teaching conditions students who learned two types of service (grouped practice: completion of total number of trials of each skill) and alternative practice: alternation of service types in predetermined order), with the group that followed alternative method of teaching to achieve higher levels of transfer and retention of these skills.

From motor control perspective, learning is directly linked to the memory that is reported as an internal data or representation of some fact or experience that preceded (Gordon, 1989). According to Anderson (1987) declarative memory is responsible of the process of learning, in cases where a performer who knows what to do to perform a motor skill. Also, the ability to recall information is influenced by the time interval that intervenes from the end of exercise up to the examination of the skill according to the closed loop theory (Adams, 1971). In this case the mnemonic trace, which is responsible for the choice and start of a certain plan of movement, becomes weaker because of the time interval and the intervention of other information before the skill or after this, and this constitutes one of the causes for the disability of the performer to utilize the essential information from the memory. Schmidt, (1991) with regard to the transfer of learning, supports that the movement-criterion, according to that the application of learning, concerns the attribution of another movement that was acquired by a different movement or situation. Moreover, according to Schmidt and Young (1987) learning of one skill influences the learning of another skill and, in this case transfer of learning leads to the creation of more complete knowledge for the utilization of various teaching strategies.

According to the Current Teaching System (CTS) in RG in our Faculty, the practice of a new skill in one apparatus

begins after the completion of the number of repetitions of the previous one and is continued until all skills are completed in each apparatus. For this reason a new system of teaching is proposed (Serial Organization System: SOS), where students practise different skills in different apparatus in random order in the same session, and it is expected that this method contributes to a positive effect on learning these skills. The purpose of this study was to investigate the effect of two different teaching systems (CTS - SOS) in learning Rhythmic Gymnastic skills that are performed in normal conditions during the course of RG in the practice hall.

## METHODS

Eighty-four female gymnasts of Faculty of Physical Education and Sport of Athens University aged 18-20 years (19.02±0.77) volunteered to participate in this study and for this reason signed a consent form. No significant difference was found in chronological age between these groups (19.05±0.76 and 19.00±0.79 respectively). All participants were novices with no previous experience in rhythmic gymnastics motor skills. Students that were gymnasts on the past in any competitive level were excluded from this study.

The initial level of performance was assessed with a pre test that includes all the examined skills. After this initial evaluation participants were separated in two groups. The first group ($n_1$=39) that followed massed practice was in accordance with CTS that means, participants of this group complete all the trials of first skill in 1st apparatus and then practised the 2nd skill in the same (first) apparatus. The second group ($n_2$=43) that followed SOS (successive practice), based on the proposed teaching system, completed trials of the 1st skill in each apparatus and then practised the 2nd skill in each apparatus, and so on. This means that participants of 2nd group have an experience, successively, in all apparatus, before they begin the 2nd skill in each apparatus. This differentiation exists in regard to the choice of apparatus and skills so that in each session new skills are taught in different apparatus in random order. The insertion of participants into two aforementioned groups was based to the definition of groups according to the time schedule of study program of this department. The time period of nine weeks that correspond to the time schedule of teaching RG in our Faculty, constitutes the macrocycle in the RG course in the periodical circle of studies for these participants. Teaching these skills was done in constant conditions for two groups. Participants practised these skills according to the study's program of the department, for 90 minutes per session, two times per week for nine weeks (one semester) for all teaching and examined skills.

All participants independently form the assigned group, performed the same skill in each apparatus in random order, according to structural groups and groups of handling of apparatus as the planning of teaching matter reports. They were simple or complex discrete skills that required coordination of body and apparatus and in other cases coordination of apparatus and body concerning the space, e.g. throwing of apparatus and catching after the flight phase (table 1). Throughout the practice sessions, participants received verbal instructions, which determined the basic technical characteristics of these skills (Kim et al, 1998; Wright, 1991). One day after the end of the interventionist program, a post test was performed to evaluate the learning of these skills. Two educators with many years of international judging experience in RG evaluated each skill separately according to the code of points (FIG, 2006). During the post test each participant did not observe performances of other participants, in order to exclude observational learning effect (Bandura, 1977; Keele, 1968) and for this reason they remained in a special formative space waiting for their call.

The apparatus that were used were the five Olympic portable apparatus (ball, hoop, rope, ribbon and clubs) according to the code of points that is in valid (FIG, 2009).

On the three factors of evaluation in the RG: execution, artistry (artistic value) and difficulties (technical value), the present research focused only in the evaluation of execution, which is done in a 0-10 points scale, and the score is calculated by deducting tenths of points depending on the degree of the mistake. The apparatus and the skills are presented in table I.

Table 1. *The apparatus and skills of Rhythmic Gymnastics according to international code of points.*

| | Ball | Hoop | Rope | Ribbon | Clubs |
|---|---|---|---|---|---|
| 1 | Swing | Swing | Swing | Swing | Swing |
| 2 | Rotation | Rotation | Rotation | Rotation | Rotation |
| 3 | Throw & catch | Throw & catch | Throw & catch | Throw & catch | Throw & catch |
| 4 | Rhythmical bounces | Rotation standing on the palm | Skips/Hops | Tosses | Small Circles |
| 5 | Roll on the floor | Roll on the floor | Small Circles / Rotations | Spirals | Mills |
| 6 | Roll over the body | Roll over the body | Skips or Hops into the rope | Snakes | Asymmetric movements |

## RESULTS

Student's test for independent samples was used to examine the differences between two groups. The level of significance was set at $p < 0.05$. There was not a group effect in the pre test in each apparatus ($p>.05$) On the contrary, in the post test there was significant group effect in the total number of examined skills (5 apparatus - 6 skills) (4.79±3.02, 5.43±2.66, 1st and 2nd group respectively). There was significant group effect between the two measurements in the total of skills in each apparatus of ribbon ($p<.05$), rope and clubs ($p<.001$). The means and standard deviations of two groups in two evaluation measurements are presented in table 2.

Table 2. *Means and standard deviations (in parentheses) on the scores in evaluations apparatus into two experimental conditions in two groups.*

| | Pre test | | Post test | | |
|---|---|---|---|---|---|
| | Group1 | Group2 | Group1 | Group2 | P |
| Ribbon | 2.04 (2.15) | 2.23 (2.09) | 5.02 (2.93) | 5.39 (2.65) | * |
| Rope | 2.02 (1.91) | 2.38 (2.13) | 4.59 (2.99) | 5.53 (2.44) | *** |
| Ball | 3.45 (1.92) | 3.61 (2.11) | 5.84 (2.35) | 6.08 (2.11) | |
| Clubs | 1.80 (2.19) | 2.44 (2.19) | 3.31 (3.36) | 4.82 (3.05) | *** |
| Hoop | 2.47 (2.02) | 2.58 (2.26) | 5.19 (2.83) | 5.27 (2.82) | |

* P < 0. 05, *** P < 0. 001

Table 3. *Means, standard deviations on the scores in evaluations skills in every apparatus in the post test in the two groups, as well as the level of significance between two measurements.*

| Apparatus | Skill | Post test | | level of significance |
|---|---|---|---|---|
| | | 1st group | 2nd group | |
| | 1 | 5.66 (2.55) | 5.79 (2.41) | |
| | 2 | 4.65 (3.47) | 6.74 (1.71) | ** |
| | 3 | 5.87 (1.52) | 5.79 (1.71) | |
| Ribbon | 4 | 2.87 (3.06) | 2.87 (3.17) | |
| | 5 | 5.33 (2.88) | 5.62 (2.42) | |
| | 6 | 5.69 (2.76) | 5.53 (2.77) | |
| | 1 | 5.10 (2.88) | 5.88 (2.21) | |
| | 2 | 3.79 (3.63) | 5.71 (2.29) | ** |
| | 3 | 4.97 (2.24) | 5.95 (1.78) | * |
| Rope | 4 | 6.42 (1.60) | 6.31 (1.44) | |
| | 5 | 3.10 (2.97) | 4.59 (3.05) | * |
| | 6 | 4.18 (3.19) | 4.70 (3.09) | |
| | 1 | 5.77 (2.24) | 5.74 (2.85) | |
| | 2 | 4.00 (3.62) | 5.14 (3.14) | |
| | 3 | 6.41 (1.16) | 6.52 (1.27) | |
| Ball | 4 | 6 .68 (0.93) | 6.76 (1.11) | |
| | 5 | 6.12 (1.69) | 6.40 (1.34) | |
| | 6 | 6.00 (2.42) | 6.19 (1.42) | |
| | 1 | 5.38 (2.85) | 6.30 (2.12) | |
| | 2 | 3.79 (3.83) | 5.55 (2.94) | * |
| | 3 | 4.92 (2.44) | 5.83 (2.41) | |
| Clubs | 4 | 4.28 (3.22) | 5.70 (2.23) | * |
| | 5 | 0.92 (2.39) | 1.46 (2.38) | |
| | 6 | 2.94 (3.34) | 2.69 (3.13) | |
| | 1 | 5.97 (1.72) | 6.11 (2.17) | |
| | 2 | 3.44 (3.56) | 4.88 (3.22) | |
| | 3 | 6.51 (1.21) | 6.37 (1.29) | |
| Hoop | 4 | 5.23 (2.89) | 4.86 (3.46) | |
| | 5 | 6.05 (1.76) | 5.93 (1.86) | |
| | 6 | 3.94 (3.56) | 3.49 (3.25) | |

p < ,05* p< ,01 **

Further, t-test for independent samples revealed significant differences of individual skills between two groups, but not in all cases. It is mentioned that in a total number of 30 skills, the 2nd group had a better performance in relation to 1st group in a 20% (6 from 30) of total skills, which characterized the superiority of this group (table III). The means and standard deviations as well the level of significance between two systems in each skill in each apparatus in the post test is presented in table 3.

According to the results of table 3 in ribbon apparatus, an unclear picture appeared regarding the comparison of two teaching systems in the allocated skills. However, it has to be stressed that the SOS had higher scores in the majority of examined skills in post test. The superiority of SOS is very clear in rope and it has to be stressed that there was a significant differences in the half of the examined skills (2nd, 3rd and 5th skill). In ball SOS showed clear superiority as well, but without any significant difference in the examined skills. The superiority of SOS is obvious in five of all six examined skills, showing significant differences in the second and fourth skill. In hoop, both teaching systems are equally efficient with some minor differences but with no statistical significance in the examined allocated skills.

## DISCUSSION

All practitioners, independent from the teaching system they followed, improved considerably ($p<001$) the initial level of performance. Maybe the level of physical conditioning of participants had a positive effect on learning rhythmic gymnastics skills as physical education student's posses an efficient level of performance. This verify previous data of Miletic and his colleagues which support that factors as coordination and strength of lower limbs contributed mainly to the jumping ability performance (Miletic, Sekulic and Jasenka, 2004), and those of Miletic et al which revealed that factors as flexibility and explosive strength contribute to successful performance in rhythmic gymnastics basic body elements (Miletic, Katic, and Males, 2004).

Whoever, the effectiveness of the proposed method is based to the fact that a great percentage of the examined skills scored higher in relation to the CTS. Serial Organization System is superior according to grades in the 20 from the total 30 examined skills. In addition, the statistical difference in six (6) skills that was appeared indicates the superiority of 2nd group in relation to the 1st group. The second group that practised simultaneously in different skills and apparatus, at the duration of each instructive hour achieved higher levels of learning concerning the team that completed the learning of skills in one apparatus and then was trained in the skills of the next apparatus. It should be reported that individual skills in RG that vary in the degree of difficulty require co-ordination of movements between body and apparatus. In this case, according to Kioumourtzoglou and his colleagues (1997), the previous experience in general motor abilities e.g. dynamic and static balance, sense of kinesthesis as well as perceptual abilities e.g. whole-body reaction time, and eye-hand movement, may affect positively the performance of rhythmic gymnastics skills in these physical education female students that participate in our study. In addition, observation of performances by other participants may influence positively performance in these experimental skills in our sample. This situation is in accordance with finding of Magill and Schoenfelder-Zohdi (1996) who using a rhythmic gymnastics rope manipulation skill, revealed that participants who observed the model made fewer errors pertaining to the coordination patterns of their body and limbs than did those participants that had not observed the model.

Further, the results of the present study are in agreement with other data (Aparo et al, 1999; Bortoli et al, 1992; French et al, 1990; Hall et al, 1994; Karpenko et al, 2005; Lisitskaja et al, 1985) which support that the application of successive method is more effective than the grouped practice when teaching motor skills.

More concretely, in skills where does not exist a change of body position but only the locomotion of apparatus in the space, the two systems are equally effective. This fact is in agreement with other studies which state that the characteristics of skills are basic factors for the existence of not statistically important differences between the grouped and successive practice, specifically in the cases where emphases is given in the precision of orbit of movement despite the correct implementation of movement (Bortoli et al, 1992; French et al, 1990). In skills where the schema-posture of body and the level of movement in the space in frontal plane are not altered, as in rotation, e.g. 4th skills in hook, SOS surpasses considerably the CTS method in the overwhelming majority of apparatus (four from the five apparatus: rope, hoop, ball, clubs, ribbon), while a mixed picture is observed in other skills independent from existing or not of transfer of learning from previous motor experiences as it happens to girls that in their childhood are engaged in motor games where they used the ball (bounces, throws and caches, rolls), the rope (rope turning forward / backward, throws and caches , rotations ) or the hoop (rolls, rotations) etc. In these cases it appears that

both systems of teaching are equal effective. On the whole, according to the results a) learning with both systems of teaching was effective, b) SOS is more effective in these skills where that are not altered the parameters of implementation (form, level). Further, both systems are equally effective in those gymnastic skills that exists transform of learning from previous motor situations or in the skills that do not exist change of body position but only change of apparatus.

Another interesting point is to emphasize the effectiveness of teaching period in our Faculty. The macrocycle devided in periods, should aim, among others, in the assimilation of a new and perfection of already known curriculum. (Karpenko et al, 2005). Conclusively, the Serial Organization System (SOS) is more effective than Current Teaching System (CTS) in learning rhythmic gymnastics' skills in contrast to the selected exercise, specifically in cases where increased co-ordination of movements of body and apparatus is required.

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