

ORIGINAL ARTICLE

**The effect of a music/
movement program on
preschooler's motor
rhythmic ability****Fotini Venetsanou¹, Olyvia
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Rhythm is present in any human activity (Oreb & Kilibarda, 1996) affecting not only the music performance but also the performance in maths, language and academic achievement (Kuhlman & Schweinhart, 1999), that is a wide framework of human cognition and behaviour. Moreover, rhythm is believed to influence the development, performance and learning of motor skills (Thomas & Moon, 1976).

However, in spite of its significance in human's life there seems to be no consensus for the exact meaning of the multifaceted rhythmic phenomenon. In late '60s, Barsch (1967) differentiated the perceived-reproduced rhythm from the performance rhythm. The first one includes the perception of a rhythmic stimulus and the reproduction of the pattern, while the latter comprises of consistent reproduction of a movement pattern with both spatial and temporal accuracy and it is closely associated with skilled motor performance (Thomas & Moon, 1976). Already in '70s, several studies showed that someone's ability to perceive the rhythm is not highly associated with his/her ability to perform rhythmic movements (Huff, 1972; Schwanda, 1970).

Abstract

The aim of the present study was to examine the effect of a music/movement program on the motor rhythmic ability of 70 children, aged 48-72 months (59.67 ± 6.38) randomly assigned to experimental (EG, $n=36$) and control group (CG, $n=34$). The EG participated in a 20-week music/movement program, while the CG did not follow any organized physical activity. Before and after the program children's rhythmic ability was measured using the subtest "Jump on the rhythm" of the Democritus-Psychomotor Assessment Tool for Preschool Children (PAT-PRE). According to the results of the two-way ANCOVA that was implemented, both program and gender had a statistically significant effect on children's scores ($F_{1,65} = 222.24, p < .001, \eta^2 = .84$ and $F_{1,65} = 6.60, p < .05, \eta^2 = .09$ respectively) after controlling for the effect of the pre-test, while there was not a significant effect of those factors' interaction. The children of the EG had significantly higher scores than those of the CG, while girls outperformed boys in both groups. However, effect size value of gender was moderate; consequently, these differences were not of practical importance. The current findings provide support for the beneficial effect of a developmentally appropriate music/movement program on rhythmic ability of preschool aged children.

Keywords: rhythm, intervention, music, preschool age, DEMOST-PRE

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Thomas and Moon (1976) described the term performance rhythm as “the ability to perform a succession of regulated, recurring gross motor events requiring both spatial and temporal accuracy” (page 21). This definition was used to describe also the terms “motor rhythmic ability” (Thomas & Moon, 1976) and “rhythmic ability” (Derri, Tsapakidou, Zachopoulou & Gini, 2001).

Rhythmic ability of children and the factors affecting it have been investigated in several studies. Thus, there is a consensus about the influence of age, as an indicator of maturation, on children’s rhythmic ability (Buchanan, 1988; Kuhlman & Schweinhart, 1999; Moog, 1976; Rainbow, 1981; Schleuter & Schleuter, 1985; Smoll, 1973; 1974; 1975). Reversely, the findings about the influence of gender are conflicting. Some researchers state that there are no differences between preschool aged boys and girls’ rhythmic ability (High, 1987; Kuhlman & Schweinhart, 1999; Smoll, 1973; 1974; 1975; Thomas & Moon, 1976), while others support girls’ superiority (Agdiniotis et al., 2009; Flohr, 1991; Kambas, Beis, Mavridis, Papargiriou & Taxildaris, 1995; Kambas, Aggeloussis, Gourgoulis, Barbas & Antoniou, 2000; Pollatou et al., 2012; Pollatou, Karadimou & Gerodimos, 2005; Schleuter & Schleuter, 1989; Weikart, 1982).

Among the previous studies, an interesting approach was that of Pollatou and colleagues (2005) who examined the differences between five-year old boys and girls’ musical aptitude, rhythmic ability and gross motor skills. For that purpose, they used the scores of 95 children in the Primary Measures of Music Audiation (PMMA) (Gordon, 1986), the High/Scope Rhythmic Competence Analysis Test (RCAT) (Weikart, 1989) and the Gross Motor Development-2 (TGMD-2) (Ulrich, 2000). According to their results, there were no significant differences in PMMA and TGMD scores, while girls surpassed boys in four of the six tasks of the RCAT (patting knees with both hands, patting knees with alternate hands, tapping floor with alternate feet from a seated position, walking in place). Regarding the superiority of girls in some tasks of Weikart’s (1989) assessment tool, similar were the findings of Derri et al. (2001), who found that girls were more accurate than boys in synchronizing bilateral hand movements to rhythm while boys were better on synchronizing bilateral foot movements.

Music is one of the most important elements of human life, it motives cognitive development (Cross, 1999), can evoke a variety of emotional responses (Mc Donald-Tselentis, 2000) and, thus, the early exposure of children to music experiences can have an impact on both their brain’s physiology (Billartz, 1998; DeBeus, 2000; Griffin, 1999) and their personality (Sergi, 1980). Orff and Dalcroze, the most important music pedagogues, developed their music and movement approaches on the belief that there is an indissoluble relationship between movement and music (Androutsos, 1995).

As movement is an integral part of children’s life, its integration with music led music teaching in new paths. Music/movement programs have been proved to be effective not only for the improvement of children’s rhythmic ability (Blessedel, 1991; Croom, 1998; High, 1988; Pollatou et al.,

2012; Zachopoulou, Derri, Chatzopoulos & Ellinoudis, 2003), but also for their motor skills (Brown, Sherrill & Gench, 1981; Chatzipanteli, Pollatou, Diggelidis & Kourtesis, 2007; Deli, Bakle & Zachopoulou, 2006; Derri, Tsapakidou, Zachopoulou & Kioumourtzoglou, 2001; Pollatou & Hatzitaki, 2001; Zachopoulou, Tsapakidou & Derri, 2004), language (Tsapakidou & Zachopoulou, 2001; Yazejian & Peisner-Feinberg, 2009) and school readiness (Pavlidou, 1998).

Focusing on studies investigating the effect of music/movement programs on children's rhythmic ability, it is revealed that in earlier studies (Blessedel, 1991; Croom, 1998; High, 1988) non-locomotor tasks were utilized for rhythmic ability assessment while in more recent ones (Pollatou et al., 2012; Zachopoulou et al., 2003), the High/Scope Beat Competence Analysis Test (Weikart, 1989) was used that includes tasks like hand tapping, foot tapping, patting knees or locomotions, such as walking in place/forward/backward.

Without ignoring the valuable evidence the above studies provide about the positive effect of music/movement programs on children's rhythmic ability, there are issues that should be discussed. Starting with the non-locomotor movements used for the assessment of rhythmic ability, it should be noticed that they are temporal and not space oriented, and they are not congruent with the definition of rhythmic ability reported earlier in this text. Except for Thomas and Moon (1976), Matei (1992) also points out that it is the speech and music rhythm that is accomplished in time, while the rhythm of the movement is accomplished both in space and time. It is obvious that for the assessment of what is called rhythmic ability in a physical education setting, locomotor tasks should be utilized. Moreover, agreeing with Gordon (1979), we strongly believe that gross motor skills should be used in the assessment of young children's rhythmic ability, since it is difficult for them to respond rhythmically using small muscle groups.

Regarding the locomotor skill of walking used in High/Scope Rhythmic Competence Analysis Test (Weikart, 1989), probably it is in accordance with Weikart's (1989) rhythmic training technique, which progresses from rhythmic activities with non-locomotor skills to activities in which children walk following the beat of the music. However, Orff and Dalcroze's approaches move further by emphasizing on reaction in external stimuli and developing movement concepts and improvisation, and thus activating large muscle groups. Moreover, through this process, children understand the rhythm elements, move on the rhythm and become coordinated movers (Gallahue, 1996). Taking into consideration the effects of music/movement programs on children's motor performance and the fact that most preschoolers can perform tasks such as clap, march, walk, jump and run without any previous training (Pica, 2000), one may wonder if assessing children's rhythmic ability by using a locomotor task like walking can show the total influence of a music/movement program on those children's motor rhythmic ability.

The aim of the present study was to investigate the effect of a music/movement program on the motor rhythmic ability of preschool children, using the subtest “jumps on the rhythm” of the Democritus-Psychomotor Assessment Tool for Preschool Children (PAT-PRE) (Kambas, Aggeloussis, & Gavrilidou, 2003), which comprises of tasks requiring both spatial and temporal accuracy.

Methods

Participants

Seventy children 48-72 months of age ($M=59.67$ months, $SD= 6.38$) volunteered to take part in the study. Having received parents’ written consent for their children’s participation, we randomly allocated the participants into the experimental (EG, $n=36$) and the control group (CG, $n=34$) respectively. The children of the EG participated in a 20-week music/movement program, while the CG did not follow any organized physical activity.

Procedure

All the measurements took place during the school hours at specially modulated indoor area at participants’ schools. Each child was measured individually, without the presence of other children or adults, according to the guidelines of the test manual.

In order to minimize the performance variability stemming from factors such as the examinees, the testing environment, the examiner and the test, and threatening the results reliability (Gowland et al., 1995), the following precautions were taken:

- a) Attention was paid on examinees’ comfort, during the measurement. Consequently, time necessary for children’s familiarization with the testing environment was given. Moreover, when a child felt tired or did not feel well, the measurement was postponed.
- b) There was an effort to create a consistent measurement environment, regarding both the space and the time of the measurement.

All the measurements were conducted by the same examiner, who was experienced with the PAT-PRE administration and scoring system. The intra-rater reliability had been checked in a previous study, using the intra-class correlation coefficient (3.1) and was found to be excellent ($R = .93$) (Venetsanou, 2007).

Measures

The “Jump on the rhythm” subtest PAT-PRE (Kambas et al., 2003) was used to assess children’s rhythmic ability before and after the implementation of the program.

The PAT-PRE is the first Greek battery for the assessment of motor performance of children aged 48-72 months and its development was based on the “Motoriktest für 4-6 jährige Kinder” (MOT 4-6) (Zimmer & Volkamer, 1987). It includes 13 tasks examining speed of movement, agility and

orientation in space, dynamic and static balance, flexibility, body coordination, rhythmic ability, upper limb coordination, visual motor coordination, response ability, aiming and anticipation. Its unique feature is that the tasks the examinee has to perform are presented through a fairytale so as he/she to be motivated to participate in the measurement. Moreover, that feature helps avoiding a rigid evaluation climate that could harm the assessment process (Eggert, 2000). Regarding its psychometric properties, research findings provide evidence supporting its construct validity (Kambas, Venetsanou & Aggelousis, 2006), concurrent validity with the BOTMP-LF (Bruininks, 1978) (Kambas, Venetsanou, Aggeloussis, Zimmer & Gavriilidou, 2008), as well as its test-retest reliability (Kambas et al., 2008; Kambas, Venetsanou & Aggeloussis, 2007).

The subtest “jump on the rhythm” includes the following tasks the individual is asked to perform:

- a) Consecutive jumps in his/her personal rhythm (there is no external stimuli) for 10 seconds.
- b) Consecutive jumps that must be synchronized in the tempo of 100 beats per minute, in a $4/4$ rhythm, produced by a metronome for 10 seconds.
- c) Jumping jacks with arms above shoulder height in his/her personal rhythm for 10 seconds.
- d) Jumping jacks with arms above shoulder height that must be synchronized in the tempo of 100 beats per minute, in a $4/4$ rhythm, produced by a metronome for 10 seconds.

The execution of the test tasks was preceded by a short practice trial lasting less than 10sec. This trial is a visual follow - the leader demonstrating the movement without an external stimulus. During the testing procedure, the examiner does not provide any instruction to the examinee, such as “faster”, “slower”, etc.

Regarding the scoring of each task, there are three criteria that should be fulfilled: coordination, rhythm and duration of the movement. For the first two tasks, one point is given for the achievement of each criterion, while for the second two tasks, two points are given. The minimum score for the subtest is zero and the maximum 18.

The technical adequacy of the subtest is sufficiently supported. Specifically, the test scores differentiate the performance of the four 6-month age groups formed in preschool age and have adequate sensitivity to identify longitudinally both the motor development and the effect of an intervention (Venetsanou, 2007). Regarding its reliability, it has been found that it has excellent interrater and test-retest reliability, as computed using the ICC (2.1) ($R = .93$ and $.854$ respectively) (Venetsanou, 2007). Moreover, due to the fact that the value of ICC is affected by sample homogeneity (low homogeneity results to high ICC values) apart from the ICC, the standard error of measurement (SEM) that is not influenced by the variability among the subjects had been calculated too (Atkinson & Nevill, 1998). The SEM was found to be 1.07. That means that when a child has a raw score of 11, we can

say (with 95% confidence) that if the same child is going to be re-assessed after a week, his/her performance will range between 9 and 13 ($11 \pm 1.96 \times 1.07$), a range that is not large if we consider that the performance in that specific test range between 0 and 18 (Venetsanou, 2007).

Program

The content of the music and movement program was based on the rhythmic education principles of Orff and Dalcroze approaches (Androutsos, 1995). Thus, emphasis was given on (a) traditional singing games, (b) percussion movements (e.g. clapping, tapping, etc) and rhythmical locomotion movements accompanied with music in a 4/4 rhythm, (c) activities emphasizing reaction in both auditory and visual stimuli and (d) activities aiming at enhancing children's creative movement. Percussion instruments, such as maracas, tambourines, etc, were also used for rhythm patterns production.

Moreover, a large part of each lesson was comprised of activities aiming at developing movement concepts (body awareness, space awareness, effort and relationships) (Dania, Koutsouba & Tyrovola, 2013; Koutsouba, 2005; Laban & Lawrence, 1974). Among them, body and space awareness constituted the core of the lessons, especially in first weeks, as they are thought to be the starting point for every movement program regarding young children (Pica, 1996). Thus, activities in which children had to identify their body parts, pretend to be large/small/tall/short statues (body shape) or walk/run/jump on straight/curved/zigzag paths were conducted.

The main education means for teaching all the aforementioned concepts was the dramatization, in order to sustain children's interest, to help them think creatively and to offer them something familiar to refer to during the recall process (Gallahue, 1996; Lorenzo-Lasa et al., 2007; Sacha & Russ, 2006).

The program was conducted for a 20 - week period, twice a week, in the preschool classroom. Each lesson lasted 45 minutes and included 8-9 game-like activities.

Statistical analysis

First, the possibility of statistical significant differences between the scores of EG ($M= 6.29$, $SD=1.7$) and the CG ($M=9.20$, $SD= 2.10$) in pre-test was checked, calculating an analysis of variance. In the presence of significant differences between the two groups ($F= 13.95$, $p< .001$), a two-way analysis of covariance [2 (program) X 2 (gender)] adjusting for pre-test measurement was implemented. The SPSS 20 was used for the statistical analysis.

Results

Means and standard deviations of both groups' performances are depicted in Table 1. The ANCOVA showed that both the factors "program" and "gender" had a statistically significant effect on children's scores ($F_{1,65}= 222.24$, $p< .001$, $\eta^2= .84$ and $F_{1,65}= 6.60$, $p < .05$, $\eta^2= .09$ respectively) after controlling for the effect of the pre-test, while there was not a significant effect

of those factors' interaction. The children of the EG had significantly higher scores than those of the CG, while girls outperformed boys in both groups.

Table 1. Means and Standard Deviations of the performance of the sample on "Jump on the rhythm" subtest at post measures

	Boys	N	Girls	N	Total	N
Experimental group	14.1 ± 1.92	21	15.47 ± 1.81	15	14.67 ± 1.97	36
Control group	8.95 ± 2.08	19	10.07 ± 1.93	15	9.44 ± 2.01	34

Discussion

The aim of the present study was to examine the effect of a music/movement program on preschool aged children's motor rhythmic ability, using a test requiring both spatial and temporal accuracy in gross motor skills. The results showed that there was a significant difference between the EG and the CG in the post-test. Specifically, the children who followed the program had higher scores than their age-mates who did not participate in any organized physical activity.

The current findings are in close agreement with previous studies investigating the effect of music/movement programs based on Orff and Dalcroze's approaches on children's rhythmic ability as it was measured with non-locomotor skills or walking. In particular, in a recent study (Pollatou et al., 2012) the effect of a 6-week music/movement program on the rhythmic ability of 180 preschool aged children was investigated. For that purpose, ninety of the participants followed the intervention program while the rest did not participate in any program. Children's rhythmic ability was assessed before and after the implementation of the program with the High/Score Beat Competence Analysis (Weikart, 1989) and according to the results, in the post-test the experimental group's rhythmic ability was significantly higher than the control's one. Similar were the findings of Zachopoulou et al. (2003) in preschool children for ten weeks and found a significant influence of the program on the EG's rhythmic ability as it was measured with the High/Score Beat Competence Analysis (Weikart, 1989). Moreover, Blessedel (1991) compared the effect of Dalcroze and Laban's approaches in three and four year old children and found that both of them helped children to be more accurate in beating the rhythm of songs. Thus, Blessedel (1991) concluded that movement can be beneficial for children's music development. Croom (1998) was led to a similar conclusion, having found that five and six year old children being taught music through rhythmic locomotions can synchronize their tapping to the rhythm better than their age-mates who received a traditional music lesson.

At this point, it should be noted that in the present study, the children's rhythmic ability was assessed by tasks including gross motor skills requiring an adequate level of motor performance. The latter, is certified by studies investigating music/movement programs on children's motor performance that provide evidence of significant effects. In particular, Derri et al. (2001)

implemented a music/movement program in 68 preschool children for ten weeks investigating its influence on the quality of children's motor skills and they found that the intervention program helped children to improve their performance on galloping, leaping, horizontal jump and skipping. These findings led Derri et al. (2001) to conclude that a music/movement program can significantly contribute to the development of complex motor skills. Pollatou and Hatzitaki (2001) studied the effect of an 8 - week music/movement program on 22 preschoolers' fundamental motor skills. Similar were the findings of Zachopoulou et al. (2004) who examined how rhythmic motor activities implemented for two months in 90 children 4-6 year old affected their performance on jumping and balance skills.

Music/movement programs have been proved to be equally or more effective for motor performance development compared with other educational means. Deli et al. (2006) compared the effects of a 10-week music/movement program on preschoolers' fundamental locomotor skills to those of a movement program without music accompaniment that lasted 10 weeks too. The seventy-five participants of the study were divided into two experimental groups that followed the aforesaid programs and one free play control group. Before and after the implementation of the programs, children's locomotor skills were assessed with the Tool of Gross Motor Development (Ulrich, 1985). According to the results both the experimental groups significantly outperformed the control one, in running, hopping, leaping, horizontal jump, and skipping, while children followed the music/movement program surpassed the control ones in sliding and the children of the movement program in running and leaping. The better results of a music/movement program on preschool children's motor performance compared to a movement one were found in the study of Brown et al. (1981), in which the experimental group participated in a program that integrated Kodaly and Dalcroze's approaches in physical education, while the control group participated in a program of movement exploration, without music.

From the aforementioned, it is obvious that music/movement programs are important educational means for preschool children, helping them to develop their rhythmic ability while at the same time they become competent movers (Gallahue, 1996). As Zimmerman (1984) states, through music and creative movement, children give shape to musical sounds through their projection in space and, at the same time, acquire a spatial sense of themselves in relation to other children and objects, thus learning concepts experientially.

As far as gender is concerned, in the present study, there was not a statistically significant interaction between factors "group" and "gender". This shows that boys and girls improved their rhythmic ability in a similar pattern. Moreover, the results revealed that gender had a statistically significant effect on children's scores, with girls having higher scores than boys. However, before comparing these findings to those of previous studies, it would be beneficial for our conclusions to interpret the results using the effects sizes apart from p values. In this study, η^2 values were used and according to Cohen's (1988) criteria, only values $>.14$ can be considered as

sufficiently large so as to be of practical significance. In this study, the value of η^2 was found to be moderate ($\eta^2 = .09$) and, consequently, the differences found are not of consequence. Several researchers have also found no significant differences between boys and girls in tasks measuring children's response to external rhythmic stimuli (High, 1987; Kuhlman & Schweinhart, 1999; Smoll, 1973; 1974; 1975; Thomas & Moon, 1976). Smoll (1973; 1974; 1975), who was the first who assessed children's rhythmic ability using tasks with not only temporal but also spatial elements, supports that there are no differences between boys' and girls' spatial-temporal motor responses to a rhythmic stimulus. Moreover, Thomas and Moon (1976), argue that gender is not a factor differentiating synchronized motor responses in preschool age.

However, in other studies, girls were found to have higher scores than boys (Agdiniotis et al., 2009; Derri et al., 2001; Flohr, 1991; Kambas et al., 1995; 2000; Pollatou et al., 2005; 2012; Schleuter & Schleuter, 1989; Weikart, 1982). Nevertheless, it should be noticed that the effect size associated with gender is not presented in any of the above studies. It is well documented that the p value describes a relationship that is unlikely to happen, assuming the null hypothesis is true and does not show the strength of the association between the independent variable and the dependent one (gender and rhythmic ability scores respectively, in our case) (Gliner, Morgan, Leech & Harmon, 2001). Consequently, the differences reported in the above studies should be interpreted with caution. Strongly agreeing with Thomas (2000), we perceive that all motor performance differences (and consequently, also rhythmic abilities ones) in preschool age, are culturally and environmentally provoked. Thus, these differences will be sustained unless expectations, perceptions and practice encouragement of "significant others" (teachers, parents, peers, etc) are not gender associated.

In conclusion, the current research findings provide support for the effectiveness of a music/movement program for the improvement of preschoolers' motor rhythmic ability. Thus, the numerous developmental benefits of music/movement experiences should be taken into account and their use should be encouraged. Music/movement activities integrating the power of music with the exploration of body competence to move and improvise can be used as a valuable educational means, providing children with the physical, cognitive and emotional experiences that the physically inactive contemporary life style cannot offer them. In an enjoyable, non-competitive environment, music and movement activities can lay a foundation for an active and healthy life style. In addition, the long-term effects of music and movement programs on children's physical, emotional, cognitive and social development should be the focus of educational research in the future.

References

- Agdiniotis, I., Pollatou, E., Gerodimos, V., Zisi, V., Karadimou, K., & Yiagoudaki F. (2009). Relationship between rhythmic ability and type of motor activities in preschool children. *European Psychomotricity Journal*, 2(1), 24-34.
- Androustos, P. (1995). *Methodoi didaskalias tis mousikis: Parousiasi kai kritiki proseggisi ton methodon Orff ke Dalcroze (Teaching methods of music: Presentation and critical approach of Orff and Dalcroze methods)*. Athens: Edition Orpheus.
- Atkinson, G. & Nevill, A. (1998). Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. *Sports Medicine*, 26(4), 217-238.
- Barsch, R. (1967). *Achieving perceptual motor efficiency*. Seattle: Special Child Publishers.
- Blessedell, D. S.(1991). *A study of the effects of two types of movement instruction on the rhythm achievement and developmental rhythm aptitude of preschool children* (Doctoral dissertation). Available through Dissertation Abstracts International, 52, 2452A.
- Brown, J., Sherrill, C., & Gench, B. (1981). Effects on an integrated physical education /music program in changing early childhood perceptual - motor performance. *Perceptual and Motor Skills*, 53, 51-154.
- Buchanan, J.C. (1988). *An exploratory study of preschool children's synchronization of a selected rhythmic activity with music set at their heart rates* (Doctoral dissertation). Available through Dissertation Abstracts International, 49, 1726A.
- Chatzipanteli, A., Pollatou, E., Diggelidis, N., & Kourtesis, T. (2007). The effectiveness of a music-movement program on manipulative skills performance of six years old children. *Inquiries in Sport & Physical Education*, 5, 19-26.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.
- Croom, P.L. (1998). *Effects of locomotor rhythm training activities on the ability of kindergarten students to synchronize non - locomotor movements to music*. (Doctoral dissertation). Available through Dissertation Abstracts International, 59, 763A.
- Cross, I. (1999). Is music the most important thing we ever did? Music, development and evolution. In: Suk Won Yi (Ed). *Music, mind and science*. Seoul: Seoul National University Press.
- Dania, A. (2012). *Apo ta simvola stin kinisi. Epidrasi tis simiografikis methodou Laban stin ekmathisi tou ellinikou paradosiakou horou (From symbols to movement. The influence of Laban's notation method to the teaching of Greek traditional dance)* (Doctoral dissertation). Department of Physical Education and Sport Science, National and Kapodistrian University of Athens, Athens.
- Dania, A., Koutsouba, M., & Tyrovolas, V. (2013). *Labankido©: a technological application for the distance learning of Greek traditional dance*. In A. Lionarakis (ed.), *Learning Methodologies, Proceedings of the 7th International Conference in Open and Distance Learning* (vol. 3, part A, pp. 144-157). Athens: Hellenic Network of Open and Distance Education.
- DeBeus, R. J. (1999). The effects of music training on electroencephalographic coherence of preschool children (Doctoral dissertation). Available through. Dissertation Abstracts International, 60, 4952B.
- Deli, E., Bakle, I., & Zachopoulou, E. (2006). Implementing intervention movement programs for kindergarten children. *Journal of Early Childhood Research*, 4(1), 5-18.
- Derri, V., Tsapakidou, A., Zachopoulou, E., & Gini, V. (2001a). Complexity of rhythmic ability as measured in preschool children. *Perceptual and Motor Skills*, 92, 777-785.

- Derri, V., Tsapakidou, A., Zachopoulou, E., & Kioumourtzoglou, E. (2001b). Effect of a music and movement programme on development of locomotor skills by children 4 to 6 years of age. *European Journal of Physical Education*, 6, 16-25.
- Eggert, D. (2000). *Diagnostisches Inventar motorischer Basiskompetenzen*. Dortmund: Borgmann.
- Flohr, J. (1991). *A preliminary study of young children's ability to perform a steady beat*. Paper presented at the 1991 Texas Music Educators Convention, San Antonio.
- Gallahue, D. (1996). *Developmental physical education for today's children*. Dubuque: Brown & Benchmark.
- Gordon, E. (1986). *Primary measures in music audition* (revised). Chicago, IL: GIA.
- Gowland, C., Boyce, W., Wright, V., Russel, D., Goldsmith, Ch., & Rosenbaum, P. (1995). Reliability of the Gross Motor Performance Measure. *Physical Therapy*, 75(7), 597-602.
- Griffin, G. A. (1999). A Content Analysis of Abstracts of Music Research with Preschool Children and Infants (1984- 1998). In: R.A. Duke (Ed.). *Texas Music Education Research* (pp. 25-36). Austin, TX: Texas Music Educators Association.
- High, L. (1988). *Effects of selected rhythmic teaching strategies on beat performance skills of kindergarten children*. (Doctoral dissertation). Available through Dissertation Abstracts International, 48, 3067A.
- Huff, J. (1972). Auditory and visual perception of rhythm by performers skilled in selected motor activities. *Research Quarterly*, 43(2), 197-207.
- Jackman, H. (1997). *Early Education Curriculum: A child's connection to the world*. New York: Delmar Publishers.
- Kambas, A., Aggeloussis, N., & Gavrilidou, Z. (2003). *Democritus-Psychomotor Assessment Tool for Preschool Children- Unpublished User's manual*. Komotini.
- Kambas, A., Aggeloussis, N., Gourgoulis, V., Barbas, I., & Antoniou, P. (2000). Epidrasi tis ilikias ka itou filou stin anaptixi ton sinarmostikon ikanotiton paidion proscholikis ilikias (Effect of age and gender in coordination abilities of preschool children). *Phisiki Drastitiotita kai Poiotita Zois (Physical Activity & Quality of Life)*, 1 (in Greek), 51-56.
- Kambas, A., Beis, K., Mavridis, Th., Papargiriou, A., & Taxildaris, K. (1995). *I anaptixi tis sinarmostikis ikanotitas paidion ilikias 4-6 eton (the development of coordination in children 4-6 years old)*. Proceedings of 3rd International Congress of Physical Education & Sports, Komotini, Greece, 19-21 May.
- Kambas, A., Venetsanou, F., & Aggeloussis, N. (2006): *Preliminary study of construct validity of the Democritus Psychomotor Assessment Tool for Preschool Children*. 11th Annual Congress of European College of Sport Science. Lausanne, 5-8 July.
- Kambas, A., Venetsanou, F., & Aggeloussis, N. (2007): *A Preliminary Study of Reliability of the Democritus - Psychomotor Assessment Tool for Preschool Children*. 12th Annual Congress of European College of Sport Science, Jyvaskyla, Finland, 11-14 July.
- Kambas, A., Venetsanou, F., Aggeloussis, N., Zimmer, R., & Gavrilidou, Z. (2008). Eleghos egirotitas kai axiopistias tis neas desmis "Dimorcritos-Ergaleio axiologisis psihokinitikis anaptixis gia paidia prosholikis ilikias" (Examination of validity and reliability of the new battery "Democritus - Psychomotor Assessment Tool for Preschool Children". 10th Pan-Hellenic Congress of Sport Psychology. Sport Psychology Association. Athens, 12-14 December.
- Koutsouba, M. (2005). *I simiografia tis horeftikis kinesis. To perasma apo thn proistoria stin istoria tou horou (Notation of dance movement. The passage from the pre-history to the history of dance)*. Athens: Propompos.

- Kuhlman, K. & Schweinhart, L. (1999). *Timing in child development*. Ypsilanti, MI: High/Scope Educational Research Foundation.
- Laban, R., & Lawrence, F.C. (1974). *Effort: economy of human movement*. London, UK: Macdonald & Evans.
- Lorenzo-Lasa, R., Ideishi, R., & Ideishi, S. (2007). Facilitating preschool learning and movement through dance. *Early Childhood Education Journal*, 35(1), 25-31.
- Martin, D. (1988). *Training in Kinder – und Jugendalter*. Verlag K. Hofmann
- Matei, P. (1992) *Rithmos (Rhythm)*. Athens: Hellenic Association of Music & Movement Education of Carl Orff (in Greek).
- Mc Donald Tselentis, C. (2000). *Effective teaching practices in a preschool music and movement program: an observational study* (Master thesis). University of Arizona.
- Moog, H. (1976). The development of musical experience in children of preschool age. *Psychology of Music*, 14, 38-47.
- Oreb, G. & Kilibarda S. (1996). The role of rhythmic abilities in dance. *Kinesiology*, 28(1), 58-63.
- Pavlidou, E. (1998). *Rhythmics as an educational means at preschool age: a combinational programme of rhythmical and movement education* ((Doctoral Dissertation). Retrieved from <http://phdtheses.ekt.gr/eadd/?locale=el>.
- Pica, R. (1996). Early childhood physical education: Educating the whole child. *Teaching Elementary Physical Education*, 7(6), 4-7.
- Pica, R. (2000). *Experiences in movement with music, activities and theory*. Delmar, NY: Thomson Learning.
- Pollatou, E. & Hatzitaki, V. (2001). The influence of a rhythmical-motor activity program on the development of fundamental motor skills in pre-school children. *Journal of Human Movement Studies*, 40, 101-113.
- Pollatou, E. Karadimou, K., & Gerodimos, V. (2005). Gender differences in musical aptitude, rhythmic ability and motor performance in preschool children. *Early Child Development and Care*, 175(4), 361-369.
- Pollatou, E., Pantelakis, G., Agdiniotis, I., Mpenta, N., Zissi, V., & Karadimou, K. (2012). How is the rhythmic ability of preschool children affected by the implementation of a music-movement program? *European Psychomotricity Journal*, 4(1), 49-56.
- Rainbow, E. (1981). A final report on a three-year investigation of the rhythmic ability of pre-school aged children. *Bulletin of the Council for the Research in Music Education*, 66-67, 69-73.
- Sacha, T. J., & Russ, S. W. (2006). Effect of pretend imagery on learning dance in preschool children. *Early Childhood Education Journal*, 33, 341-345.
- Schleuter, S. & Schleuter, L. (1985). The relationship of grade level and sex differences to certain rhythmic responses of primary grade children. *Journal of Research in Music Education*, 33(1), 23-29.
- Schwanda, N.(1970). A study of rhythmic ability and movement performance. *Research Quarterly*, 40(3), 567-573.
- Sergi, L. (1980). *Music education as a factor for the formation of the personality of the child: interdisciplinary method of teaching with central core music to children aged four to six years old* (Doctoral dissertation). Retrieved from <http://phdtheses.ekt.gr/eadd/?locale=el>.
- Smoll, F. (1973). Communications: A rhythmic ability analysis system. *Research Quarterly*, 44(2), 232-236.
- Smoll, F. (1974). Development of rhythmic ability on response to selected tempos. *Perceptual and Motor Skills*, 39, 767-772.

- Smoll, F. (1975b). Variability in development of spatial and temporal elements of rhythmic ability. *Perceptual and Motor Skills*, 40, 140.
- Thomas, J. (2000). 1999 C.H. McCloy research lecture: Children's control, learning, and performance of motor skills. *Research Quarterly for Exercise and Sport*, 71(1), 1-9.
- Thomas, J. & Moon, D. (1976). Measuring motor rhythmic ability in children. *Research Quarterly*, 47(1), 20-32.
- Tsapakidou, A. & Zachopoulou, E. (2001). Diathemaktiki didaskalia: kalliergia tou proforikou logou ton nipion meso tis kinesis kai tou rithmou (Integrative teaching: cultivation of preschoolers; speech through movement and rhythm). *Fisiki drastiriotita ke poiouta zois (Physical Activity and Life Quality)*, 2(in Greek), 65-72.
- Ulrich, D. (1985). *Test of Gross Motor Development*. Austin: Pro-Ed.
- Ulrich, D. (2000). *Test of Gross Motor Development* (2nd edn). Austin: Pro-Ed.
- Venetsanou, F. (2007). *A study on the motor development of preschool aged children in Peloponnesus* (Doctoral dissertation). Department of Physical Education and Sports Science, Democritus University of Thrace, Komotini.
- Weikart, P. (1989). *Teaching movement and dance*. Ypsilanti, Michigan: High/Scope Press.
- Weikart, P. (1982). *Teaching movement and dance: Sequential approach to rhythmic movement*. Ypsilanti, Michigan: High/Scope Press
- Yazejian, N. & Peisner-Feinberg, E. S. (2009). Effects of a preschool music and movement curriculum on children's language skills, NHSA dialog: A research-to-practice. *Journal for the Early Childhood Field*, 12(4), 327-341.
- Zachopoulou, E., Derri, V., Chatzopoulos, D., & Ellinoudis Th. (2003). Application of Orff and Dalcroze activities in preschool children: Do they affect the level of rhythmic ability? *The Physical Educator*, 114-120.
- Zachopoulou, E., Tsapakidou, A., & Derri, V. (2004). The effects of a developmentally appropriate music and movement program on motor performance. *Early Childhood Research Quarterly*, 19, 631-642.
- Zimmer, R. & Volkamer, M. (1987). *Motoriktest für vier -bis- sechsjährige Kinder: Manual* (Motor Test for 4 - 6 year old children: Manual). Weinheim: Betz.
- Zimmerman, M. P. (1984). State of the art in early childhood music and research. In J. Boswell (Ed.), *The young child and music: Contemporary principles in child development and music* (pp.65-78). VA: Music Educators National Conference.