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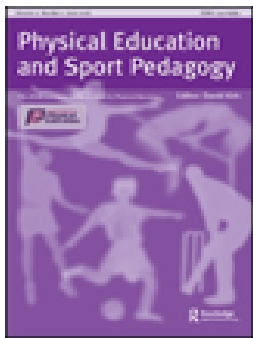
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SKIPing with teachers: an early years motor skill intervention

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ABSTRACT

Background: Fundamental motor skill (FMS) interventions when delivered by an expert can significantly improve the FMS of young children with and without developmental delays. However, there is a gap in the literature as few early childhood centers employ experts with the professional background to deliver FMS intervention.

Purpose: The primary purpose of this study was to investigate the effects of a motor skill program called SKIP (Successful Kinesthetic Instruction for Preschoolers) on student learning of object control skills (OC). A secondary purpose was to examine the extent to which early childhood teachers could implement the SKIP program with fidelity (while receiving on-going coaching and support) and the extent to which instructional fidelity influenced OC improvement in the SKIP condition.

Participants and setting: There were two levels of participants in this study, early childhood teachers ($N = 2$, Women = 2) and their students ($N = 57$; Boys = 53%; $M_{\text{age}} = 4.39$, Range 3–6). All participants were from the same early childhood center located on the campus of a large Midwestern University located in the United States.

Data Collection: This study featured a pretest–posttest control group quasi-experimental design. The director of the early childhood center selected the experimental SKIP teachers ($N = 2$). Experimental SKIP children ($n = 26$) were identified from the classrooms of the experimental SKIP teachers. Teachers implemented SKIP to their students for six weeks (360 minutes of instruction). SKIP teachers' lesson plan fidelity was calculated using a predetermined checklist based upon the lesson plan via digital recordings. Control students ($n = 31$) were randomly selected from the remaining six classrooms at the center. Control students received the business as usual condition, which consisted of free play with the availability of the same equipment allocated to the SKIP condition. All students were pretested and posttested using the OC subscale of the Test of Gross Motor Development-2 (TGMD-2) [Ulrich, D. A. 2000. *The Test of Gross Motor Development*. 2nd ed. Austin: PRO-ED].

Data Analysis: A two-level (students nested within teacher) Hierarchical Linear Model (HLM) examined the extent to which the SKIP intervention improved the OC skills of the students compared to the control group. Lesson plan fidelity was calculated using descriptive statistics. An additional two-level HLM examined the extent to which fidelity of SKIP influenced the OC scores of students in the SKIP condition only.

Results: SKIP students significantly improved their OC skills compared to the control students ($p < .001$, $\eta^2 = .61$). SKIP teachers implemented SKIP with fidelity ($M = 86.5\%$, $SD = .18$). Level of fidelity of SKIP significantly

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influenced students' improvements in OC scores ($p < .001$).

Conclusion: SKIP was highly effective in improving the OC skills of the students and SKIP teachers implemented SKIP with fidelity. Greater fidelity positively influenced OC outcomes for students. Further research is warranted to confirm that students' FMS development can be enhanced through FMS intervention with high-quality teaching that is implemented by classroom teachers.

Introduction

Fundamental motor skills (FMS) consist of object control skills (OC) such as throwing and catching; locomotor skills such as running and leaping; and stability skills like bending and twisting (Gallahue, Ozmun, and Goodway 2012). Developing competence in FMS is a prerequisite to developing more complex and sport-specific movement patterns (Clark and Metcalfe 2002; Gallahue, Ozmun, and Goodway 2012; Seefeldt 1980). Several models of motor development situate the importance of FMS in relation to participating in sport and lifetime activities (Clark and Metcalfe 2002; Gallahue, Ozmun, and Goodway 2012; Seefeldt 1980) and engagement in physical activity (Stodden et al. 2008).

OC are noted to be particularly important for children to demonstrate higher levels of health-related physical fitness (Stodden et al. 2008) and to participate in physical activity as they advance into adolescence (Barnett et al. 2009). The emerging associations between OC skills, PA and fitness may be related to their requisite importance for successful participation in a variety of leisure games and sports that most children play (Ericsson 2011; Graham, Holt/Hale, and Parker 2013; MacNamara et al. 2011). Therefore, it is suggested that young children need to develop OC skill competence during the early years in order to increase the likelihood of physical activity participation in adolescence (Barnett et al. 2009).

In many educational settings (i.e. early years classroom or early childhood centers), teachers are charged with providing gross motor activities (e.g. FMS). Unfortunately, early childhood classroom teachers rarely receive coursework and/or training relating to principles of motor development and/or physical education (McWilliams et al. 2009). To assist early childhood teachers in promoting the development of FMS in the early years, the National Association for Sports and Physical Education (NASPE 2009 now called SHAPE America) developed its Active Start Guidelines for physical activity. According to the Active Start Guidelines (NASPE 2009), 'All children from birth to age five should engage daily in physical activity that promotes movement skillfulness and foundations of health-related fitness' (5) with guideline three highlighting the importance of FMS development. However, most early childhood teachers are unaware of the Active Start Guidelines and believe that well-equipped free play is the sole appropriate vehicle through which a child will develop gross motor skills (McWilliams et al. 2009).

Empirical evidence supports that well-equipped free play is not sufficient to adequately promote the development of a child's gross motor skills (Iivonen and Saakslähti 2013; Logan et al. 2011; Riethmüller, Jones, and Okely 2009). Within the motor skill intervention literature, children who received the 'business as usual' free play condition persisted in their motor skill delays despite 30 minutes of well-equipped daily free play (Hürmeriç-Altunsöz and Goodway 2015; Martin, Rudisill, and Hastie 2009; Valentini and Rudisill 2004). Additionally, recent evidence suggests many children who do not adequately develop their movement skill and fitness levels in early childhood will demonstrate negative developmental trajectories across childhood (Rodriguez, Stodden, and Lopes 2015). Thus, without carefully planned motor skill experiences, young children become highly at-risk for delays with their FMS (Hürmeriç-Altunsöz and Goodway 2015; Martin, Rudisill, and Hastie 2009; Valentini and Rudisill 2004) and may be placed onto a negative developmental trajectory (Rodriguez, Stodden, and Lopes 2015).

To provide carefully planned motor skill experiences, motor development experts developed structured FMS interventions to remediate/prevent motor skill delays in young children (Ericsson 2011; Goodway and Branta 2003; Valentini and Rudisill 2004). One such program called SKIP (Successful Kinesthetic Instruction for Preschoolers) has been successful with remediating motor skill delays in as little as eight weeks (8–12 weeks, 360–420 minutes) with effect sizes in the range of $\eta^2 = .60-.81$ (Goodway and Branta 2003; Robinson and Goodway 2009). However, a major limitation of the SKIP program and other FMS interventions is their lack of ecological validity (Logan et al. 2011), as very few early childhood centers employ staff with a background in motor development or physical education (McWilliams et al. 2009) and very few motor development experts are available to deliver structured motor programming to preschoolers. In addition, little is known about whether early childhood teachers can deliver structured FMS programming like SKIP as it was originally intended (with fidelity). Furthermore, there is little evidence to determine whether a teacher-led FMS intervention will bring about changes in the FMS competence of children in the early childhood years. Such data would be valuable in order to identify policies to promote motor skill development in early years children. Thus, the primary purpose of this study was to investigate the effects of a six-week SKIP program taught by early childhood teachers on their students' learning of OC skills. In order to contextualize student learning in OC skills, a secondary purpose was to examine the extent to which early childhood teachers could implement the SKIP program with fidelity and how instructional fidelity influenced OC improvement in the SKIP condition.

Methods

Theoretical framework

This study is situated within a Dynamical Systems Theory (DST; Thelen, Kelso, and Fogel 1987) perspective of motor development (Thelen 1988) and translated through Newell's Constraints Theory (Newell 1984, 1986). DST approaches the developmental aspects of movement and coordination from a process-oriented perspective (Clark and Whittall 1989). Dynamical systems purport that coordination, control, and movement skill is a result of the interactions (constraints) among many subsystems (such as balance and strength) within the human.

Newell's constraints theory provides a framework to translate DST practically (Langendorfer and Robertson 2002). Newell suggests that motor skill acquisition in an individual learner is the result of the interaction between task, environmental, and organismic (person) constraints (1984, 1986) and not the isolated variable of maturation alone (Langendorfer and Robertson 2002). In developing interventions for a child, it is important to consider the organismic constraints (child characteristics such as balance and strength) a child brings to an instructional setting while manipulating environmental and task constraints to meet the needs of the learner.

The SKIP program is situated within this constraints theoretical framework along with being rooted in physical education pedagogy best practices (Graham, Holt/Hale, and Parker 2013; Rink 2014; Siedentop and Tannehill 2000). The SKIP program accommodates individual constraints by modifying equipment and designing developmentally appropriate tasks that align with the child's current level of motor development. Additionally, a focus on maximum opportunities to respond, correct practice trials, time on task, academic learning time, and physical activity (Rink 2014; Siedentop and Tannehill 2000) places the child in an optimal environment to promote their motor skill development. This study adds a dimension to the SKIP program from a constraints perspective by having teachers who receive coaching and support from experts deliver SKIP. Teachers receiving coaching and support from an expert represent a manipulation of organismic constraints for the teachers (manipulating their knowledge of FMS and delivery of PE content) and a manipulation of task constraints for the child (receiving teacher-led SKIP).

Setting

The location for this study was an early childhood center located on the campus of a large Midwestern University located in the United States. The center included eight early years classrooms, seven toddler classrooms, seven infant classrooms, and one kindergarten classroom providing full day care to children of faculty, staff, and college students. There was ample space and equipment for both indoor and outdoor gross motor learning and free play.

The center's 'business as usual' curriculum for gross motor skill development and physical activity consisted of 30 minutes of well-equipped free play monitored by lead and assistant classroom teachers. During this time, the teachers provided access to a wide variety of motor skill equipment (balls, bats, etc.). During good weather, the children played outside and also had access to playground structures (swings, slides, climbing frame, etc.). Free play occurred daily regardless of weather due to the availability of both indoor gross motor space and outdoor playground space. Similar equipment existed both indoors and outdoors including access to equipment necessary to perform OC skills. During 'business as usual' the teachers monitored the playground for safety but did not provide instruction or intervene with the children.

Participants

There were both child and teacher participants that were selected from a child care center at a large Midwestern University in the USA. As this was a pilot study, it was important to conduct SKIP with experienced early years teachers with the underlying assumption being that if experienced teachers could not implement SKIP with fidelity then less experienced teachers would struggle to be successful. Therefore, the center director identified two of his most experienced classroom teachers as the experimental SKIP classrooms from the eight total classrooms within the center.

The experimental SKIP teachers ($N = 2$; Women = 2) were White, Non-Hispanic females with more than 15 years of teaching experience. Both teachers earned a Master's degree in early childhood education, and self-reported age bands between 40 and 60 years of age. One teacher reported completing a motor development course during her undergraduate initial teacher-training program while the other teacher reported no previous motor development/physical education experience. Neither teacher reported high levels of daily physical activity with one claiming an interest in yoga and the other enjoying walking. There were no data collected on the control teachers beyond the observations described in procedures as they were implementing the 'business as usual' condition. Therefore, the total number of teacher participants in this study was two.

The primary participants were early years students ($N = 57$; Boys = 53%; $M_{\text{age}} = 4.39$, Range 3–6 years) in the child care center. Students in the Experimental SKIP condition ($n = 26$; Boys = 52%, Caucasian = 62%, African American = 19%, Hispanic = 0%, Asian = 12%, other = 8%) were purposefully selected from the intact SKIP classrooms of the two SKIP teachers. Students in the control condition ($n = 31$; Boys = 56%, Caucasian = 61%, African American = 13%, Hispanic = 0%, Asian = 16%, other = 10%) were randomly selected from the remaining six classrooms at the center. There was no drop out of participants in this study.

Design and variables

This study featured a pretest–posttest quasi-experimental design with a SKIP and control (business as usual) condition. The main independent variable for the students was SKIP compared with a 'business as usual' well-equipped, unstructured free play. There was a secondary independent variable for SKIP students only, which was the percent fidelity of the SKIP intervention by the SKIP

teachers. The primary dependent variable for the students was OC skill competence. Only descriptive data on percent of lesson plan fidelity were reported on the SKIP teachers.

Instrumentation

Object control competence

The OC subscale of the Test of Gross Motor Development-2 (TGMD-2; Ulrich 2000) examined the OC skills of the students. The TGMD-2 is a norm and criterion-referenced, standardized, valid, and reliable assessment of FMS of children ages 3–10 years, 11 months (Ulrich 2000). The OC skill subscale contains six items: throw, catch, kick, roll, dribble, and strike. Students completed one practice trial and then two coded trials of each skill. Each individual item contains three to five critical elements with every individual critical element per skill receiving either a one for being correct and present or a zero for an incorrect performance of the critical element. As there were two trials, each skill could total between 6 and 10 points. The six skills in the OC subscale were summed to create a raw score between 0 and 48 points. Raw scores were converted into standard scores and percentile ranks as a norm reference to the same age and gender population in the United States (Ulrich 2000).

For the purpose of this study, the lead researcher and two members of the research team coded all trials of the TGMD-2 via digital recording. Coders established an inter-rater reliability of 92.5%. In addition, 30% of the sample was double-blind coded (blinded to group or test time) by a trained, independent rater and provided an additional 98% reliability. All statistical procedures were conducted using standard scores to account for gender, age, and time. Mean percentile ranks were reported (Table 1) to identify children who were developmentally delayed (IDEA 2004) using the cut point of scoring below the 30th percentile and to provide a description of the sample.

Lesson plan fidelity

Lesson plan fidelity, or the extent to which the teachers delivered the SKIP program as it was originally intended (O'Donnell 2008), was calculated using a lesson plan fidelity check sheet based upon the SKIP lesson plans. Each SKIP lesson was digitally recorded with teachers wearing a wireless microphone to record their instruction. The lead researcher coded and calculated lesson plan fidelity from the digital recordings of each teacher. It was possible for each lesson to score between 0 and 72 check marks (points). If the fidelity measure was present, it received one point (yes) and if it was absent it received a zero (no). For example, if a teacher was supposed to explain two critical elements of catching followed by a demonstration, a teacher could accrue three check marks

Table 1. Lesson plan fidelity by teacher by lesson.

Lesson	Teacher 1	Teacher 2
1	31	25
2	42	39
3	67	86
4	98	72
5	84	69
6	89	61
7	97	100
8	89	89
9	86	92
10	100	86
11	78	69
12	100	89
Mean (SD)	87 (.18)	86 (.15)

Note: Scores are a percentage.

(points) for that part of the lesson. One rater coded all lesson plans. Inter-rater reliability was determined by an independent, trained rater on 30% of the lesson plans and provided a 97.6% measure of inter-rater reliability. Lesson plan fidelity served as the measure of internal validity of the SKIP program (see the SKIP condition section).

Site conditions

All students participated in the center's typical curriculum, which consisted of 'business as usual' well-equipped free play. Free play occurred daily for 30 minutes either indoors within the gross motor space or outdoors on the playground. During free play, the students were allowed to choose their activities and were monitored for safety by the lead and assistant teachers of the classroom. The indoor gross motor space included equipment that varied from balance beams, slides, scooters, parachutes, playground balls, bean bags, batting tees, foam paddles, etc. and also included a CD player for music. All indoor equipment could be transferred outdoors. Outdoors, the center had three sets of playground equipment including a sand box, jungle gym, and ample space for locomotion. During the SKIP intervention, the control students had 'business as usual' free play five times per week. In contrast, the SKIP students had 'business as usual' free play three times per week with two of the sessions being replaced by the SKIP program.

Control group intervention integrity

The lead researcher observed free play of each control classroom once per week for a total of six times for two reasons: (a) to report any incidence of known intervention contamination and (b) to provide an account of internal validity for the control condition. Given that both the SKIP groups and the control groups existed at the same early childhood center, it was possible that contamination across groups could occur (Robinson and Goodway 2009). In addition, explicitly describing and reporting the control condition helps to improve the internal validity of the study or that the changes in the SKIP group occurred as a result of SKIP and not some other confounding variable (Lomax and Hahs-Vaughn 2012). During each of the six observations, only free play occurred and no control teacher attempted to instruct the students. During each observation, no child chose to practice OC skills although numerous pieces of equipment to play with OC skills were present. Riding on scooters, running, playing on balance beams, playing on the jungle gym, playing in the sand box, and talking were the main forms of interaction observed by the lead researcher.

The SKIP program

The SKIP students received the SKIP program instead of free play two times per week. The other three days, SKIP students received the 'business as usual' free play programming. The SKIP program is a valid and reliable program for remediating motor skill delays and/or improving the FMS of young children (see Goodway and Branta 2003; Hürmeriç-Altunsöz and Goodway 2015 for a description of SKIP). The SKIP program is rooted in motor development theory, and best pedagogical practices in physical education, and features developmentally appropriate instruction and practice (Hürmeriç-Altunsöz and Goodway 2015).

Coaching of SKIP. In order to deliver the SKIP program, the two SKIP teachers were provided with initial coaching prior to the SKIP intervention and on-going support during the delivery of the SKIP curriculum. The SKIP teachers received two, 30-minute initial coaching sessions prior to the start of SKIP. The focus of the initial 30-minute training sessions was to guide the teachers through the content provided to them on an Apple iPad. Within the iPad, teachers received all content necessary to conduct SKIP including lesson plans, video modules, task analyses, as well as physical education and motor development theory and principles.

Throughout the six-week SKIP intervention, the lead researcher was present at all sessions and provided on-going coaching and support to the SKIP teachers on a faded schedule (see Procedures). Examples of coaching included: (a) answering questions from the SKIP teachers before, during, and after lessons, (b) debriefing the week's lessons and briefing the following week's lessons for 20 minutes on Fridays, (c) intervening during the lesson if and when a safety concern arose, and (d) providing external prompts when demonstration, cueing, feedback, and prompting errors occurred. Only the lead teachers were coached under the premise they would disseminate that knowledge to their assistant teachers.

Following the initial coaching session, the lead teacher and her assistant teacher delivered SKIP to their students two days per week, for 30 minutes each session for a total of 360 minutes, in place of well-equipped free play. The instructional format of SKIP included direct instruction pedagogy, which is considered highly effective in physical education when seeking maximal student learning with younger children (Miller, Vine, and Larkin 2007). A typical SKIP lesson plan included a 2–3 minute musical warm-up, two 10-minute OC skill progression stations/activities (students switching groups from lead to assistant teacher and vice versa), a 3–4 minute locomotor music break, and a 2–3 minute closure. SKIP lesson plan content focused on individualized instruction with cues, prompts, and modifications that were all aligned with the present level of performance of the individual child.

All SKIP lesson plans occurred within the indoor gross motor space with adequate space and equipment for each child. SKIP teachers provided demonstrations, feedback, verbal, physical, and visual prompts, task and environmental modifications, and were instructed to make modifications based upon the present level of performance of the students. In order to assist teachers with modification decisions, teachers were provided with a task analysis matrix of each skill. The task analysis matrix included a sequence of task modifications from making the task easier to making the task more complex including verbal, visual, and physical prompts that were aligned to the present level of performance of the child. For example, if the task of catching a beach ball was too difficult for the child, the teacher could modify the task by changing the beach ball to a scarf, provide a verbal prompt of catch the scarf with two hands, and assist the child by physically assisting the child to catch the scarf with two hands.

Procedures

This study engaged in appropriate ethics. Institutional review board approval was secured prior to the recruitment of participants and no member of the research team possessed a financial conflict of interest within this study. Teachers gave informed consent and parental permission was secured for all students. Students subsequently assented to participate. All students were pretested on the TGMD-2 following standardized procedures (Ulrich 2000) to determine baseline OC skill competence. Concurrently, SKIP teachers provided their demographic information before the start of the intervention. After the pretest, SKIP teachers received two 30-minute initial coaching sessions and an Apple iPad, loaded with all content necessary to conduct the SKIP program. All sessions were digitally recorded and SKIP teachers wore a wireless microphone to measure lesson plan fidelity.

Throughout the SKIP sessions, teachers received coaching and support from a motor development expert on a faded schedule. The research team determined the faded schedule after the first lesson plan based upon present level of performance of both teachers. The schedule was standardized to provide each teacher with similar types of coaching procedures (e.g. debriefing on a Friday, intervening due to improper setup) while allowing for individual differences within the content of the coaching (e.g. demonstrating the kick or providing congruent feedback). Moreover, the research team decided to fade the coaching and support schedule to demonstrate that the teachers could implement SKIP with minimal support by the end of the six-week intervention. The faded schedule included the following:

- weeks 1–2, pre- and post-SKIP meetings on Fridays to debrief the week's lessons and brief upcoming lessons, intervene during the lesson if needed, provide post-lesson feedback,
- weeks 3–4, intervene during the lessons if needed and provide post-lesson feedback,
- week 5, only deliver support when asked, provide post-lesson feedback
- week 6, only provide support when asked.

After the conclusion of the SKIP intervention, all students were posttested on the TGMD-2 following the same procedures as the pretest.

Data analyses

Influence of SKIP on OC competence

A two-level Hierarchical Linear Model (HLM) examined the effectiveness of the teacher-led SKIP program on the OC skills of students ($N = 57$) where students were nested within teacher's classrooms. The independent variable was the group (SKIP vs. control). Pretest scores were a covariate centered around the grand mean. Age and gender were not inserted as covariates because TGMD-2 standard scores were used as the dependent variable. TGMD-2 standard scores control for age and gender. TGMD-2 standard scores can also be converted into percentile ranks. Descriptive statistics of percentile ranks provide a normative reference in regards to the gender and age of the participant (Ulrich 2000).

A second HLM examined the extent to which fidelity of the SKIP program influenced students' OC skills. The second HLM only featured the SKIP group ($n = 26$). The independent variable was percentage of lesson plan fidelity. Pretest scores were entered as a covariate and centered around the grand mean. Age and gender were not inserted as covariates because the dependent variable was TGMD-2 standard scores.

This study was considered a multilevel design due to the nesting of the unit of analysis (students) within the experimental unit (teacher). HLM accounted for nesting effects within the statistical procedures and decreased the risk for Type-1 errors providing a more rigorous statistical technique where multilevel designs occur (Raudenbush et al. 2011). Using HLM is only warranted when a true nesting effect occurs despite using a multilevel design. To examine the nesting effect, an intra-class correlation coefficient (ICC) measured the amount of variance in student level posttest OC scores attributed to the teacher. If the ICC is below 5% then nesting effects are not present and multilevel procedures are not necessary (Raudenbush and Bryk 2002). All HLM procedures and ICC calculations occurred using HLM version 7 for windows (Raudenbush et al. 2011). Finally, eta squared calculations (Becker 2000) provided measures of effect size.

Teacher fidelity of SKIP

The lead researcher calculated lesson plan fidelity via descriptive analyses (means and standard deviations) for SKIP teachers using the Statistical Packages for the Social Sciences (SPSS) version 22 (Armonk, NY). SKIP teachers must produce a minimum requisite of 50% fidelity in order for teacher-led SKIP to be considered internally valid (O'Donnell 2008).

Results

The results of the secondary research question on fidelity of SKIP by the teacher will be described first followed by the results of the first/primary research question on the influence of SKIP on the OC competence of early years students.

Teacher fidelity of SKIP as a measure of internal validity

Descriptive results demonstrated that teachers were unable to establish lesson plan fidelity over 50% for the first two lessons (Table 1). For lessons 3–12, teachers were able to exhibit lesson plan fidelity over 50% (Table 1). Overall, teachers demonstrated lesson plan fidelity over the prerequisite 50% mark for internal validity ($M_{\text{fidelity}} = 86.5\%$; $\text{Range} = 31\text{--}100\%$; Table 1).

The influence of SKIP on the OC competence of students

Pretest data revealed that the majority (82%) of the sample scored below the 30th percentile for OC skills and thus were considered developmentally delayed in their motor skills (IDEA 2004). An HLM examined the influence of SKIP on the OC competence of the students. The ICC for the amount of variance in posttest scores attributed to the teacher was 5% ($\tau = .17$; $\sigma^2 = 3.79$) warranting the use of HLM (Raudenbush and Bryk 2002).

The HLM analyses revealed that pretest OC standard scores significantly influenced posttest scores ($\beta = .42$, $t = 2.68$, $p < .001$) in that every one point increase in pretest scores was associated with posttest scores being increased by .42 standard score points (Table 2). At the posttest, SKIP students were significantly higher ($p < .001$) than the control students (while controlling for pretest scores) showing the influence of SKIP. Specifically, assuming pretest scores of 0, control students achieved a TGMD-2 OC standard score of 7 (16th percentile; $\beta = 7.01$, $t = 17.4$, $p < .001$), while SKIP students attained a TGMD-2 OC standard score of 12 (75th percentile; $\beta = 5.17$, $t = 8.2$, $p < .001$) at the posttest. The effect size was $\eta^2 = .61$ and can be interpreted as very strong (Lomax and Hahs-Vaughn 2012). Overall, results provide strong support for the effectiveness of SKIP on the OC competence of students.

The influence of teacher fidelity in delivering SKIP on posttest OC scores

HLM analysis revealed that assuming pretest scores of 0% and 100% fidelity, SKIP students were predicted to achieve a standard score of 13 (84th percentile; $\beta = 6.08$, $t = 11.2$, $p < .001$) by the posttest. In addition, every 1% increase in fidelity (from 0% fidelity to 100% fidelity) was predicted to increase posttest OC standard scores by .13 standard score points (Table 2). Results show that teacher fidelity in delivering SKIP significantly influences posttest scores. These analyses can compare the performance of an expert delivering SKIP (100% fidelity) to the actual fidelity demonstrated by the two SKIP teachers in the current study (86.5%). Using the data from the HLM analyses, the expert (100% fidelity) would yield a posttest OC percentile of 84 (standard score = 13) in contrast to the 75th percentile (standard score = 12) of the two SKIP teachers.

Table 2. HLM results.

Fixed effect	Coefficient	SE	T	df	p
Influence of SKIP on OC competence ^a					
β_0	7.08	.41	17.36	5	.001*
β_1	5.17	.63	8.19	5	.001*
Slope	.41	.15	2.67	6	.037*
Influence of fidelity on posttest OC SKIP scores ^b					
β_0	7.08	.42	17.36	5	.001*
β_1	6.08	.54	11.21	5	.001*
Slope	.42	.11	3.93	6	.008*

Note: OC, object control skill.

^a $N = 57$ (SKIP & control).

^b $n = 26$ (SKIP group only).

* $p < .05$.

Discussion

The primary purpose of this study was to investigate the effects of a six-week SKIP program taught by early childhood teachers on their students' learning of OC skills. In order to contextualize student learning in OC skills, a secondary purpose was to examine the extent to which early childhood teachers could implement the SKIP program with fidelity and how instructional fidelity influenced OC improvement in the SKIP condition. The secondary aim of the study will be discussed first as means to contextualize the findings from the primary aim of this study.

Teachers' fidelity in delivering SKIP

Overall, teachers were able to deliver SKIP with a lesson plan fidelity mean of 86.5%. However, the teachers failed to deliver SKIP adequately during the first two lessons (Table 1). Informal observations during the first two lessons revealed that teachers initially struggled to provide congruent feedback, give proper demonstrations, set up progressions correctly, and implement SKIP with appropriate pacing. After the weekly briefing of the following week's lessons, SKIP teachers were able to improve their lesson plan fidelity and began to deliver SKIP above the accepted level of 50% (O'Donnell 2008).

Anecdotal evidence revealed that teachers seemed to gain confidence with the content as the duration of SKIP passed. The nature of the coaching support shifted from basic content knowledge (e.g. ability to set up and teach a basic OC skill progression) to deeper content knowledge (e.g. how to modify the lesson for individual learners). Once teachers felt more comfortable with the content, the teachers' fidelity jumped over 80% and never dipped below 50% (Table 1). The findings from this secondary study aim to demonstrate the internal validity of SKIP. As a result, it is reasonable to state the SKIP program was feasible for teachers to implement with coaching and support and this study was internally valid.

A strength to this study was the manner by which the lead researcher provided on-going coaching and support to the teachers. Providing teachers with on-going coaching and support not only ensured that teachers would meet fidelity requirements but was also in line with the professional development literature in physical education (Patton and Parker 2014). According to Patton and Parker (2014), only providing a one-shot dose of professional development may not be enough to ensure that knowledge learned in the professional development session will transfer into the classroom. From the fidelity findings in this study providing teachers with on-going coaching and support throughout the intervention was effective in ensuring teacher success in delivering SKIP. It was not within the confines of this study to examine the teacher fidelity data and coaching support in depth. Future research needs to examine this issue from a professional development perspective.

The primary purpose of this study was to determine the effects of SKIP on the OC skills of students in the early childhood years (3–5 year olds). Eighty-two percent of the students demonstrated OC skills below the 30th percentile and were considered developmentally delayed in their OC skills ($M = 18$ th percentile, $SD = 11$; Table 3) at the pretest. The mean pretest percentile rank of 18 (Table 3) was consistent with the previous literature (Goodway and Branta 2003 = 17th percentile; Robinson and Goodway 2009 = 25th percentile). The majority of the students in this study presented OC skill delays at the pretest despite attending an early childhood center with experienced teachers who possessed more than 15 years of teaching, large indoor and outdoor gross motor spaces, equipment available to practice OC skills, and a minimum of 30 minutes of daily gross motor free play. This study provides further evidence to support that free play alone, no matter how well equipped and monitored, is not a sufficient pedagogical strategy to drive FMS development and that FMS do not naturally emerge as a result of maturation alone (Goodway and Branta 2003; Logan et al. 2011; Riethmuller, Jones, and Okely 2009; Robinson and Goodway 2009; Valentini and Rudisill 2004). This finding has implications to policy and practice in early childhood programs, suggesting that children need to receive structured opportunities to develop their FMS.

Table 3. Pretest and posttest raw scores, standard scores, and percentile ranks.

Group	OC raw		OC SS		OC PR	
	Pre	Post	Mean (SD)		Pre	Post
			Pre	Post		
SKIP	16 (1.1)	32 (1.4)	7 (1.8)	12 (2.2)	15 (1.9)	72 (4.4)
Control	18 (1.4)	19 (1.2)	7 (1.7)	7 (1.7)	18 (2.4)	22 (3.2)

Note: OC, object control skill; SS, standard scores; PR, percentile rank.

Consistent with the previous motor skill intervention literature (Goodway and Branta 2003; Robinson and Goodway 2009; Valentini and Rudisill 2004), the results of this study reveal that when children receive developmentally appropriate, structured motor programming delivered through a direct instruction pedagogy they will significantly improve their FMS (Goodway and Branta 2003; Hürmeriç-Altunsöz and Goodway 2015; Robinson and Goodway 2009; Valentini and Rudisill 2004). From a pedagogical perspective, direct instruction is considered a best practice for eliciting maximal student learning in physical education settings (Miller, Vine, and Larkin 2007). During the SKIP program, the students also received ongoing feedback aligned to their developmental level, task modifications, and ample opportunities to respond. Additionally, the block plan for SKIP provided re-occurring cycles of skills across the six weeks of the intervention. In undertaking these best pedagogical practices (Rink 2014), it was believed that students were able to improve their skills. When students only receive well-equipped free play, they may not have received the feedback, opportunities to respond, and ability to experience success necessary to learn FMS. As a result, it is not surprising that the control students remained delayed in their OC skills at the posttest and SKIP students were significantly better than control students at the posttest.

This study was unique in that previous studies had featured motor development and physical education experts as the implementers of SKIP (Goodway and Branta 2003; Hürmeriç-Altunsöz and Goodway 2015; Robinson and Goodway 2009). The effect sizes of the previous SKIP studies were very high and the students within these studies were able to remediate their motor skill delays in 540 and 1080 minutes of instruction (Goodway and Branta 2003; Hürmeriç-Altunsöz and Goodway 2015; Robinson and Goodway 2009). In the present study, only 360 minutes of instruction was provided as it was a pilot study resulting in a $\eta^2 = .61$ effect size. The effect sizes for this study ($\eta^2 = .61$) were slightly lower than the effect sizes for the previous SKIP studies ($\eta^2 = .70$; Goodway and Branta 2003 and $\eta^2 = .73$; Robinson and Goodway 2009).

The smaller effect sizes may be due to the lesser dose of this intervention (360 minutes across six weeks) compared to other studies (540–1080 minutes) or due to classroom teachers not possessing the depth of pedagogical content knowledge as motor development experts. The results of the second HLM support the second claim that although the SKIP teachers yielded substantial gains in OC skills, their gains were not as high as experts. The HLM analysis revealed, as stated earlier, every 1% increase in fidelity was predicted to increase posttest scores by .12 standard score points supporting the importance of teachers being able to deliver SKIP with fidelity. A motor development expert should implement SKIP with over 95% fidelity and the SKIP teachers in the present study produced an 86.5% mean fidelity. As a result, the students in this study improved their OC skills, but not to the effect of students who learned SKIP from a motor development expert. Although it was feasible for the SKIP teachers to effectively deliver SKIP with fidelity, early childhood centers should consider hiring motor development and physical education experts to maximize student learning in gross motor skills.

Seeing such strong results speaks to the extent to which SKIP, as a program, is robust, valid, and reliable. The instructional tasks that made up the SKIP lesson plans have been empirically validated and refined over two decades of research (Goodway and Branta 2003; Hürmeriç-Altunsöz and Goodway 2015). Additionally the goal of these activities is to consider individual constraints and manipulate task and environmental constraints to align the activity to the child's developmental

level. Thus, despite fidelity that is not as strong as an expert, the content and pedagogical approach of the SKIP program itself may have helped account for the improvements in OC skills demonstrated by the students. The overall findings from the present study support the application of SKIP in a larger group randomized trial in future research.

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