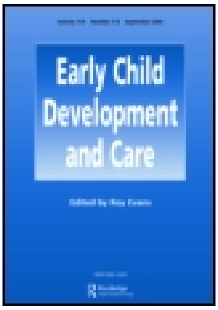

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Incorporating a movement skill programme into a preschool daily schedule

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Children's participation in physical activity is a leading health indicator to combat obesity and sedentary lifestyles. The challenge to battle this problem is placed in the hands of early childhood educators. However, there is little evidence that early childhood educators have the skills and knowledge to design and implement appropriate movement practices for young children. The purpose of this study was to assess the effectiveness of a movement programme implemented by classroom teachers. Participants were 33 preschoolers. The BOT-2 test was used to assess children's motor skills. Results showed that improvement in motor proficiency was observed in both the control ($p = .02$) and experimental ($p = .001$) groups. However, the improvement observed in the experimental group was significantly greater than the control group ($p = .04$). Acceptability of the intervention questionnaire responded to by teachers showed that the intervention was easy to implement and beneficial to the children.

Keywords: motor skills; structured physical activity; Minds-in-Motion programme; preschool children

Although growth and motor development are influenced by genetic makeup and maturation, these factors per se do not result in children's skillful forms of movement (Haywood & Getchell, 2009). In fact, environments such as family, school, and community play crucial roles in children's development of movement skills, specifically when these skills are appropriately practiced (Maude, 2001). Appropriate practices are considered activities designed based on children's developmental levels (National Association for Education of Young Children [NAEYC], 2009; Stork & Sanders, 2008). The engagement in appropriate practices of movement skills during early childhood results in children's confidence and competence to participate in physical activity (Goodway, Wall, & Getchell, 2009). In addition, early successful participation in movement activities are building blocks for future involvement in specialised movement skills (Clark, 1994), such as individual, duo, and team sports.

Children's participation in physical activity is targeted as a leading health indicator of national and international initiatives (U.S. Department of Health and Human Services, 2009; World Health Organization, 2010) to combat obesity and the sedentary lifestyle epidemic. The Children's Defense Fund (2010) reports that 21.2% of children between two and five years of age are obese or overweight. The challenge to battle this problem is placed in the hands of early childhood educators, since preschools and day-

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care centres are recommended to be the best settings to provide young children with appropriate practices of movement skills (Logan, Robinson, Wilson, & Lucas, 2011; Robinson, Webster, Logan, Lucas, & Barber, 2012; Schneider & Lounsbery, 2008; Vidoni & Ignico, 2011). In the USA, approximately 58.4% of children between three and five years of age are enrolled in preschools or day-care centres (U.S. Department of Education, 2012). Although preschool is not mandatory in the USA, parents are increasingly valuing it as a critical tool for early preparation for formal education (Stork & Sanders, 2008).

Educational associations recommend the incorporation of movement skills in early childhood settings (NAEYC, 2009; National Association for Sport and Physical Education [NASPE], 2009a, 2009b). The National Association for the Education of Young Children (NAEYC, 2009) offers a voluntary accreditation to preschools and day-care centres that seek high-quality learning environments for children. NAEYC has principles and standards indicating that movement has an impact in all learning domains. Further, NAEYC (2009) suggests that movement provides children with opportunities to explore the world, and children's mobility contributes to the development of cognitive and sense of autonomy skills. The physical domain is considered a catalyst in children's development of self-regulation, language, cognition, and social competence (Zigler, Gillian, & Jones, 2006).

The NASPE developed two publications that target appropriate practices in movement skills during early childhood. Both publications advocate that preschool-aged children accumulate at least 60 minutes of structured and 60 minutes of unstructured daily physical activity (NASPE, 2009a, 2009b). Structured physical activity time refers to age-appropriate activities purposefully led by the teacher, and unstructured physical activity time relates to activities initiated by the children (NASPE 2009a). *Active Start* (NASPE, 2009a) is one of the NASPE publications that provides physical activity guidelines for caregivers and parents responsible for children from birth to five years of age. The five guidelines for preschoolers suggest:

(1) Minimum of 60 minutes of structured physical activity per day.
(2) Minimum of 60 minutes of unstructured physical activity, and no more than total of 60 minutes of sedentary behaviour per day.
(3) Opportunities to develop fundamental motor skills (e.g. running, jumping, kicking, and throwing).
(4) Access to outdoor and indoor areas that are safe for children engagement in large-muscle-groups activities.
(5) Caregivers and parents of preschoolers are to be knowledgeable of the benefits of physical activity and responsible for promoting structured and unstructured physical activity time for children's experiences in movement skills.

Appropriate Practices for Movement Programs for Children Age 3–5 (NASPE, 2009b) is another NASPE publication that provides information for educational programmes professionals who are responsible for children from three to five years of age. This NASPE publication includes descriptions of appropriate and inappropriate practices regarding learning environment, instructional strategies, curriculum, assessment, and professionalism. Besides recommending the minimum of 60 minutes for structured and 60 minutes for unstructured daily physical activity time, *Appropriate Practices for Movement Programs for Children Age 3–5* (NASPE, 2009b) indicates five premises of quality of movement programmes are designed:

(1) To provide children with a variety of experiences based on their developmental level.
(2) To actively engage children with the environment and tasks that meet their needs.
(3) To promote motor skills experiences for children that incorporate cognitive, emotional, and social developmental domains.
(4) To combine a regular schedule of unstructured and planned movement experiences for children to develop and freely practice fundamental motor skills.
(5) To facilitate children's active involvement, observation, and modelling in learning tasks, allow children to make choices and solve problems, and adapt learning experiences based on children's responses and interests.

NASPE publications (2009a, 2009b) and NAEYC (2009) have put in effort to inform early childhood professionals about the importance of movement during early ages. However, there is little evidence that early childhood teachers are providing high-quality movement programmes (Robinson et al., 2012; Schneider & Lounsbery, 2008; Stork & Sanders, 2008; Wadsworth, Robinson, Beckham, & Webster, 2012; Wright & Stork, 2013). Based on the uncertainty as to whether early childhood teachers have the skills and knowledge to design and implement appropriate movement practices for young children, some programmes have been designed to train teachers on how to implement planned activities during structured physical activity time.

Mastery Climate is a student-centred approach where the teacher initially models the learning tasks and gradually shifts the control of these tasks to the students (Robinson & Goodway, 2009). Robinson et al. (2012) conducted a study with 20 Early Childhood Education majors enrolled in a course entitled Motor Development during School Years. Students were trained to implement Mastery Climate Instructional Approach during 22 lessons (11 weeks) to preschool children. The programme focused on development of fundamental motor skills (e.g. running, jumping, throwing, and catching). The lessons consisted of three minutes of warm-up, 24 minutes of instruction of fundamental motor skills, and three minutes of cool down. Two fundamental motor skills were taught per day in a station format, and activities were designed with low, moderate, and high levels of difficulty to accommodate children's choices. The findings of this study provided evidence that the training of a movement programme was effective in improving children's performance of fundamental motor skills.

A different approach that has been used by classroom teachers is a byproduct of a programme called Minds-in-Motion (MIM). MIM is an advanced development programme with the goal of improving children's visual and auditory processing, and motor skills (MIM, 2012). MIM centres have trained staff who work with children in one-on-one or small group activities using high technology (e.g. vibration plates and computer software) and physical activity equipment such as several types of gymnastics mats, balance beams, parallel bars, balls, ropes, balance boards, and bean bags. Derived from the MIM centres, and with the intention of outreaching a larger population, the *Maze* approach was developed (C.S. Meyer, personal communication, February 21, 2012). The Maze approach was created to be implemented in schools by classroom or physical education teachers, and to be used in feasible indoor or outdoor space with affordable or recycled equipment.

The Maze approach suggests 15 movement activities that involve skill-related fitness components such as balance, coordination (eye–hand, eye–foot, and bilateral limbs), and power. The Maze approach also includes health-related fitness components such as muscular strength and endurance, flexibility, and cardiovascular endurance.

The MIM premise, including the Maze approach, is that there is a link between early afferent neural stimulation and cognitive abilities (Meyer, 2012). Specifically, movement activities that stimulate the vestibular system such as balancing, rolling, pushing, pulling, stomping, jumping, to name a few, have an impact on children's academic, social, behavioural, and physical domains (Meyer, 2012). The *Maze Handbook* (Meyer, 2012) provides step-by-step information to create a circuit (i.e. obstacle course) that can be adjusted to a small or large space and to school schedule. In addition, the Maze approach is aligned with NASPE *Active Start* (2009a) and *Appropriate Practices in Movement Programs for Children Ages 3–5* (2009b) publications in relation to movement programmes that are designed to foster children's development and refinement of fundamental motor skills during structured physical activity time.

The Maze approach has been implemented in several preschools, elementary schools, and student centres in 12 different states (C.S. Meyer, personal communication, June 26, 2013). It seems to be an alternative approach for preschool teachers to meet national recommendations (NASPE, 2009a, 2009b) and incorporate it into their schedule as structured physical activity time. To date, MIM has generated hundreds of data points that were collected during children's clinical experiences in its facilities, but none that was generated in preschool settings yet. Therefore, the primary purpose of this pilot study was to investigate the effects of the Maze approach combined with station movement activities on preschool children's gross and fine motor skills. This study also aimed to assess teachers' acceptability of the implementation of the Maze approach and stations.

Method

Participants and setting

Participants were 33 children (15 control and 18 experimental), 17 were females (9 control and 8 experimental), and 16 males (6 control and 10 experimental) with an average age of 4.5, ranging from 3.9 to 5.0. Two classes from a metropolitan university-based day-care centre in the Southern region of the USA were randomly selected to experimental and control groups. In the experimental group, 12 children were Caucasian (60%), four were African-American (20%), two were Hispanic (10%), one Asian (5%), and one mixed-ethnicity (5%). In the control group, 10 children were Caucasian (59%), 4 children were African-American (23%), 2 children were Asian (12%), and 1 was of mixed ethnicity (6%). Eight participant teachers were randomly assigned to be part of the experimental and control groups. Their age ranged from 30 to 45 years. One male and three female teachers along with two female teacher assistants were part of the experimental group. All teachers and their assistants for the control group were females.

This study was formally approved by the University of Louisville Institutional Review Board in compliance with all the institutional and federal regulations concerning the ethical use of human volunteers for research studies. Informed consent was obtained from parents/caregivers of all children from both classes. All teachers of the participants also consented to the study.

Intervention: structured physical activity time

Children from the experimental group received 11 weeks of a 30-minute structured physical activity programme on a daily basis. The activities took place in a physical activity room, approximately 50 feet by 40 feet. The physical activity programme was implemented during 52 sessions.

Every day at the same time the experimental group went to the physical activity room on the third floor of the day-care centre to participate in the maze and station activities. The children's classrooms were located on the second floor of the building. As part of the daily activities, children used the stairs to go to the third floor by stepping backwards under supervision of the classroom teachers. As soon as they arrived on the third floor they started participating in the maze (i.e. obstacle course) for 15 minutes and then 15 minutes of station activities.

All teachers received a week plan based on the *Maze Handbook* prior to the implementation sessions. Every Monday, increments and additional challenges were added to the activities and remained the same throughout the week. The repetitions throughout the week helped children refine and improve efficiency and mastery of skills necessary to accomplish the skills learned (Maude, 2001).

Mondays were sessions in which children received consistent verbal instructions, explanations, demonstrations, prompts, and feedback because of the increments and new challenges. In the remaining days of the week, prompts, feedback, and additional demonstrations were delivered when needed, but not systematically planned. The goal was to let children explore, adapt, and experience the tasks according to their needs and developmental level. In addition, the approach was built to have all children participating at the same time without waiting for turns or equipment available.

Maze

The maze followed the *Maze Handbook* approach (Meyer, 2012), which consists of an obstacle course with start and end points. In the first week of the maze, for example, the activities were (a) tossing and catching a beanbag while walking, (b) walking on balance beams, (c) pushing against the wall with palms of hands (i.e. push-up), (d) walking by lifting knees high while touching alternating knee with opposite hand, (e) rolling on a mat on the floor (i.e. pencil roll), (f) standing on a balance board, (g) crawling on hands and knees on the floor, (h) stomping down hard on pads laid out on the floor, (i) stepping over hurdles of different heights, and (j) eye-tracking a pencil with a target on top managed by the teacher.

Stations

Prior to the first week of the programme, children were placed into five groups. Each group was identified with a different color, and consisted of four children and one adult leader. The leaders were teachers, teacher assistants, and research assistants who helped in the absence of teachers. Children spent two minutes performing a specific task in each station. An expert from MIM provided the instructions for the stations. The stations consisted of (a) trampolines and spinning boards, (b) agility floor ladders, (c) hand-stands on mat against the wall, (d) back lifts and somersaults on a mat, and (e) 'car push' (i.e. children pushing each other in big plastic bins). Patterns of each station were modified in the following weeks.

Control group

While the experimental group received structured movement skills time, the control group participated in unstructured physical activity in the classroom and playground when the weather permitted. The 30-minute unstructured time was already in place at the day-care centre's daily schedule. During classroom unstructured time, children had opportunities to play with balls, small toys, and beanbags without receiving specific instructions from the teachers. During outdoor play children played on slides, climbing ladders, balls, and the sand box.

Fidelity of the intervention

The teachers, teacher assistants, researchers, and graduate assistants received a training provided by an MIM expert prior to the study. The training consisted of background information of the programme, how to use the *Maze Handbook*, demonstrations of each activity in the handbook, what kinds of equipment could be used, and how to set up the maze and stations. In order to verify if the intervention was implemented as it was planned, at least one of the researchers and one graduate assistant were present in every session of the study and checked the fidelity of the intervention using the week plan.

Instrumentation

All participants completed the short form of the Bruinicks-Oseretsky Test of Motor Proficiency 2nd edition (BOT-2; Bruinincks & Bruininks, 2005) during pre- and post-tests. BOT-2 is a norm-referenced standardised test designed to assess fine and gross motor skills for individuals from four to 21 years of age. The complete form consists of four composites with eight subtests. The composites are (a) fine manual control, (b) manual coordination, (c) body coordination, and (d) strength and agility. The short form consists of features from all composites and it is recommended for screening of young children.

BOT-2 short form consists of eight subtests for (a) fine motor precision (drawing through paths and folding paper), (b) fine motor integration (copying figures), (c) manual dexterity (transferring small objects), (d) bilateral coordination (jumping in place and tapping feet and fingers – same sides synchronised), (e) balance (walking forward on a line and standing on one leg on a balance beam with eyes open), (f) agility (one-legged stationary hop), (g) upper-limb coordination (dropping and catching a ball with both hands and dribbling a ball alternating hands), and (h) strength (knee push-ups and sit-ups). For each task the raw score (i.e. number of repetitions) is converted into a point score system that ranks from 0 to 10 and varies depending on the task (e.g. for balance the score ranks from 0 to 4 while for balance it is 0–10).

The individual point scores for each subtest are added to get a total point score, in which 88 points in the highest possible score. BOT-2 complete form validity has been tested for content and factor analysis correlation coefficients. Test–retest reliability r = 0.86–0.89. A high correlation between the complete and short forms was found, with ~r = 0.80 s (Cools, De Martelaer, Samaey, & Andries, 2008).

Five university faculty and two graduate assistants were trained to use BOT-2. The training consisted of BOT-2 video sessions and two sessions of actual test with children from four to six years of age in the university gymnasium.

Acceptability of the intervention

At the end of the intervention, the experimental group teachers were asked to respond to an acceptability of intervention questionnaire. Teachers were asked seven questions (a) how clear the procedures were, (b) how acceptable the procedures were regarding students improvement of motor skills, (c) how acceptable the procedures were regarding students social or emotional behaviours, (d) how willing they would be to implement this procedure on a daily basis, (e) how acceptable the 30-minute structured time of movement skills was, (f) how many days a week they think would be reasonable to implement this procedure, and (g) how well they would carry out the procedures on their own. Responses to these questions were on a seven-point scale, with scale one indicating 'not clear', 'not at all acceptable', 'not at all willing', or 'not at all well' and scale seven indicating 'very clear', 'very acceptable', 'very willing', or 'very well'. The questionnaire also prompted the teachers for open-ended written comments.

Data analysis

Scaled scores from the BOT-2 assessments at the initial and follow-up visits for the control and experimental groups were summarised with means and standard deviations. The homogeneity of groups at the pre-test was evaluated with comparisons of BOT-2 scaled scores, age, sex, and race using the Wilcoxon rank sum test (BOT-2 and age) and Fisher's exact test (sex and race). The efficacy of each intervention (control and experimental) was tested by comparing pre- and post-intervention scaled BOT-2 scores for each group using the Wilcoxon signed rank test. Improvement in motor proficiency was compared between groups using the Wilcoxon rank sum test. The Wilcoxon tests were conservatively employed as a safeguard against violations of assumptions for t-tests. For each item of the BOT-2, the number of subjects experiencing improvement in each group was calculated and empirically compared.

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Results

Impact of intervention on motor proficiency

The control and experimental groups were homogeneous with respect to motor proficiency at the initial assessment, as BOT-2 scaled scores did not significantly differ (Table 1, $p = .46$). Additionally, there were no significant differences between groups with respect to age ($p = .79$), sex ($p = .49$) and race ($p = 1.0$). Significant improvement in motor proficiency was observed in both the control ($p = .02$) and experimental ($p = .001$) groups. The improvement observed in the experimental group was significantly greater than that observed in the control group ($p = .04$).

Subjects in the experimental group were more likely than the control group to improve (or remain stable) in three tasks (a) tapping feet and fingers, (b) standing on

Table 1. Mean (±SD) scaled BOT-2 scores pre- and post-intervention, with pre- to post-intervention changes.

Time	Control	Experimental
Pre	52 ± 9	50 ± 10
Post	56 ± 10	61 ± 9
Change	5 ± 7	11 ± 9

one leg on a balance beam, and (c) dribbling a ball (Table 2). Subjects in the control group were more likely to improve in the fine motor precision tasks such as (a) drawing lines through paths, (b) folding paper, and (c) transferring pennies.

Acceptability of intervention

All teachers who participated in the intervention responded to the anonymous questionnaire. Table 3 summaries the finding of teachers' responses. All teachers responded that the procedures of the intervention were clear. Two of them responded that the intervention procedures were acceptable to improve children's gross motor skills, one responded fairly acceptable, and one was neutral. Two teachers responded that the intervention procedures were fairly acceptable to improve children's fine motor skills, one responded that they were acceptable, and one was neutral. Two of the teachers responded that the intervention procedures were fairly acceptable to improve children's social and emotional behaviours, and two were neutral. Two teachers responded that were very willing to implement the intervention procedures on a daily basis, while two responded they were willing to do. Two teachers were neutral regarding implementing the intervention procedures daily for 30 minutes, while one was very willing, and one was willing. Two teachers responded that it would be reasonable to implement the intervention procedures three times a week, one responded five times a week, and one responded twice a week. Two teachers responded they would carry out the intervention procedures after the research study fairly well and two responded not so well.

Only two teachers made written comments about the acceptability of the intervention. One teacher reported that the intervention was a great experience for the children, and she or he loved to see how children used their concentration skills to make their way through the maze and stations. The other teacher reported that she or he found the training, the equipment, reasoning/philosophy very logical and well organised and helpful. But she or he was concerned that children did not have much free time

Table 2. Number of subjects exhibiting improvement (or no change) on the BOT-2 by experimental group.

Subtest	Item	Control ($N = 15$)	Experimental ($N = 18$)	All ($N = 33$)
Fine motor precision	Drawing lines through paths	15	14	29
	Folding paper	15	13	28
Fine motor integration	Copying a square	10	13	23
	Copying a star	15	18	33
Manual dexterity	Transferring pennies	14	14	28
Bilateral coordination	Jumping in place	14	17	31
	Tapping feet and fingers	9	17	26
Balance	Walking forward on line	15	18	33
	Standing one legged on a balance beam	12	16	28
Running speed/agility	Stationary hop	15	16	31
Upper limb coordination	Drop and catch ball	11	13	24
	Dribble ball	11	17	28
Strength	Knee push-up	15	16	31
	Sit-up	14	18	32

Table 3. Summary of teachers' responses to the acceptability of the intervention questionnaire.

Questions	Teacher 1	Teacher 2	Teacher 3	Teacher 4
1. Clear procedures	6	6	7	7
2. Acceptable – motor skills	6	5	4	5
3. Acceptable – social/emotional	6	6	4	5
4. Willingness to implement	6	7	4	4
5. Acceptable – time frame	6	7	7	6
6. Days per week	3/week	5/week	2/week	3/week
7. Carry out on own	6	6	7	5

Note: Responses based on a seven-point scale questionnaire, with 1 = not all clear/acceptable/willing/well; 2 = not clear/acceptable/willing/well; 3 = not quite clear/acceptable/willing/well; 4 = neutral; 5 = fair; 6 = clear/acceptable/willing/well; and 7 = very clear/acceptable/willing/well.

and outdoor play in the school schedule. She or he reported that the intervention group children had lack of fresh air until five o'clock in the afternoon.

Discussion

The purpose of this pilot study was to investigate the effectiveness of the Maze approach along with stations activities on preschool children's gross and fine motor skills. The results showed that the daily implementation of the Maze approach and stations during a period of 11 weeks had positive effects on preschoolers' balance and coordination skills measured by the BOT-2 Test. Tables 1 and 2 provide information about pre- and post-intervention changes for both control and experimental groups. Whereas the control group demonstrated positive changes in fine motor skills tests, the statistical analysis showed that improvements observed in the experimental group were significantly higher ($p = .04$). It can be suggested that children's consistent engagement in activities that required exertion of large muscle groups resulted in improvements in their gross motor skills. From a motor-development perspective, the motor skills improved in this study do not naturally develop through children's growth and maturation (Haywood & Getchell, 2009). Environmental factors such as the structured time for movement practices play a crucial role in the degree up to which the fundamental motor skills are developed (Gallahue, Ozmun, & Goodway, 2011).

The implementation of structured physical activity time is challenging in preschool settings due to the longer time required for transitions moving children from one school space to another and setting up/putting away equipment, and also the difficulties classroom teachers have to plan and implement appropriate practices. The acceptability of the intervention questionnaire responded to by the participant teachers showed that the maze and stations approach was easy to implement, possible to do, and beneficial for the participant children. One teacher expressed her/his concerns that the structured physical activity time implemented took away children's opportunities from outdoors free play. This aspect is a limitation of this study. Due to the fact that this intervention was part of a research investigation, there was no flexibility on the schedule and location. The intervention was chosen to be indoors and at the same time every day to maintain all the components of the independent variables constant, without interference of weather or other environmental factors that could affect children's participation in the activities planned.

Preschool children need short bouts of activity, with breaks or contrasting tasks in between sessions to recover strength and muscles, and maintain good energy levels (Maude, 2001). Several small bouts of structured and unstructured physical activities can be planned and led by teachers throughout the daily schedule, such as few minutes for movement songs, dance routines, riding tricycles, and parachute and ball activities. The practicality of the Maze approach and stations is that teachers can incorporate structured activity time into their schedules in different ways throughout the day and even throughout the week. Variations of this intervention approach could include: playing indoors or outdoors, in the morning or afternoon, and two bouts of 15 minutes or three bouts of 10 minutes each. Nevertheless, in order to be successful the activities prescribed in this approach have to be appropriately implemented and part of the school schedule (C.S. Meyer, personal communication, June, 2012).

The 30-minute physical activity intervention implemented in this study supports Wright and Stork's (2013) description of structured time. Based on the Maze approach and MIM premises (Meyer, 2012), during the 30-minute structured time split between maze and stations activities, the teachers (a) identified and shared the purpose of the activities with the children, (b) demonstrated tasks, (c) used language specifically related to children's movement literacy, (d) monitored children's performances, (e) provided feedback, (f) adjusted tasks to the level of children's development, and (g) allowed children to make self-adaptations to the tasks. These components of the intervention were aligned with some of the NASPE recommendations for preschoolers (NASPE, 2009a, 2009b).

The results of this study contribute to the existing literature in several ways: (a) it adds an a new evidence-based physical activity approach to the field that improved children's balance and coordination skills, (b) it confirms that regular children's participation in appropriate practices resulted in increasing levels of movement skills, (c) it demonstrates that classroom teachers found it feasible to incorporate structured time for physical activity into their schedule, and (d) it suggests that after training, teachers and staff from a day-care centre were able to implement a physical activity approach in the way it was planned.

This pilot study presented some limitations. First, the sample size was small. The findings of this study cannot be generalised unless replications of the intervention show consistent results. Second, the use of the BOT-2 short form to assess children's performance was limited to assess certain skills. Anecdotal observations reported by teachers and researchers showed children's tremendous improvement in tasks such as: (a) balance on the balance beam and boards, (b) strength when pushing each other in the plastic bins, (c) agility in the agility floor ladder, (d) coordination during tossing and catching beanbags and skipping, and (e) agility and coordination during somersaults. Perhaps the full battery of the BOT-2 or an alternative (e.g. TGMD-2, Ulrich, 2000) test could have provided more evidence of children's improvement in a variety of skills.

Conclusion

The present study shows that the Maze approach and stations intervention resulted in significant changes in preschoolers' motor skills, specifically in balance and coordination. This study also shows that teachers who were trained to use this teaching approach found it easy, feasible to implement, and beneficial for the children. The results of this study suggest that it is possible to provide preschoolers with daily structured physical activity time that they can benefit from it. It is important to point out that even though that classroom teacher can effectively design and implement quality of movement programmes, school administrators play a major role in encouraging teachers to learn, implement, and sustain planned movement activities approaches. The sustainability of a structured programme such as this is critical to the development of children's locomotor (e.g. running, jumping, skipping, and hopping), manipulative (e.g. catching, throwing, and striking), and body-management skills (e.g. agility, balance, coordination, and flexibility). These skills are building blocks for engagement in lifetime physical activity and health benefits (Gallahue et al., 2011; Haywood & Getchell, 2009). Future research is needed to replicate the findings of the intervention with a larger sample size, a different population of students, and additional instruments to assess locomotor, manipulative, body-management skills and levels of children's physical activity.

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References

Bruinincks, R. H., & Bruininks, B. D. (2005). *Test of motor proficiency. Manual* (2nd ed.). Minneapolis, MN: Pearson Assessments.

Children's Defense Fund. (2010). *The state of America's children, 2010*. Washington, DC: Author. Retrieved August 15, 2013, from http://www.childrensdefense.org

Clark, J. E. (1994). Motor development. In V. S. Ramachandram (Ed.), *Encyclopedia of human behavior* (Vol. 3, pp. 163–190). San Diego, CA: Academic Press.

Cools, W., De Martelaer, K., Samaey, C., & Andries, C. (2008). Movement skill assessment of typically developing preschool children: A review of seven movement skill assessment tools. *Journal of Sports Sciences and Medicine*, *8*, 154–168.

Gallahue, D. L., Ozmun, J. C., & Goodway, J. D. (2011). *Understanding motor development: Infants, children, adolescents, adults*. New York, NY: McGraw-Hill.

Goodway, J. D., Wall, S., & Getchell, N. (2009). Promoting and 'active start' for young children: Developing competent and confident early movers. *Strategies*, *23*(2), 30–32.

Haywood, K. M., & Getchell, N. (2009). *Life span motor development* (5th ed.). Champaign, IL: Human Kinetics.

Logan, S. W., Robinson, L. E., Wilson, A. E., & Lucas, W. A. (2011). Getting the fundamentals of movement: A meta-analysis of the effectiveness of motor skill interventions in children. *Child: Care, Health and Development*, *38*(3), 305–315.

Maude, P. (2001). *Physical children, active teaching: Investigating physical literacy*. Buckingham, UK: Open University Press.

Meyer, C. S. (2012). *Minds-in-Motion: The Maze Handbook*. Louisville, KY: Minds-in-Motion Inc. Press.

Minds-in-Motion. (2012). Retrieved August 15, 2013, from http://mimlearning.com/

National Association for Sport and Physical Education (NASPE). (2009a). *Active start: A statement of physical activity guidelines for children from birth to five years*. Sewickley, PA: AAHPERD Publications Center.

National Association for Sport and Physical Education (NASPE). (2009b). *Appropriate practices in movement programs for children ages 3–5*. Sewickley, PA: AAHPERD Publications Center.

National Association for the Education of Young Children (NAEYC). (2009). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. Washington, DC: Author. Retrieved August 15, 2013, from http://www.naeyc.org/DAP

Robinson, L., & Goodway, J. (2009). Instructional climates in preschool children who are at-risk. Part I: Object control skill development. *Research Quarterly for Exercise and Sport*, *80*(3), 533–542.

Robinson, L. E., Webster, E. K., Logan, S. W., Lucas, W. A., & Barber, L. T. (2012). Teaching practices that promote motor skills in early childhood settings. *Early Childhood Education Journal*, *40*, 79–86.

Schneider, H., & Lounsbery, M. (2008). Setting the stage for lifetime physical activity in early childhood. *Journal of Physical Education, Recreation and Dance*, *79*(6), 19–23.

Stork, S., & Sanders, S. W. (2008). Physical education in early childhood. *The Elementary School Journal*, *108*(3), 197–206.

Ulrich, D. A. (2000). *The test of gross motor development* (2nd ed.). Austin, TX: Pre-ed.

U.S. Department of Education, Institute of Education Sciences. (2012). *Enrollment of 3-, 4-, and 5-year old children in preprimary programs, by level of program, control of program, and attendance status: Selected years 1965 through 2011*. Washington, DC: Author. Retrieved March 7, 2013, from http://nces.ed.gov/programs/digest/d12/tables/dt12_053.asp

U.S. Department of Health and Human Services (USDHHS). (2009). *Healthy people 2020: The road ahead*. Washington, DC: U.S. Government printing Services.

Vidoni, C., & Ignico, A. (2011). Promoting physical activity during early childhood. *Early Childhood Development & Care Journal*, *181*(9), 1261–1269.

Wadsworth, D. D., Robinson, L. E., Beckham, K., & Webster, K. (2012). Break for physical activity Incorporating classroom-based physical activity breaks into preschools. *Early Childhood Education Journal*, *39*, 391–395.

World Health Organization. (2010). *Global recommendations on physical activity for health*. Switzerland: WHO Press.

Wright, P. M., & Stork, S. (2013). Recommended practices for promoting physical activity in early childhood education settings. *Journal of Physical Education, Recreation and Dance*, *84*(5), 40–43.

Zigler, E., Gillian, W. S., & Jones, S. M. (2006). A whole child approach: The importance of social and emotional development. In E. Zigler, W. S. Gillian, & S. M. Jones (Eds.), *A vision for universal preschool education* (pp. 130–148). New York, NY: Cambridge University Press.