Getting An Active Start: Evaluating The Feasibility of *INDO-SKIP* to Promote Motor Competence, Perceived Motor Competence and Executive Function In Young, Muslim Children In Indonesia

Dissertation

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Abstract

The primary purpose of the study was to determine the effectiveness of an eight-week *INDO-SKIP* motor skill program on Indonesian preschool children's motor competence and perceived motor competence. A secondary purpose of the study was to investigate the influence of the *INDO-SKIP* program on Indonesian preschoolers' executive function. Early childhood teachers (n=12) were recruited from four early childhood centers. Classrooms were purposively assigned to *INDO-SKIP* group (n=6) and control group (n=6), and children (n= 156) were nested into either group. Teachers in the *INDO-SKIP* group were trained in 9-hour initial workshop on *INDO-SKIP*. During the workshop, the teachers were assessed to determine the effectiveness of the workshop on teachers' motor development and physical education knowledge. Children in the *INDO-SKIP* group received 16, 30 minutes session over eight week of *INDO-SKIP* intervention delivered by teachers, while children in the control group received business as usual condition. All children were pretested and posttested on: 1) motor competence: measured by the Test of Gross Motor Development-2 (TGMD-2)-Object control (OC) subscale, and Movement Assessment Battery for Children-2 (MABC-2), 2) perceived motor competence: measured by Perceived Physical Competence (PPC) Subscale of the Pictorial Scale for Perceived Competence and Social Acceptance for Young Children, and the Pictorial Scale of Perceived Movement Skill Competence (PMSC) for Young

Children instrument, and 3) Executive Function: measured by Day and Night (DN) Task, and Head-Toes-Knee-Shoulder (HTKS) Task. Teachers' fidelity on teaching *INDO-SKIP* was 77.14%, and it was also determined that there were sufficient distinguishing features of the *INDO-SKIP* intervention differentiating it form the business as usual instruction of the control condition. The impact of the *INDO-SKIP* intervention on child outcomes was analyzed using Multivariate Analysis of Covariance (MANCOVA). The influence of teacher's fidelity on teaching *INDO-SKIP* was analyzed using Hierarchical Linear Modeling (HLM). Results showed that *INDO-SKIP* intervention influence children OC skill competence (p <.001) with large effect size (η^2= .55) but not MABC-2. The *INDO-SKIP* intervention also influenced both PPC (p= .00) with small effect size (η^2 = .15) and PMSC (p <.001) also with small effect size (η^2 = .07). It was found that teacher's fidelity did not significantly (p = .24) influence children outcome on OC competence and perceived motor competence. Moreover, the *INDO-SKIP* intervention also influenced children DN score (p = .01). In conclusion, this study revealed the feasibility of trained early childhood teachers to deliver *INDO-SKIP* intervention in Indonesia to improve children motor competence, perceived motor competence, and executive function. Future studies will be needed to examine the impact of INDO-SKIP intervention in the larger sample size with randomization experimental design.

Dedication

In dedication to my husband Al Halim,

my parents Husrun and Farida, and my Brother Heryk

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Haegele, J. A., Famelia, R., & Lee, J. (2016). Health-related quality of life, physical activity, and sedentary behavior of adults with visual impairments. *Disability and Rehabilitation*, 1-8.

Goodway, J. D., Famelia, R., & Bakhtiar, S. (2014). Future Directions in Physical Education & Sport: Developing Fundamental Motor Competence in the Early Years Is Paramount to Lifelong Physical Activity. *Asian Social Science*, *10*(5), p44 - 54.

Goodway, J.D., Brian, A., Chang, S.H., Famelia, R., Tsuda, E., & Robinson, L. (October, 2013). Promoting Physical Literacy in the Early Years Through Project SKIP. *ICSSPE Bulletin - Journal of Sport Science and Physical Education*, *65*. Retrieved from https://www.icsspe.org/content/no-65-cd-rom

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Chapter 1. Introduction

Indonesia is a developing country and the fourth most populous nation in the world with 260 million people, 25.4% of which are aged 0-14 years (Central Intelligence Agency [CIA], 2016). Forty percent of the Indonesian population is classified as poor. More recently Indonesia has undergone aggressive urbanization leading to large-scale migration from rural to urban areas, with a prediction that by 2030, 71% of Indonesia's population will live in urban areas posing many challenges (CIA, 2016; United Nation [UN], 2015). One of the major challenges Indonesia faces is that it has just joined the ranks of the top ten most obese countries in the world (Organization for Economic Co-operation and Development [OECD], 2014). Although there is little evidence, what is available suggests the prevalence of overweight and obesity has increased two-fold in Indonesia in a short period of time with a developmental trajectory of the rate of obesity increasing with age from early childhood to higher levels in adolescence (Julia, Prawirohartono, Suriono, & Delemarre-van, 2008). By the time Indonesian youth are 15 years old 19% of youth (45 million) are obese (Roemling & Qaim, 2012). A major contributor of this obesity crisis is the low physical activity level of Indonesian children with time spent in physical activity being replaced by screen time (Collins, Pakiz, & Rock, 2008; Roemling & Qaim, 2012). As a result there is significant concern about the physical activity levels of Indonesian children and adolescents, which are well below recommended guidelines for health (Center for Disease Control and Prevention [CDC], 2015; OECD, 2014; World Health Organization [WHO], 2011).

The World Health Organization (WHO) identifies access to physical activity for children as a key humanitarian right (WHO, 2011) and suggests children “should be physically active daily as part of play, games, sports, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities.” (pg.18). However, Indonesia does not currently have any national physical activity guidelines. There are also no educational practices/policies or systematic strategies to get children physically active early and keep them moving, such approaches are needed. Scholars in Indonesia have recognized the importance of the early childhood years stating that Indonesia must respond quickly with “early efforts on the prevention of obesity” and “applying balanced diet and physical activity as early as possible” (Usfar et al, 2010). Thus it is clear that Indonesia must develop evidenced-based approaches to promoting physical activity in it’s young children. Since preschools enrollment rates have been increasing in Indonesia, governments have begun to look to preschools as part of a preventive action plan providing population-based access to intervene and implement physical activity interventions as part of a wider obesity prevention agenda (Denboba, Hasan, & Wodon, 2015).

Childhood physical activity is an important part of a healthy developmental trajectory (Robinson et al., 2015; Stodden et al., 2008). The body of evidence on the importance of physical activity to overall health is quite conclusive (CDC, 2015; Robinson et al., 2015). A well-cited model in the motor development literature by

Stodden and colleagues (2008) suggests that motor competence is a key underlying mechanism driving physical activity behaviors across childhood and adolescence, and into adulthood. An increasing body of evidence supports this claim suggesting that motor competence developed in the early childhood and elementary years is predictive of later physical activity levels (Lubans, Morgan, Cliff, Barnett, & Okely, 2010; Robinson et al., 2015). However, many young children in Indonesia do not have the necessary opportunities and or possess the requisite skills to be physically active (Famelia, Goodway, Bakhtiar, & Mardela, 2016; Goodway, Famelia, & Bakhtiar, 2014; Goodway & Smith, 2005). Thus it is important to identify evidenced-based programs that promote the motor competence of young children.

Fundamental Motor Skills Form the Foundation of the Mountain of Motor Development

In early childhood the type of motor competence to be developed is fundamental motor skills competence. These fundamental motor skills are considered the building blocks to more advanced movement patterns like sport-skills (Gallahue, Ozmun, & Goodway, 2012). Similar with reading and writing, in which children need to recognize the letter before composing a word and formulating a sentence; fundamental motor skills are the ABCs of movement (Goodway & Robinson, 2006) that later can be combined or modified for playing in games or sport-related activities. In other words, fundamental motor skills are the foundation for children in order to be fluid and skillful movers (Hands, 2012). Fundamental motor skills are categorized into Object control (OC) or manipulation skills, Locomotor (LOC) skills, and stability skills (Gallahue, et al., 2012).

Object control (OC) skills are a set of skills to manipulate or control an object by the hand or foot. They include throwing, catching, kicking, striking, rolling and bouncing. Locomotor (LOC) skills are a set of skills that involve moving the body from one point to another, for instance, running, galloping, skipping, sliding, leaping, jumping, and hopping. Stability refers to the ability to gain and maintain the equilibrium (balance) in relation to the force of gravity during movement (Gallahue et al., 2012). Stability is inherent in all movements and important to develop during early childhood (Gallahue et al., 2012). The development of LOC and OC competence along with stability during movement is a key developmental milestone important to the early childhood years (Gallahue et al., 2012; Hands, 2012).

Several models of motor development speak to the importance of developing fundamental motor skills competence during the early childhood years (Clark & Metcalfe, 2002; Gallahue et al., 2012; Seefeldt, 1980; Stodden et al., 2008). An older sequential model of motor development by Seefeldt (1980) explains that children must develop competence in fundamental motor skills before breaking through a hypothetical proficiency barrier and being able to apply their skills successfully in transitional motor skills and later sports, games and lifetime activities. Seefeldt's model is supported by Clark and Metcalfe's (2002) model that suggests fundamental motor skills form the "base camp" to the motor development mountain. That is, children need to develop competency in fundamental motor skills in order to progress up the mountain to context specific activities (e.g. sports) and skillfulness. Thus, both models emphasize that fundamental motor skills are a prerequisite to develop more advanced movement skills, and the early childhood (3 – 7 years of age) timeframe is a critical period to develop fundamental motor skills competence (Gallahue, et al., 2012). However, fundamental motor skills do not naturally emerge as a prewired part of the maturational process (Gallahue et al., 2012). Many children do not reach proficiency in their fundamental motor skills across childhood and are not able to successfully perform sport-related skills (Goodway & Branta, 2003; Goodway, Crowe, & Ward, 2003; Goodway, Robinson, & Crowe, 2010; Goodway & Smith, 2005; Hamilton, Goodway, & Haubenstriker, 1999; Robinson & Goodway, 2009; Robinson, 2011; Valentini & Rudisill, 2004). Thus, structured programs are needed to promote fundamental motor skills development in children (Gallahue et al., 2012; Goodway & Branta, 2003; Goodway et al., 2003).

The Stodden et al. model (2008) identified above links fundamental motor skills competence to physical activity levels, higher perceived motor competence, physical fitness and a healthy weight trajectory (Stodden et al., 2008). This model hypothesizes that motor competence is an essential element underlying the physical activity behaviors of children and adolescents (Stodden et al., 2008). It proposes a dynamic and bi-directional relationship between physical activity and motor competence, which contributes to whether an individual would be more likely to have a healthy or unhealthy weight status. A number of studies (Barnett, Beurden, Morgan, Brooks, & Beard, 2009; Cohen, Morgan, Plotnikoff, Callister, & Lubans, 2015; Holfelder, & Schott, 2014; Lubans et al., 2010) have supported the ideas proposed by this model and have demonstrated that OC competence in childhood was particularly important and related to physical activity outcomes in adolescence. Such evidence further supports the importance of developing fundamental motor skills competence in the early childhood years.

Perceptions of Motor Competence are Important to Develop

The model by Stodden et al. (2008) also suggests that in addition to motor competence we must consider a child's perceived motor competence as this aspect of their development become increasingly important over developmental time. Perceived motor competence is one's perception of his/her motor competence, which changes across the developmental period (Harter, 1999). Perceived motor competence often mediates the relationship between motor competence and physical activity (Babic, et al., 2014; Barnett, Morgan, van Beurden, & Beard, 2008; Barnett, Ridgers, & Salmon, 2015; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Young children tend to over-estimate their perceptions of motor competence due to limitations in cognitive processing (Harter & Pike, 1984; LaGear, et al., 2012) and there is often a mis-match between their perceptions of competence and their actual motor competence (Goodway & Rudisill, 1996; Harter & Pike, 1984; Robinson, 2011; Robinson, Rudisill, & Goodway, 2009). Although young children tend to have higher levels of perceived motor competence it is still critical to promote perceived competence during early childhood (Robinson et al., 2015). We need to understand that there is a developmental trajectory to perceived motor competence and that as children shift from early to late childhood/adolescence their perceived competence will align more closely with their actual motor competence (Barnett, et al., 2009; Harter, 1999; Harter & Pike, 1984). If actual motor competence is low, then as children move into the upper elementary years their perceived motor competence will drop dramatically and will also be low. This ultimately will affect their engagement in physical activity (Babic et al., 2014) and they will be drawn into a negative spiral of disengagement (Stodden et al., 2008). Thus, the data in this area further support the need to develop fundamental motor skills competence in the early childhood years as actual motor competence underpins perceived motor competence and implement strategies to enhance children's perceived motor competence.

Relationship between Physical Activity and Cognition

Motor competence also benefits cognitive development through a child's exploration of her/his environment and surroundings (Payne & Isaacs, 2016). Research on brain development has indicated that motor development and cognitive development are interrelated (Diamond, 2000; Smith, Thelen, Titzer, & McLin, 1999). Findings from the literature reveal that balance (Rizutto & Knight, 1993), motor ability (Oja & Jurimae, 2002), coordination (Nourbakhsh, 2006), and fine and gross motor skills (Son & Meisels, 2006) have a positive moderate to strong relationship with academic performance. Recently the Centers for Disease Control and Prevention (2010) conducted a large-scale review of the empirical relationship between physical activity and academic performance. Academic performance was defined broadly and included: 1) cognitive skills and attitude (e.g. attention, executive function), 2) academic behavior (e.g. time on task, conduct), and 3) academic achievement (grades, test). Fifty studies were reviewed by the CDC with 251 associations (2010). In 50.5% of cases the association between physical activity and academic performance was positive, in 48% of cases more physical activity did not take away from academic outcomes, and in only 1.5% of the associations was the relationship negative (CDC, 2010). However, this literature was focused on academic performance and physical activity in school-aged children. We know little to nothing about the motor competence and cognitive development of young children.

In the early childhood years a primary focus of the work in cognition is looking at executive function instead of academic performance (Best & Miller, 2010). Executive function is an umbrella term that refers to higher order of thought process and self-regulation, which includes inhibitory control, planning, speed processing, attention flexibility and problem solving (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Chan, Shum, Toulopoulou, & Chen, 2008). Similar with motor development, the first five years are very important in the development of executive function development (Garon, Bryson, & Smith, 2008). A few small studies have reported a relationship between executive function and motor development (Cameron et al., 2012; MacDonald et al., 2016). Stockel & Hughes (2016) reported that inhibitory control and working memory capacity predicted young children's fine motor skills. In contrast, Piek, Dawson, Smith, & Gasson (2008) found that there was no significant relationship between fine motor skills and cognitive ability. Instead, gross motor skills from birth to age 4 years predicted the cognitive ability of children once they reached school age (Piek et al., 2008). However, there is little literature in this area and further research is warranted. To my knowledge there is no literature that has investigated the relationship between fundamental motor skills and executive function, specifically executive attention that involves behavioral regulation and inhibitory control. With more pressure on early childhood teachers to improve academic performance that often leads to decreased physical activity time (Hirsh-Pasek, Golinkoff, & Eyer, 2004), it would be valuable to provide evidence whether promoting fundamental motor skills would also positively influences executive function. Given the limited time in schools to address a wide variety of content in the early childhood years, evidenced-based programs that impact multiple domains of development would make a significant contribution to the education of young children.

In summary, models in motor development show that fundamental motor skills are building blocks to advanced motor skills that are part of sports and games. Initial research evidence shows that OC skill competence in early childhood predicted physical activity in older age (Barnett et al., 2009). Also, as children get older, their perceptions of motor competence become more important in motivating children to be physically active. Thus, we need to begin to develop children's motor competence and perceived motor competence in the early childhood years. In addition, a new area of research suggests that physical activity is related to cognitive development, especially executive function. However, we do not know much about the relationship of fundamental motor skills and executive function in the early childhood years. Therefore, this study addresses a gap in the literature by examining to what extent motor skill development affect preschoolers' executive function. It is clear from motor development theory and scientific findings that motor competence, perceived motor competence, and executive function are really important to develop in the early years. Therefore, a program to improve children's motor competence and perceived motor competence should be implemented in the early years, with hopes that improving motor competence would also impact executive function.

Need Evidenced-Based Motor Skill Interventions

There is little fundamental motor skills data in Indonesia to inform the development of motor skill programs for young children. The body of evidence within the USA suggests that young children who are poor and grow up in urban environments are developmentally delayed in their fundamental motor skills (Goodway & Branta, 2003; Goodway et al., 2003; Goodway et al., 2010; Robinson & Goodway, 2009; Robinson, 2011; Valentini & Rudisill, 2004). There are no gender differences in LOC skills but the literature consistently reports gender differences in OC skills with boys outperforming girls (Kordi, et al., 2012; Zask et al., 2012a, 2012b). A pilot study conducted in Padang, West Sumatera (Famelia, Goodway, Bakhtiar, & Mardela, 2016) showed similar findings with Indonesian children. Preschoolers had low competence in their LOC and OC skills, and boys significantly outperformed girls in OC skills (Famelia, et al., 2016). However, preschoolers perceived themselves as "pretty good" on their motor competence and there was no gender difference. Preschoolers also spent 80% of their school day in sedentary behavior. This is due to the current curriculum in Indonesia that is heavily academic and has moved away from a play-based curriculum (UNESCO, 2003). This initial work in Indonesia supports the concerns raised earlier about the motor competence and physical activity behaviors of young Indonesian children. Thus it is clear that evidenced-based approaches to promoting fundamental motor skills in Indonesian preschools are warranted. However, there are currently no evidence-based motor skill program in Indonesia that can be used by preschools. Therefore, there is a need to design a structured motor skill intervention for Indonesian young children that can be delivered by early childhood teachers to promote children's motor competence and perceived motor competence.

Meanwhile within the USA, an evidenced-based fundamental motor skills program called *SKIP* (Successful Kinesthetic Instruction for Preschoolers) for early childhood, has been developed by Goodway and colleagues and revealed large effect sizes (η^2=.63-.81) for the influence of *SKIP* on motor competence and perceived motor competence as compared to a Business as Usual condition (Altunsöz, & Goodway, 2016; Goodway, & Branta, 2003; Goodway et al., 2003; Robinson, & Goodway, 2009). The dose of this program has been 30-45 minutes, two times per week for 8 to 12 weeks delivered by motor development experts (Altunsöz, & Goodway, 2016; Goodway & Branta, 2003; Goodway et al., 2003; Robinson & Goodway, 2009). More recently, one study attempted to address the social validity issues of *SKIP* (Brian, Goodway, Logan, & Sutherland, 2016a) and trained early childhood teachers to deliver the *SKIP* program focused on OC skills (30 minutes each session, 2 times per week for six weeks). This study showed that preschoolers improved their OC skills with a high effect size (η^2=.61). Thus, the *SKIP* program can be used as the foundation of an evidence-base to improve children's motor competence and perceived motor competence in Indonesia and flexibly tailored to local conditions in Indonesia and modified into the *INDO-SKIP* program.

Indonesia faces some unique challenges in promoting motor competence in young children through a preschool-based *INDO-SKIP* program that involves cultural differences and the quality of early childhood training. Early childhood education for children younger than 5 years was not a common practice in Indonesia until 2008.

Considering the diversity and large disparity in socio-economics and cultural diversity, Indonesia has adopted an approach of community driven early childhood centers (Pradhan et al., 2013). The national guidelines for early childhood education cover more general components, and in practice, the early childhood centers are influenced more by the community culture. Padang, in which this study will be conducted, is the capital city of West Sumatera. The majority of the population in Padang is the indigenous ethnic group, known as Minangkabau people, which is the largest matrilineal society in the world strongly founded upon Islamic law. In this society, many Muslim girls have little opportunities to be physically active outside and are encouraged to stay inside and play sedentary activities. This culture to some extent influences the early childhood center's practice. In addition to the cultural influences, the ability of early childhood education teachers to implement the motor skill intervention in schools is also a challenge. Early childhood teacher training for young children (aged 3 to 6 years) is a relatively new program in Indonesia (Hasan, Hyson, & Chang, 2013). As such, it is still in developing a qualified curriculum and practice to yield well-trained early childhood teachers. Therefore, it is not clear whether the current early childhood teachers in Indonesia have the capability to implement *INDO-SKIP* with fidelity and bring about learning outcomes for children. Another challenge to implementing *INDO-SKIP* is most early childhood centers do not have dedicated motor skill spaces in their schools, as the only physical activity session during the school day is a free-play session on the playground which is often just a dirt or cement area with no playground equipment.

In summary, children who are disadvantaged are more likely to be delayed in their fundamental motor skills development. As 40% of the Indonesian population lives in poverty, many young children would be at risk of developmental delay. The limited data collected in Padang showed that preschoolers had low motor skill competence. In addition, the daily academically focused curriculum in preschools resulted in large (80%) amounts of the school day being sedentary which in turn does not support the motor skill development of preschoolers. The higher perceived motor competence in preschoolers can be seen as an asset for working with preschoolers in fundamental motor skills. Drawing from the evidenced-based *SKIP* curriculum, an early years motor skill program called *INDO-SKIP* will be implemented. As motor development is related with cognitive development (and perhaps executive function), providing an *INDO-SKIP* program in early childhood centers could serve as a multi-utility program for preschoolers to promote their motor competence and executive function. To date, no studies have conducted motor skill interventions with Indonesian preschoolers. Also, there are no studies that have looked at the relationship between the OC skills and executive function development in preschoolers. Therefore, this study aimed to address these gaps in the literature.

Purpose of Study

The primary purpose of the study was to determine the effectiveness of an eight-week *INDO-SKIP* motor skill program on Indonesian preschool children's motor competence and perceived motor competence. A secondary purpose of the study was to investigate the influence of the *INDO-SKIP* program on executive function in young children. The following research questions (RQs) were addressed:

RQ1: what are the effects of an eight-week *INDO-SKIP* intervention implemented by trained early childhood teachers on preschool children's motor competence and perceived motor competence? There were four hypotheses proposed to answer this question, as following:

H1a. Children would score under the 30^{th} percentile on their motor competence (OC skills and Movement Assessment Battery for Children-2) yet perceive themselves "pretty good" on perceived motor competence at the pretest.

H1b. There will be a gender differences in motor competence (OC and MABC-2), but no gender differences in perceived motor competence at the pretest.

H1c. Children in the INDO-SKIP group would have significantly higher motor competence and perceived motor competence than children in the control group at the posttest when accounting for pretest scores.

H1d. Pretest, and gender will influence children's improvement in motor competence and perceived motor competence after the 8-week *INDO-SKIP* implementation.

RQ2: to what extent do teachers implement *INDO-SKIP* with fidelity and how does that influence the effect of the *INDO-SKIP* intervention on children's motor competence and perceived motor competence?

H2: Teacher fidelity in delivering the intervention will significantly influence the outcome of the *INDO-SKIP* intervention with respect to motor competence and perceived motor competence.

RQ3: What are the effects of the *INDO-SKIP* intervention implemented by early childhood education teachers on children's executive function?

H3a. There will be a significant correlation between measures of executive function and motor competence and perceived motor competence at the pretest.

H3b: Children in the INDO-SKIP group will have significantly higher executive function (self-regulation and inhibitory control) than children in the control group at the posttest when accounting for pretest scores.

Delimitations of the Study

This study is delimited to the following:

1. Boys and girls aged 3-6 years enrolled in urban early childhood education centers in Padang, West Sumatera, Indonesia, most of whom will be of the Muslim faith.
2. Early childhood centers that have an indoor space for motor skill activities for the *INDO-SKIP* program.
3. Typically developing preschoolers without disabilities.
4. The intervention was delivered by trained early childhood teachers with an early childhood teaching license issued by the Office of Education of West Sumatera.
5. The *INDO-SKIP* program focuses on OC competence and is delivered for eight weeks, twice per week for 30 minutes per session with on going coaching by the investigator.

Limitations of Study

The limitations of this study are the following:

1. The Test of Gross Motor Development-2 has the potential to have floor effects in

measuring some of the OC skills. The coding with binary system (0 when the criteria element does not present and 1 when it presents) limits the ability of TGMD-2 to capture the variability within skills. For instance, in catching, TGMD-2 cannot differentiate between catching stage 4 (catching with hand and stationary) and 5 (catching with hand while moving).

2. Quasi-experimental design with no random selected and no random assignment of early childhood centers into experimental and control group.
3. There was only one teacher per classroom, which will affect the pace of teaching.
4. Access to ideal space for assessing children was very limited.
5. The weather during data collection was very hot (96 to 100 degree Fahrenheit). Data of participants in two early childhood centers were collected on the playground. Thus, it might influence children performance on motor competence assessment.
6. The data analysis (using MANCOVA) did not account for the variance attributed to the children being nested within classrooms.

Definition of Terms

Motor competence is the ability of individual to perform common fundamental motor skills in proficient level (Stodden et al., 2008).

Fundamental Motor Skills are the basic patterns of movement that can be observed visually (Gallahue et al., 2012). Fundamental motor skills includes LOC skills, OC skills, and stability skills.

Locomotor skills are are a set of skills that involve moving body from one point to another. For instance, running, sliding, leaping, skipping, and jumping (Gallahue et al., 2012)

Object control skills are skills to manipulate or control an object by hand or foot. For instance, kicking, throwing, catching, and striking (Gallahue et al., 2012).

Dynamic System Theory (DST) is a theory that captures that the development change is dynamic. In this study, it means that the motor development is not linear (Gallahue et al., 2012; Smith and Thelen, 2013), which allows individual to experience different pathways to produce the same results. This is related the concept that developing organism involves complex systems, including the biological systems within individuals and the environmental systems. This concept describes that specific behavior could emerge when the complex system is self-organized, in which when the biological systems in the body is supported by environmental factors (Gallahue et al., 2012). Biological and environmental factors that influence the dynamic change in development also known as *control parameter*. Control parameter can be positive (affordance) that encourages the developmental change, and negative factors (rate limiters) that tend to slow down the change (Gallahue et al., 2012).

Perceived motor competence refers to one's perception of his/her competence in movement and fundamental motor skills.

Executive function is defined as the executive attention that associates with behavioral regulation, speed process, and inhibitory control (Cameron et al., 2012; Stuss & Benson, 1986).

Behavioral regulation is the ability to control and direct actions, pay attention and remember the instructions. It includes inhibitory control, attention, and working memory. (Ponitz et al., 2008).

Inhibitory control is a self-regulation mechanism to impede responses to unrelated stimuli while pursuing a cognitively represented goal (Rothbart & Ahadi, 1994; Thorell & Wahlstedt, 2006).

Inhibitory control is important for flexible interaction during changing in the tasks or environment (Garavan, Ross, Murphy, Roche, & Stein, 2002).

Attention is the ability of brain to detect errors and to resolve conflict among different responses (Botvinick, Braver, Barch, Carter, & Cohen, 2001), which includes focusing, sustaining, and shifting attention (Ponitz et al., 2008).

Working memory refers to maintaining information in mind while processing new information (Adams, Bourke, & Willis, 1999).

Chapter 2. Literature Review

This chapter presents the theoretical underpinnings and literature that frames this study. This chapter provides an overview of the Dynamical Systems Theories and Newell Constraints Perspectives, motor competence, perceived motor competence, review of motor skill intervention studies, and executive function. A general summary of Chapter 2 is provided at the end of the chapter.

Dynamic System Theory

This study is grounded by Dynamic System Theory. Dynamic Systems Theory (DST) portrays the complex phenomena of human motor development in a manner that attempts to organize chaos metaphorically (Thelen & Smith, 1998). Dynamic System Theory is based on the Chaos Theory (Thelen & Ulrich, 1991), which explains how order and complexity arise from the chaotic nature of the universe (Thiétart & Forgues, 1995). One tenet of DST is multicausality, which suggests that development in systems (people) is complex and consists of multiple sub-systems within the individual and the environment (Smith & Thelen, 2003). According to DST, humans are ever changing, transactional systems that co-exist within the larger environmental system. Within the human system patterns of movement emerge from numerous interactions among multiple subsystems (e.g. multi-limb coordination, perceptual, and cognitive) and the lowest components (e.g. blood cells, nerves, metabolic enzymes etc.) of the system. An individual's performance on a skill such as a motor skill is a product of the interaction among the multiple sub-systems all of which have varying rates of development (Gallahue et al., 2012). Dynamic systems are emergent phenomenon that self-organize and are characterized by periods of stability and instability in their behavior (Smith & Thelen, 2003).

When an individual is in a stable pattern of behavior he/she would be considered to be in a behavioral attractor phase. When an individual demonstrates instability in her/his patterns of behavior they would be considered to be going through a phase shift. A *behavioral attractor* is a stable pattern of behavior that is observed across multiple trials and conditions (Clark & Phillips, 1993; Langendorfer & Roberton, 2002). From a fundamental motor skills standpoint these behavioral attractors are in fact the stages of development from stage theory. Contrary to stage theory, DST suggests that children do not necessarily develop their motor skills in order (e.g. 1, 2, 3). Rather, behavioral attractors represent the movement repertoire of a child, the possible solutions to a movement problem. Some children may skip some stages or may develop skills in a non-sequential manner (Langendorfer & Roberton, 2002). For example, in throwing, there are five behavioral attractors (stages) that could be demonstrated in any order.

A phase shift refers to changes or transitions in movement behavior from one behavioral attractor to another behavioral attractor that is qualitatively different (Newell, 1984; 1986; Thelen & Ulrich, 1991). For example, a child who is throwing with an ipsilateral step and then learns how to throw with a contralateral step has undergone a phase shift. When children phase shift they often bounce back and forth between the different patterns of movement before settling on a more efficient and complex pattern of movement. As a child shows more variability in her/his performance there is a window of opportunity to manipulate task and environmental constraints to “push” the child into a phase shift and a more efficient pattern of performance.

When a child phase shifts between different patterns of movement it is typically because one of the underlying sub-systems has changed causing the child to shift to a different pattern of movement. Sub-systems that bring about a phase shift are also known as ***control parameters***. Control parameter can be positive (improve the skill) and negative (cause the skill to decline). A positive control parameter is known as an ***affordance*** and a negative control parameter is referred to as a ***rate limiter***. Affordances tend to encourage and promote more efficient developmental change and rate limiters tend to slow down the developmental change (Gallahue, et al., 2012).

In motor skill programs, the control parameter could be environmental such as in the size, the texture, and the weight of the ball in catching. The bigger size and the lighter foam balls would be easier to catch. In contrast, a smaller, heavier ball would be harder to catch. In the latter case the ball may be considered an environmental rate limiter because it delays developmental change. One of the goals of a high quality motor skill intervention is to provide environmental affordances to children in order to elicit developmental change in motor skills. By manipulating environmental constraints such as the equipment, teachers should be able to promote the development of motor skills from less proficient to more proficient attractor states.

Newell's Constraints Perspective

Within DST, the affordances and rate limiters can also be viewed as constraints (Gallahue, et al., 2012). The word constraint does not have a negative connotation. Constraints serve to channel the movement dynamics into a motor solution (Newell, 1996). Newell defined constraints as boundaries, parameters, or features that limit motion and reduce the number of possible configurations of a system (Newell, 1984; 1986). Newell (1984; 1986) organized constraints into three categories: the learner, the task, and the environment (Figure 1.1). Newell argues that the constraints within the individual, environment, and the movement tasks interact resulting in movement performance. These constraints can be modified, which lead to the shifting from less proficient to more proficient patterns in motor skill performance (Newell, 1986; Thelen & Ulrich, 1991).

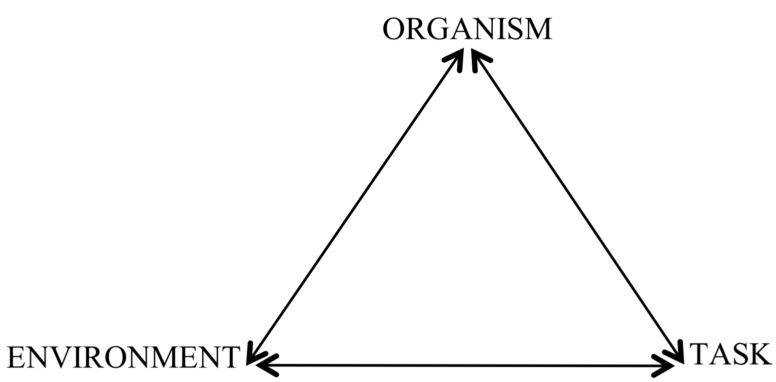

Figure 1. The categories of constraints in Newell constraint perspective.

Organism. Organismic constraints are internal or biological factors that influence development (Newell, 1984; 1986). In this study, the organism refers to the preschoolers. Some organismic constraints cannot be manipulated, for example, gender and ethnicity. Other organismic constraints can be changed but will require a longer time to be manipulated, such as body weight, body height, motor skill level, static/dynamic balance, strength, and flexibility. Furthermore, other constraints can be modified quickly, for instance, motivation and attention.

Environment. Environmental constraints are external constraints that are ambient conditions for the task (Newel, 1986). Environmental constraints include instructional approach, temperature, facilities, equipment, society culture, and altitude. Within this study society and culture may be a powerful influence. For example, soccer is one of the most favorite sports in Indonesia, and as such preschoolers have lots of role models for kicking and may be more highly motivated to kick and more comfortable in learning kicking compared to throwing. Equipment used in the motor skill instruction is another example of environmental constraints. Each skill has unique environmental constraints that can be manipulated to make the task harder or easier. For example, size, texture and weight of the ball along with the distance from which the ball is tossed are common constraints for catching. In throwing, size and distance of target are two common environmental constraints. From a pedagogical standpoint these environmental constraints are often the factors that are changed in a developmental task analysis (Davis & Burton, 1991; Hastie, Rudisill, & Boyd, 2016).

Task. Task constraints emphasize the specific goal and the specific constraints enforced within the activity (Newell, 1986). Newell (1986) stated that there are three categories of task constraints:

1. The goal of the task (e.g., throwing for distance or throwing for accuracy).
2. The rules of the task or activity (e.g., kicking with instep of foot, not kicking with

toes).

3. The implements or machines used in the action (e.g., the length of bat for striking a ball).

In summary, there are four main messages from DST and Newell Constraints Perspective that underpin this study:

1. Motor development is not prewired and predominantly maturational, it is emergent based on the interaction of the cooperating and competing sub-systems.
2. Motor development is not linear. It is dynamic and it involves many subsystems. Those subsystems are self-organized to produce stable movement behaviors.
3. Development occurs over different timescales. It is influenced by positive and negative control parameters that come from internal and external sources.
4. Sub-systems within the organism, environment, and task interact and can be modified to move the child from less proficient to more proficient patterns of motor performance.
5. Teachers should examine a child's individual constraints (e.g. strength, balance) and design developmentally appropriate tasks that take advantage of manipulating environmental constraints.

Models of Motor Development

According to Clark and Whitall (1989), motor development is defined as "changes in motor behavior over the lifespan and the processes which underlie these changes" (p.194). There are three main models of motor development in the literature: 1) Sequential Model of Motor Development (Seefeldt, 1980), 2) Mountain of Motor

Development Model (Clark & Metcalfe, 2002), 3) Triangulated Hourglass Model (Gallahue, et al., 2012).

Sequential Model of Motor Development. The "Sequential Model of Motor Development" (Seefeldt, 1980) describes the sequence of motor skill development across development time. At the bottom of the model are reflexes. Then the next layer of the model is the acquisition of fundamental motor skills that must be developed during early childhood. Following fundamental motor skills Seefeldt proposed a hypothetical proficiency barrier; in which one must be proficient in fundamental motor skills in order to break through this proficiency barrier to experience success in more advanced motor skills related to transitional skills and various sports, games, and physical activity. Hence, those who are less competent in fundamental motor skills will be unlikely to break through the proficiency barrier and master more advanced fundamental motor skills and be active later on in life. This model suggests that proficiency in fundamental motor skills acquisition should occur in the early childhood years.

Mountain of Motor Development. Clark and Metcalfe (2002) developed a model called the "Mountain of Motor Development." This model explains that motor skills develop through six phases of motor development across life span. Those phases are reflexive, pre-adaptive, fundamental motor patterns, context-specific, and skillful. This model suggests that fundamental motor skills are the "base camp" from which all individuals begin their motor development journey toward the top of the mountain performance of context specific skills and skillful movement. The mountain of motor development model recognizes that fundamental motor skills development is different within one individual (intra-individual) and between individuals (inter-individual). Within one individual, the proficiency of fundamental motor skills competence may vary among skills. For example, an individual may have a high level of competency at striking with two hands, but may not be very proficient at kicking. These variants in motor skill proficiency are conveyed as different "peaks" of the mountain within the model. Not only does an individual have different peaks, but also each person's mountain looks different, as there is intra-individual variance.

Triangulated Hourglass Model. Another motor development model introduced by Gallahue is called the Triangulated Hourglass Model (Gallahue et al., 2012). This model considers that the rate of motor development is influenced by individual factors (such as genetics), task and environmental constraints. Individuals progress through four stages in their motor development: reflexive movements, rudimentary movements, fundamental motor skills, and specialized movements. In the hourglass model, fundamental motor skills are situated between rudimentary movements and a specialized movement phase. According to Gallahue, one must become proficient in fundamental motor skills before being able to achieve specialized movements, which leads to motor control and movement competence.

Definition and Importance of Motor Competence

The three models above speak to children developing motor competence. However, there has been a variable definition of and measurement of motor competence in the literature. Some studies refer to motor competence as motor ability, which are general traits underlying movement skills (Burton & Miller, 1998) such as static and dynamic balance (Iivonen, Saakslahti, & Nissinen, 2011), and fine and gross motor skills (Bonvin et al., 2013; Monsalves, Castro, Zapata, Rosales, & Salazar, 2015; Piek et al., 2013; Venetsanou & Kambas, 2004). While other studies define motor competence as fundamental motor skills, including both LOC skills and OC skills (Deli, Bakle & Zachopoulou, 2006; Goodway & Branta, 2003; Goodway et al., 2003; Hamilton et al., 1999; Jones, et al., 2011; Martin et al., 2009; Robinson & Goodway, 2009). Therefore, there are different understandings that muddle the findings on motor competence. For this study, motor competence is defined as competence in performing fundamental motor skills, specifically OC skills. Furthermore, this study looks at motor competence from a process perspective. That is the ability to perform the technique of fundamental motor skills.

Fundamental Motor Skills refers to movement of the body or body parts that is learned, goal-oriented, and voluntary (Gallahue, et al., 2012). Motor skills are not entirely maturational in nature (Newell, 1986) but require learning and practice in a developmentally appropriate environment where the learner has opportunities to experience success early and frequently (Gagen & Getchell, 2006). Fundamental motor skills are classified into Locomotor (LOC) skills, Object control (OC) skills, and stability skills (Gallahue et al., 2012). Locomotor (LOC) skills are skills that move the body from one point in space to another point, for instance, running, leaping, hopping, sliding, galloping, skipping, and jumping. Object control (OC) skills are the ability to manipulate, project and receive an object with either the hands or feet, such as throwing, catching, kicking, hand dribbling, and striking (Gallahue et al., 2012). Stability refers to the ability to gain and maintain the equilibrium (balance) in relation to the force of gravity during movement, including twisting, pulling, pushing, and turning (Gallahue et al., 2012).

Fundamental Motor Skills are considered the building blocks or “base camp” to climb up the mountain of motor development into more complex movement patterns (Clark & Metcalfe, 2002; Seefeldt, 1980). Fundamental motor skills develop during the early childhood years when a child is capable of moving independently (Clark & Metcalfe, 2002; Haywood & Getchell, 2008; Seefeldt, 1980).

Relationship Between motor competence and physical activity. The three models above highlight the importance of fundamental motor skills in developing motor competence. However, none of those models explains the relationship between motor competence and physical activity and health throughout the lifespan. A recent model by Stodden et al. (2008) proposes a synergistic relationship between motor competence and physical activity. Furthermore, this model suggests the interactions among the variables in the model will drive individuals toward a healthy or unhealthy weight status. Stodden and colleagues (2008) suggest during early childhood, opportunities to engage in physical activity drive the development of motor competence (in this case fundamental motor skills competence). In contrast, for adolescents, motor competence drives physical activity participation. The relationship between motor competence and physical activity is mediated by perceived motor competence and physical fitness (Figure 2).

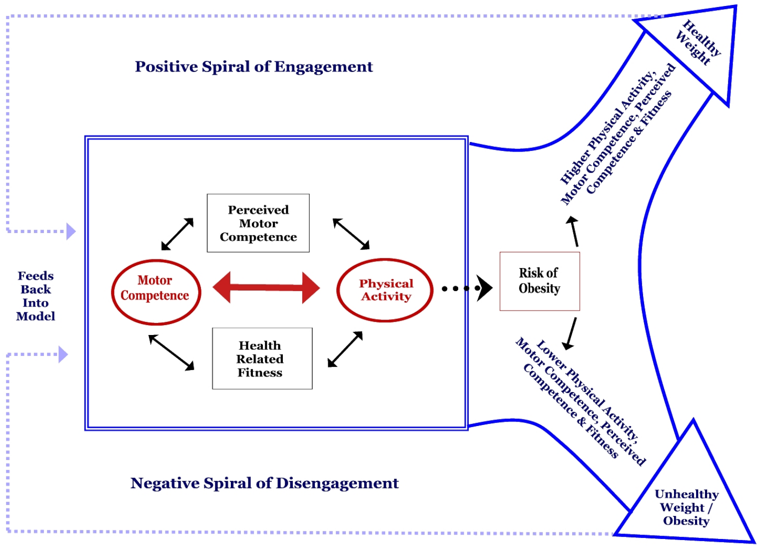

Figure 2. Developmental mechanisms influencing physical activity trajectories of children. Reprinted from "A Developmental Perspective on the Role of Physical Competence in Physical Activity: An Emergent Relationship" by Stodden, et al., 2008, *Quest, 60*, p. 290-306. Copyright 2008 National Association for Kinesiology and Physical Education in Higher Education.

A young child who is less active physically will have less opportunity to improve fundamental motor skills. Later, this child will opt out of physical activity when given a chance (e.g. in recess), which will further compound their low motor competence. Ultimately they will also develop low perceived motor competence and low physical fitness levels. All of these relationships strengthen from early childhood to adolescence resulting in a child who is inactive and overweight/obese. The relationships among these four variables influence the likelihood for individuals to experience the positive spiral of engagement, which lead them to a healthy weight status, or to experience a negative spiral of engagement, which lead them to an unhealthy weight status.

The conceptual model by Stodden and colleagues has been supported by a growing body of evidence and suggest that children need to develop motor competence in fundamental motor skills in order to be physically active across the lifespan (Barnett et al., 2009; Lopes, Stodden, Bianchi, Maia, & Rodrigues, 2012; Robinson et al., 2015). Early childhood is the timeframe in which to develop motor competence to set children on a positive spiral of engagement and a healthy developmental trajectory (Holfelder, & Schott, 2014; Lubans et al., 2010; Robinson et al; 2015). Thus, one of the primary take-home messages for this study is the importance of development fundamental motor skills competence and perceived motor competence in the early childhood years.

In summary, all four models of motor development highlight the importance of fundamental motor skills. The Seefeldt model (1980) emphasized the importance of young children becoming proficient at fundamental motor skills in order to be able to perform more advanced sports skills. Clark and Metcalfe's (2002) Model emphasizes that there is intra-individual and inter-individual factors that influence the rate of skill development within and between individuals. Interactions of intra- and inter-individual factors result an individual performs better in a skill than other skills, and have the proficiency different than other individuals. Gallahue's Triangulated Hourglass Model (Gallahue et al., 2012) emphasizes the interaction between biological factors (genetics) and external factors (tasks and environment) in the motor skill development of individuals. Gallahue suggests that the interaction among these three factors will influence the rate of fundamental motor skills skill development. Finally, Stodden et al (2008) recognizes the importance of fundamental motor skills in an individual's health and fitness. Overall, all models agree that fundamental motor skills should develop during early childhood through practice and successful experiences.

Disadvantaged Children and Fundamental Motor Skills.

When children do not have enough exposure to practice fundamental motor skills in the early childhood years, young children may become at risk for motor skill development delay (Logan et al., 2012; Riethmuller et al., 2009). Motor delays are of concern as developmental delays in motor skills have the potential to affect various outcomes such as physical activity participation, body composition, and perceived motor competence (Lubans, et al., 2010; Robinson et al., 2015; Stodden et al., 2008). One segment of the population, children from disadvantaged environments, have been found to be particularly at-risk for motor development delay (Goodway & Amui, 2007; Goodway & Branta, 2003; Goodway et al., 2010; Goodway & Smith, 2005; Robinson, 2011; Robinson & Goodway, 2009).

A number of studies have highlighted motor delays in young children who are disadvantaged (Goodway & Branta, 2003; Goodway et al., 2010; Robinson & Goodway, 2009; Martin et al., 2009; Valentini & Rudisill, 2004). Some studies (e.g., Goodway & Branta, 2003; Goodway, Crowe, & Robinson, 2010; Robinson & Goodway, 2009; Martin et al., 2009; Valentini & Rudisill, 2004) measured children's motor competence by using the Test of Gross Motor Development (TGMD; Ulrich, 1985; 2000) which is a norm-referenced and validated process-oriented test to measure fundamental motor skills competence of children ages 3- 10 years, 11 months (Cools, De Martelaer, Samaey, & Andries, 2008). According to the TGMD scoring, a child who scores below the 30th percentile on the TGMD is classified as being developmentally delayed.

Studies of young children who are disadvantaged conducted in the USA show that regardless of gender, participants on average scored at or below the 30th percentile on the TGMD (Hamilton et al., 1999; Goodway & Branta, 2003; Goodway et al., 2010; Robinson & Goodway, 2009; Martin et al., 2009; Valentini & Rudisill, 2004). These findings of developmental delay among disadvantaged preschool children have been consistently reported across geographic regions (Hamilton et al.,1999; Goodway & Branta, 2003; Martin et al., 2009; Robinson & Goodway, 2009; Valentini & Rudisill, 2004). The average TGMD score for typical motor skill development should fall in between 30th to 90th percentile. Children who have TGMD score greater than 90th percentile are considered advance on their fundamental motor skills competence (Ulrich, 2000). Goodway & Smith (2005) suggested that the risk for developmental delay in disadvantaged children may be due to limited opportunities to play outside because of safety concerns, the increased use of screen time, lack of structured physical activity in and out of school, and lack of structured play with parents due to work hours.

Gender Differences in Fundamental Motor Skills. The motor development literature also suggests that there are gender difference in fundamental motor skills. Studies often suggest that boys outperform girls in OC skills, whereas there is no gender difference in LOC skills (Barnett, van Beurden, Morgan, Brooks, & Beard, 2010; Garcia & Garcia, 2002; Goodway et al., 2010; Lorson, & Goodway, 2008). The gender gap for fundamental motor skills increases from early childhood to adolescence (Goodway et al., 2010) if not addressed at an early age. One possible explanation for fundamental motor skills gender differences may be the social-ecological environment (Garcia, 1994). Garcia (1994) reported that boys tended to be more competitive in motor skill environments while girls were more caring and interested in sharing. A competitive orientation motivated boys to more engaged with the task than girls and also get more practice trials of the skill (Garcia, 1994; Williams, Haywood, & Painter, 1996).

Perceived Motor Competence

Perceived competence is one's perception on his/her performance, which changes along with the developmental and cognitive capacity to make meaningful self-evaluations about one's-self (Harter, 1982; Harter & Pike, 1984). Harter and her colleagues suggest perceived competence is a more general construct and can be evaluated in several domains such as cognitive, social, physical, or personality traits (Harter, 1982; Harter & Pike, 1984). This is different to self-concept, which is self-perceptions in a more specific domain or different skill domains (Harter & Pike, 1984). In order to analyze self-perception on different domains, Harter & Pike (1984) developed an instrument called the Pictorial Scale of Perceived Competence and Social Acceptance (PSPCSA) for young children. This instrument has two versions: for preschoolers/kindergartens and for first and second graders. Both scales consist of four subscales, which are cognitive competence, peer acceptance, physical competence, and maternal acceptance. The perceived physical competence (PPC) subscale measures children's perception on general motor competence items including swinging, climbing the monkey bar, tying shoe laces, skipping, hopping, and running (Harter & Pike, 1984). The PSPCSA instrument is a valid instrument for young children with reliability for internal consistency of the individual items ranged from .52 to .89, with a reliability of .86 for the combined subscales. Overall this is a well-validated instrument (Harter & Pike, 1984) that has been used extensively in the motor development literature (Sturgess, Rodger, & Ozanne, 2002; Valentini & Rudisill, 2004).

More recently, Barnett and colleagues developed a new instrument, Perceived Motor Skill Competence (PMSC), measuring children's perception specifically on their fundamental motor skills competence (Barnett, Ridgers, Zask, & Salmon, 2015). The PMSC measures the child's perception on six LOC skills (run, gallop, hop, leap, jump, and slide) and six ball skills (throw, catch, roll a ball, kick, strike, and dribble) by using Harter & Pike's instrumentation structure. The PMSC is a valid and reliable instrument with an internal consistency coefficient (ICC) ranged from 0.60 to 0.81 and all skill ICC=.83 (Barnett et al., 2015).

The PMSC and PPC instruments are developmentally appropriate as they use pictorial plates with two separate pictures of a child performing a skill side-by-side. One picture depicts a competent child performing the skills and the other a less competent child. The child selects the picture that is most like the self (competent or not competence). Then the child identifies whether a child is a lot like (score 4 or 1) or somewhat like (score 3 or 2) the picture. There are separate plates for boys and girls, African Americans, Hispanic and Asians (Harter & Pike, 1984).

A growing body of work in motor development has examined the relationship between actual and perceived motor competence and their relationship to physical activity. Empirical findings from this work have shown that perceived physical competence, also known as Perceived Motor Competence (PMC) mediates the relationship between motor competence and physical activity (Babic et al., 2014; LeGear et al., 2012; Robinson et al., 2015; Southall, Okely, & Steele, 2004). One of the important findings from this body of work is that children with low motor competence and low perceptions of motor competence are less likely to be physically active (Barnett et al., 2008). Correspondingly, children with high perceived physical competence are more likely to be physically active (Barnet et al., 2008; Robinson et al., 2015). From a pragmatic standpoint, this makes sense as children are more willing to engage and persist in tasks in which they feel competent (Barnett et al., 2008; Carroll & Loumidis, 2001; Harter, 1978). From this perspective, PMC is an important variable in teaching fundamental motor skills for children in order to maintain their participation and active engagement in the motor skills program and physical activity.

Many of the empirical literature shows that there is a weak and non-significant relationship between PMC and fundamental motor skills competence in the early childhood years. This weak relationship is due to lack ability of young children to accurately assess their perception on their actual fundamental motor skills competence. Young children's cognitive ability has not fully developed yet. They are still in the Piaget's preoperational period in their cognitive development. Children in this stage are not able to conserve and reverse information on their thought (Wadsworth, 1996). Therefore, they tend to be less accurate in their perceived motor competence (Harter & Pike, 1984; Robinson et al., 2015). However, as children age, their cognitive function has developed to the concrete operational stage, in which they have ability to conserve and reverse the information on the stages of reasoning. As a result, children in middle and late childhood are able to be more accurate in perceived their fundamental motor skills competence. Therefore, the relationship between PMC and fundamental motor skills competence becomes stronger (Robinson et al., 2015). If children in middle or late childhood have low fundamental motor skills competence, the level of PMC also decreases as children's cognitive capacity allows them to make more realistic evaluations about themselves (Barnett, Morgan, van Beurden, Ball, & Lubans, 2011; Harter & Pike, 1984; Stodden et al., 2008). By 7 to 8 years old, the mismatch between PMC and actual fundamental motor skills competence begins to disappear and a child's perceived competence accurately reflects to their actual competence (Rudisill et al., 1993). In regard to relationship between PMC and physical activity, Babic et al. (2014) reviewed that PMC has a strongest relationship to physical activity behavior compared to other aspects of self-concept, yet this relationship is mediated by age. Thus, it is still important to consider perceived motor competence in young children as there is a developmental trajectory to perceptions of motor competence and by late childhood and adolescence perceptions of motor competence are one of the most important predictors of physical activity (Babic et al., 2014; Barnett et al., 2009).

Overall, some studies have shown that perceived motor competence mediates the relationship between fundamental motor skills competence and physical activity. Even though this relationship is weak in early childhood, it gets stronger as children age, and it becomes the more important in the middle and late childhood. Therefore, it is important to give attention to children's PMC in early childhood to prepare them to have good perception on motor competence in the middle and late childhood.

Gender Difference in PMC. While the research on fundamental motor skills competence is quite consistent regarding gender differences in OC skills, the research on PMC has inconclusive finding about gender differences in young children's perceptions of motor competence. Some studies showed that there were no gender difference on children perceptions of motor competence (Famelia et al., 2016; Goodway & Rudisill, 1996 & 1997; Planinsec & Fosnaric, 2005). Other studies showed there were gender differences on children's perceptions of motor competence, in which boys had higher perception of motor competence than girls (Robinson, 2010; Toftegaard-Stoeckel et al., 2010) or girls had better perception on their motor competence than boys (LeGear, 2012). One study supported the notion that boy's perception of their motor competence is related to their actual OC competence (Liong, Ridgers, & Barnett, 2015). Despite the inconclusive findings on perceived motor competence, research has agreed that young children are less accurate in their perceptions of motor competence (Harter & Pike, 1984; Harter, 1987) and tend to over-estimate their perception of motor competence (LaGear, 2012). In the early years the lack of alignment between perceived and actual motor competence can be seen as an asset. The positive perceptions of their motor competence is more likely to keep motivation and engagement in physical activity high allowing them to keep moving and promote their motor competence (LaGear, 2012). Therefore, promoting motor competence in early childhood is important to maintain positive perceptions of motor competence at a later age, so children will not lose their motivation to be physically active.

To conclude, young children's PMC tends to be over inflated relative to actual motor competence due to the limited cognitive ability of young children (Harter & Pike, 1984; Robinson et al., 2015), and that this inflated PMC is an asset in the instructional environment. In spite of an over inflated PMC we should be concerned about the mis-alignment between actual and perceived motor competence. There is a developmental trajectory to PMC, where as children's cognitive capabilities become more sophisticated the alignment between actual and perceived motor competence becomes more accurate as children get older. Therefore, children who are less proficient in motor competence will have lower perceptions of motor competence. Thus, it is important to improve children's motor competence in early childhood to decrease the possibility of having low PMC as children get older. Finally, it is not clear whether there is gender difference with children's PMC. Therefore, further study is needed.

Motor Skill Interventions

There is an emerging body of literature that suggests motor competence developed in the early years is an underlying mechanism driving physical activity levels at older ages (Barnett et al, 2009; Logan, Webster, Getchell, Pfeiffer, & Robinson, 2015; Lopes et al., 2012; Robinson et al. 2015). Thus, motor skill intervention (MSI) implemented in preschools is important to promote motor skill development and remediate the delay in motor development for disadvantaged children.

Review of the Motor Skill Intervention Literature

A literature review was conducted to summarize the literature on motor skill interventions for young children. The relevant studies were searched using the following databases: a) Academic Search Complete, b) ERIC, c) SPORTDiscus with Full Text, d) MEDLINE with Full Text, and e) PsycINFO. Key terms for the search included motor skills, fundamental motor skill, movement skills, children, young children, and intervention. The search strategy included using single and combined terms. Thirty-two quantitative studies about motor skill intervention were identified that met all inclusion criteria which were: 1) in the English language, 2) young children (aged 3 to 6 years), 3) in peer-reviewed journals, 4) original data, 5) quantitative, qualitative and single subject, 6) intervention study, and 7) motor skills assessment included in dependent variable. The articles were excluded based on these criteria: 1) secondary data sources, 2) review articles, 3) children over 6 years and under 3 years, and 4) children with disability (autism, ADHD, Learning disabilities, intellectual disabilities). Nineteen of 31 studies used a quasi-experimental design, with the absence of randomization (random assignment and/or random selection), or control group. Other studies used experimental designs with randomized controlled trials or cluster randomized controlled trials. Randomized controlled trial is randomization of individual into intervention or control group, while cluster randomized controlled trial is randomization of class or group into intervention or control group. All studies had repeated measures pre-post-test design, except five studies conducted pre-post-retention-test design. Sixteen studies explicitly stated the hypotheses or research questions of the studies.

Theoretical Framework. Three common theories that were used to frame motor skill intervention studies are Dynamic System Theory combined with Newell's Constraints Perspective, Achievement Goal Theory, and Social-Ecological System Theory. Around nineteen percent (6 studies) were underpinned by Dynamic System Theory (Iivonen et al., 2011; Piek,et al., 2013) and Newell's Constraints perspective

(Brian et al., 2017a & 2017b; Goodway & Branta, 2003; Goodway et al., 2003; Robinson & Goodway, 2009). In general, these studies designed the intervention by manipulating environmental and task constraints creating an environment that provided children with the opportunity to develop their skills (Brian, et al., 2017b; Goodway & Branta, 2003; Goodway, et al., 2003; Piek, et al., 2013, & Robinson & Goodway, 2009). Five studies were framed by Achievement Goal Theory (Ames, 1987, 1992a, 1992b; Ames and Archer 1988; Nicholls 1984, 1992) using the motivation and self-perception components of the learning process through mastery orientation. All five studies used a mastery motivational climate to organize the environment around task, authority, recognition, grouping, evaluation, and time (TARGET) principles (Ames, 1992a). Children had autonomy of the tasks they did and could select any of the tasks at a skill station in order to promote children's motor skills development and perceived motor competence (Valentini & Rudisill, 2004; Robinson , 2011; Robinson & Goodway, 2009; Martin et al., 2009; Logan, Robinson, Webster, & Barber, 2013). Three studies used the Socio-Ecological System Theory (Bronfenbrenner's, 1979) as the theoretical basis for the study where children's development is influenced by biological (individual) and environmental factors (Bonvin et.al., 2013; Golos, Sarid, Weill, & Weintraub, 2011; Hamilton et al., 1999). Yet, to what extent the Socio-Ecological System Theory influenced the design and contents of the intervention programs in those studies is not very clear. Among all reviewed articles, 45% (14 articles) of studies did not explicitly state the theory that framed their studies.

Region/Country of Conducted Studies. Forty-two percent of the reviewed studies were conducted in North America (12 studies in USA and 1 study in Canada). Eight studies were conducted in Europe (2 in Greece, 2 in Switzerland, 1 in Germany, 1 in Scotland, 1 in Finland, and 1 in Israel). Six studies were conducted in Australia (5 in New South Wales, 1 in Western Australia), two studies were conducted in Iran, one in South Africa, and one in Chile, South America. Most studies were conducted in urban areas (15 studies), in which the majority of those studies were in USA. One study implemented the intervention in rural and urban areas, one study was in a rural area and one study was in a semi-rural area. Fourteen articles did not report the region of research site, and most of these were the studies conducted outside of the USA.

Motor skill Intervention Studies in the USA

In the USA, motor skill intervention studies were conducted in the Midwest (6 studies) and Southern (6 studies). All interventions taught OC skills and some of the studies added LOC skills. All studies focused on motor skill intervention, except one study (Winter & Sass, 2011) that combined a motor skill intervention with a reading intervention. The interventions were delivered by the motor development experts or researchers and preschool teachers as the instructor assistants, except a study conducted by Brian, et al. (2017a & 2017b) that had trained preschool teachers to deliver the intervention. The studies mostly involved a smaller sample size and disadvantaged children, predominantly African American and Hispanic children. Some studies conducted fidelity check procedures (Hamilton, et al., 1999; Logan, et al., 2013; Martin et al, 2009; Robinson & Goodway, 2009; Valentini & Rudisill, 2004).

The majority of studies used the TGMD or TGMD-2 instrument to collect fundamental motor skills data. Overall the motor skill interventions implemented in the USA showed significant improvement of children's fundamental motor skills compared to the control group who did not receive the intervention (e.g. Brian et., 2017b; Goodway & Branta, 2003: LOC $F_{(1,57)}=134.23$, $p<.001$, OC $F_{(1,57)}=161.55$, $p<.001$; Goodway et al., 2003: LOC $F_{(1,61)}= 101.04$, $p<.001$, OC $F_{(1,61)}=99.05$, $p<.001$). The results, particularly on OC skills improvement showed large effect sizes ranging from $\eta^2= .11$ (Valentini & Rudisill, 2004) to $\eta^2=.96$ (Logan, et al., 2013). Furthermore, some interventions have been replicated with the same or different pedagogical approaches (Logan, et al, 2013; Robinson & Goodway, 2009). This replication reported a similar result in which the motor skill intervention significantly improved OC skills and better than control groups.

Table 1. Motor Skill Intervention in the USA

No	References	Participants		DV Instrument	Content of Intervention	Dose	Delivered by	Primary Findings
		N	Population					
1.	Hamilton, M., Goodway, J., & Haubenstricker, J. (1999).	27	African American, at-risk, Urban	TGMD-OC Subscale	Throwing, kicking, catching, striking, bouncing.	45 min, 2 session /week, 8 weeks = 720 mins.	Parents	1) The intervention had significant effect on group and test and interaction of group and test. 2) Intervention group significantly improved OC and better than control group, while control group did not change. 3) Cohen's kappa=1.85
2.	Goodway, J. D., Crowe, H., & Ward, P. (2003).	63	Hispanic, African American, White, Asian, at-risk, Urban	TGMD	Bouncing, striking, kicking, catching, throwing: each 80 min, running: 20 min, galloping, skipping and jumping: each 40 min. Delivered in English and Spanish, with progression	35 min, 2 session /week, 9 weeks = 630 mins	Motor development expert and teacher	1) Intervention had statistically significant effect for OC and Loc from pre to post against the control group. 2) No improvement on OC and Loc skills for control group in. 3) There was gender differences on OC in pretest, but no gender differences at post test.

Continued

Table 1 continued

3.	Goodway, J. D., & Branta, C. F. (2003).	59	African American, At risk, Urban.	TGMD-2	Gallop & Hop (50 min), Jump (80 min), Bounce (90 min), Strike (100 min), Kick (110min), Throw & Catch (120min) with progression	45 min, 2 session /week, 12 weeks = 1080 mins	Motor development expert and teacher	1) Both LC and OC skill sig.ly improved and higher than control group. 2) Effect Size Loc= η^2=.70, OC=η^2=.74
4.	Valentini, N., & Rudisill, M. E. (2004).	106	African American, caucasian, Asian American, At risk, Urban.	TGMD, Harter and Pike PSPCSA, parents questionnair e	Walking, running, rolling, jumping hopping, skipping, leaping, manipulative abilities such as kicking and throwing.	35 min, 2 session /week, 12 weeks = 840 mins	Motor development expert.	1) Loc: MMC group significantly improved from pre to post-test and significantly difference from low-autonomy group. 2) OC: MMC group significantly improved from pre to post-test, but there was no group difference. 3) In retention test, MMC group had higher OC than low-autonomy group. 4) PMC: MMC group significantly improved PMC and was significantly higher than low-autonomy group. 5) Effect Size: Loc=η^2=.11, OC=η^2=.86, PMC=η^2= .28

Continued

Table 1 continued

5.	Martin, E. H., Rudisill, M. E., & Hastie, P. A. (2009).	64	African American, Caucasian, At risk, Rural.	TGMD-2 (raw score)	Fundamental motor skills (not explained in details)	30 min, 5 session /week, 6 weeks = 900 mins	MMC delivered by researcher and control group by PE teacher	1) Loc: MMC significantly improved from pre to post, and significantly higher than direct instructional group. 2) OC: MMC significantly improved from pre to post, and significantly higher than direct instructional group 3) Effect Size: η^2=.34.
6.	Robinson, L. E., & Goodway, J. D. (2009).	117	N/A, At risk, Urban	TGMD-2 OC subscales raw data	Strike, catch, throw, roll, dribble, and kick with task progression.	30 min, 2 session /week, 9 weeks = 540 mins	Motor development expert and PhD student in Motor Development.	1) OC: both Low autonomy (LA) and MMC were significantly better than control group, but LA and MMC were not significantly different. 2) OC: for both LA and MMC significantly dropped in retention test, yet still higher than control group. 3) Effect Size: η^2=.73.
7	Robinson, L. E. (2011).	40	N/A, At risk, Urban	TGMD-2 raw score for OC, and Pictorial scale (PSPCSA)	Strike, catch, throw, roll, dribble, and kick with task progression.	30 min, 2 session /week, 9 weeks = 540 mins	Motor development expert and PhD student in Motor Development.	MMC improved OC and PMC significantly

Continued

Table 1 continued

8	Winter, S. M., & Sass, D. A. (2011).	405	Hispanic, At risk, Urban	SOFIT, Brigance Diagnostic Inventory of Early Develop-ment—II, Peabody Picture Vocabulary Test III (PPVT-III).	Curriculum kit for teachers and parents on literacy and PA to prevent obesity. Parents had monthly meeting about how to implement PA games for kids at home. Teachers received 20 hrs training on curriculum.	24 weeks	teachers and parents	1) Intervention group significantly improved gross motor skills and better than control group. 2) There was no significant differences in physical activity and BMI, 3) There was marginal significant difference in literacy skills
9	Robinson, L. E., Webster, E. K., Logan, S. W., Lucas, W. A., & Barber, L. T. (2012).	14	Caucasian, Asian, African American, and mixed decent.	TGMD-2	Running, jumping, sliding, galloping, leaping, hopping, striking, dribbling, kicking, throwing, catching, and rolling.	30 min, 2 session /week, 11 weeks = 660 mins	undergradua te Early Childhood Education majors.	1) There was significant improvement in mean percentile on total performance of the TGMD-2 from pre- to post-test. 2) Loc: significantly imprived, but OC did not significantly improve from pre- to post-test.

Continued

Table 1 continued

10	Logan, S., Robinson, L., Webster, E. K., & Barber, L. (2013).	25	N/A, Urban	OC subscale of TGMD-2, PSPCSA, video analysis of appropriate and inappropriate tasks.	OC skills	30 min, 2 session /week, 9 weeks = 540 mins	2 trained doctoral students	1) no significant difference in appropriate skill attempts between MMC and Direct instruction climate, 2) Regardless of climate, children improved in OC percentile and that low-skilled children improved significantly more than high-skilled children. 3) the high-autonomy group significantly improved on PMC and was significantly better than the low-autonomy group, regardless of skill level. 4) Effect Size: OC η^2=.96, PMC η^2=.21
11	Vidoni, C., Lorenz, D. J., & de Paleville, D. T. (2014).	33	Caucasian, African-American, Hispanic, Asian, & mixed-ethnicity, Urban.	Short BOT-2, questionnaire for teachers	Tossing, catching, balance beams, pushing, pencil roll, balance, trampolines, agility, somersaults	30 min, 5 session /week, 11 weeks = 1650 mins	Teachers and assistant teachers	1) There was significant improvement in motor proficiency in both control and intervention groups. 2) The improvement of intervention group was significantly greater than the control group, 3) the acceptibility test: the intervention was easy to implement and beneficial to the children.

Continued

Table 1 continued

12	Brian, A., Goodway, J. D., Logan, J. A., & Sutherland, S. (2017b).	57	Caucasian, African American, Asian, Other. Urban.	TGMD-2, OC subscale	OC skills	30 min, 2 session /week, 6 weeks	Trained teachers	1) Children in the intervention group improved their OC significantly. 2) Effect Size: η^2=.61

Note. FMS= Fundamental motor skills, OC= Object control skills, Loc= Locomotor skills

Overall, most of motor skill intervention studies in the USA has shown effective in improving children fundamental motor skills and perceived motor skills, with small (η^2=.11) to large (η^2=.96) effect size. Most studies implemented the intervention that focused more on OC skills, with dose ranged from 360 mins – 1080 mins. Some studies explained the intervention content, even with the dose of each skill in the intervention.

Motor skill Intervention Studies outside the USA

Some studies outside the USA implemented the motor skill intervention as a part of a larger program, which combined healthy diet and physical activity behavior interventions. Most interventions were delivered by preschool teachers or physical education teachers. Some involved parents in the intervention as well. The studies involved larger sample sizes and more heterogeneous participants. Some studies conducted fidelity check procedures (Golos, et al., 2011; Jones, et al., 2011; Piek, et al., 2013), however the majority of the studies did not. Different from motor skill intervention in the USA, studies outside the USA measured motor ability and motor skills as the dependent variables. Also, there were studies that measured LOC skills only. Two studies conducted in Greece implemented a motor skill intervention combining music and movement (Deli et al., 2006).

Table 2. Motor Skill Intervention Studies Outside of the USA.

No	References	Participants		DV Instrument	Content of Intervention	Dose	Delivered by	Primary Findings
		N	Population					
1	Adamo, K. B., Wilson, S., Harvey, A. J., Grattan, K. P., Naylor, P., Temple, V. A., & Goldfield, G. S. (2015).	83	N/A	TGMD-2, ActicalÒ accelerome-ters.	Healthy Opportunities for Preschoolers (HOP)	24 weeks	Trained teachers	1) the intervention group demonstrated significantly greater change in GMQ, 2) intervention group significantly improved Loc and higher than control group, 3) OC of control group significantly declined, but no changes in intervention group. There was no difference in OC between group, 4) intervention group PA improved significantly in, but not MVPA. 5) Effect Size: η^2=.59-.61.
2	Barnett, L. M., Zask, A., Rose, L., Hughes, D., & Adams, J. (2015c).	111	N/A	TGMD-2 raw score, live coded, ActiGraph Model GT1M accelerometer.	12 skills in TGMD-2, sport equipment accessed in playground, parent workshop and written ideas about some games to play at home.	2 session /week, 40 weeks	Trained teachers at school.	1) gender and age predicted MVPA. 2) Loc: significantly predicted waist circumference. 3) the intervention, OC, Loc, BMI, and waist circumference did not predict MVPA, 4) intervention, OC, MVPA, and age did not predict waist circumference 5) intervention, OC, Loc, sex, age, and MVPA did not predict BMI.

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Table 2 Continued

3	Bonvin, A., Barral, J., Kakebeeke, T. H., Kriemler, S., Longchamp, A., Schindler, C., & ... Puder, J. J. (2013).	648	N/A Urban and rural	Zurich Neuromotor Assessment (ZNA), GT1M Actigraph accelerometer , observation and question-naire.	1)Training and support of the educators, 2)Rearrangeme nt of the child care built environment, 3)Encourageme nt of parental involvement, 4)Recommendat ion of daily physical activity	36 weeks	Teachers and parents	There was no intervention effect on the motor skills, body mass index, physical activity, and quality of life.
4	Deli, E., Bakle, I., & Zachopoulou, E. (2006).	75	N/A	TGMD, raw score	Body and space awareness, running, jumping, hopping, galloping, skipping, sliding, and leaping	35 min, 2 session /week, 10 weeks = 700 mins	Motor development expert	Children significantly improved their motor competence in 2 intervention groups (group A: movement and B: music and movement) and better than control group (group C).
5	Donath, L., Faude, O., Hagmann, S., Roth, R., & Zahner, L. (2015).	57	N/A At-risk	TGMD-2 OC subscale except striking,	dribbling for 54 ± 15min, throwing for 91±17min , catching for 38± 4min, kicking for 55±4min , and rolling for 91±31 min	30 min 2 session /week, 6 weeks =360 mins.	Motor development experts	1) Intervention group significantly improved and better than control. 2) dribble: significant time effect and timee x group interaction effect, rolling: significant time effect not interaction, catching, throwing, kicking: no significant in time, group, and interaction. 3) Overall effect Size: η^2=.007

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Table 2 Continued

6	Draper, C. E., Achmat, M., Forbes, J., & Lambert, E. V. (2012).	201	Black African, At-risk, Urban.	TGMD-2, The Herbst test	Supervised freeplay to light intensity structured activities. speed, agility, balance, eye-hand/eye-foot coordination and spatial awareness	45-60 min, 3-4 session /week, 32 weeks = 4320-7680 mins	1 or 2 trained coaches per center recruited from the communities.	1) Experimental group scored higher than control for both cognitive and OC even though both groups exceeded age standards. 2) cognitive function of children in experimental group improved, however they were higher than controls from the start.
7	Golos, A., Sarid, M., Weill, M., & Weintraub, N. (2011).	81	Israel, At risk	Test of Visual Motor Integration (VMI), M-ABC, Miller Assessment for Preschool (MAP), and The structured preschool observation (SPO).	graphomotor activities, manual dexterity, and gross motor activities.	30 min, 1 session /week, 32 weeks = 960 mins	teacher and pediatric occupational therapist	1) Intervention group significantly improved VMI, balance skills in MABC, cognitive complex task skills in MAP and SPO. 2) There were no significant differences in MAP manual dexterity and ball skills in MABC and non verbal skills in MAP.
8	Hardy, L. L., King, L., Kelly, B., Farrell, L., & Howlett, S. (2010).	430	N/A	TGMD, Audit Lunchbox (AGHE), interview, survey.	healthy eating, games-based skills activities, unstructured PA, Loc, OC, and stability skills	20 weeks	Teachers	1) Loc, OC, and total FMS score significantly improved in the intervention group compared with the control group. 2) Lunchbox audit showed that children in the intervention group significantly reduced sweetened drinks.

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Table 2 Continued

9	Jones, R. A., Riethmuller, A., Hesketh, K., Trezise, J., Batterham, M., & Okely, A. D. (2011).	97	N/A	TGMD-2, MTI 7164 Actigraph accelerometer .	run, catch, jump, kick, hop,	20 min, 3 session /week, 20 weeks = 1200 mins	Trained teacher and researchers.	1) Children in the intervention group significantly improved their motor skills and PA compared to control group. 2) Staff reported 90% of the program content was appropriate, high satisfaction with the program. All PD content and structured lessons were delivered, strongly agreed with the intervention design.
10	Kordi, R., Nourian, R., Ghayour, M., Kordi, M., & Younesian, A. (2012).	147	N/A	TGMD-2	motor skills.	15-30 min, 5 session /week, 10 weeks = 750-1500 mins	nursery teachers	1) There was no gender difference in Loc, but boy significantly higher in OC. 2) Intervention significantly improved FMS. 3) Poor/very poor GMQ decreased from 26.6% to 2% after intervention.
11	Krombholz, H. (2012).	428	N/A, Urban	Motor test battery (MoTB 3-7), portable stadiometer, scales, skinfold caliper, parent question-naires.	running, jumping, climbing, kicking, throwing and catching, and movement games.	45+20 min, 1 session /week 80 weeks = 5200 mins	Teachers	1) children in the intervention group had significant better motor performance than children in the control group. 2) Children with higher BMI in the intervention group had significant better motor scores than children with higher BMI in the control group, but the intervention had no effect on body weight, BMI, or skinfold thickness. 3) Effect Size: η^2=.18

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Table 2 Continued

12	Iivonen, S., Saakslahti, A., & Nissinen, K. (2011).	84	Finland, Urban.	APM Inventory	Physical education curriculum (PEC, but no detail information)	45 min, 2 session /week, 24 weeks = 2160 mins	PE Teachers	PEC significantly promotes motor skills.
13	Monsalves-Álvarez, M., Castro-Sepúlveda, M., Zapata-Lamana, R., Rosales-Soto, G., Salazar, G. (2015).	70	N/A, Suburban	Standing long jump (SLJ), 12 m run.	jumps, sprints, carrying medicinal balls, gallops, crawling's, tunnels, coordination scales cones.	45 mins, 3 session /week, 24 weeks = 3240 mins.	Trained instructors and guided by PE teachers	1) 12 meter run test: there was no significant changes after the intervention when compared by gender, when compared by BMI, there was a significant reduction in the time normal weight girls and overweight boys. 2) SLJ: boys and girls significantly improved.
14	Mostafavi, R., Ziaee, V., Akbari, H., & Haji-Hosseini, S. (2013).	90	N/A	TGMD-2	SPARK	3 session /week, 8 weeks.	Teachers	1) SPARK group showed significant improvement in FMS, and significant better than control group.
15	Piek, J. P., McLaren, S., Kane, R., Jensen, L., Dender, A., Roberts, C., & ... Straker, L. (2013).	511	N/A At-risk, Urban	BOT2-short form, MABC-2	Balance, LOC, OC, strength, fine motor skills, and social emotional skills	30 min, 4 session /week 10 weeks = 1200 mins	Trained teachers	1) Intervention showed significant interaction effect 2) There was no significant effect on pre-post and post-retention for control and intervention group, 3) motor competence on pre-retention was not significant for control, but significant for intervention group. 4) boys significantly higher in motor skills than girls. No difference in control group.

Continued

Table 2 Continued

16	Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H., & ... Grant, S. (2006).	545	NA	CSA/MTI WAM-7164 accelerometer , movement battery	PA and FMS at schools, PA games and reduced TV time at home	30 min, 1 session /week, 24 weeks = 720 mins	Trained teachers at schools, and parents at home	1) children in the intervention group significantly improved their FMS and better than control group. 2) Girls significantly improved more than boys. 3) intervention had no sig.effect on BMI and PA behavior.
17	Venetsanou, F., & Kambas, A. (2004).	66	Greek	MOT 4-6	coordination abilities (kinesthetic differentiation, balance ability, orientation in space, rhythmic ability and response ability	45 min, 2 session /week, 20 weeks = 1800 mins	Physical education teacher	Children in intervention group significantly improved their motor competence from pre- to post-test and higher than then control group.
18	Zask, A., Adams, J. K., Brooks, L. O., & Hughes, D. F. (2012a).	789	N/A	TGMD live coded, parent questionnaire.	FMS, playground equipped with sports equipment, workshop for parents about physical activity, FMS, and diet, monthly newsletter for parents.	2 session /week, 40 weeks	teachers and parents	1) children in intervention group significantly improved FMS, had more fruits and vegetables served, and less likely to have unhealthy food items in their lunch boxes. 2) girls significantly improved FMS more than boys. 3) no gender differences in Loc, boys OC sig.ly better than girls. 4) sig. difference in waist circumference growth and BMI, which is lower than control group.

Continued

Table 2 Continued

19	Zask, A., Barnett, L. M., Rose, L., Brooks, L. O., Molyneux, M., Hughes, D., & ... Salmon, J. (2012b).	137	N/A	TGMD-2 (raw score and live coded)	12 skills in TGMD-2, sport equipment accessed in playground, parent workshop and written ideas about some games to play at home.	2 session/week, 40 weeks	Trained teachers at school.	1) OC: boys was significantly better than girls, Intervention children were significantly better than control. 2) girls' OC improvement in intervention significantly higher than changing in control group. No significant differences for boys improvement in between group. 3) girls' OC improvement was significantly higher than boys. 4) Loc: no differences of changes pattern between intervention and control from pre to retention test for both boys and girls.

Note. FMS= Fundamental motor skills, OC= Object control skills, Loc= Locomotor skills

Overall, most of motor skill intervention studies outside of the USA were also effective in improving children's fundamental motor skills. However, only three studies reported the effect size of the intervention, ranging from small (η^2=.01) to large (η^2=.61). Most interventions were delivered by trained teachers with a large sample size from different sites. However, most studies did not assess fidelity in delivering the intervention. The dose of the intervention was also longer then studies in the USA, and ranged from 360 minutes – 7680 minutes. Most studies also explained the intervention content.

In summary, despite the location, the content and setting of motor skill interventions, there are similar findings among those studies reviewed:

1. There are gender differences in motor skills. Boys are better at OC skills than girls (Kordi, et al., 2012; Zask et al., 2012a, 2012b). Also there is a trend that boys are also better in other motor performance (motor ability) measures than girls (Piek, et al., 2013).
2. There are no gender differences in LOC skills (Kordi, et al., 2012; Zask et al., 2012a, 2012b).
3. Control groups showed no improvement in motor skills or motor abilities (Goodway et al, 2003; Hamilton et al, 1999; Piek et al., 2013).
4. Studies conducted in the USA showed larger effect sizes (Goodway et al., 2003: η^2= .63; Logan et al., 2013: η^2=.96) than studies conducted outside the USA (Donath, et al., 2015: η^2=.007; Adamo et al., 2015: η^2=.61).

5. Studies that focused on motor skill intervention and provided structured intervention showed significantly better outcomes in improving children's motor development (Hamilton et al., 1999; Logan et al., 2013; Martin et al., 2009; Robinson & Goodway, 2009; Valentini & Rudisill, 2004) than studies that combined motor skill intervention with other programs, such as a healthy diet and physical activity behavior interventions (Bonvin et al., 2013; Piek et al., 2013).
6. The dose of motor skill interventions ranged from 360 mins to 7680 mins. Motor skill interventions with a minimum of 360 minutes of instructional time has shown significant improvement in children's motor competence, and up to large effect sizes (Brian et al., 2017b).
7. Even though motor skill intervention studies in the USA had larger effect sizes, they showed a lack of ecology validity, because the intervention was implemented by experts in more controlled settings. On the other hand, studies outside of the USA had more ecologic validity. These interventions were implemented by teachers and parents, with less direct supervision from researchers, and represented a more "real world" setting.
8. There is a trend that girls improved their OC skills significantly more than boys as an effect of the intervention (Zask et al., 2012a, 2012b). A study in the USA (Goodway et al., 2003) supports this trend, however it was not significant ($F_{(1.61)}$= 3.32, p=.08). In the pretest, the OC skills of girls was significantly lower than boys. In contrast, at the posttest, there was no gender difference in OC skills, even though the improvement of OC skills for both genders was significant. This indicates that girls

were able to catch up to boys on OC skills during the intervention. Compared to studies in Australia, the small sample size in the study in the USA (n=63) might contribute to not being able to detect the significant gender differences pattern of OC improvement. However, this needs to be studied more in future research.

9. Motor skill intervention is needed to improve children's motor skill development.
10. There is no motor skill intervention study conducted in Southeast Asia, particularly in Indonesia.

From the review of the articles on motor skill intervention, some main gaps in the literature are identified, as following:

1. The lack of ecological validity in the studies, especially within motor skill intervention studies in the USA. In most studies, motor development experts delivered the motor skill intervention.
2. Only a few studies used fidelity checks to ensure intervention integrity. Therefore, the quality of the intervention implementation in the studies to some extent is questioned.
3. A lack of long-term follow-up of the intervention. Only two studies examined the long-term effects of the intervention (Zask, et al., 2012b; Barnett, et al., 2015c), yet both studies had less rigorous research designs.
4. A lack of information about what is going on with children during the intervention sessions. Among the 32 reviewed articles, only one study provided data about how children engaged in the activities during the intervention session (Logan et al., 2013). Most studies collected pre-test and post-test data, without considering what happened with children during the intervention.

5. Most studies had quasi-experimental designs with no control group or no random assignment.

Early Childhood Teacher Training

Early Childhood Educator Professional Development. Early childhood education is an important program to support children's early and continued learning. However, many states in the USA estimate that half of their children arrive at kindergarten inadequately prepared for academic success (Zill & West, 2001). Therefore, understanding how to provide children with adequate early foundation skills is very important. A number of studies on the professional development of early childhood educators have increased recently (Buysse, Winton, & Rous, 2009). Buysse et al. (2009) defined professional development as "facilitated teaching and learning experiences that are transactional and designed to support the acquisition of professional knowledge, skills, and dispositions as well as the application of this knowledge in practice" (p. 239). In addition, professional development includes planning, implementation, reflection, evaluation, and revision in a continuous manner (Ohio Department of Education, 2015). Some studies have shown that higher quality settings in professional development can result in better opportunities for child development (Mashburn, et al., 2008; Paro et al., 2009).

A review study examining early childhood professional development studies, was conducted by Buysse and colleagues (2009) in order to inform conceptualizations and definitions of professional development. They proposed four important elements in terms of professional development for early childhood educators.

1. The term professional development includes various types of facilitated learning. For instance, workshops and summer institutes (Guskey & Yoon, 2009), coaching and mentoring (Neuman & Cunningham, 2009; Neuman & Kamil, 2010), study groups (Ball & Cohen, 1996), self or observer examination of educator practice (Downer, Locasale-Crouch, Hamre, & Pianta, 2009), online educational opportunities (Mashburn, Downer, Hamre, Justice, & Pianta, 2010), and educators' own inquiry/action research (Anderson, Herr, & Nihlen, 2007).
2. Early childhood educators are widely diverse in their backgrounds and thus professional development must effectively serve this diverse population. In addition, settings vary across early childhood education centers.
3. The educator should actively engage in the professional development learning experiences in order to acquire professional knowledge, beliefs, and skills needed to apply knowledge to practice.
4. The role of the professional development facilitator is to organize and facilitate learning experiences and respond to and support the learning process and dialogue regarding "problems in practice".

Theories of Adult Learning. Andragogy has become synonymous with the education of adults (Pratt, 1998), and is defined as "an intentional and professionally guided activity that aims at change in an adult person" (Knowles, 1980, p. 60). Over the past 40 years, many scholars have continued to investigate andragogy and adult learning (Taylor, 1998; Merriam & Kim, 2012). Learning is defined as a process to interpret the meaning of one's experience by using prior interpretation to result in a new guide/interpretation for future action (Mezirow, 2000, p. 5). Knowles (1975, p. 57-63) identified six assumptions of adult learning based on characteristics. These assumptions are:

1. Adults need to know why they need to learn something before undertaking it.
2. Adult learners involve a self-concept of being responsible for their own learning.
3. The adults' varied life experiences play a major role in contributing to learning outcomes and serve as a rich resource for the learning environment.
4. Adults are ready to learn the things they need to know and able to do in order to cope effectively with their real-life situations.
5. Adults exhibit an orientation to learning and a motivation to learn when they perceive that learning will help them perform tasks or deal with problems that they confront in their life situations.
6. Motivation to learn is in response to internal and external factors.

These assumptions provide guidelines for facilitators of adult learning in order to successfully plan and facilitate teachers learning experiences in professional development. In addition, Knowles (1980) emphasized the importance of communicating clear learning objectives and discussing the relevance of the content (e.g., significance to everyday life/work as a result of a trigger or transition event). Moreover, the facilitators need to identify strategies and teaching practices that best suit adults' personal learning needs. The ultimate goal is for adults to become self-directed learners (Knowles, 1980). Self-directed learning may be influenced by various learner characteristics such as culture, age, education, and socioeconomic status (Merriam and Caffarella, 1999).

Therefore, facilitators have a responsibility to consider adult learning principles, phases of the learning process, content, reflection, learner characteristics, and social and environmental influences to support self-directed learning (Danis, 1992; Merriam, 2001).

Regarding the adult learning in professional development setting, one essential component to ensuring transfer and prolonged engagement in professional development is not providing a “one-shot” dose of professional development (Bechtel & O’Sullivan, 2006; Patton & Parker, 2012; Shelton & Jones, 1996; Ward & Doutis, 1999). A “one-shot” dose of professional development is a one-time session and then stops further professional development with the teachers involved. In contrast, it is recommended that professional development occur continuously for a prolonged duration (Armour & Yelling, 2004). Continuous professional development can include, multiple professional development sessions, communities of practice as well as coaching and support from peers and experts (Armour & Yelling, 2004). A continuous professional development is more advantageous than a “one-shot” dose as teachers are more likely to “buy-in”, learning is more likely to be maintained, questions can be answered, and teachers are more likely to feel valued by the facilitator (NPEAT, 1999; Shelton & Jones, 1996). When facilitating professional development based on these recommendations, it is more likely to promote the transfer of learning into the classroom and sustained engagement with the content (NPEAT, 1999; Shelton & Jones, 1996).

In summary, teacher learning in professional development should be designed to promote adult learning principles, in which prior experience and knowledge in teaching practice are important to promote the adult learning process. In addition, teachers need to know the goal and the reason why they need to learn. Theories of adult learning suggest that integrating adult teaching practices, motivation and engagement would lead to changes in educators' knowledge, beliefs, and classroom practices. Also, the prolonged engagement of professional development will be more likely to promote transferring of teacher learning to classroom practice.

***INDO-SKIP* Teacher Training.** *INDO-SKIP* early childhood teacher training is designed based on the principles and theories of professional development (Armour & Yelling, 2004; Bechtel & O'Sullivan, 2006; Buysse et al., 2009; Patton & Parker, 2012; Shelton & Jones, 1996; Ward & Doutis, 1999) and theories of adult learning (Knowles, 1975, 1980; Terehoff, 2002). As this study will be the first motor skill intervention study in Indonesia, it is reasonable to expect that none of the teachers involved in this study would have prior experience in teaching motor skill intervention or physical education settings. Moreover, prior dialogue with teachers reveals that early childhood teachers had limited knowledge in motor development. Therefore, the content of the *INDO-SKIP* training was designed to provide basic to more advanced knowledge to prepare them to deliver the *INDO-SKIP* intervention. To maintain the engagement of teachers in the training, various and interactive pedagogical approaches were used. Table 7 in Chapter 3 explains detailed information of the contents and pedagogical approach of the *INDO-SKIP* training. Furthermore, to achieve the prolonged engagement in *INDO-SKIP* teacher training, early childhood teachers were coached during the *INDO-SKIP* implementation.

Executive Function

The notion of motor competence and cognitive development being related was proposed many decades ago. Gesell's maturational theory (Gessel & Thompson, 1934) proposed that physical, motor, and cognitive development are prewired and predetermined by genetics and are related to one another. Similarly, Piaget's cognitive development theory (Piaget & Inhelder, 1966) views that motor and cognitive development are strongly related and driven by heredity. According to Piaget, cognitive development cannot occur without corresponding motor skill development. That is by applying motor skills in the early years children explore their environment leading to the development of cognitive skills. Although these constructs are often investigated separately, the importance of motor competence and cognitive performance being related has been acknowledged (Diamond, 2000; Edelman, 1987; Piek et al., 2004; Weimer, 1977). Moreover, using dynamic systems theory, Adolph & Berger (2006) and Thelen & Smith (1998) highlighted motor development as a critical domain of development where motor actions result in a child generating new information and correspondingly improving their cognitive abilities. Similarly, Bushnell & Boudreau (1993) suggested that motor development might function as a "control parameter" for other developmental functions, such as perceptual and cognitive development.

A child's well-developed cognition is characterized by the ability to hold information in the mind, manipulate that information, act on the basis of the information (Davidson, Amso, Anderson, & Diamond, 2006), exhibit self-regulation and flexibly adapt behavior to changing situations. These abilities are referred to respectively as working memory, inhibition, and cognitive flexibility (Davidson, et al., 2006). Together they are key components of both “cognitive control” and “executive functions” (Carlson , 2005; Chan, Shum, Toulopoulou, & Chen, 2008; Davidson et al., 2006; Zelazo et al., 2003). In general, executive function is an umbrella term that refers to higher order cognitive processes (inhibitory control, working memory, and attentional flexibility) that establishes goal-directed action and adaptive responses to novel stimulation or situation (Hughes, 2011). In other words, executive function is a brain-behavior relationship, in which the behavior control is the core of the executive function (Koziol, Budding, & Chidekel, 2012).

With increasing interest with respect to school readiness, a number of studies have found that academic achievement is predicted by fine motor skills (Bart, Hajami, & Bar-Haim, 2007; Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010; Luo, Jose, Huntsinger, & Pigott, 2007; Pagani, Fithpatrick, Archambault, & Janosz, 2010; Son & Meisels, 2006) and gross motor skills (Piek et al., 2004). There are several explanations for the relationship between motor competence and executive function. First, motor and cognitive functions use the same brain structures (Diamond, 2000). For instance, both motor and cognitive functions involve the cerebellum and the pre-frontal cortex (Westendorp, Hartman, Houwen, Smith, & Visscher, 2011). The second explanation is, motor and cognitive function develop in the same period with an accelerated development between 5 and 10 years of age (Ahnert, Bos, & Schneider, 2003; Anderson, 2002; Gabbard, 2008). Third, both motor and cognitive skills have several common underlying processes, such as sequencing (Hartman, Houwen, Scherder, & Visscher, 2010), monitoring, and planning (Roebers & Kauer, 2009; Sergeant, 2000).

A contemporary perspective presents different concepts about school readiness and academic achievement. One concept highlights the importance of emotional and behavioral regulation in driving children's school readiness (Blair, 2002; Raver, Garner, & Smith-Donald, 2007), and is conceptualized as the emotional component of executive function or *hot* executive function. This concept argues that children who are emotionally prepared can control their behavior to comply to the demands in the classroom (Brock, et al., 2009). Another concept emphasizes academic skills supports children's school readiness (Duncan et al., 2007, The School Readiness Act of 2005), and is conceptualized as a cognitive component of executive function or *cool* executive function. Knowledge of numbers and letters is an example of cool executive function. Both hot and cool executive functions are interrelated (Blair et al., 2007; Metcalfe & Mischel, 1999; Zelazo and Muller, 2002).

In practice, even though academic skills are considered essential for school readiness, most kindergarten teachers believe children's self-regulation is more important than children's academic knowledge in predicting adjustment to kindergarten (Lin, Lawrence, & Gorell, 2003; Rimm-Kaufman, Pianta, & Cox, 2000). Many kindergarteners have difficulties in mastering self-regulation that enable them to successfully engage in classroom learning (Rimm-Kaufman, et al., 2000). Self-regulation is defined as coordinating the systems related to emotional arousal and cognitive control (Blair, Granger, & Razza, 2005) and related to planning and behavior (Rothbart, Posner, & Kieras, 2006). To be more specific, Ponitz, McClelland, Matthews, & Morrison,

(2009) suggests that behavioral self-regulation involves attentional focusing, working memory, and inhibitory control. Attention is the ability of the brain to detect errors and to resolve conflict among different responses (Botvinick, et al., 2001), which includes focusing, sustaining, and shifting attention (Ponitz et al., 2008). Working memory refers to maintaining information in the mind while processing new information (Adams, et al., 1999). Inhibitory control is a self-regulation mechanism to impede responses to unrelated stimuli while pursuing a cognitively represented goal (Rothbart & Ahadi, 1994; Thorell & Wahlstedt, 2006).

In the classroom, children are exposed to an overwhelming array of stimuli and situations that are often emotionally laden. Children are required to remember instructions and represent the goal of the lesson (working memory), attend to the important features of the lesson (executive attention), and stay on task (inhibitory control), suggesting a need for children to master behavioral regulation (Brock et al., 2009). A study in South Africa (Draper, et al., 2012) implemented a motor skill intervention in early childhood centers for eight months. They found that the intervention significantly improved children's motor competence and cognitive function ($p<.001$). However, this finding was reported from a combination of two studies that implemented the same motor skill intervention, but in different participants. To date, there is no study that has reported the effect of motor skill improvement (from motor skill intervention) on executive function improvements in young children. Therefore, there is a need to investigate the relationship between motor skill development and executive function development in young children.

In summary, it is believed that motor and cognitive development is interrelated. As a higher order cognitive process, emerging evidence has shown that executive function is related to motor competence. In early childhood, hot executive function drives the ability of children to regulate themselves that enable them to be more successful academically. Therefore, this study focuses on measuring children's hot executive function, specifically behavioral regulation and inhibitory control in relation to motor competence and motor skill intervention.

Overall summary

Gesell's maturational theory suggests that motor development is prewired. However, a more contemporary approach to motor development, Dynamic System Theory highlights that motor development is not prewired and is emergent based upon the interaction of cooperating and competing sub-systems within the organism. More specifically, motor skills emerge based on the interaction of many sub-systems within organism, environment, and task. Those sub-systems are self-organized to produce stable movement behaviors. Fundamental motor skills are an important foundation for more complex movement. Fundamental motor skills, particularly OC skills, also predict physical activity behavior in later age, mediated by perceived motor competence (PMC). Studies have shown that fundamental motor skills should be taught using a structured approach during early childhood. Motor skill intervention in early childhood has effectively improved children's fundamental motor skills. Studies showed that motor skills interventions that were designed and implemented in the USA have significantly improved children's fundamental motor skills with large effect sizes than motor skill intervention implemented outside of the USA. Yet, most studies in the USA were implemented by motor development experts, thus they lack ecological validity. Thus, future studies need to incorporate trained teachers to implement motor skill intervention to improve the ecological validity of the intervention. A few studies have also depicted the relationship between motor skills and executive or cognitive function but many of these studies were flawed methodologically. Therefore, there is a need for more evidence on the effect of motor development of executive or cognitive function development.

Chapter 3: Methods

The overall goal of this study was to determine the feasibility and effectiveness of the *INDO-SKIP* program on motor competence, perceived motor competence and executive function of Indonesian preschoolers as compared to a business-as-usual condition. This chapter provides an overview of the theoretical framework, a summary of the pilot study, context of the study, research design, variables, instrumentation, procedures of the study, and data analysis.

Theoretical Framework

This study is situated within the Dynamic System Theory and Newell's Constrain perspective (Newell, 1984; 1986). The Dynamic System Theory (DST) captures that changes in motor performance are dynamic and non-linear (Gallahue et al., 2012; Smith & Thelen, 2003). In motor skill development, DST suggests every individual has a different individual trajectory in how they learn motor skills. Some skills might develop earlier in one child, but later in another child. The dynamic development of motor skill occurs as a result of the interactions among internal and external subsystems. Those subsystems are typically broken down into the *individual,* the *task* and the *environment*, which are also known as constraints (Newell, 1986). The interaction among these three constraints will influence how a child performs his/her motor skills.

The individual constraints operating in this study that were measured or considered were Indonesian children, gender, preschool age, anthropometrics, current motor competence and perceived motor competence. Embedded in the individual constraints will be factors such as strength, balance and motivation but these are not measured directly. The environmental constraints in this study were the teachers, the *INDO-SKIP* intervention, and the variety of equipment being used in *INDO-SKIP*. The task constraints were OC and LOC tasks and activities that were designed as part of the *INDO-SKIP* curriculum. The primary focus of this study was to examine the effects of the *INDO-SKIP* intervention delivered by trained preschool teachers on children's motor competence, perceived motor competence, and executive function. Therefore, this study will strategically use the interaction among the individual, environmental, and task constraints to design the *INDO-SKIP* intervention as an appropriate motor skill intervention for preschoolers in Indonesia. Figure 3 shows the constraints and the factors under each constrain that are the focus on this study.

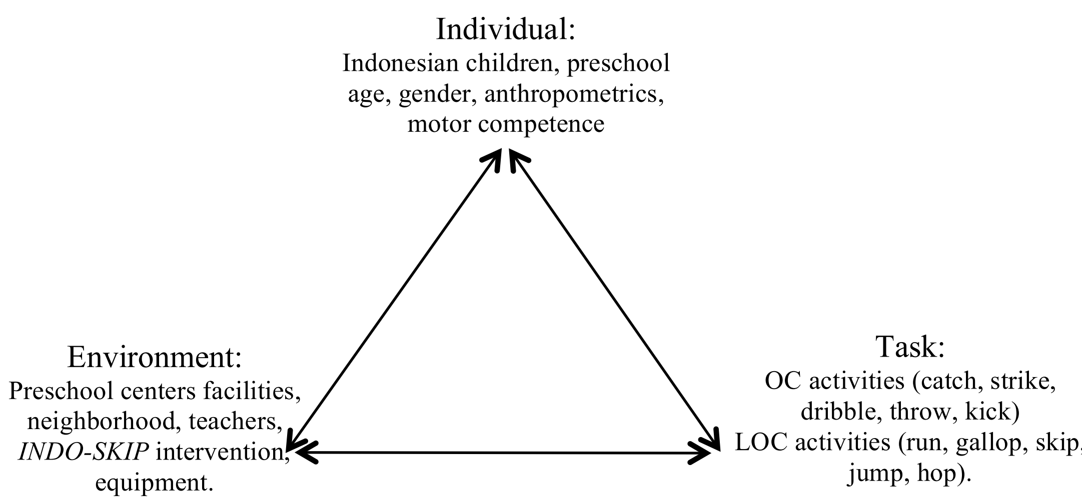


Figure 3. Summary of individual, environmental, and task constraints in the study.

Based on the individual constraints, the task and environmental constraints are designed/manipulated to produce developmentally appropriate activities for preschoolers. After implementing those activities, then children start changing their individual constraints (e.g. motor competence), which leads to further modifications of the environmental and task constrains to accommodate the progression individuals (children) have made. Thus, *INDO-SKIP* is not a static curriculum, it is a dynamic process that is constantly changing as children change their motor performance. Table 3 shows the dynamic constraints approach used in this study.

Table 3. Throwing Example Application of the Constraints Perspectives within *INDO-SKIP*

Approach	**Example of skill: Throwing**
1. Identify the developmental stage of the child in the skill	Ipsilateral step in throwing (stage 3)
2. Considering individual constraints that influence skill development (control parameters)	Static/dynamic balance, strength, multi-limb coordination
3. Identify the next step in the developmental progression for the skill	Contralateral step in throwing (stage 4)
4. Designing tasks & consider which environmental constraints can be manipulated to align the task and environment to the skill level of the child	Task: step with opposite foot in throwing Environment modification: – Provide hoop or line or footstep to cue child to step over it – Tie scarf on the leg or stick a sticker on the stepping foot to prompt a contralateral step – Manipulate target to be large, close (about 8 feet away) and head height – Throw a bean bag or yarn ball for ease of grip
5. Considering motivation to encourage child engagement on task	Have motivating targets, for example cartoon pictures, or a net with bells to motivate child to throw hard.

The perspective outlined in Table 3 served as a core underlying principle of *INDO-SKIP* pedagogy throughout the intervention. Task and environment were very dynamic and continually changing as children evolve in their motor skill competence.

Pilot Study

A pilot study was conducted in Summer 2015 in Padang, West Sumatera. The primary purpose of this study was to secure baseline data on motor competence, physical activity levels, and perceived motor competence of preschool boys and girls enrolled in urban and rural child care centers. The secondary purpose was to examine whether preschool teachers could demonstrate fidelity in delivering the modified-*SKIP* program in an Indonesian preschool context.

Procedures

Prior to the start of the study, all procedures were approved by the Institution Review Board of OSU. Parental permission, children assent and the teacher consent were secured. Sixty-six preschoolers, aged 3 to 6 years enrolled in 2 urban and 2 rural early childhood education centers participated in this study. None of the children had a documented disability. Urban participants (n=35) were 21 girls and 14 boys (*M* age = 59.57 months, *SD* = 8.42). Rural participants (n=31) were 15 girls and 16 boys (*M* age = 61.45 months, *SD* = 5.80). Three early childhood teachers were trained on modified-SKIP, then one teacher volunteered to teach the modified-*SKIP* program.

The TGMD-3 (Ulrich, 2016) was administered to the preschoolers using the standardized protocol by two trained data collectors and the lead researcher. The physical activity data was measured by an accelerometer worn on the right hip (ActiGraph's

Bluetooth Smart wGT3X-BT) using a 15 epoch (Pate, Almeida, McIver, Pfeiffer, & Dowda, 2006) during the entire school day (from approximately 7:30am-11:30am). Physical activity data was collected across three typical school days that were randomly selected and not on the day when other data was collected. The physical activity data during playground time was extracted from this school day's physical activity data. Percent of school day and percent of playground spent in MVPA and sedentary behaviors was calculated from the data and used for analysis. The data collection for perceived motor competence of children was collected by using the Perceived Movement Skill Competence for Young Children (PMSC) instrument (Barnett et al., 2015a) and the Perceived Physical Competence subscale (PPC) of the Pictorial Scale for Perceived Competence and Social Acceptance for Young Children (Harter & Pike, 1984). More detail on these measures is found below.

Three early childhood education teachers were trained on a modified *SKIP* intervention called *INDO-SKIP*, along with motor development, and pedagogical principles for three sessions of two hours. One of those teachers volunteered to implement *INDO-SKIP* for two weeks, two sessions/week, and thirty-five minutes per session, while being coached by the lead researcher. The other two teachers who were trained on the modified-*SKIP* observed this implementation. A group discussion was conducted after the 2-week implementation of *INDO-SKIP* with all teachers to get feedback on future teacher training and the *INDO-SKIP* intervention program.

In order to examine baseline measures and potential differences by gender and location, a 2 Gender (girl, boy) X 2 Location (urban, rural) analyses of variance

(ANOVAs) were conducted for TGMD-3 (LOC and ball skills), PMSC, and PPC. As the two physical activity measures were correlated (MVPA and sedentary behavior), four separate 2 Gender (girl, boy) X 2 Location (urban, rural) multivariate analyses of variance (MANOVAs) were conducted on the percentage of time spent in sedentary behavior and MVPA (one MANOVA for school day and one MANOVA for playground time).

Results

On average the Indonesian preschoolers scored 17-18 points out of a possible 46 point raw score for LOC skills, and 16-19 points out of 54 possible total raw score for ball skills. There are currently no standard scores/percentiles available for the TGMD3. The Indonesian preschoolers felt they were "pretty good" for both PPC (3.41-3.46) and PMSC (3.29-3.45). On average over three school days children spent 83.57-84.95% of their day being sedentary, with only 6.68-7.62% in MVPA. On the playground, 66.62-76.54% of the time was sedentary and only 12.04-17.75% in MVPA. ANOVA analysis showed that boys (M=18.93) outperformed girls (M=16.39) in ball skills ($F_{[1,62]}$=6.82, p=.011, η^2=.10) with no differences in LOC skills (p=.60). Additionally, MANOVA analysis showed that rural children (M =74.63%) were more sedentary than urban children (M=67.80%) on the playground ($F_{[1,62]}$=4.74, p=.03, η^2=.07). Overall, Indonesian preschoolers demonstrated low motor competence, high perceived motor competence and low PA levels similar to Western children. Further, the results highlight the importance of developing perceived and actual motor competence in the early years to promote physical activity.

The group discussion with the early childhood teachers after the training and two week implementation of *INDO-SKIP* revealed that six hours was not enough to cover all the materials and to understand all motor skills. Some LOC skills, such as gallop and skip, were new terms for teachers, and some OC skills such as two-hand strike and dribble, are not commonly performed in West Sumatera. Therefore, when teaching the skills, teachers had difficulties in demonstrating the skills correctly to the children. Moreover, with only one teacher per class, the teacher had difficulties in class management and following the lesson plan. This might be due to the lack of understanding in physical education pedagogy and physical activity experiences.

Lesson Learned from the Pilot Study

The pilot study helped in informing the current study. The findings showed that preschoolers in Padang, West Sumatera were low in their motor competence. Thus, there is a need to provide them with motor skill intervention to promote motor skill development. On the other hand, preschoolers perceived themselves as pretty good in motor skills. One might assume that Muslim girls' perception on their motor competence would be lower than boys. However, this pilot study did not support that assumption. Therefore, there is no concern for disengagement in the intervention, since boys and girls had positive perception that motivated them to participate in the intervention.

The feedback obtained from group discussion by teachers helped in formulating some recommendations for the current study, as following:

1. More time for training and include teacher peer practice of motor skills during the training.

2. On-going coaching during the intervention implementation as the initial lessons were very hard for teachers and they needed additional supports.
3. Using direct instruction pedagogy because there is only one teacher in each class. Therefore, having teacher direct the lesson would be more feasible to create good classroom management to support teacher's instruction and child learning.
4. The tasks/activities designed in *INDO-SKIP* were appropriate for Indonesian preschoolers
5. As teachers are new to the *INDO-SKIP* program, they need to learn how to set up the station and to manage the class while they are teaching. Therefore, in the first one to two weeks of *INDO-SKIP* implementation, only one station will be set up. We anticipate that teachers will set up two stations in every lesson when they feel more confident in their teaching of *INDO-SKIP* lessons.
6. The lesson structure includes warming up, skill development tasks/activities, and cooling down.
7. Thirty minutes session worked appropriately with the current daily curriculum at early childhood centers
8. Early childhood centers had no equipment for motor skill intervention. Therefore, researchers need to provide equipment for the *INDO-SKIP* implementation.
9. In order to get enough sample size in the intervention group, the intervention group should be in early childhood education centers that have more than one class due to half-time school days. Therefore, the lead researcher can record the session and coach the teacher for more than one class in a day.

10. In the next study to only use early childhood centers in an urban context rather than adding the additional variable of urban and rural environments.

Context of the Study

Setting

This study was conducted in Padang, West Sumatera, Indonesia. Padang is the capital city of West Sumatera province with 268 square miles area located on the west coast of Sumatera Island. It has eleven administrative districts, in which four of them are located in the center of the city (urban area) and the other seven districts are located in suburban and rural areas. The population of Padang is approximately 1 million, which mostly consists of an indigenous, ethnic group called the Minangkabau. The Minangkabau are the largest matrilineal society in the world strongly founded upon Islamic law.

The Indonesian government has established the general basic guidelines that need to be followed by the centers, for instance the basic curriculum and expected outcomes for children, the teacher licensing procedures, and the centers registration. In general, early childhood services operate for 2.5 to 4.5 hours per day, Monday to Friday. The curriculum consists of religion, morals, motoric (particularly fine motor skills), academic, language, social emotional, and arts.

Early Childhood Centers. In this study, four early childhood education centers from urban Padang were purposively selected. These centers followed a structured academic curriculum, and the early childhood teachers had a bachelor's degree in early childhood education. A typical day for the early childhood centers can be seen in Table 4.

Among all four early childhood centers, only one center (center #1) has dedicated space for muscle room and other three centers (center #2, center #3, and center #4) do not have muscle rooms. However, all centers had access to an outdoor playground, yet the playground did not have enough space to do the *INDO-SKIP* intervention. Therefore, center#1 and center #2, which is located close to the center #1, were assigned into *INDO-SKIP* group, and other two centers (center #3 and center #4) were assigned into the control group.

Table 4. Daily schedule of early childhood education centers

Time	Activities
7:00 – 7:15 AM	Preschoolers arrive to the center
7:15 – 7:30 AM	Musical aerobic exercise outside of the classroom
7:30 – 8:00 AM	Circle time: Introduction activities on that day, Quran and Islamic lesson
8:00 – 10:00 AM	Academic time: language (spelling, reading, writing), sciences (body parts, plants, animals, environments), mathematics (numbers, counting, basic arithmetic), arts (drawing, painting, cutting and gluing, building)
10:00 – 10:30 AM	Outdoor free play activities
10:30 – 11:30 AM	Role plays/free activities in classroom
11:00 – 11:30 AM	Closure (singing, daily discussion, and praying)

Teacher Participants

This study was an initial feasibility step to explore whether the *INDO-SKIP* intervention could be delivered to Indonesian preschoolers by Indonesian early childhood teachers, and whether it would result in positive outcomes for Indonesian preschoolers. The intent of this study was to inform a future Group Randomized Trial and to identify the modifications needed in the design to be implemented in a larger study (Leon, Davis, & Kraemer, 2011). Therefore the teacher participants in this study were purposively selected. Twelve early childhood education teachers were selected to participate in this study based upon the following criteria:

1. Certified early childhood teacher in schools identified by the investigators
2. Aged at least 22 years old (the age necessary to receive a teaching license).

Six teachers delivered the *INDO-SKIP* program and the other six teachers were control teachers. Table 5 shows the characteristic of teachers in the *INDO-SKIP* group.

Table 5. Demographics of *INDO-SKIP* Teachers

Characteristics	Teacher 101	Teacher 102	Teacher 1033	Teacher 1044	Teacher 105	Teacher 106
Age	36 yrs	34 yrs	25 yrs	26 yrs	32 yrs	24 yrs
Gender	Female	Female	Female	Female	Female	Female
Years of Teaching	8 yrs	6 yrs	3 yrs	3 yrs	6 yrs	3 yrs
Degree	Bachelor	Bachelor	Bachelor	Bachelor	Bachelor	Associate
Recreational Experience	None	None	None	None	None	None
Sport Experience	None	None	None	None	None	None

The control teachers were aged between 25– 36 years, with 3 – 8 years of teaching experience.

Child Participants

The child participants were selected based upon enrollment in the classes of consented teachers for *INDO-SKIP* and matched classrooms similar to the *INDO-SKIP* classroom for the Control group. Early childhood classrooms in Indonesia typically include 15 to 20 children. Participants were aged 4 to 6 years, and were enrolled in early childhood centers in urban area in Padang. Only children who were typically developing with parental permission were included in this study. There were 85 children (boys=33, girls=52) participated in the intervention group and 71 children (boys=34, girls=37) participated in control group. Table 6 reports the characteristics of child participants in this study.

Table 6. Child Participants Demographics

	Class in *INDO-SKIP* Intervention							**Class in Control Group**						
	1	2	3	4	5	6	Over all	7	8	9	10	11	12	Over all
N	**14**	**14**	**15**	**14**	**15**	**13**	**85**	**14**	**10**	**13**	**12**	**10**	**12**	**71**
Boys	6	5	5	5	6	6	33	8	6	3	7	4	6	34
Girls	8	9	10	9	9	7	52	6	4	10	5	6	6	37
Age (mo)	73.4	70.2	64.7	58.9	71.7	72.4	68.5	71.7	63.8	70.9	73.6	71.6	72.5	70.6
SD	3.4	3.8	2.6	4.7	4.3	3.2	3.7	5.9	4.6	3.4	4.4	3.7	3.8	4.3
BMI	15.3	13.8	13.2	14.9	13.9	14.4	14.25	14.3	15.5	14.4	14.5	16.1	16.1	15.2
SD	3.7	1.7	1.0	1.7	0.9	1.6	1.7	1.7	2.4	1.5	1.4	2.6	2.4	2.0
BMI%	47.2	26.5	19.5	32.5	20.1	33.3	29.9	28.8	43.6	28.8	36.9	58.4	54.0	41.75
SD	42.8	34.9	22.1	31.1	19.5	31.4	30.3	29.6	37.5	32.1	23.6	40.0	33.4	32.7

Researcher Positionality

The primary researcher in this study was an Indonesian, Muslim woman. She is a multilingual and Bahasa Indonesian is her first language. She lived in Indonesia for the majority of her life and was a faculty member at a State university in Indonesia. At the time of the study she was in the doctoral program at a large Midwestern university for Kinesiology. Prior to the doctoral program she did not have any experience in physical activity and sports. She also did not have any experience in teaching motor skill programs until the doctoral program. Prior to the start of the study she had interactions with some of the teacher participants in this study. The teacher participants indicated to her that they saw her life experiences very similar to their own. The life experiences of the primary researcher influenced her positionality to this study and possibly the reaction of the teachers to her study.

Research Design

This study was a quasi-experimental study, pretest posttest control group design. The quasi-experimental design is "to fit the design to settings more like the real world while still controlling as many of the threats to internal validity as possible" (Thomas, Nelson, & Silverman, 2011). The intervention and control groups were purposively selected and assigned into intervention and control groups.

This quasi-experimental design has strengths and weaknesses that pose threats to the internal validity and external validity of this research. In this study, selection bias, which is non-randomization of assignment into the intervention and control group, was a threat for internal validity (Campbell and Stanley, 1963). However, some other threats were regulated to control for the internal validity threats. The threat of history was controlled by location selection, teacher's education background, school curriculum and facilities. Preschoolers for both intervention and control groups were selected from early childhood education centers that were located in the same area. Therefore, the history, neighborhood, and the experience of participants should be similar to each other. Teacher participants were also selected with similar educational backgrounds (having a Bachelors or Associate degree in early childhood education) with teaching experience in early childhood education ranging from 3 to 8 years. Furthermore, the early childhood education centers that participated in this study had similar curriculum, which was focused on the school readiness and Islamic values. Also, these centers had access to an outside playground equipped by some stationary games equipment, such as a monkey bar, swing, and slide. Another internal validity threat that was addressed in this study was experimental mortality. Since participants were enrolled in early childhood centers as part of their typical school experience, the possible loss of participants was less likely.

Non-randomization of participants to condition was a threat for external validity. However, since the intervention took place at early childhood education centers, it was not possible to randomize at the level of the child, as children exist in intact classrooms. In order to partially deal with this threat, the nesting effects of the child embedded in the classroom will be accounted for during statistical analysis. This is a legitimate threat for generalizability of study results. However, the main purpose of this study was piloting the *INDO-SKIP* intervention in order to determine the feasibility of this intervention and identify the strength and weakness of this intervention to be modified for larger study in the future. Therefore, the generalization of the findings will be limited to the current group.

Dependent Variables and Instrumentations

The dependent variables for this study were collected from preschoolers and early childhood teachers.

Variables and Instrumentation - Preschoolers

Variables that were measured from preschoolers were motor competence, perceived motor competence and executive function.

1. Motor competence.

Motor competence refers to fundamental motor skills, which is the basic and observable movement behavior that should be developed during early childhood (Graham, Holt/Hale, & Parker, 2012) and considered as building blocks to more advanced patterns of movement such as sport-related skills (Gallahue et al., 2012). Fundamental motor skills can be categorized into LOC and OC skills. Locomotor skills are skills to move body from one point to another, for instance, running, galloping, skipping, sliding, leaping, jumping, and hopping. Object control (OC) skills are skills to manipulate or control an object with the hand or foot, for instance, throwing, catching, kicking, striking, rolling and bouncing. This study only measured children's OC skill competence. Children motor competence was measured using process and product evaluation of fundamental motor skills.

Process assessment for motor competence was measured by the Test of Gross Motor Development 2 (TGMD-2) OC Subscale (Ulrich, 2000). The TGMD-2 is a criterion, norm-referenced standardized, and validated measurement that quantitatively measures children's performance on fundamental motor skills for children ages 3-11 (Ulrich, 2000). The TGMD-2 consists of two subscales: LOC and OC skills. Only the OC subscale was used in this study, which measures throw, catch, kick, bounce, strike off a tee, and roll skills. The TGMD-2 is a valid (GFI =.9-.96) and reliable test of OC subscale (ICC=.86-.92; Ulrich, 2000). The TGMD-2 OC Subscale was assessed in a physical activity room or playground in small groups (4 to 5 children). Children were videotaped performing 2 trials of all 6 skills and behavioral/performance criteria for each skill coded by trained observers off the videotape. The score ranges from 0-48 points, and standard scores and percentile ranks are calculated based on age and gender. Prior to coding the videotapes, inter-observer agreement training was conducted with an expert (description is provided under the phase 1 in the Procedures section).

The product assessments for motor competence were measured by the Movement Assessment Battery for Children-2 (MABC-2) for age band 1: 3-6 years (Henderson, Sugden, & Barnett, 2007). The MABC-2 is valid and reliable (CFI = .957, ICC= .61- .96; Ellinoudis, 2011; Smits-Engelsman, Niemeijer, & van Waelvelde, 2011). The primary purpose of the instrument is to identify whether children are delayed on their motor performance. The MABC-2 measures three motor skill categories, which are 1) Manual Dexterity, which includes post coins task, threading beads task, and drawing trail task, 2) Aiming and Catching, which consists of catching a beanbag and throwing a beanbag onto a mat, and 3) Balance that includes a one-leg balance, walking with heels raised, and jumping on mats. Children were assessed individually using the standardized protocol of the MABC-2. Raw scores for tasks are in the seconds, the number of success trials, or the number of errors. The raw score were converted to standard scores and percentiles and summed for a total score.

2. Perceived motor competence

Perceived motor competence refers to a child's perception of his/her physical competence and the perception of his/her motor competence. Children's perceived motor competence was measured by the Perceived Physical Competence subscale (PPC) of the Pictorial Scale for Perceived Competence and Social Acceptance for Young Children (Harter & Pike, 1984), and the Pictorial Scale of Perceived Movement Skill Competence (PMSC) for Young Children instrument (Barnett, Ridgers, Zask, & Salmon, 2015a). Both instruments used a similar pictorial approach to measuring the constructs.

The PPC measures a child's perception on six general physical competencies (swinging, climbing the monkey bar, tying shoe laces, skipping, hopping, and running) with an internal consistency of 0.66 (Harter & Pike 1984). The PMSC measures the child's perception on six LOC skills (run, gallop, hop, leap, jump, and slide) and six ball skills (throw, catch, roll a ball, kick, strike, and dribble) with an internal consistency of 0.60–0.81 (Barnett, et al., 2015a). Both the PMSC and PPC instruments used pictorial plates with two separate pictures side-by-side. One picture depicts a competent child performing the skills (scored 4 or 3) and the other a less competent child (scored 1 or 2). The child first selected the picture that is most like the self. Then, the child indicated whether he/she is "just a little bit" (score 3 or 2) or "a lot like" (score 4 or 1) the child in the picture she/he selected. The score recorded was the mean (1-4 points) of 12 items in the PMSC instrument and the mean of 6 items in the PPC.

3. Executive function

In this study, executive function is defined as the executive attention that involves higher-level cortical functioning such as planning, stimuli and response selection, and monitoring of daily performance (Stuss & Benson, 1986). Executive attention is associated with behavioral regulation, speed processing, and inhibitory control. Executive function was measured by the Head-Toes-Knee-Shoulder Task and the Day-Night Task. Prior to administering and scoring both instruments, the tester training was conducted (description is provided under the phase 1 in Procedure section).

Head-Toes-Knee-Shoulder (HTKS) Task is an assessment to measure behavioral regulation, including inhibitory control, attention, and working memory (Ponitz et al., 2008). HTKS has construct validity with high inter-rater reliability k=.90.

The HTKS is an extension of the Head-to-Toes (HTT) assessment (Ponitz et al., 2008), because the HTT has a ceiling effect in participants older than 5 years. The HTKS includes two parts, and each part has 10 trials. The first part of the task is with the head-toes commands, in which a child is asked to touch her/his head or toes but using the opposite of the commands. For instance, when the instruction is "touch your head", then child should touch her/his toes, while when the instruction is "touch your toes", then child should touch his/her head. In part 2, there are two additional commands, which are the knee-shoulder commands. The child is supposed to touch the knees when the instruction is to "touch your shoulder" and vice versa. A correct response earns 2 points, incorrect response earns 0 point, and the child will score a 1 if she/he self-corrects an incorrect response without any prompt from the test administer.

Prior to the test trials, the child received training and practice trials. During the training, the tester explained the task to the child along with two training trials, which allowed the tester to prompt the child if the response is incorrect. The explanation can be repeated up to three times. Then the child received four practice trials without prompts from the tester, followed by 10 test trials of part I. If the child's correct response was 5 or more, then the assessment continued to part II. The child received a training session prior to test trials in part II. The final score was the sum of the first two training trials, first four practice trials, and test trials for part I and/or part II, with total score range 0-52.

Day-Night Task (DNT) – The DNT test is a widely used assessment to measure children's inhibitory control (Gerstadt, Hong, & Diamond, 1994) with reliability reported from .89 (Rhoades, Greenberg, & Domitrovich, 2009) to .93 (Chasiotis, Kiessling, Winter, & Hofer, 2006). This assessment used a set of cards with pictures of a sun or a moon. The dimension of each card was 13.5 x 10 cm. The child was instructed to say "day" when a card with the picture of the moon is shown and say "night" when a card with a picture of the sun is shown. Sixteen trials were presented with eight "day" cards and eight "night" cards on the pseudorandom sequence. The day (d) and night (n) cards were presented in the order of n, d, d, n, d, n, n, d, d, n, d, n, n, d, n, d. Prior the assessment, the test administrator explained the tasks to the child and asked the child to repeat the answer (day or night) during the explanation. Then, the test administrator followed with practice trials by showing one "day" card and one "night" card. If a child's responses were correct for both practice trials, the test administrator praised the child, and those trials were coded as test trials. The task then continued with another 14 test trials following the order. If none of the child's responses were correct or only one response was correct, then the test administrator gave another explanation until the child got the first two trials correct. Correct responses were scored as 1 and incorrect scored as 0. The total range of score was between 0 – 16 (Gerstadt, Hong, & Diamond, 1994).

Variables and Instrumentation – *INDO-SKIP* Teachers

A number of variables were collected from the early childhood teachers who delivered the *INDO-SKIP* intervention and these included: demographic information, motor development knowledge, physical education knowledge, and lesson fidelity assessment.

1. Demographic information

All teachers completed a demographic questionnaire prior to the start of the study.

The demographic information included years of teaching, previous experience teaching physical education, any prior training in motor development and structured physical activity, how many years teaching at the current child care center, age-range category, gender, current personal levels of recreational sport and/or physical activity, prior experience in school-level sport, and club sports.

2. Teachers' motor development and physical education knowledge

All teachers completed a formative assessment as a process measure of their motor development/physical education knowledge during the initial workshop of *INDO-SKIP*. The purpose of the exam was to determine the teachers' level of competency with the content. Teachers were tested on the following three items:

- **Developmental Stages**: Teachers demonstrated and described the stages for four OC skills (throw, catch, kick, strike). Demonstration were videotaped and coded as:
  - 3= teachers demonstrated accurately and described in detail.
  - 2=teachers demonstrated accurately but could not describe in detail OR teachers could not demonstrate accurately but described in detail.
  - 1=teachers cannot demonstrate accurately and/or only described in limited detail.
  - 0=teachers could not demonstrate accurately and could not describe the skill.

This assessment measured whether teachers were able to discriminate each stage of OC skills, a foundational principle in the *INDO-SKIP* program. The total range of score was between 0–12 points (4 OC skills X 3 points).

- **Accurate demonstration of all OC skills**: Teachers demonstrated the *INDO-SKIP* (overhand throw, catch, kick, 2-handed strike, dribble, roll) skills. Teachers were videotaped and coded on the TGMD-2 critical elements. This assessment measured whether teachers could demonstrate the proficient performance of each OC skill. Scored 0-48 points.
- **Teaching a mini-lesson** on 3 skills, 5 minutes each. Teachers were videotaped to evaluate the accuracy of task set up, demonstration of task, explanation of task and identifying 2 critical elements of a skill, by using the Fidelity of *INDO-SKIP* Assessment coding sheet. The teaching of the mini lessons examined whether teachers were able to teach the skills. Total raw score range from 0 to 39, and the percentage was calculated.

Although fidelity was being collected on teachers, it is not viewed as teacher instrumentation, rather an index of the extent to which the intervention was delivered as intended. Thus, description of teacher's fidelity can be found under the *INDO-SKIP* Implementation heading.

Procedures

Phase I: Pretesting and *INDO-SKIP* Teacher Training

1. Recruitment

After receiving approval from the Human Subjects Institutional Review Board, parental permission forms were distributed to the parents of potential participants and consent forms distributed to potential teachers. Following securing parental permission, children were individually assented in a private part of the classroom.

2. Training of Coders and Testers

Training of TGMD-2 Coders. The members of the research team coded the results of the TGMD-2. Prior to coding the data, training on coding the OC Subscale of TGMD-2 was conducted. The training procedures included:

1. Definition of terms on TGMD-2.
2. Performing OC skills and identifying the TGMD-2 criteria of each skill.
3. One member of the research team coding another member of the research team's performance on OC skills.
4. Observing videotapes and identifying each criteria of the TGMD-2 of each skill as a group led by an expert coder including discussion over why an element was awarded or not.
5. Individual practice in coding of OC Subscale of the TGMD-2. The videos were pre-coded by experts. Then the research team received feedback from this practice.
6. Gold standards test tapes, in which each research member coded 2 children with TGMD-2. The percentage of agreement was calculated, and we had ≥ 90% of agreement.

Training Testers in Indonesia. Prior to data collection, the testers in Indonesia were trained. The testers received the written description of each instrument. The principle investigator facilitated the training, which included:

1. Demonstrating OC skills for the TGMD-2 and all skills in MABC-2, HTKS and DNT accurately.
2. Small groups (3 testers in each group) setting up the task and administering the test accurately with the investigator's feedback in the beginning until they were able to perform accurately without feedback.
3. Testers practiced collecting the data with a small group of children and accuracy of implementing the test coded by the investigator.
4. Some of the testers were retrained because they were not able to administer the tests accurately and re-practiced collecting the data.
5. Random checks were conducted from the study videotapes to observe the adherence of testers to the procedures. Intra-rater reliability was calculated across the study.

3. Pretesting on Motor Competence, Perceived Motor Competence, and Executive Function

All children in both the intervention and control groups were pretested on the motor competence, perceived motor competence, and executive function following the standardized manual/procedures.

- The TGMD-2 OC Subscale was assessed in a physical activity room or playground in small groups (4 to 5 children) and videotaped.
- The MABC-2 was assessed in a physical activity room individually.

- The PPC and PMSC were measured individually in a corner of the classroom away from other children in a conversational style.
- The HTSK was assessed in a physical activity room/ playground or quiet corner of the classroom individually.
- The DNT was assessed in a physical activity room or quiet corner of the classroom individually and videotaped.
- Children's height and weight were measured in physical activity room or in the corner of classroom.

4. Early Education Teacher *INDO-SKIP* Initial Training and Teacher Measure of Training

Prior to the start of the study, the early childhood teachers in the intervention group were trained on the *INDO-SKIP* curriculum by the primary researcher. The teachers received 2 day training, 4 hours of training in the first day and 5 hours training in the second day (total of 9 hours). The training covered motor development principles, the stages of motor skills, and pedagogy in teaching motor skills. Table 7 describes the contents of *INDO-SKIP* teacher training.

Table 7. Teachers *INDO-SKIP* Training Plan and Training Assessment

Content	Pedagogical Approach	Time	Evaluation
	DAY 1		
Demographic Questionnaire	Teachers complete questionnaire individually	15 mins	Questionnaire
Overview of project & models of motor development	Lecture PowerPoint	45 mins	No evaluation
Demonstration and practice of stages of catch, throw, kick, and strike skills.	Gymnasium practical activity	1 hour	Developmental stages assessment
Demonstration, critical elements and practice of roll and dribble.	Gymnasium practical activity	30 mins	
Demonstration of all OC skills	Gymnasium practical activity	30 mins	Accurate demonstration assessment
In depth presentation and discussion on OC skills (kicking, catching, throwing), including: – Control parameters – Constraints to manipulating the task and environment – Task progression – Cues/prompts in instruction – Feedback and Motivation	Gymnasium practical activity	1 hour	No evaluation
	DAY 2		
In depth presentation and discussion on OC skills-continued (dribbling, rolling, two hand striking, and one hand striking), including: – Control parameters – Constraints to manipulating the task and environment – Task progression – Cues/prompts in instruction – Feedback and Motivation	Gymnasium practical activity	1 hour	No evaluation

Continued

Table 7 Continued

Understanding pedagogy in teaching lesson plan, including: – Walk through some lesson plans – Rules, routines and expectation – Freeze and Replay – Proper demonstration in skill station – Monitoring – Safety issues – Individual task modification	Gymnasium practical activity	1 hour	No evaluation
Lesson plan implementation, including: – Lesson plans were provided – Each teacher had 10 minutes to prepare their teaching and 5 minutes of teaching each task/skill – Teachers set up the task – Teachers taught the tasks/skills – Teachers used the pedagogy features (such as freeze-replay, monitoring, safety concerns, feedback) – Teachers received feedback	Gymnasium practical activity	2.5 hours	Fidelity of *INDO-SKIP* Assessment (FIA) of teaching mini lesson
Closure: – Wrapping up, communication procedures, scheduling, and providing incentives to the teachers.	Discussion	30 mins	

Phase II: Implementation of *INDO-SKIP* and Control Conditions

All participants in both experimental and control group received the typical curriculum for early childhood centers, including academic and Islamic content. Schools started at 7:15 and ended at 11:30 am. Children received 30 minutes of free play activities on the playground. In addition, children in the experimental group received the *INDO-SKIP* program for nine weeks, two sessions in a week, 30 minutes per session.

1. *INDO-SKIP* Program

The experimental group for this study was an *INDO-SKIP* group. The typical preschool program had 30 minutes of free play activities on the playground 5 days per week. On 2 of the 5 days, academic time was replaced with two, 30-minute *INDO-SKIP* sessions per week for 8 weeks. Thus, the dose of the program was 480 minutes of OC skills over 8 weeks. This dose was based on the previous *SKIP* project that reported the dose of the SKIP program between 470 minutes (8 weeks, 2 x 30 mins) to 1080 minutes (12 weeks, 2 x 45 mins) has been effective to significantly improve children's motor competence with high effect size (η^2=.70 - .73;). Also, a review of eleven motor skill interventions revealed that children who received a motor skill program that lasted between 480-1440 minutes within 6 – 15 weeks showed significant improvement on their LOC and OC skills (Logan, Robinson, Wilson, & Lucas, 2011).

2. Design And Core Principles of *INDO-SKIP*

The *INDO-SKIP* intervention is a modification of The Successful Kinesthetic Intervention for Preschoolers program (*SKIP*: Altunsöz, & Goodway, 2016; Goodway, & Branta, 2003; Goodway, Crowe, & Ward, 2003; Robinson, & Goodway, 2009) and *SKIP*ing with teachers (Brian et al., 2017a & 2017b) intervention. The *SKIP* intervention (Goodway et al., 2003) is a structured motor skill intervention that consists of LOC and OC skills taught by motor development experts two times per week for 30-45 minutes each session for 9-12 weeks. Locomotor skills included run, gallop, skip and jump, and the OC skills included dribble, strike, kick, catch, and throw (Altunsöz, & Goodway, 2016; Goodway, & Branta, 2003; Goodway et al., 2003; Robinson, & Goodway, 2009). SKIPing with teachers (Brian, et al., 2017a & 2017b) is a modification of the *SKIP* intervention, in which the intervention was delivered by trained, lead-teachers and assistant teachers, in early childhood centers, for nine weeks, twice a week for 30 minutes each session. SKIPing with teachers emphasized OC skills (dribble, kick, strike, catch, and throw). Locomotor skills were taught as a break or transition during the sessions. The *INDO-SKIP* program is a modification of both *SKIP* and SKIPing with teachers. The modifications included:

1. While SKIPing with teachers intervention was delivered by the lead teacher and an assistant teacher, *INDO-SKIP* will be delivered only by one teacher per class.
2. The *INDO-SKIP* program will focus on OC skills, which is similar with the SKIPing with teacher intervention.
3. If needed, children will be grouped based on gender due to religious considerations. Since early childhood education in Indonesia is driven by community values, some centers practice Islamic law more than other centers. Also, some children who are growing up in a family with a more conservative way in practicing Islam tend to be more comfortable in gender-segregated groups. Therefore, this study accommodated this cultural value.

The *INDO-SKIP* curriculum and lesson plans are designed based on task principles and pedagogical principles. The task principles ensure that the tasks itself are good tasks that will benefit children to improve their motor competence even though their teachers may not be good at giving feedback. The task principles include:

1. The lessons should be developmentally appropriate based upon the motor development stage of children (Gallahue et al., 2012) and cognitive function of children. After children's stage on a skill was identified, the lesson was designed to be challenging enough to improve their motor skill to a higher stage, but still

fun for their age, for instance using fun themes.

2. A focus on OC skill instruction. The LOC skills were taught during the transition break between one activity to another.
3. The lesson should be developed based on the developmental task analysis to establish task progression for low, medium and high difficulty through extension, refinement, and application (Rink, 2009).
4. The tasks are individualized to provide appropriate level of challenge and success in performing the tasks. When tasks were too difficult or too easy for the child, the tasks were modified by manipulating the environment or equipment. For instance, by changing the distance to the target, or the size of the ball, or using a moving target instead of a stationary target.
5. The learning experience was developed to provide maximum practice trials and practice time for children (Siedentop & Tannehill, 2000). Therefore, the lesson was taught with enough equipment for children to decrease wait time.
6. Repetitive cycles of skills were implemented in the overall block plan. That is, each skill was introduced, developed and re-introduced in cycles of development across the nine weeks.
7. The *INDO-SKIP* program was environmentally and culturally designed to motivate children's participation. Traditional Indonesian music was used. In addition, targets for tasks were pictures of common animation in Indonesia. Furthermore, the word of "monkey face" would not be used because it is considered a mockery in Padang.

The following pedagogical principles were used to bring about high quality instruction to deliver the *INDO-SKIP* intervention:

1. Direct instructional pedagogy with increasing child choice as the intervention progressed.
2. Stage evaluation and critical element identification of each motor skill.
3. An array of developmental tasks from simple to more complex with the environment being manipulated to add complexity to the task
4. Accurate demonstration of the task and identification of cue words to complete the skill.
5. The ability to modify the task based on the stage evaluation, critical element identification and modification of equipment to the stage of the child.
6. Critical cue words and feedback that were developmentally and instructionally appropriate. For instance: an appropriate cue to enforce tracking the ball in catching was “eyes on the ball”.

3. *INDO-SKIP* Lesson Structure

The typical *INDO-SKIP* intervention had 3-4 minutes of warm-up (moving with music or face pace games), followed by 20 minutes of skill development activities and 3-4 minutes of cooling down. The primary researcher developed the lesson plans for the program and the lesson plan structure was based on the SKIP structure. Teachers taught 2 OC related tasks in each session. After warming up, the tasks were taught as a whole class instruction, not in station settings. The teacher taught one skill after another and provided a 3-minute LOC break in between. Therefore, children engaged in the same activity at the same time. Table 8 shows an example of the lesson plan format.

Table 8. Lesson Plan for Catching and Rolling

Time	Activity	Organization	Critical Elements/Cues
3 min	Opening activity "Listen and Move"	Children are in big circle in the middle of the gym room. Teacher play the music and call the LOC skills. Children move around in big circle.	Encourage children to participate.
Each child has their own station with all equipment and polyspot have been set up on the perimeter of the gym room for catching activities. Stations are set up as a pair, so a child will play with a friend through out the activities.			
15 s	Transition	Teacher lead children to walk slowly and find their station Children stand up in their own station and pay attention to teacher	Walk slowly
10 min	Activity 1: self toss. The progression: - Self toss using scarf 2 sets x 10 repetition	- Teacher stands in the middle of gym room and introduce the activity. - Teacher demonstrates self toss and catch the scarf.	- Eyes on the scarf
	- 2 sets x 10 repetition - Self toss using beach ball 2 sets x 10 repetition - Roll a beach ball with a friend 3 ft away 3 sets x 10 repetition	- Teacher instructs children to start practicing and follow the progression.	- Eyes on the ball - Reach for the ball - Roll the ball slowly - Provide individualized feedback
15 s	Transition	Children get ready for activity break in front of their own station	
3 min	Activity Break: Gallop with a noodle	- Teacher introduce gallop by demonstrating gallop by using a noodle - Teacher instruct children to gallop from a side of the gym room to another side of the room.	- Lead foot in the front - Provide individualized feedback
15 s	Transition	Children get back to their own station and ready for next activity	

Continued

Table 8 Continued

10 min	Activity 3: Roll a tennis ball on the floor The progression: - Roll a ball to a friend 5 ft away 3 sets x 10 repetition - Roll a ball to a friend 7 ft away 3 sets x 10 repetition	- Teacher calls a child to help her in demonstration - Teacher and child face each other 5 ft a way - Teacher demonstrate the roll a ball on the floor to the child - Teacher explain the critical elements: chest face forward, knees bend, contralateral step, swing back, and roll the ball close to the floor - Teacher ask the child to roll the ball back - Teacher has the child to go back to his/her own station then have children to start practicing.	- Face forward - Step and roll - Swing back - Roll on the floor - Provide individualized feedback -
15 s	Transition	- Teacher instruct children to walk slowly and sit on the big circle in the middle of room	
3 min	Closure: Cool down	Reinforce skills and critical element	

4. Implementation of *INDO-SKIP*

***Activities prior to INDO-SKIP*.** Prior to INDO-SKIP implementation, the primary researchers had a number of discussions with the teachers and spent two weeks in their classrooms in order to understand the classroom ecology and behavior management, and to learn about the children. This approach was useful for the researcher to get to know the teachers and to understand their teaching method, routine, rules and regulation in the classrooms and in the early childhood centers. During meetings/discussions, teachers shared about their teaching philosophy, teaching experience, experience in physical activity, sports and physical education, courses they took in their degree program, and concerns that they had about participating in this study. This information was beneficial for the researcher to design appropriate methods for the workshop and on-going coaching for teachers during the *INDO-SKIP* implementation. During that time, the researcher also had time to learn about logistical procedures to support this study. However, during this time no formal data was collected to document the entry and rapport building process. Future research should consider collecting data of the procedures necessary to build rapport with the participants and better understand the setting, teachers and children.

Delivery of INDO-SKIP. The *INDO-SKIP* program was delivered for 480 minutes of instruction over 8 weeks, two 30 minutes-session per week. Over 16 sessions, OC skill instruction consisted of 20 minutes of instruction, except the first session, which only provided 10 minutes of OC instruction. Table 9 reports the block plan for each skill.

Table 9. Block Plan for Instructional Sessions of *INDO-SKIP*

Session	Catch	Roll	Throw	Dribble	Two-hand Strike	Kick	Forehand Strike
1.1	10m	Teach routines, regulation, expectation					
1.2	10m	10m					
2.1		10m	10m				
2.2			10m	10m			
3.1				10m	10m		
3.2					10m	10m	
4.1						10m	10m
4.2	10m						10m
5.1	10m	10m					
5.2		10m	10m				
6.1			10m	10m			
6.2				10m	10m		
7.1					10m	10m	
7.2						10m	10m
8.1	10m						10m
8.2			10m		10m		
Total min/ skill	50m	40m	50m	40m	50m	40m	40m

Total time = 310 minutes of OC skills and 48 minutes of LOC skills (during break)

The *INDO-SKIP* program dedicated 50 minutes for overhand throwing, catching, and two-hand striking, 40 minutes for kicking, dribbling, rolling and one-hand striking. Overall, the dose of *INDO-SKIP* was 480 minutes of instruction with 310 minutes of the program dedicated to OC instruction.

A day before teaching or in the morning of the teaching day, teachers set up the tasks in the motor skill space. Therefore, on the teaching day, teachers were ready to transition their children from the class to the motor space. The lesson plans for each week were provided by the researchers ahead of time, so the teachers had time to understand the lessons. A sample teaching day consisted of a teacher led warm-up for 3-4 minutes. Then the teacher provided an instruction-demonstration of the first task and started with the first activity. For example a pair of children rolled a beach ball back and forth on the floor from a short distance (3 ft) to a farther distance (5 ft). Then the children received a 3-minute break for LOC skills. After that, each additional task had an instruction demonstration and opportunity to practice according to the lesson plan. The lesson plan consisted of one more familiar activity (taught the lesson before) and one novel activity station. After the first ten minutes, children had a 3-minute LOC break led by the teacher. Then teachers made a quick adjustment in the gym room setting when it was needed before rolling over to the second task. The teacher cued the children when to start and stop the practice. During these two activities, the teacher provided feedback to emphasize the critical elements of each skill. The session was closed with fun cooling down activities for 3-4 minutes. The teacher modified the activity when it was needed, for example to make the task more or less challenging by moving children back further from a target or changing the ball with different size or texture.

On-going Coaching Support during INDO-SKIP Implementation. In addition to the initial training, throughout the intervention, on-going coaching support was provided to each teacher. For weeks 1-5, the primary researcher met with each teacher for 30 minutes at the beginning of each week to prepare the teacher for classroom setup and review the lesson plan. Then, the primary researcher video recorded the sessions and provided ongoing coaching support throughout the entire lesson. For instance, if the teacher demonstrated a task incorrectly, then the primary researcher stepped in to demonstrate the task correctly or talk to the teacher to show the correct way to demonstrate. For week 6-8, the lead researcher video recorded each session. There was no support provided prior to or during the teaching of the lessons, unless the teachers asked for help, questions, or if a safety concern occurred.

5. Fidelity of *INDO-SKIP* Implementation

Intervention efficacy was examined using a fidelity check. Fidelity refers to the extent to which specific content, learning tasks, and delivery strategies have been implemented in accordance with the planned manual/procedures (Hulleman, Rim-Kaufman, & Ambry, 2013). For the purpose of this study, each lesson was video recorded and a fidelity assessment conducted from the videos in three components, including: (a) duration and exposure, which is the number and length of the intervention sessions implemented, (b) adherence, which is the extent to which components of the intervention were delivered as planned, and (c) differentiation, which is the extent to which the intervention was differentiated from the control condition based on the features present (O'Donnell, 2008).

Duration and exposure. To examine intervention duration and exposure, each teacher and the researcher kept an intervention log. The intervention logs were utilized to report the time spent on the lesson, group/class size, session location, and completion of basic activities for the skills targeted for each of the intervention lessons.

Adherence. Adherence was examined using the *Fidelity of INDO-SKIP Assessment (FIA).* The FIA was designed specifically for the *INDO-SKIP* curriculum. The researcher coded six randomly selected videos of lessons from each classroom across 8 weeks (approximately 37% of total lessons) to examine the extent to which they were delivered as intended.

The FIA recorded the length of time for each activity and total lesson time. To address adherence, the FIA was categorized into activity fidelity and instructional fidelity in a checklist section of the FIA Observation Sheet (Appendix G). Activity fidelity examined whether tasks were implemented as designed and whether children practiced the tasks as the teacher explained. Instruction fidelity examine whether teachers implemented a correct instructional approach in teaching, including correct explanation and demonstration. The coding system scored a “0” if the procedural element or core principle was absent, a “1” if it was executed or modified consistent with principle of *INDO-SKIP*, and a “2” if it was executed exactly like what was in the lesson plan. For example, if a teacher was supposed to demonstrate a proficient stage of throwing before an activity, which is wind-up-contralateral step-throw-follow through, a 0 will be coded if the teacher did not conduct the demonstration correctly, or a 1 if he/she modified the demonstration with no wind-up due to children developmental stage in throwing was very delayed, or a 2 if he/she demonstrated as it was in lesson plan. Score 1 and 2 were calculated as the lesson was implemented following the *INDO-SKIP* principles. Total raw score of FIA was between 0-26. Overall fidelity was calculated as a percentage for each lesson and an overall percentage for the class and condition.

Differentiation. To determine the differentiation between the intervention and control group, observations of the control group were conducted. The free playtime in the control schools were observed four times in randomly selected days across the nine weeks of the study. The teachers in the control groups were not notified prior the observation to minimize the influence of the researchers presence. The researcher took field notes on what the children were doing (e.g. playing on swing, slide, sitting and talking) and what the teacher was doing (playing with children, teaching them a game, watching them play).

6. Control Group Condition

The teacher and preschool participants in the control group were enrolled in different early childhood centers than the intervention group to avoid the contamination effects. However, the curriculum and the daily schedule among centers in the control and intervention group was similar.

As a part of the current practice of curriculum in the early childhood education centers, children received 30-minutes of free play activities every day for 5 days per week. The session took place on the outdoor playground under the teacher's supervision. There was no motor skill intervention provided.

Phase III: Post-testing, Data Cleaning, and Data Analysis

1. Post-testing

After the *INDO-SKIP* implementation, all children in both the *INDO-SKIP* experimental and control groups were post tested on motor competence, perceived motor competence, and executive function. The procedures of this testing was the same with the pretesting in Phase 1 of this study. At the end of the post-testing, *INDO-SKIP* teachers and preschoolers received their incentives.

2. Data Cleaning

Prior to data analysis, a data cleaning process was conducted. This process included: a) manually checking for errors in all data columns, b) missing data analysis by using SPSS 22.0 package. (If there is missing data, appropriate missing data imputation was conducted), c) Calculating the descriptive statistics to examine the ranges and frequencies of each variable to ensure that all data were within expected ranges and c) the assumptions for the analysis of multilevel data analysis were checked.

3. Data Analysis

Power consideration. A power analysis was conducted using optimal design (Raudenbush et al., 2011; Spybrook et al., 2011). Having 12 classes, purposively selected and assigned into treatment and control group, this study was powered 80% to demonstrate .60 effect size. Figure 4. reports the optimal design analysis. As this study was a feasibility study and the first study ever in Indonesia, this is a good step to be able to power the study at 80%.

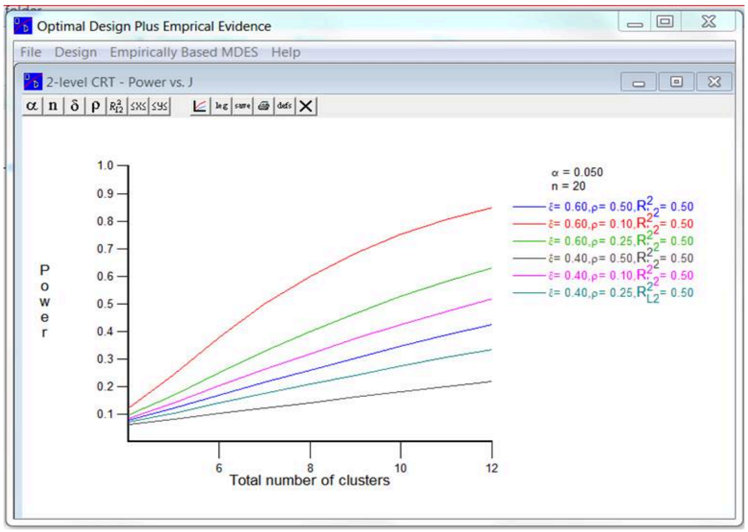


Figure 4. Power analysis using optimal design

Regarding the power of this study and the previous studies of SKIP implemented by experts showed high effect size (η^2= .60-.89; e.g. Goodway & Branta, 2003; Robinson & Goodway, 2009), and the SKIP implemented by teachers also showed an high effect size (η^2= .56-.61; Brian, 2014; Brian, et al., 2016), therefore, the inherent risk built into the design of this study to yield statistical significance was minimized.

Reliability of Measurements. Cronbach's alpha was used to calculate the reliability of measurements on TGMD-2 OC subscale, MABC-2, PPC, PMSC, DN and HTKS assessment. The Cronbach's alpha reliability coefficient indicates the consistency, stability, and precision of test scores (Gall, et. al 2007).

Statistical analysis. Child participants were nested within classrooms during this study and as such statistical analysis should have accounted for the effects of nesting by using a technique like Hierarchical Linear Modeling. However, as this was a feasibility study it was decided to use children as the unit of analysis in an un-nested design. Additional data that drove this decision was the fact that there were considerable similarities among the participants in the classrooms including children and teachers. All teachers who participated in this study were licensed early childhood teachers with a degree in early childhood. Teachers had experience in teaching from 3 to 8 years. All early childhood centers were located in the same area. The *INDO-SKIP* intervention was implemented in the same motor room for all classrooms using the same equipment and lesson plans under coaching of the primary researcher. Teachers also had less variation in fidelity (mean ranged from 67.31% to 81.41%) of teaching the *INDO-SKIP* lesson plans. Therefore, data was analyzed using Multivariate Analysis of Covariance (MANCOVA) analyses to examine the influence of the *INDO-SKIP* intervention on children's motor competence and perceived motor competence. Given that students were nested in the class, Hierarchical Linear Model analysis was conducted only to examine teacher effects in delivering the INDO-SKIP intervention on children's motor competence and perceived motor competence. Kruskal Wallis analyses were run to examine the influence of the *INDO-SKIP* intervention on children's executive function. Raw scores of measurements were used in all analyses. The details of the statistical analysis conducted for each question is explained below.

RQ1: What are the effects of an eight-week *INDO-SKIP* intervention implemented by trained early childhood teachers on preschool children's motor competence and perceived motor competence? There were four hypotheses proposed to answer this question, as following:

H1a. Children would score under the 30th percentile on their motor competence (OC skills and MABC-2) yet perceive themselves "pretty good" on perceived motor competence at the pretest.

Descriptive analyses were conducted to analyze hypothesis H1a.

H1b. There will be gender differences in motor competence (OC and MABC-2), but no gender differences in perceived motor competence at the pretest.

To analyze hypothesis H1b, two one-way MANOVAs by gender (boy, girl) on motor competence (pretest OC raw score and pretest MABC-2 raw score) and perceived motor competence (pretest PPC and pretest PMSC) were conducted.

H1c. Children in the *INDO-SKIP* group would have significantly higher motor competence and perceived motor competence than children in the control group at the posttest when accounting for pretest scores.

Prior to analyzing hypothesis H1c, two one-way MANOVAs by group analyses were conducted on pretest motor competence (OC raw score and MABC-2 raw scores) and pretest perceived motor competence (PPC and PMSC). It was found that there were significant group differences on pretest OC raw scores, pretest PPC and pretest PMSC. Therefore, to examine hypothesis 1c, two, one-way MANCOVAs by Group were conducted to examine the effect of the *INDO-SKIP* intervention on preschoolers posttest motor competence and perceived motor competence with pretest as the covariate. For motor competence, the dependent variables for the MANCOVA were posttest OC raw scores and posttest MABC-2 raw scores, and the covariate was pretest OC raw scores. The same approach was used for perceived motor competence. A MANCOVA analysis was conducted with the dependent variables being posttest PPC and posttest PMSC, and the covariates were pretest PPC and pretest PMSC.

H1d. Pretest, and gender will influence children's improvement in motor competence and perceived motor competence after the 8-week *INDO-SKIP* implementation.

In order to analyze hypothesis H1d, three Hierarchical Linear Models (HLMs) were conducted on OC raw scores, PPC, and PMSC only with the *INDO-SKIP* intervention participants. HLM was not conducted on the MABC-2 raw score as this measure did not show a significant effect of *INDO-SKIP*. Both pretest OC raw scores and gender were entered un-centered in level-1. Three models analyzed by HLM were:

$$OC\ raw\ score_{posttest} = b_0 + b_1(OC\ raw\ score\ pretest) + b_2(gender)$$

$$PPC_{posttest} = b_0 + b_1(PPC\ pretest) + b_2(gender)$$

$$PMC_{posttest} = b_0 + b_1(PMSC\ pretest) + b_2(gender)$$

RQ2: To what extent do teachers implement *INDO-SKIP* with fidelity and how does that influence the effect of the *INDO-SKIP* intervention on children's motor competence and perceived motor competence?

H2: Teacher fidelity in delivering the intervention will significantly influence the outcome of the *INDO-SKIP* intervention with respect to motor competence and perceived motor competence.

In order to examine hypothesis H2, three HLM analyses were conducted on posttest OC raw scores, PPC and PMSC only with the *INDO-SKIP* intervention participants. The average percentage of the teachers' fidelity across all 6 lessons served as predictors in the teacher/class level equation. Since pretest scores and gender were not significantly related to child outcomes on posttest OC raw scores, posttest PPC and posttest PMSC, only the teachers' fidelity was entered into the Model. Three models analyzed by HLM were:

$OC\ raw\ score_{posttest} = b_0 + b_1(teacher's\ fidelity)$

$PPC_{posttest} = b_0 + b_1(teacher's\ fidelity)$

$PMC_{posttest} = b_0 + b_1(teacher's\ fidelity)$

RQ3: What are the effects of the *INDO-SKIP* intervention implemented by early childhood education teachers on children's executive function?

H3a. There will be a significant correlation between measures of executive function and motor competence and perceived motor competence at the pretest.

In order to examine hypothesis H3a, Pearson correlation coefficients were computed to determine the relationship among executive function (Day and Night Task-DN, and Head-Toes-Knee-Shoulder Assessment-HTKS), motor competence (OC raw scores and MABC-2 raw scores), and perceived motor competence (PPC and PMSC) at the pretest.

H3b: Children in the *INDO-SKIP* group will have significantly higher executive function (self-regulation and inhibitory control) than children in the control group at the posttest when accounting for pretest scores.

Since DN and HTKS data violated the normality distribution, non-parametric analyses were conducted to examine hypothesis H3b.

Kruskal Wallis analyses were run to verify whether there were significant differences at the pretest and posttest on executive function (DN, HTKS) between the *INDO-SKIP* group and control group.

Chapter 4. Results

Chapter 4 reports findings of the effect of the *INDO-SKIP* intervention delivered by trained teachers on the motor skills and executive function of preschool children from Indonesia. The results of the teacher's performance from the *INDO-SKIP* workshop will be provided prior to answering the primary intervention research questions of this study. This chapter includes results for three research questions: 1) what are the effects of an eight-week *INDO-SKIP* intervention implemented by trained early childhood teachers on preschool children's motor competence and perceived motor competence. 2) To what extent do teachers implement *INDO-SKIP* with fidelity and how does that influence the effect of the *INDO-SKIP* intervention on children's motor competence and perceived motor competence? 3) What are the effects of the *INDO-SKIP* intervention implemented by early childhood education teachers on children executive function? Descriptive statistics including means, and standard deviations on all variables were examined at the student, teacher and school levels. Multivariate Analysis Covariance (MANCOVA) was conducted to examine the effect of the *INDO-SKIP* intervention on children's motor competence and perceived motor competence. Given that students were nested in the class, Hierarchical Linear Model analysis was also conducted to examine teacher effects in delivering the *INDO-SKIP* intervention.

Data Screening

Data screening was conducted using IBM SPSS version 24. Accuracy of data entry, missing values, and fit between their distributions and the assumptions of multivariate analysis were the focus of this data screening. The Cronbach's alpha coefficient of the TGMD-2 OC subscale was .82, MABC-2 was .64, PPC was .67, PMSC was .84, DN was .92, and HTKS was .88. The variables were examined separately. The minimum and maximum values, means, and standard deviations of each of the variables were inspected for plausibility and were determined to be accurate. Approximately 7% of the total values and 35% of data cases from all variables were missing. The Little's MCAR test and separate variance *t*-test indicated the missing values were randomly missing (χ^2 = 265.64, *df* = 205, *p* = .003).

Teacher Data from the *INDO-SKIP* Workshop

Prior to *INDO-SKIP* intervention, early childhood teachers received a nine-hour initial training on motor development principles and the *INDO-SKIP* program. During this initial training, teachers completed three formative assessments to measure their motor development/physical education knowledge during the initial workshop. Those measurements are: 1) Developmental stages to evaluate whether teachers were able to discriminate each stage of four OC skills (throw, catch, kick, strike). The total range of score was between 0–12 points. 2) Accurate demonstration of all OC skills to measure teachers' ability to demonstrate the proficient performance of each OC skill by using TGMD-2 critical elements. The total possible score was 0-48 points. 3) Teaching a mini-lesson to examine whether teachers were able to teach the skills by using the Fidelity of

INDO-SKIP Assessment (FIA). A total raw score range from 0 to 39 were calculated. This total raw score were changed into a percentage of accurate lesson demonstrated. The results of all three assessments are reported in Table 10.

Table 10. Teacher Motor Development and Physical Education Knowledge

Measurements	Teacher							
	101	102	103	104	105	106	Mean	SD
Developmental stages (0-12)	11	10	10	12	10	10	10.50	0.84
Demonstration accuracy (0-48)	47	40	42	45	38	44	42.67	3.33
Percentage score of Teaching mini lesson (0-100)	76.92	69.23	71.79	79.49	74.36	74.36	74.36	3.63

Descriptive analysis in Table 10 shows that in general teachers had high score on all three assessments. Teachers' score ranged from 10 to 12 out of 12 total points for developmental stages. Teachers demonstrated 38 to 47 out of 48 of the total points in demonstration accuracy. In addition, teachers showed 69.23 to 79.49 % of fidelity in teaching a mini lesson.

Research Questions and Hypotheses

Research Question 1

The first research question in this study was, what are the effects of an eight-week *INDO-SKIP* intervention implemented by trained early childhood teachers on preschool children's motor competence and perceived motor competence? There were four hypotheses proposed to answer this question:

Hypothesis 1a. Children would score under the 30^{th} percentile on their motor competence (OC skills and Movement Assessment Battery for Children-2) yet perceive themselves "pretty good" on perceived motor competence at the pretest.

Hypothesis 1b. There will be gender differences in motor competence (OC and MABC-2), but no gender differences in perceived motor competence (PPC and PMSC).

Hypothesis 1c. Children in the *INDO-SKIP* group would have significantly higher motor competence (OC and MABC-2) and perceived motor competence (PPC and PMSC) than children in the control group at the posttest.

Hypothesis 1d. Pretest, and gender will influence children's improvement in motor competence and perceived motor competence after the 8-week *INDO-SKIP* implementation.

Hypothesis 1a. Children would score under the 30^{th} percentile on their motor competence (OC skills and MABC-2) yet perceive themselves "pretty good" on perceived motor competence in the pretest.

Descriptive analyses of motor competence (OC skills and MABC-2) and perceived motor competence (Perceived Physical Competence-PPC and Perceived Motor Skill Competence-PMSC) were conducted. Analyses were conducted on raw score, standard score and percentile score for OC and MABC-2. Standard scores were calculated based on age and gender of participants for the TGMD-2, and based on age only for MABC-2. Percentile scores were calculated based on the standard scores. Based on the Individuals with Disabilities in Education Improvement Act (IDEA, 2004) guidelines, ranks at or below the 30^{th} percentile indicated developmental delay. The descriptive statistics by group (intervention and control) and gender (boys and girls) were computed and reported in Table 11 and Table 12.

Table 11. Pretest And Posttest Object Control and Movement Assessment Battery for Children-2 Raw Scores, Standard Scores, and Percentiles Across Group by Gender.

Measurement	Gender	*INDO-SKIP* (n=85)		Control (n=71)		Total (N=156)	
		Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
OC Raw Score (0-48)	Boys	15.77 (6.62)	34.00 (6.26)	20.26 (6.39)	22.19 (6.32)	18.02 (6.83)	28.09 (8.63)
	Girls	12.40 (4.37)	28.89 (5.49)	16.48 (4.15)	18.14 (4.88)	14.13 (4.71)	24.68 (7.43)
	Total	13.78 (5.61)	31.01 (6.33)	18.31 (5.64)	20.26 (5.99)	15.85 (6.05)	26.26 (8.16)
OC Standard Score (1-20)	Boys	3.81 (2.26)	9.66 (1.95)	4.97 (2.26)	5.31 (2.13)	4.39 (2.31)	7.48 (2.98)
	Girls	3.98 (1.66)	9.78 (2.14)	4.67 (1.43)	5.10 (2.01)	4.27 (1.59)	7.95 (3.10)
	Total	3.91 (1.91)	9.73 (2.05)	4.81 (1.87)	5.21 (2.06)	4.32 (1.94)	7.73 (3.04)
OC Percentile (1-99)	Boys	5.10 (7.73)	46.59 (22.31)	9.13 (11.47)	10.06 (12.54)	7.11 (9.91)	28.33 (25.72)
	Girls	4.00 (5.28)	47.09 (24.36)	5.21 (4.49)	9.07 (12.64)	4.51 (4.97)	32.19 (27.72)
	Total	4.45 (6.37)	46.88 (23.38)	7.11 (8.76)	9.59 (12.49)	5.66 (7.64)	30.40 (26.78)
MABC-2 Raw Score (1-120+)	Boys	87.77 (22.32)	96.87 (13.19)	84.39 (14.92)	91.14 (11.40)	87.49 (15.42)	94.05 (12.58)
	Girls	91.57 (12.65)	95.60 (17.27)	89.13 (15.71)	95.41 (13.69)	90.56 (13.94)	95.52 (15.82)
	Total	90.04 (17.17)	96.09 (15.73)	86.79 (15.39)	93.38 (12.73)	89.22 (14.63)	94.89 (14.49)
MABC-2 Standard Score (1-19)	Boys	13.23 (4.18)	14.77 (3.40)	11.58 (3.76)	13.28 (3.19)	12.39 (4.03)	14.03 (3.36)
	Girls	13.46 (3.42)	14.62 (4.23)	12.84 (3.99)	14.38 (3.56)	13.21 (3.66)	14.52 (3.95)
	Total	13.37 (3.72)	14.68 (3.90)	12.22 (3.90)	13.85 (3.41)	12.85 (3.83)	14.31 (3.70)
MABC-2 Percentile (1-99.9)	Boys	72.11 (31.67)	84.50 (22.88)	62.73 (32.16)	76.58 (22.19)	67.34 (32.00)	80.61 (22.70)
	Girls	76.39 (24.72)	82.11 (27.80)	69.97 (31.17)	81.33 (22.43)	73.76 (27.54)	81.79 (25.61)
	Total	74.70 (27.55)	83.04 (25.86)	66.40 (31.61)	79.07 (22.26)	70.94 (29.64)	81.29 (24.32)

Ninety seven percent of participants were delayed on their OC skills as reported by the TGMD-2. In contrast, a grand mean of the MABC-2 percentile for the preschoolers was 70.94 (SD = 29.64). On average, children in *INDO-SKIP* group were at the 74.70 percentile and children in control group at the 66.40 percentile for the MABC-2. There were 15.8% of participants delayed on their MABC-2.

Table 12. Pretest and Posttest Perceived Physical Competence and Perceived Motor Skill Competence Across Group by Gender.

Measurement	Gender	*INDO-SKIP* (n=85)		Control (n=71)		Total (N=156)	
		Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
PPC (1-4)	Boys	3.34 (0.53)	3.80 (0.26)	3.56 (0.39)	3.65 (0.35)	3.45 (0.48)	3.72 (0.32)
	Girls	3.23 (0.44)	3.73 (0.32)	3.38 (0.49)	3.69 (0.37)	3.29 (0.46)	3.71 (0.34)
	Total	3.27 (0.48)	3.76 (0.30)	3.47 (0.44)	3.67 (0.36)	3.36 (0.47)	3.72 (0.33)
PMSC (1-4)	Boys	3.37 (0.52)	3.75 (0.28)	3.54 (0.28)	3.55 (0.35)	3.45 (0.42)	3.64 (0.33)
	Girls	3.19 (0.51)	3.67 (0.21)	3.36 (0.45)	3.59 (0.37)	3.25 (0.49)	3.64 (0.29)
	Total	3.26 (0.62)	3.70 (0.24)	3.45 (0.38)	3.57 (0.36)	3.34 (0.47)	3.64 (0.31)

Table 12 shows that participants perceived themselves as “pretty good” on their motor competence, a grand mean for PPC was 3.36 (SD = 0.47) and PMSC was 3.34 (SD = 0.47). Overall, descriptive statistics partially supports hypothesis 1a. The majority of participants were delayed on their OC skills as determined by the TGMD-2, but not delayed on their MABC-2. Furthermore, participants perceived themselves as pretty good at motor skills prior to the intervention.

Hypothesis 1b. There will be gender differences in motor competence (OC skills and MABC-2), but no gender differences in perceived motor competence.

Two one-way MANOVAs were conducted to examine gender differences on motor competence (pretest OC raw scores and pretest MABC-2 raw scores), and on perceived motor competence (Pre-PPC and Pre-PMSC). A one-way MANOVA on motor competence showed there was significant gender difference on motor competence ($F_{[2,131]} = 8.93$, $p<.001$, $\eta^2=.12$).

Table 13. Univariate Analysis for Pretest Motor Competence by Gender.

Source	DV	Sum of Squares	df	Mean Square	F	Sig.	η^2
Gender	OC Raw	510.66	1	510.66	15.49	<.001	.10
	MABC-2 Raw	513.12	1	513.12	1.89	.17	.01
Error	OC Raw	4351.07	132	32.96			
	MABC-2 Raw	35853.12	132	271.62			
Total	OC Raw	39358.00	134				
	MABC-2 Raw	1083588.00	134				

Note. DV= dependent variable, OC= Object control, MABC-2= Movement Assessment Battery for Children-2.

Follow-up univariate analysis (Table 13) showed that there were significant gender differences in pretest OC raw scores ($F_{[1,132]} = 15.49$, $p<.001$, $\eta^2=.10$), where boys (M= 18.12, SD = 6.80) performed better on OC skills than girls (M = 14.13, SD = 4.71). However, there was not a significant gender difference in pretest MABC-2 raw scores (p = .17). The mean score of the MABC-2 for boys was 87.49 (SD = 15.42) and for girls was 90.56 (SD = 13.94).

A one-way MANOVA on perceived motor competence showed there was significant gender difference on perceived motor competence ($F_{[2,137]} = 3.33$, $p=.04$, $\eta^2=.05$).

Table 14. Univariate Analysis for Pretest Perceived Motor Competence by Gender.

Source	DV	Sum of Squares	df	Mean Square	F	Sig.	η^2
Gender	PPC	0.93	1	0.93	4.22	.04	.03
	PMSC	1.35	1	1.35	6.27	.01	.04
Error	PPC	30.26	138	0.22			
	PMSC	29.62	138	0.21			
Total	PPC	1610.39	140				
	PMSC	1593.39	140				

Note. PPC= Perceived Physical Competence, PMSC= Perceived Motor Skill Competence.

Follow-up univariate analysis (Table 14) revealed that there were statistically significant gender difference on pretest PPC ($F_{[1,138]} = 4.22$, p=.04, η^2=.03), in which boys had higher scores (M = 3.45, SD = 0.47) than girls (M = 3.29, SD = 0.46). In addition, there was also a significant gender difference in PMSC ($F_{[1,138]} = 6.27$, p = .03, η^2 = .04), in which boys (M = 3.45, SD = 0.42) had higher scores for their PMSC than girls (M = 3.25, SD = 0.49). In spite of the statistically significant differences between boys and girls in perceived motor competence, one must exert caution in terms of a meaningful difference. The gender differences in PPC and PMSC may not be a meaningful difference because boys and girls both fell into the category where they perceived themselves as “pretty good” on their motor competence.

Overall, it was found that boys outperformed girls on OC and perceived motor competence (both PPC and PMSC), but there were no gender differences in motor competence measured by the MABC-2.

Hypothesis 1c. Children in the *INDO-SKIP* group would have significantly higher motor competence and perceived motor competence than children in the control group at the posttest.

Prior to conducting the analysis to answer hypothesis 1c, two one-way MANOVAs were run by group to verify whether there were significant differences on pretest motor competence and perceived motor competence between the intervention and control group. A MANOVA analyses on motor competence showed that there was significant group difference on pretest motor competence ($F_{[2,131]} = 11.50$, $p < .001$, $\eta^2 = .15$). Subsequent univariate analyses showed that there was a significant group difference on pretest OC raw scores ($F_{[1,133]} = 21.70$, $p < .001$, $\eta^2 = .14$), but there was no significant group difference on pretest MABC-2 raw score (, $p = .14$). A MANOVA analysis on perceived motor competence revealed that there was a significant group difference on pretest perceived motor competence ($F_{[2,137]} = 3.90$, $p = .02$, $\eta^2 = .05$). Subsequent univariate analyses showed that there was a significant group difference on pretest PPC ($F_{[1,138]} = 6.57$, $p = .01$, $\eta^2 = .04$) and PMSC ($F_{[1,138]} = 6.04$, $p = .01$, $\eta^2 = .04$). Therefore, in order to examine hypothesis 1c, two, one-way MANCOVAs by Group were conducted to examine the effect of the *INDO-SKIP* intervention on preschoolers motor competence and perceived motor competence from pretest to posttest. The dependent variables for the MANCOVA were posttest OC raw scores and posttest MABC-2 raw scores, and the covariate was pretest OC raw scores. The same approach was used for perceived motor competence. A MANCOVA analysis was conducted with the dependent variables being posttest PPC and posttest PMSC, and the covariates were pretest PPC and pretest PMSC. Prior to conducting the analyses, assumptions for MANCOVA were examined.

MANCOVA Assumptions.

Normality of dependent variable distribution analyses showed that skewness and kurtosis statistics for all variables were between the range of -2 and 2, except for the kurtosis of the posttest PPC for the intervention group was 3.84. Shapiro-Wilk tests for all variables were significant, except for the posttest of the MABC-2 of the control group. However, the Q-Q plots and histograms of each dependent variable by group suggested that normality was a reasonable assumption. The overall assumption of normality was satisfied since univariate F is robust to modest violations of normality as long as the violations are not due to outliers (Tabachnick & Fidell, 2013). With regards to **homogeneity of variance and covariance**, the Box's test yielded a non-significant result for motor competence (p = .97) but a significant result for perceived motor competence (p = .00). Therefore, the Wilks' Lambda test was used for motor competence and Pillai's Trace for perceived motor competence. Levene's tests for the dependent variables were also not significant for all dependent variables. Therefore, the assumptions of homogeneity of variance and covariance were satisfied. **Linearity** of the dependent variables with covariates was examined with scatterplots. Overall, the scatterplot of the dependent variables with the covariates suggested a positive linear relationship. **Homogeneity of regression slopes** was suggested by similar regression lines evidenced in the scatterplots of the dependent variables and covariate by group. This assumption was confirmed by a non-statistically significant interaction of covariates by group (p=.32 for motor competence and p=.05 for perceived motor competence). MANCOVA analyses were conducted using the original data with the listwise deletion approach for cases that had missing values.

Correlation. Prior to conducting the MANCOVA, a bivariate correlation analysis among the dependent variables and the covariate was employed to determine if there was multicollinearity among the variables. Multicollinearity occurs when variables are highly (*r* = .90 and higher) correlated (Tabachnick & Fidell's, 2013). Correlation analysis showed a reasonable correlation between dependent variables and covariates, which was less than .80. The bivariate correlation matrix is presented in Table 15.

Table 15. Bivariate Correlations Among Dependent Variable and Covariates

	OC1	OC2	MABC1	MABC2	PPC1	PPC2	PMSC1	PMSC2
OC1	1	.08	.01	.11	.05	.10	.23**	0.08
OC2	-	1	.17	.23**	-.09	.26**	-.01	.28**
MABCT1	-	-	1	.42**	.24**	.20*	0.13	0.10
MABCT2	-	-	-	1	.04	.26**	0.13	.18*
PPC1	-	-	-	-	1	.37**	.62**	.22*
PPC2	-	-	-	-	-	1	.36**	.74**
PMSC1	-	-	-	-	-	-	1	.33**
PMSC2	-	-	-	-	-	-	-	1

Notes. OC1= pretest Object control raw scores, OC2= posttest Object control raw scores, MABC1= pretest Movement Assessment Battery for Children-2 raw scores, MABC2= posttest Movement Assessment Battery for Children-2 raw scores, PPC1= pretest Physical Perceived Competence, PPC2= posttest Physical Perceived Competence, PMSC1= pretest Perceived Motor Skill Competence, PMSC2= posttest Perceived Motor Skill Competence. *p <.05, **p<.01.

Influence of the *INDO-SKIP* Intervention on Motor Competence

Research question 1 investigated the effects of an eight-week *INDO-SKIP* intervention implemented by trained early childhood teachers on preschool children's motor competence looking at both OC raw scores and MABC2 raw scores. Table 16 demonstrates the results of the MANCOVA analysis for motor competence using Wilk's Lambda criterion.

Table 16. MANCOVA of Posttest Object Control Raw Scores and Movement Assessment Battery for Children -2 Raw Scores by Group.

Effect	Value	*F*	Hypothesis df	Error df	Sig.	Partial η^2	Cohen's *d*	Observed Power
Intercept	.01	3817.07	2.00	109.00	<.001	.99	19.90	1.00
OC1	.98	1.22	2.00	109.00	.30	.02	0.29	.26
Group	.45	67.02	2.00	109.00	<.001	.55	2.21	1.00

Notes. OC1= pretest Object control raw scores.

The results of the MANCOVA suggested a non-significant effect of covariates, pretest OC raw scores, on participants posttest OC raw scores and MABC-2 raw scores (p =.30). This indicates that the pretest OC raw scores is not significantly correlated with the set of motor competence measures at the posttest. More importantly, after controlling for the effect of pretest OC raw scores, there was a statistically significant effect of the *INDO-SKIP* intervention on participants motor competence ($F_{[2,109]} = 67.02$; p <.001), with a large effect size ($\eta^2_{group} = .55$, Cohens' $d = 2.21$). The effect size identifies that 55% of the variance in posttest motor competence (posttest OC raw scores and MABC-2 raw scores) can be accounted for by the *INDO-SKIP* intervention when controlling for pretest OC raw scores. Post hoc analysis of covariance (ANCOVA) was performed to isolate relationships between each dependent variable, the covariate, and the grouping variable by using the Bonferroni correction. The Bonferroni adjustment of an alpha level of .05 yielded an alpha level of .025. The results of this analysis can be seen in Table 17.

Table 17. Test of Between-Subjects Effects on Pretest Object Control Raw Scores, Posttest Object Control Raw Scores, Posttest Movement Assessment Battery for Children-2 Raw Scores, and Group.

Source	Dependent Variable	df	Mean Square	*F*	Sig.	Partial η^2	Cohen's *d*	Observed Power
Pretest OC Raw Scores	Posttest OC Raw Scores	1	63.28	2.06	.15	.02	0.28	.29
	Posttest MABC-2 Raw Scores	1	111.11	.61	.44	.01	0.20	.12
Group	Posttest OC Raw Scores	1	4141.85	134.85	<.001	.55	2.21	1.00
	Posttest MABC-2 Raw Scores	1	621.62	3.42	.07	.03	0.35	.45
Error	Posttest OC Raw Scores	110	30.71					
	Posttest MABC-2 Raw Scores	110	181.56					

Note. OC= Object control, MABC-2= Movement Assessment Battery for Children-2. The alpha level was adjusted using the Bonferroni correction, α = .025.

Post hoc ANCOVA showed that there were significant differences in posttest OC raw scores ($F_{[1.110]} = 134.85$; $p < .001$) when accounting for pretest scores. There was a large effect size ($\eta^2 = .55$, Cohens'*d* = 2.21). Participants in the *INDO-SKIP* group performed better on OC skills at the posttest (M_{Posttest} $\text{OC}_{\text{raw scores}} = 31.01$; $SD = 6.33$) than participants in control group (M_{Posttest} $\text{OC}_{\text{raw scores}} = 20.26$; $SD = 5.99$) when controlling for pretest scores. In order to portray the improvements of the *INDO-SKIP* group in OC skills, Figure 4.1 shows the OC percentiles of participants in the *INDO-SKIP* group compared to participants in the control group from pretest to posttest.

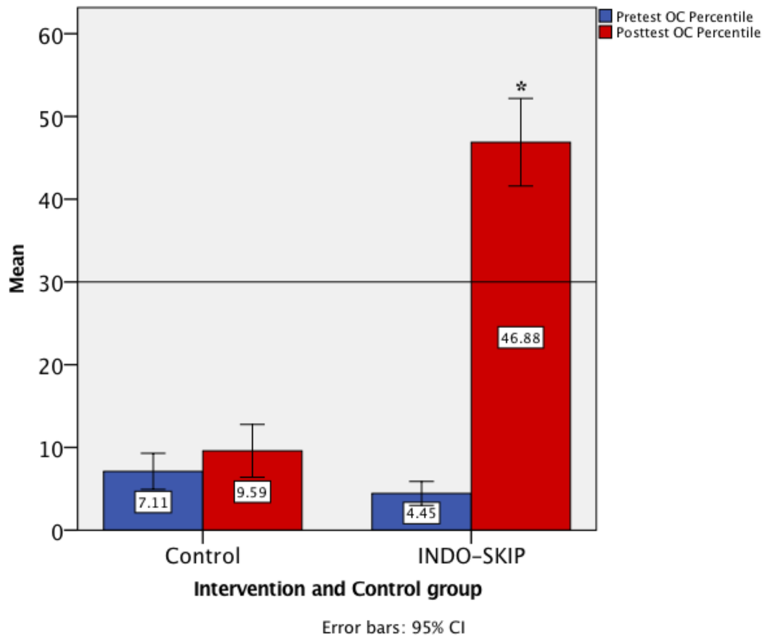


Figure 5. Group mean Object control percentile pre- and posttest. The line below the 30th percentile represents developmental delay.

As reported above, Figure 5 shows that on average, participants in both the *INDO-SKIP* and control groups were delayed in their OC skills (OC was under 30th percentile). After an 8-week *INDO-SKIP* intervention, on average participants improved their OC competence from the 4th percentile to 47th percentile. However, the control group did not show significant improvement on participants OC percentiles from pre-to posttest. The control group went from the 7th percentile to the 9th percentile.

A second post hoc ANCOVA showed that there were no significant differences in posttest MABC2 raw scores (p = .07) when accounting for pretest scores. Figure 6 shows the MABC-2 percentile of participants in the *INDO-SKIP* and the control groups from pretest to posttest.

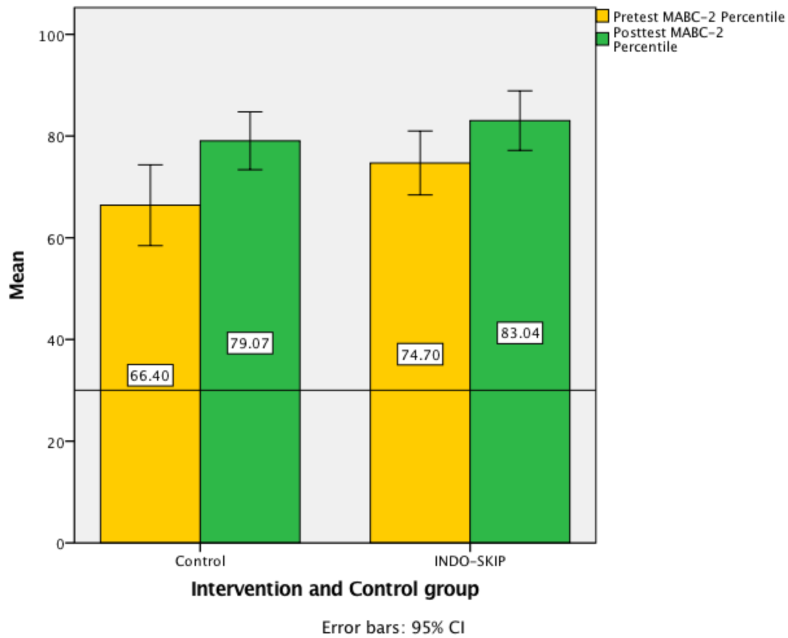


Figure 6. Group mean MABC-2 percentile pre- and posttest. The line under the 30th percentile represents developmentally delayed

As reported above, when examining the MABC-2 scores the participants in both the *INDO-SKIP* and control groups on average were not delayed (MABC-2 greater than 30th percentile). After an 8-week *INDO-SKIP* intervention there was a non-significant change in the participants' MABC-2 in both groups.

Influence of the *INDO-SKIP* Intervention on Perceived Motor Competence

Research question 1 also investigated the effects of an eight-week *INDO-SKIP* intervention implemented by trained early childhood teachers on preschool children's perceived motor competence looking at both Perceived Physical Competence (PPC) and Perceived Motor Skill Competence (PMSC). A MANCOVA analysis was conducted to calculate the mean difference on posttest PPC and posttest PMSC when accounting for pretest PPC and pretest PMSC. The result of this analysis is reported in Table 18.

Table 18. MANCOVA of Posttest Perceived Physical Competence and Posttest Perceived Motor Skill Competence by Group.

Effect	Value	*F*	Hypothesis df	Error df	Sig.	Partial η^2	Cohens' *d*	Observed Power
Intercept	.99	12950.24	2.00	121.00	.000	.99	19.90	1.00
Pretest PPC	.15	10.50	2.00	121.00	.000	.15	.84	.99
Pretest PMSC	.07	4.66	2.00	121.00	.01	.07	.55	.78
Group	.11	7.37	2.00	121.00	.00	.11	.70	.94

The Pillai's Trace criterion was used for perceived motor competence as the data of PPC and PMSC violated the homogeneity of variance and covariance assumptions. The results of the MANCOVA suggested a significant effect of covariates, pretest PPC ($F_{[2,121]} = 10.50$; $p < .001$; $\eta^2 = .15$) and pretest PMSC ($F_{[2,121]} = 4.66$; $p = .01$; $\eta^2 = .07$) on participants posttest perceived motor competence (posttest PPC and posttest PMC). This indicates that the pretest PPC and pretest PMSC are significantly correlated with a set of perceived motor competence measures (posttest PPC and posttest PMSC) at the posttest. More importantly, after controlling for the effect of pretest PPC and pretest PMSC, there was a statistically significant effect of the *INDO-SKIP* intervention on participants perceived motor competence ($F_{[2,121]} = 7.37$; $p = .00$), with a small effect size ($\eta^2_{group} = .11$, Cohens'$d = .70$). The effect size suggests that about 11% of the variance in posttest perceived motor competence can be accounted for by the *INDO-SKIP* intervention when controlling for pretest PPC and pretest PMSC scores. Following this analysis post hoc ANCOVA were conducted using a Bonferroni alpha level of .025 (reported in Table 19).

Table 19. Test of Between-Subjects Effects on Pretest Perceived Physical Competence, Pretest Perceived Motor Skill Competence, Posttest Perceived Physical Competence, Posttest Perceived Motor Skill Competence, and Group.

Source	Dependent Variable	df	Mean Square	*F*	Sig.	Partial η^2	Cohens' *d*	Observed Power
Pretest PPC	Posttest PPC	1	1.63	20.68	<.001	.15	0.84	.99
	Posttest PMSC	1	0.55	7.36	.01	.06	0.50	.77
Pretest PMSC	Posttest PPC	1	0.39	4.98	.03	.04	0.41	.60
	Posttest PMSC	1	0.70	9.39	.00	.07	0.55	.86
Group	Posttest PPC	1	0.93	11.81	.00	.08	0.59	.93
	Posttest PMSC	1	1.01	13.41	<.001	.10	0.67	.95
Error	Posttest PPC	122	0.08					
	Posttest PMSC	122	0.07					

Note. PPC= Perceived Physical Competence, PMSC= Perceived Motor Skill Competence. The alpha level was adjusted using the Bonferroni correction, $\alpha = .025$.

The post hoc ANCOVA revealed that pretest PPC had a significant effect on posttest PPC ($F_{[1,122]} = 20.68$; $p < .001$; $\eta^2 = .15$; Cohens'$d = 0.84$) and posttest PMSC ($F_{[1,122]} = 7.36$; $p = .01$; $\eta^2 = .06$; Cohens'$d = 0.50$). Pretest PMSC also had a significant effect on posttest PMSC ($F_{[1,122]} = 9.39$; $p = .00$; $\eta^2 = .07$; Cohens'$d = 0.55$), but had no significant effect on posttest PPC ($p = .03$). These results indicate that posttest PPC was related only to pretest scores of PPC. However, posttest PMSC was related to pretest scores of both PPC and PMSC with a small effect size. Moreover, the *INDO-SKIP* intervention had a significant effect on posttest PPC ($F_{[1,122]} = 11.81$; $p = .00$; $\eta^2 = .08$; Cohens'$d = 0.59$) and on posttest PMSC ($F_{[1,122]} = 13.41$; $p < .001$; $\eta^2 = .10$; Cohens'$d =$ 0.67). Participants in the *INDO-SKIP* group had higher posttest PPC (M_{Posttest} PPC = 3.76; *SD* = .30) than participants in the control group (M_{Posttest} PPC = 3.67; *SD* = .36) when accounting for pretest scores. Also, participants in *INDO-SKIP* group had higher posttest PMSC (M_{Posttest} PMSC = 3.7; *SD* = .24) than participants in control group (M_{Posttest} PMSC = 3.57; *SD* = .36) when accounting for pretest scores.

Figure 7 shows that participants in both the *INDO-SKIP* and control group perceived themselves as “pretty good” at the pretest for PPC. At the posttest children in both the *INDO-SKIP* and control groups perceived themselves close to “really good”.

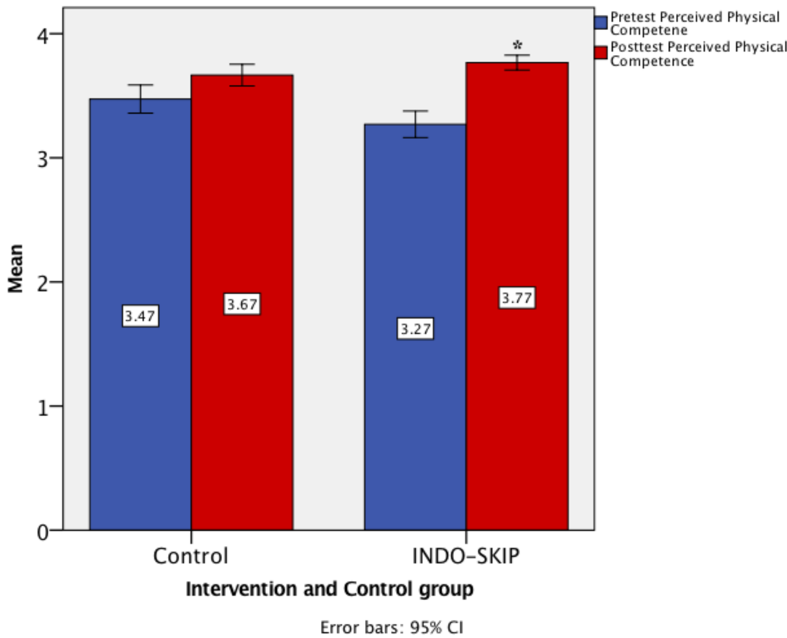


Figure 7. Group mean Perceived Physical Competence scores at the pretest and posttest.

Figure 8 shows that participants in both the *INDO-SKIP* and control groups perceived themselves as “pretty good” at the pretest in PMSC. However, at the posttest children in the *INDO-SKIP* group perceived themselves close to “really good”, while children in the control group still perceived themselves as “pretty good”.

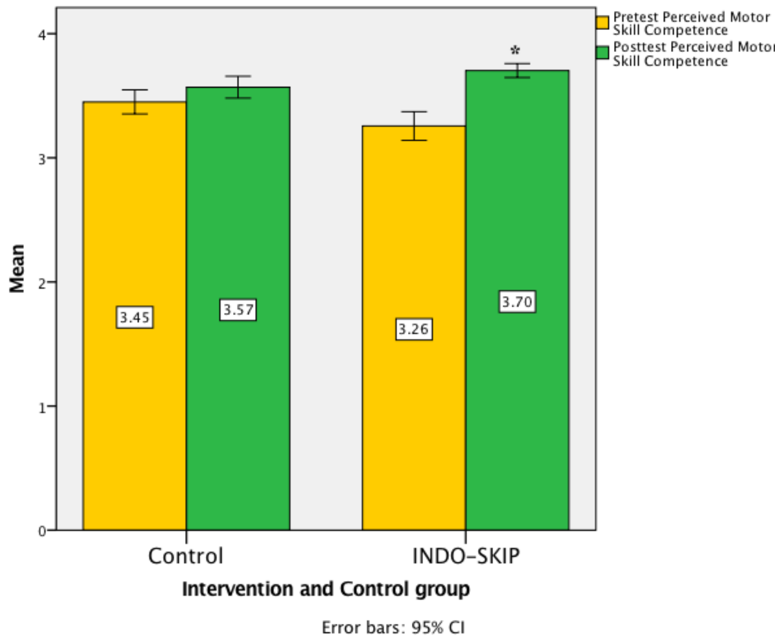


Figure 8. Group mean Perceived Motor Skill Competence scores at the pretest and posttest.

Summary of the influence of *INDO-SKIP* on motor competence and perceived motor competence. Overall, these data support hypothesis 1c, in which an eight-week *INDO-SKIP* intervention significantly influenced on preschoolers' posttest OC skills (when accounting for pretest scores) with a large effect size. The *INDO-SKIP* intervention also had a significant effect on preschoolers' posttest PPC and PMSC (when accounting for pretest scores), but the effect size was small. However, the *INDO-SKIP* intervention did not significantly influence preschoolers' MABC-2 scores.

Hypothesis 1d. Given the significant effect of the *INDO-SKIP* intervention on OC raw scores, PPC and PMSC, it was important to determine if pretest, and gender would influence children's improvement in motor competence and perceived motor competence after the 8-week *INDO-SKIP* implementation.

In order to determine if pretest and gender would influence the outcome of the *INDO-SKIP* intervention, three Hierarchical Linear Models (HLMs) were conducted on OC raw scores, PPC, and PMSC only with the *INDO-SKIP* intervention participants. HLM was not conducted on the MABC-2 as this measure did not show a significant effect of *INDO-SKIP*. Prior to the analysis, missing data were imputed by using the expectation maximization (EM) method. HLM analyses were performed with ten multiple imputation data. Pretest scores and gender were entered as predictors at the student level (level-1) of the HLM analyses.

Pretest object control raw scores, and gender on posttest object control raw scores

Step 1: Estimate the Unconditional Model for object control (OC) Raw Scores

The result of the unconditional model for posttest OC raw scores is presented in Table 20.

Table 20. Fixed Effects (Top) and Variance-Covariance Estimates (Bottom) for the Unconditional Model for Posttest Object Control Raw Scores.

Fixed Effects	Coefficient (*SE*)	t(df)	Sig.	Reliability
Model for intercept, mean posttest OC(β_0)				.65
Intercept (γ_{00})	30.86 (1.15)	26.79 (5)	<.001	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	5.13	5	14.86 (p=.01)
Children level variance (σ^2)	36.69		

Note. OC= Object control

One-way random effects ANOVA models showed that across all 6 classes in the *INDO-SKIP* group, the average posttest OC raw scores were statistically different from zero (γ_{00} = 30.86, t = 26.79, p <.001). There was significant variability in the teacher/class means (τ_{oo} = 5.13, p = .01), in which 12.3% of the total variability in posttest OC raw scores could be attributed to the teachers (*ICC* = .123), and the other 87.7% of the total variability was within the preschoolers.

Step 2: Estimate the Conditional Model for detecting pretest OC raw scores and gender effects on posttest OC raw scores

In this step, pretest OC raw scores and gender were included as a predictor in the model. Both variables were entered un-centered. Table 21 shows the results of this model.

Table 21. Fixed Effects (Top) and Variance-Covariance Estimates (Bottom) for the Conditional Model for Detecting Pretest Object Control Raw Scores and Gender for Posttest Object Control Raw Scores.

Fixed Effects	Coefficient (SE)	t(df)	Sig.	Reliability
Model for intercept, mean posttest OC raw scores (β_0)				.70
Intercept (γ_{00})	26.79 (4.22)	6.34 (5)	.00	
Model for girl slope (β_1)				.65
Intercept (γ_{10})	-3.29 (2.07)	-1.59 (5)	.17	
Model for pretest OC raw score slope (β_2)				.48
Intercept (γ_{20})	.42 (0.18)	2.29 (5)	.07	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	77.36	5	23.81 (p<.001)
Variance in girl slope (τ_{11})	17.02	5	15.66 (p=.01)
Variance in pretest OC raw score slope (τ_{22})	0.10	5	8.86 (p=.11)
Children level variance (σ^2)	22.38		

Note. OC= Object control

HLM analysis including pretest OC raw scores and gender showed that the overall mean posttest OC raw scores across all teachers was statistically different from zero (γ_{00} = 26.79, *p* = .00). On average across teachers/classes, preschoolers' gender (girl) was not significantly related to posttest OC raw scores (*p* = .17). Preschoolers' pretest OC raw scores was also not significantly (*p* = .07) related to posttest OC raw scores of preschoolers.

Overall, HLM analyses showed that pretest OC raw scores and gender did not influence children improvement in motor competence and perceived motor competence after *INDO-SKIP* intervention.

Pretest Perceived Physical Competence and gender on posttest Perceived Physical Competence scores

Step 1: Estimate the Unconditional Model for Perceived Physical Competence (PPC)

The result of the unconditional model for posttest PPC scores is presented in Table 22.

Table 22. Fixed Effects (Top) and Variance-Covariance Estimates (Bottom) for the Unconditional Model for Posttest Perceived Physical Competence Scores.

Fixed Effects	Coefficient (SE)	t(df)	Sig.	Reliability
Model for intercept, mean posttest PPC (β_0)				.49
Intercept (γ_{00})	3.75 (.04)	81.60 (5)	<.001	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	.006	5	10.06 (p=.07)
Children level variance (σ^2)	.08		

Note. PPC= Perceived Physical Competence

One-way random effects ANOVA models showed that across all 6 teachers/classes in the *INDO-SKIP* group, the average posttest PPC was statistically different from zero (γ_{00} = 3.75, t = 81.60, p =<.001). However, variability in the teacher/class means was not significant (τ_{oo} = .006, p = .07), in which 7.5% of the total variability in posttest PPC can be attributed to the teachers (*ICC* = .075), and another 92.5% of the total variability was within preschoolers.

Step 2: Estimate the Conditional Model for detecting pretest PPC and gender effects on posttest PPC

In this step, pretest PPC scores and gender were included as predictors in the model. Both variables were entered un-centered. HLM analysis including pretest PPC score and gender showed that the overall mean posttest PPC scores across all teachers was statistically different from zero (γ_{00} = 3.28, *p* <.001). On average across teachers/classes, preschoolers' gender (girl) was not significantly related to posttest PPC score (*p* = .58). Preschoolers' pretest PPC scores was also not significantly (*p* = .20) related to participants posttest PPC. Table 23 shows the results of this model.

Table 23. Fixed Effects (Top) and Variance-Covariance Estimates (Bottom) for the Conditional Model for Detecting Pretest Perceived Physical Competence and Gender for Posttest Perceived Physical Competence.

Fixed Effects	Coefficient (SE)	t(df)	Sig.	Reliability
Model for intercept, mean posttest PPC (β_0)				.58
Intercept (γ_{00})	3.28 (.33)	8.99 (5)	<.001	
Model for girl slope (β_1)				.26
Intercept (γ_{10})	-0.04 (.07)	-.59 (5)	.58	
Model for pretest PPC slope (β_2)				.55
Intercept (γ_{20})	.15 (0.10)	1.49 (5)	.20	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	.48	5	14.09(p=.02)
Variance in girl slope (τ_{11})	.01	5	8.16 (p=.15)
Variance in pretest PPC slope (τ_{22})	.03	5	13.16 (p=.02)
Children level variance (σ^2)	.07		

Note. PPC= Perceived Physical Competence

In summary, HLM analyses showed that pretest PPC and gender did not influence children improvement in PPC scores after *INDO-SKIP* intervention

Pretest Perceived Motor Skill Competence and gender on posttest Perceived Motor Skill Competence scores

Step 1: Estimate the Unconditional Model for Perceived Motor Skill Competence (PMSC)

The result of the unconditional model for posttest PMSC scores is presented in Table 24.

Table 24. Fixed Effects (Top) and Variance-Covariance Estimates (Bottom) for the Unconditional Model for Posttest Perceived Motor Skill Competence Scores.

Fixed Effects	Coefficient (SE)	t(df)	Sig.	Reliability
Model for intercept, mean posttest PMSC (β_0)				.39
Intercept (γ_{00})	3.70 (.04)	94.57 (5)	<.001	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	.003	5	8.84 (p=.11)
Children level variance (σ^2)	.06		

Note. PMSC= Perceived Motor Skill Competence.

The HLM showed that across all 6 teachers/classes in the *INDO-SKIP* group, the average posttest PMSC was statistically different from zero (γ_{00} = 3.70, t = 94.57, p <.001). However, variability in the teacher/class means was not significant (τ_{oo} = .003, p = .11), in which 5% of the total variability in posttest PMSC can be attributed to the teachers (*ICC* = .05), and another 95% of the total variability was within preschoolers.

Step 2: Estimate the Conditional Model for detecting pretest PMSC and gender effects on posttest PMSC

In this step, pretest PMSC scores and gender were included as predictors in the model. Both variables were entered un-centered. HLM analysis including pretest PMSC score and gender showed that the overall mean posttest PMSC scores across all teachers/classes was statistically different from zero (γ_{00} = 3.46, p = <.001). On average across teachers/classes, preschoolers' gender (girl) was not significantly related to posttest PPC score (p = .48). Preschoolers' pretest PMSC scores were also not significantly (p = .34) related to participants' posttest PMSC scores. Table 25 shows the results of this model.

Table 25. Fixed Effects (Top) and Variance-Covariance Estimates (Bottom) for the Conditional Model for Detecting Pretest Perceived Motor Skill Competence and Gender for Posttest Perceived Motor Skill Competence.

Fixed Effects	Coefficient (SE)	t(df)	Sig.	Reliability
Model for intercept, mean posttest PMSC (β_0)				.42
Intercept (γ_{00})	3.46 (.26)	13.34 (5)	<.001	
Model for girl slope (β_1)				.39
Intercept (γ_{10})	-0.05 (.07)	-.76 (5)	.48	
Model for pretest PMSC slope (β_2)				.45
Intercept (γ_{20})	.08 (0.07)	1.06 (5)	.34	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	.16	5	7.62 (p=.17)
Variance in girl slope (τ_{11})	.01	5	7.06 (p=.21)
Variance in pretest PMSC slope (τ_{22})	.01	5	8.29 (p=.14)
Children level variance (σ^2)	.05		

Note. PMSC= Perceived Motor Skill Competence

Overall, similar with PPC, HLM analyses also showed that pretest PMSC and gender also did not influence the increasing of PMSC scores of children after *INDO-SKIP* intervention.

Research Question 2

The second research question was to examine to what extent do teachers implement *INDO-SKIP* with fidelity and how that influences the effect of the *INDO-SKIP* intervention on children's motor competence and perceived motor competence?

Descriptive analysis and HLM analyses were conducted to address research question 2. Teachers in the *INDO-SKIP* group delivered 16 lessons across eight weeks of the intervention. The fidelity of *INDO-SKIP* Assessment (FIA) was conducted on six lesson plans (37.5% of total lesson plans) for each teacher. Assessments were conducted on two lesson plans from the early phase (lesson 2 and lesson 3), mid phase (lesson 8 and lesson 9), and end phase (lesson 14 and lesson 15) of the intervention. Fidelity was calculated as a percentage of total possible fidelity points. In each lesson plan, the total possible point of the FIA was 26 points. The percentage of fidelity in each lesson and the average of total percentage across six lessons are presented in Table 26.

Table 26. Fidelity Percentage by Lesson by Teachers.

Lesson	Teachers							
	101	102	103	104	105	106	Mean	SD
Lesson 2	57.69	23.08	50.00	50.00	42.31	57.69	46.80	12.97
Lesson 3	76.92	69.23	69.23	84.62	73.08	73.08	74.36	5.79
Lesson 8	73.08	61.54	73.08	76.92	84.62	73.08	73.72	7.47
Lesson 9	88.46	84.62	80.77	88.46	96.15	88.46	87.82	5.11
Lesson 14	92.31	88.46	92.31	84.62	92.31	84.62	89.11	3.78
Lesson 15	96.15	76.92	92.31	92.31	100.00	88.46	91.03	7.95
Mean	80.77	67.31	76.28	79.49	81.41	77.56	77.14	
SD	14.39	23.80	16.03	15.32	21.40	12.02		

The fidelity assessment showed that the grand mean of teachers' fidelity in delivering the *INDO-SKIP* intervention for 8 weeks was 77.14%. Teachers had lower fidelity in delivering the *INDO-SKIP* intervention in the early phase of intervention (M_{Lesson2} = 46.80%, SD = 12.97). Then, overall the teachers gradually improved their fidelity (M_{Lesson15} = 91.03% SD = 7.95) across the remaining lesson plans. On average, each teacher delivered the *INDO-SKIP* intervention with pretty high fidelity, which was 67% to 81% of fidelity over eight week of the intervention. This indicated that teachers followed the lesson plans with 67% to 81% correct.

Three HLM analyses were conducted on OC raw scores, PPC and PMSC in order to examine the influence of teachers' fidelity on the effect of the *INDO-SKIP* intervention on children's motor competence and perceived motor competence. The average percentage of the teachers' fidelity across all 6 lessons served as predictors in the teacher/class level equation. When teacher fidelity is referred to below in the HLM analysis, the data being used is the average percentage of correct lesson elements across the six lessons evaluated using the Fidelity of *INDO-SKIP* instrument. There was no hypothesis proposed for these analyses due to the limited literature evidence to support the hypothesis.

Teacher fidelity and its' effect on posttest object control raw scores.

Since pretest OC raw scores and gender were not significantly related to posttest OC raw scores, only the teachers' fidelity was entered into the Model. The effect of the teachers' fidelity on posttest OC raw scores is shown in Table 27.

Table 27. Fixed Effects (Top) and Variance-Covariance Estimates (Bottom) for the Conditional Model for Detecting Teacher Fidelity on Posttest Object Control Raw Scores.

Fixed Effects	Coefficient (SE)	t(df)	Sig.	Reliability
Model for intercept, mean posttest OC raw scores (β_0)				.56
Intercept (γ_{00})	7.50 (17.03)	.44 (4)	.68	
Teacher Fidelity (γ_{01})	0.30 (.22)	1.37 (4)	.24	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	3.94	4	9.97 (p=.04)
Children level variance (σ^2)	36.70		

Note. OC= Object control

Based on the chi square test, there was significant variability at the teacher level (τ_{oo} = 3.94, χ^2 = 9.97, p =.04). However, teacher fidelity scores were not significantly related to posttest OC raw scores (p =.24).

Teacher fidelity and its' effect on posttest Perceived Physical Competence scores.

Since pretest PPC scores and gender were not significantly related to posttest PPC scores, in this step, both variables were not included. Teacher's fidelity was entered at level-2 of the HLM analysis. Table 28 shows the results of this model.

Table 28. Fixed Effects (Top) aand Variance-Covariance Estimates (Bottom) for Conditional Model for Detecting Teacher Fidelity on Posttest Perceived Physical Competence Scores.

Fixed Effects	Coefficient (SE)	t(df)	Sig.	Reliability
Model for intercept, mean posttest PPC (β_0)				.57
Intercept (γ_{00})	3.46 (.80)	4.33 (4)	.01	
Teacher Fidelity (γ_{01})	0.00 (.01)	.37(4)	.73	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	.00	4	9.70 (p=.04)
Children level variance (σ^2)	.08		

Note. PPC= Perceived Physical Competence

The results showed that based on the chi square test, there was significant variability at the teacher level (τ_{oo} = .00, χ^2 = 9.70, p=.04). However, teachers' fidelity was not significantly related to posttest PPC scores (p=.67).

Teacher fidelity and its' effect on Perceived Motor Skill Competence scores

Similar with PPC, teacher's fidelity was entered at level 2 of the model. Pretest PMSC scores and gender were not entered into the model because both variables were not significantly related to posttest PMSC. The results showed that based on the chi square test, there was not significant variability at the teachers' level (τ_{oo} = .00, χ^2 = 8.77, *p* =.06). Teachers' fidelity was also not significantly (*p* =.88) related to posttest PMSC scores. Table 29 shows the results of this model.

Table 29. Fixed effects (top) and variance-covariance estimates (bottom) for conditional model for detecting teacher fidelity on posttest perceived physical motor competence scores.

Fixed Effects	Coefficient (SE)	t(df)	Sig.	Reliability
Model for intercept, mean posttest PMSC (β_0)				.50
Intercept (γ_{00})	3.61 (.65)	5.54 (4)	.00	
Teacher Fidelity (γ_{01})	0.00 (.01)	.12(4)	.91	

Random Effects (Var.Components)	Variance	df	Chi-square
Teacher level variance (τ_{oo})	.00	4	8.77 (p=.06)
Children level variance (σ^2)	.06		

Note. PMSC= Perceived Motor Skill Competence

Overall, teachers started teaching the *INDO-SKIP* intervention with lower fidelity (M = 46.80%) and gradually improved their fidelity toward the end of the intervention (M=91.03%). On average, teachers' fidelity in delivering the *INDO-SKIP* intervention was pretty high. Even though there was significant variability among teachers in delivering the lesson plans, it did not significantly influence the effect of the *INDO-SKIP* intervention on children's motor competence and perceived motor competence.

Research Question 3

The third research question was what are the effects of the *INDO-SKIP* intervention implemented by early childhood education teachers on children's executive function?

Hypothesis 3a. There will be a significant correlation between measures of executive function and motor competence and perceived motor competence at the pretest. In order to examine this hypothesis, Pearson correlation coefficients were computed to determine the relationship among executive function (Day and Night Task-DN, and

Head-Toes-Knee-Shoulder Assessment-HTKS), motor competence (OC raw scores and MABC-2 raw scores), and perceived motor competence (PPC and PMSC) at the pretest. Bivariate correlation analyses showed that the DN task was significantly correlated with PMSC ($r = .22$, $p = .00$). The HTKS assessment was significantly correlated with the MABC-2 raw scores ($r = .20$, $p = .02$), PPC ($r = .18$, $p = .03$), and PMSC ($r = .26$, $p = .00$). However, none of the executive function assessment scores showed a significant correlation with OC raw scores. The result of the correlation analyses is reported in Table 30.

Table 30. Bivariate correlations among executive function, motor competence, and perceived motor competence.

	DN	HTKS	OC	MABC-2	PPC	PMSC
DN	1	0.16	-0.07	-0.02	0.06	.22**
HTKS		1	0.11	.20*	.18*	.26**
OC			1	0.01	0.05	.23**
MABC-2				1	.24**	0.13
PPC					1	.62**
PMSC						1

Notes. DN= Day and Night Task, HTKS= Head-Toes-Knee-Shoulder Task, OC= Object control raw scores, MABC-2= Movement Assessment Battery for Children-2 raw scores, PPC= Perceived Physical Competence, PMSC= Perceived Motor Skill Competence. *p <.05, **p<.01.

Overall, data at the pretest showed that executive function had a small, positive, and significant relationship with perceived motor competence. Yet, executive function only showed a small, positive, and significant correlation with the MABC-2 raw scores. Therefore, these data only partially supported hypothesis 3a.

Hypothesis 3b. Children in the *INDO-SKIP* group will have significantly higher executive function (e.g. behavioral regulation and inhibitory control) than children in the control group after the 8-week *INDO-SKIP* implementation.

Prior to conducting the analyses to answer hypothesis 3b, the assumptions underlying this analysis were examined for the DN and HTKS data. Normality distribution analysis showed that skewness and kurtosis statistics for both variables were outside of the range of -2 and 2. Shapiro-Wilk tests for both DN and HTKS were also significant. Moreover, the Q-Q plots and histograms of each dependent variable by group suggested that the DN and HTKS data violated the normality distribution. Therefore, further analyses were conducted using non-parametric analyses.

In order to examine the effect of the *INDO-SKIP* intervention on participants' executive function, two Kruskal Wallis analyses were run to verify whether there were significant differences at the pretest on executive function (DN, HTKS) between the *INDO-SKIP* group and control group. Kruskal Wallis analyses showed that there was no significant group differences for pretest DN scores ($\chi^2 = 2.61$, $df = 1$, $p=.11$). Yet, there was a significant group difference on pretest HTKS scores ($\chi^2 = 13.41$, $df = 1$, $p < .001$), in which the mean rank of the control group was higher (M=84.99) than the *INDO-SKIP* group (M=59.70). After the 8-week *INDO-SKIP* intervention, Kruskal Wallis on posttest DN scores showed there was significant group differences on posttest DN scores ($\chi^2 = 6.68$, $df = 1$, $p = .01$), in which the mean rank of the *INDO-SKIP* group was higher (M= 78.92) than the control group (M=66.30). Participants in the *INDO-SKIP* group increased their DN score from pretest (M = 14.40, SD = 3.47) to posttest (M = 15.47, SD = 2.00). In contrast, participants in the control group slightly decreased their average DN score from pretest (M = 15.17, SD = 2.00) to posttest (M = 14.98, SD = 2.32). Figure 9 shows pretest and posttest score of the DN assessment by group.

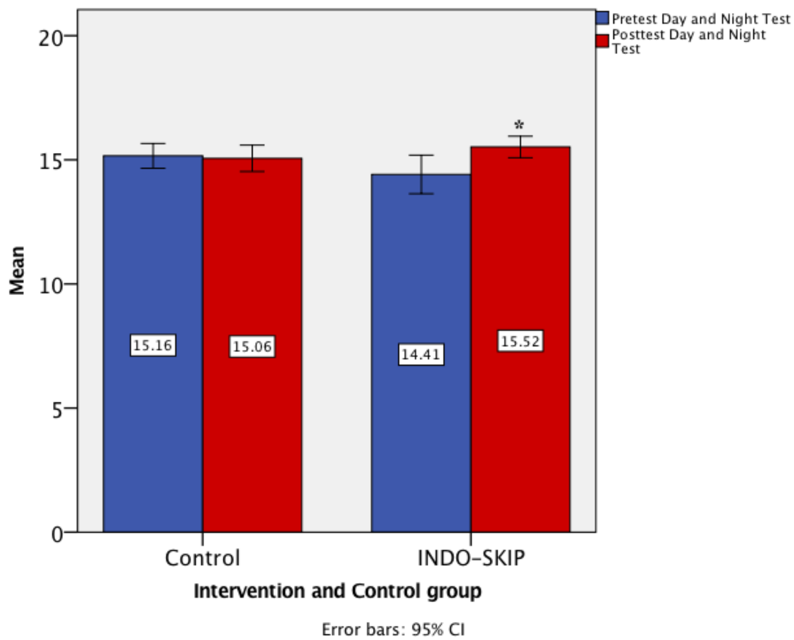


Figure 9. Group mean Day and Night scores at the pre- and posttest.

Moreover, Kruskal Wallis analyses showed there were no significant group differences on posttest HTKS scores (p =.39). The mean rank of the *INDO-SKIP* group was 70.18 and the control group was 76.19. On average, participants in the *INDO-SKIP* group increased their HTKS scores from pretest (M = 32.46, SD = 17.17) to posttest (M = 45.20, SD = 13.16). Participants in the control group also increased their HTKS score from pretest (M = 39.72, SD = 15.01) to posttest (M = 45.73, SD = 17.50). Even though the average of the HTKS scores of children in the control group were slightly higher than children in *INDO-SKIP* group, children in the intervention group made larger improvement on their HTKS (12.74 points) than children in the control group (6.01 points). In summary, the data for hypothesis is mixed. On the one hand both the *INDO-SKIP* and control group improved their HTKS scores from pretest to posttest, but on the other hand the *INDO-SKIP* group had a larger improvement in their pretest-posttest scores than the control group. Figure 10 shows pretest and posttest scores of the HTKS assessment by group.

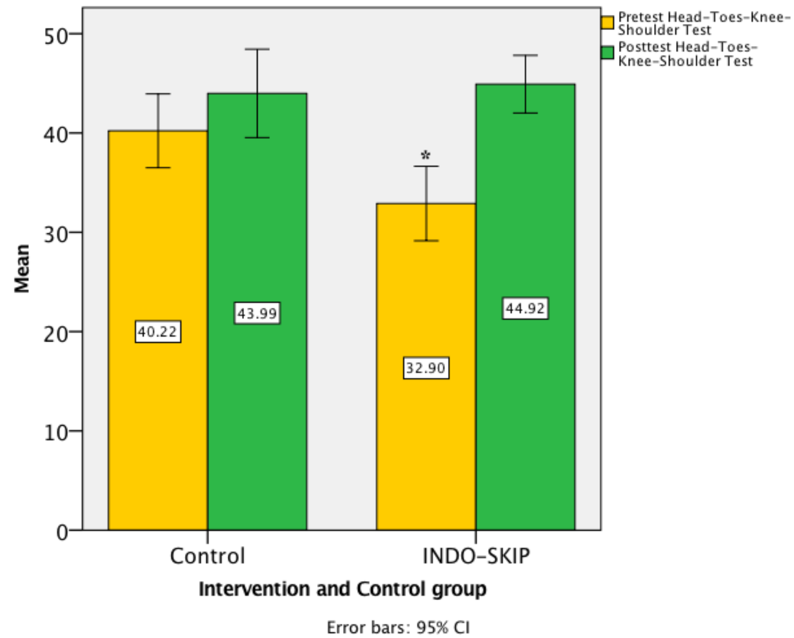


Figure 10. Group mean Head-Toes-Knee-Shoulder score pre- and posttest.

Overall, hypothesis 3b was partially supported by the data, in which children in the *INDO-SKIP* group had higher posttest DN scores than children in the control group. However, the data for the HTKS test was inconclusive with both *INDO-SKIP* and control groups significantly improving their pre-post scores, but the *INDO-SKIP* group had double the improvement in their HTKS scores than children in the control group.

Summary

In summary, three research questions were addressed in this study. Prior to the intervention phase, early childhood teachers in the *INDO-SKIP* group were trained on motor development principles and the *INDO-SKIP* program. The assessment from the training demonstrated that teachers had high knowledge on developmental stages and were able to demonstrate OC skills with a high degree of proficiency. Additionally they were able to teach mini *INDO-SKIP* lessons with 74% fidelity. The primary research question in this study was to examine the effect of an eight-week *INDO-SKIP* intervention on preschoolers' motor competence and perceived motor competence. The majority (97 %) of preschoolers in this study were developmentally delayed on their OC skills, but typical in their MABC-2 scores. In spite of this they perceived themselves to be "pretty good" on their motor competence. There were gender differences on pretest OC raw scores, PPC, and PMSC, in which boys outperformed girls in all three variables. There were no gender differences on MABC-2 scores.

An eight-week *INDO-SKIP* intervention delivered by six trained early childhood teachers showed that the *INDO-SKIP* group had significantly better posttest OC raw scores than the control group when accounting for pretest scores. There was a large effect size ($\eta^2 = .55$, Cohens'd = 2.21). The *INDO-SKIP* group also had significantly better posttest PPC ($\eta^2 = .08$; Cohens'$d = .59$) and PMSC ($\eta^2 = .10$; Cohens'$d = .67$) scores when accounting for pretest scores. There were small effect sizes for PPC and PMSC. The *INDO-SKIP* group was not significantly different than the control group for posttest MABC-2 scores when accounting for pretest scores. Moreover, gender and pretest scores did not influence the effect of the *INDO-SKIP* intervention on posttest OC raw scores, PPC, and PMSC scores.

The secondary research question in this study examined the influence of teacher fidelity in delivering *INDO-SKIP* lessons on children's outcomes. On average, teachers had pretty high fidelity scores (67% - 81% fidelity). HLM analysis indicated that there was significant variability in teachers' fidelity, but that fidelity did not influence the effect of the *INDO-SKIP* intervention on children's OC raw scores, PPC and PMSC at the posttest.

In addition to motor competence and perceived motor competence, this study also examined the effect of the *INDO-SKIP* intervention on preschoolers' executive function (DN, HTKS). Non-parametric analyses showed that there was no difference on pretest measures of DN scores, but there was a group difference on HTKS scores between the *INDO-SKIP* group and control group. When examining posttest scores, the children in the *INDO-SKIP* group had significantly higher DN posttest scores than children in the control group. In contrast, there was no significant group difference on posttest HTKS scores. Although there were no significant findings for the posttest HTKS scores, it was noted that the *INDO-SKIP* group had double the improvement (posttest minus pretest) than children in the control group.

Chapter 5. Discussion

As Indonesia has become one of the top ten most obese countries in the world (OECD, 2014), an immediate preventive action in early childhood is needed (Usfar et al, 2010). Physical inactivity is identified as a major factor that may contribute to the increasing overweight and obesity rates in Indonesia. There has been a call in Indonesia for population-based interventions to promote physical activity starting in the early years (Denboba, et al., 2015; Usfar et al, 2010). Motor competence and perceived motor competence are important underlying factors driving physical activity behaviors, thus it is important to examine the effectiveness of programs like *INDO-SKIP* that promote motor competence and perceived motor competence in young children. Therefore, the primary purpose of this study was to determine the effectiveness of an eight-week *INDO-SKIP* motor skill program on Indonesian preschool children's motor competence and perceived motor competence. A secondary purpose of the study was to investigate the influence of the *INDO-SKIP* program on executive function in young children. The overall intent of this study was to pilot the *INDO-SKIP* intervention in order to determine the feasibility of this intervention in the Indonesian educational environment as a precursor to a larger study in the future.

This chapter will discuss the findings of the study relative to: a) the initial training workshop preparing the early childhood teachers to deliver *INDO-SKIP* and the outcomes measured during this workshop, b) the fidelity with which the early childhood teachers implemented *INDO-SKIP*, c) baseline data of motor competence, perceived motor competence and executive function of Indonesian preschoolers, and, d) the effects of an eight-week *INDO-SKIP* intervention implemented by trained early childhood teachers on preschool children's motor competence, perceived motor competence, and executive function (research question 1).

***INDO-SKIP* Initial Training for Early Childhood Teachers**

Prior to delivering the intervention, early childhood teachers in the intervention group received a nine-hour initial training on key motor development principles and the delivery of the *INDO-SKIP* intervention. The training covered motor development principles, the stages of motor skills, and pedagogy in teaching motor skills along with going over *INDO-SKIP* lesson plans. In meetings prior to the initial training, teachers disclosed that they had no prior knowledge of motor skills, which made them feel insecure in teaching motor skill lessons in a physical education environment. This information was essential to help me create a better approach to increase teachers' confidence in teaching *INDO-SKIP*. As I reflected on the teacher training workshop the following approaches to the training aimed to help teacher's motivation and engagement in the workshop. I would use these approaches again and recommend them in future research in this area:

1. Start the workshop by telling my experience in implementing the SKIP program and my lack of athletic/motor skill background before starting. I was hoping that by

sharing my personal story it would help teachers understand that it is common for them to experience some challenges in the beginning, but with help and on-going coaching throughout the intervention, they would be able to deliver the program. I found that having a background as a biologist with no experience in teaching preschoolers gave a sense to teachers that it is not impossible for them to learn and teach motor skills to children in school.

2. Creating a "team-work" atmosphere in the training. Culturally, in Indonesia teachers perceive a faculty member or researchers as superior to them. Therefore, training sessions such as this are usually viewed as a one-way communication. My goal was to ask for ongoing input from the teachers during the training promoting a two-way communication to give the teachers a sense that we were a "team" in doing this study. The aim of this approach was to identify specific factors that were critical to improve teachers' confidence in delivering the *INDO-SKIP* program. I found that this approach was very beneficial because teachers felt I listened to them and they would ask for help when they needed it. Most importantly they demonstrated a high motivation and commitment for *INDO-SKIP* throughout the study. These issues of teacher's background and changes in teacher's motivation and confidence to deliver the intervention needs to be studied using mixed methods (qualitative and quantitative) in future research.
3. Inviting the principal of the school and staff administration to the initial workshop. The early childhood centers I used did not schedule gross motor skills as part of their daily schedule. I needed support from the principal of the schools and staff

administration to be able to plan the delivery of the *INDO-SKIP* intervention and also the pre-and posttesting. I found involving the principal and administrators in the training enabled them to see the importance of *INDO-SKIP* for the overall development of their children. As a result they appeared to "buy-in" to the study and encouraged teachers to be involved and committed to this study.

Content of the Teacher Training Workshop

The initial training consisted of (see Table. 7 in the methods for more detail): 1) a brief lecture of background to the study, 2) gymnasium activity going over stages, 3) gymnasium practical activity on demonstrating all skills appropriately, 4) going over the pedagogy of teaching *INDO-SKIP*, and, 5) gymnasium activities over teaching mini-lessons. This training schedule allowed teachers to learn motor skill development and pedagogy in teaching motor skill interventions using a practical and discussion-oriented approach. Teachers had enough opportunity to practice skill demonstrations while learning developmental stages of motor skills. By the end of the training, teachers were able to perform the skills proficiently (more explanation is provided in the next session). The most difficult part for the teachers in the training was when we went through the lesson plans. Teachers had difficulties in comprehending how the lesson looked with only one teacher teaching a class of children, especially related to equipment placement and the activities. For future trainings, it would be better to show teachers a video of a teacher teaching an *INDO-SKIP* lesson so they could see what it looked like.

Pedagogical Approach to the Teacher Training Workshop

A number of pedagogical approaches were used in delivering the *INDO-SKIP* training workshop. There was an initial lecture providing the background to the study (e.g. childhood obesity trends in Indonesia and models of motor development). This lecture was very important for following reasons:

1. Preparing the teachers to understand the background that led to the study and the potential benefits of being involved in this study for the teacher and the children.
2. Providing basic knowledge on the development of fundamental motor skills and models of motor development. This part of the workshop challenged teacher's current understanding of fundamental motor skills as skills that would naturally emerge without instruction.
3. Helping teachers' interest and "buy-in" to delivering the *INDO-SKIP* intervention. This was an important aspect of the workshop as early childhood centers in Indonesia tend to focus more heavily on academic content (UNESCO, 2003) and thus convincing teachers of the importance of fundamental motor skills was important. The teachers anecdotally reported that by providing theory and evidences on the relationship between fundamental motor skill competence, cognitive development, and fine motor skills in the presentation motivated them to be involved in the *INDO-SKIP* intervention.

The majority of the workshop was practically focused and took place in the gymnasium. The first part of the gymnasium activities was learning the developmental stages of fundamental motor skills, as this was a core principle of the *INDO-SKIP* intervention. I initially demonstrated all stages and explained them, then the teachers practiced the stages, then they coached each other on the stages, then I asked them to demonstrate the stages out of sequence to help them remember the stages more deeply. Having teachers practice the stages in the gymnasium helped teachers to learn these stages quickly and proficiently and seemed to boost their confidence as evidenced by excitement/verbalizations at them being able to perform the stages. Teachers also began to see the links to their own children and recognized different children they taught who demonstrated a specific stage as indicated by them saying things like “Nabila is a stage 3”. After learning and practicing developmental stages of motor skills, teachers' understanding of developmental stages of catching, throwing, kicking, and striking was assessed by using a Developmental Stages Assessment. I called a developmental stage of a skill (for example kicking stage 3), and then the teacher demonstrated the skill and described the stage. This assessment was conducted individually. Overall, the teachers' scores ranged from 10 to 12 (*M*= 10.50) out of 12 total possible points demonstrating their mastery of developmental stages.

The second part of the workshop built on the developmental stages of fundamental motor skills and had the teachers work on being able to demonstrate each of catching, throwing, striking, kicking, rolling, and dribbling skills with proficiency. This was important for the teachers to be able to do as they would be the ones modeling these skills to the children during the *INDO-SKIP* intervention. A number of studies highlight the importance of correct demonstration as a teaching tool (Hodges & Franks, 2012; Lee & White, 1990). The TGMD-2 criteria were used as proficient performance. During this session, I demonstrated each skill and explained the critical elements for each OC skill based on the TGMD-2 criteria. Teachers practiced the skills while peer coaching. Then, I coached the teachers and refined their demonstration. In order to examine teachers' proficiency in demonstrating OC skills, the teacher's were evaluated by using the TGMD-2 OC subscale assessment. All teachers performed each OC skill three times. All trials were videotaped and two trials were coded using the TGMD-2 OC subscale criteria. Raw scores of this coding were used for data analysis. The teachers scored 38 – 47 (M = 42.67) out of a possible 48 showing their accuracy in demonstrating OC skills as measured by the TGMD-2. Together with the Developmental Stages Assessment, these data indicated that the initial training was effective in improving the early childhood teachers' knowledge on developmental stages of motor skills and the ability to perform OC skills with proficiency. The one thing I would change in the initial training if possible would be to have a group of children come in and perform OC skills and let the teachers identify the stages from observing them.

Some skills presented a particular challenge for the teachers. During the initial training, I identified that five of the teachers had never performed the dribble and strike a ball before the training. Additionally, all of the teachers reported they were not familiar with galloping and skipping. Thus the practical aspects (stages and TGMD performance) of the training helped these teachers acquire the necessary demonstration skills to be able to model appropriately during the *INDO-SKIP* intervention. The teachers reported that the developmental stages of kicking was easiest for them as soccer is a very common sport in Indonesia and an integral part of all communities. Kicking is an ontogenetic skill in Indonesia. In contrast, learning the developmental stages of striking was the most difficult for teachers. Baseball or cricket are not common in Indonesia and there is little modeling of these skills in the community. At first most of the teachers demonstrated a stage 2 of striking, which is striking horizontally without rotation or with block rotation and no step. Therefore, I provided the teachers with more time to practice striking than other skills to help them understand the skills and the stages of development. As researchers delivering training in communities it is important to consider which motor skills are more ontogentic (or not) to a community and allow extra time to practice those skills with which participants have little experience.

The next part of the initial training provided time for teachers to walk through lesson plans and practice their teaching skills in the gymnasium. Lesson plans were provided for teachers. Over one hour, I explained each lesson plan to the teachers, including task set up, equipment placement, children's position in the station, demonstration position, and lesson plan modification. As we did the training in the motor room where the *INDO-SKIP* was delivered, we were able to walk over the lesson plan as to how it was supposed to look when teachers taught the lesson. Then, teachers practiced the lesson plans with other teachers. Afterwards, each teacher taught mini lessons of three OC that they selected. Each teacher was given 10 minutes to prepare her teaching followed by 5 minutes of teaching each OC skill. All mini lessons taught by the teacher were recorded and evaluated using the Fidelity of *INDO-SKIP* Assessment (FIA). This FIA assessed the teacher's fidelity of the activity and fidelity of instruction. Fidelity of the activity examined whether tasks were implemented as designed and fidelity of instruction examined whether teachers implemented a correct instructional approach in teaching, including correct explanation and demonstration. The total possible score on the

FIA for the mini lesson was 0 – 39 and then converted into a percentage. Teachers' performed their min lessons with 69.23% to 79.49 % fidelity. Their scores showed that they had adequate knowledge and skills in teaching *INDO-SKIP*. However, during discussion after the teaching of the mini lessons, the teachers expressed their concern about the following elements of teaching:

1. Classroom management. Teachers were concerned about the *INDO-SKIP* class being chaotic (lots of children moving) because children would not follow instructions. Their prior teaching experiences were in classrooms where all children were sitting learning academic content quietly. Since children do not really move during desk-based learning, teachers were anxious about the active nature of *INDO-SKIP*. In the workshop they practiced their mini lessons teaching fellow teachers, but were concerned that during *INDO-SKIP* they would be teaching a big group of children (13 to 16 children). Transitions were also a concern, e.g. from the first to second activity and how to set up the equipment.
2. Modifying tasks to meet individual need based on identifying stages. Since teachers did not get the experience of watching children perform motor skills live, they were doubtful that they would be able to identify skills and modify tasks when they were teaching children.

These concerns that teacher's expressed during and after the initial training provide beneficial information to navigate what I expected and what I needed to do when I was providing on-going coaching during teachers teaching of the *INDO-SKIP* lessons.

Limitation of the initial training. Even though the initial training was effective in increasing teachers' knowledge and skills in developmental stages, demonstration of motor skills and ability to teach *INDO-SKIP* lessons, there were still concerns about the lack of authentic environment in which the training occurred. It would have been better if teachers could have worked with children after learning this content to apply their knowledge in a real setting with real children but time limitations with these teachers prevented this happening. Providing experiences for teachers to observe and practice teaching with a classroom of children is recommended in future research if it is feasible. One way to get teachers this experience is to have a transition period between the end of the training and the start of *INDO-SKIP* where teachers engage their children in fun games involving motor skills so that teachers have the opportunity to recognize stages and consider the developmental level of their children. It would also give teachers opportunities to navigate their instruction and classroom management in physical education settings. I believe this would help teachers to get a sense of what to expect and what they need to prepare before the start of *INDO-SKIP*.

Overall, I would make the following changes to the teacher training workshop by involving children in the training. This could be having a group of children (10 to 15 children) coming to the training. Therefore teachers are able to observe and practice teaching with them during the training. Another approach could be having teachers observe and practice teaching children in their own classroom if feasible. Another recommendation would be to add time to the initial training. From the experience in this study, I would propose to add 2 to 3 more hours to the initial training and break the training into three days. This should provide enough time for teachers in Indonesia to learn the content and practice the *INDO-SKIP* lesson plans.

Fidelity of *INDO-SKIP* Implementation and On-Going Coaching

An important aspect of any intervention study is to document if the intervention is delivered as intended, the fidelity of the intervention. In the *INDO-SKIP* intervention I defined fidelity as the extent to which specific content, learning tasks, and delivery strategies have been implemented in accordance with the planned manual/procedures (Hulleman et al., 2013). For this study, fidelity included three components, which were: (1) duration and exposure, (2) adherence, and (3) differentiation (O'Donnell, 2008). Duration and exposure refers to the number and length of the intervention sessions implemented. Adherence is the extent to which components of the intervention were delivered as planned. Adherence, was examined using the Fidelity of *INDO-SKIP* Assessment (FIA) identified above under the workshop training. The FIA measures teacher's fidelity in teaching the *INDO-SKIP* lesson (scored 0-26 points). It was categorized into activity fidelity and instructional fidelity. Differentiation is the extent to which the intervention was differentiated from the control condition based on the features present (O'Donnell, 2008). Differentiation between the intervention and control group was evaluated by conducting observations of the control group. Schools in the control group were observed during four free playtimes, on randomly selected days across the eight weeks of the study.

Duration and exposure was measured by recording the time spent in lesson and group/class size. Data showed that all children received 16 sessions of *INDO-SKIP* over 8 weeks, two sessions per week resulting in a total of 480 mins. All session were implemented according to the schedule. There were no missed sessions. The duration and exposure of this study at 480 mins was comparable to other studies in the literature (Brian, et al., 2017b; Robinson & Goodway, 2009). The dose of the intervention relative to child outcomes will be discussed later in the chapter.

Adherence or teachers' fidelity was measured by using FIA on six sessions (37% of total videos of teaching) from videos of teachers teaching the *INDO-SKIP* sessions. Teachers' fidelity was presented as a percentage.

This study's fidelity assessment built on prior measures in the literature (Brian, et al., 2017b). Brian and colleagues implemented a motor skill intervention called T-SKIP that categorized fidelity into two levels. Level-1 fidelity measured the core principles in T-SKIP including pacing of the lesson, providing critical elements of skills during demonstrations, using verbal prompts (feedback), and implementing each progression of the tasks. Level-2 fidelity measured components that were highly desirable in teaching the T-SKIP lessons, including warming up, modification of lesson, verbal introduction and closure, and checking for understanding. The Brian et al (2017b) study concluded that level-1 fidelity was most associated with child outcomes. The FIA coding system in this study focused on many of the Level 1 items from the Brian et al. study but differentiated between fidelity of activity (content) and fidelity of instruction (pedagogy), which allowed the researcher to easily identify whether content and delivery were implemented as planned. The FIA was able to capture how teachers improved their knowledge and skill in content and pedagogy of teaching *INDO-SKIP*. This approach is aligned with the definition of fidelity suggested by Hulleman et al., (2013), which is the extent to which specific content, learning tasks, and delivery strategies have been implemented in accordance with the planned manual/procedures.

The teachers started teaching *INDO-SKIP* lessons with lower fidelity (*M* = 46.80%, *SD*=12.97) in the first week of intervention (lesson 2). However, teachers gradually improved their fidelity in teaching toward the end of intervention (*M* = 91.03%, *SD*=7.95). On average, teachers' fidelity in teaching was 77.14%, which is adequate for educational settings. Previous studies in educational settings have suggested that fidelity below 50% would present a significant threat to internal validity of the study (Durlak & DuPre, 2008; O'Donnell, 2008). The element in the fidelity of activity that was most commonly missing was the teacher correctly modified the task/equipment. During the intervention, teachers seemed to have difficulties in modifying tasks based on children's skill analysis. Discussion with teachers after teaching revealed that teachers were overwhelmed with the many parts of the lesson and helping to correct task performance was the things they focused on last. Some children needed manual guidance (e.g. manipulating an arm or leg) to correct their movement. This took the teacher's attention and time from the rest of class. Thus, on the whole teachers were not able to make individual modifications for children. However, this is not surprising. Lynch & Donnell (2005) also supported this view that first year teachers teaching a new curriculum did not modify the lesson. They were more focused on how to get the lesson going. When the teacher's made a modification it tended to be for children who were more skilled than for children who were less skilled and performed a lower stage. However, anecdotal evidence from observing the lessons and videos of the lessons, this did not really seem to affect the children's excitement as the tasks seemed to be still interesting enough for children to engage in them. This may be due to the novelty of the gymnasium environment, which was new to the children. Towards the end of the intervention the teachers began to demonstrate the ability to modify tasks. As a result, in the last week of the intervention FIA scores ranged from 76.92 % to 100 %. Four teachers scored above 90% in their FIA in the last week of teaching.

Gagen & Getchel (2006) stated that modifying the tasks to meet individual needs is best practice in teaching motor development or physical education. Another anecdotal observation from *INDO-SKIP* was that as teachers increased their fidelity in delivering *INDO-SKIP* across the intervention, they had more control over child behaviors and specifically off task behaviors appeared to decrease. It may be that they were better able to focus on children's motor performance and modify as needed when not dealing with behavior management. This pattern is similar with a study conducted by Shoval, Erlich, & Fejgin, (2010). They reported that beginner physical education teachers understood the content and the pedagogy of teaching physical education, but were not able yet able to apply their knowledge. However, practice and professional support helped beginner teachers to improve their teaching, so that students can improve their learning. Future research needs to investigate the process and factors that influence early childhood teachers' improvement in teaching motor skills.

For instructional fidelity, in the early phase of the intervention teachers were missing scores related to position in demonstrating tasks and reinforcing the critical elements of motor skills. In observing the lessons, the biggest challenge that teachers faced delivering the *INDO-SKIP* intervention in the first week of teaching was classroom management. Teachers struggled to keep children on tasks due to poor task explanations. Post-teaching conversations with teachers highlighted their anxiety and lack of confidence in demonstrating and explaining the tasks. However, by the second to fourth week of the intervention, informal conversation with teachers and anecdotal observation in teaching suggested that teachers appeared to gain in confidence and have control over the children in teaching. By the fifth week the teachers were beginning to teach skills for the second time and the teacher's self-reported to the researcher that they were more confident to teach the *INDO-SKIP* lessons. They were able to demonstrate correctly and provide critical elements. Unfortunately, no formal data was collected to capture the progress of teachers' confidence and this is a recommendation for future research.

A third aspect of fidelity was the **differentiation** between the *INDO-SKIP* intervention group and control group. Field notes from control group observations showed that children in the control group did not receive any motor skill instruction during the study. The only physical activity control children got was during free play activity on the equipped playground for 30 minutes every day. In contrast, children in the *INDO-SKIP* intervention group received two-30 minutes sessions per week of the *INDO-SKIP* intervention in addition to the 30 minutes-daily of free play activity on the playground. Clearly, children in the *INDO-SKIP* intervention group received more opportunity to be physically active than children in the control group. Preschoolers in both the *INDO-SKIP* and control groups had the freedom to choose any activities they wanted to play on the playground. However, large numbers of children on the playground

(35 to 60 children) and the small size of the playground may have influenced their activity. The playground size did not meet expert recommendations of 75 square feet of outdoor play area for each child (NASPE, 2009). In observations of the control group playground, the majority of children were sitting, standing or chatting on the side of the playground. Only a small number of children were engaged in running, jumping, and climbing the monkey bar. None of the control children received any motor skill related instruction or any feedback on motor skills on the playground by their classroom teachers.

Overall, all teachers in the *INDO-SKIP* intervention group were able to deliver the lesson according to the schedule, which was 16 sessions over an 8-week intervention. Both children in the *INDO-SKIP* intervention group and control group had 30-minutes of daily free-play activity on the playground. Yet, children in the control group did not receive any motor skill intervention. The FIA scores captured the progress that teachers made delivering the *INDO-SKIP* intervention. Over the intervention teachers gradually improved their FIA scores. For example, teacher 102 started with the lowest FIA score in the first week (23.08%) and improved her teaching to 88% fidelity toward the end of the intervention. Similar trends were shown for other teachers where their FIA scores gradually improved from the early weeks of *INDO-SKIP* to later phases of the intervention. On-going coaching was believed to have helped these teachers improve their teaching.

On-going Coaching during the *INDO-SKIP* Implementation. On-going coaching during *INDO-SKIP* was an important process in *INDO-SKIP* implementation.

After the nine hours of initial training, teachers had low fidelity (ranged from 23.08% to 57.69%) in their teaching in the first week of *INDO-SKIP* implementation. This suggests that a "one-shot training" was not enough for teachers to understand and use all concepts of *INDO-SKIP* in their teaching. Previous studies have shown that a short-term professional development, such as a short workshop or conference, is not as effective in impacting teachers' skills and knowledge as more prolonged support (Birman, Desimone, Porter, & Garet, 2000; Boyle, While, & Boyle, 2004). A continuous and prolonged approach to professional development is suggested as best to transfer knowledge to teachers (Bayar, 2014; Ward & Doutis, 1999). Continuous and prolonged professional development can include, multiple professional development sessions, and coaching and support from peers and experts (Armour & Yelling, 2004).

In this study, on-going coaching was utilized to provide continuous support to teachers to improve their knowledge and skills in teaching the *INDO-SKIP* intervention. Prior to on-going coaching, the primary researcher had built a good rapport with the teachers. Some meeting and casual discussion were conducted prior to the study for two weeks in order to understand the teachers' experience in teaching and in physical activity. The primary researcher also spent time in the classroom to understand the routines, rules and regulations teachers implemented in their classrooms and to learn more about the children. This rapport helped the researcher to identify the teachers' opinion and concern related to motor development and teaching the motor skill program to children. For weeks 1-5, the researcher met with each teacher for 30 minutes at the beginning of each week (150 minutes meeting in total). During this meeting, the researcher and teachers reviewed teaching in the previous week, prepared the teachers for classroom setup, and reviewed the lesson plan. Teachers were encouraged to do self-reflection on their teaching. In some occasions, short video clips of teaching were shown to teachers to help them to evaluate their teaching and develop some plans to solve problems they were facing in teaching the *INDO-SKIP* lesson plans. On-going coaching also occurred during teaching. The researcher provided assistance when teachers needed direct help for them to stay with the lesson plan. Some examples of on-going coaching that frequently occurred during the *INDO-SKIP i*ntervention implementation is described in Table 31.

Table 31. Example of cases in on-going coaching during *INDO-SKIP* intervention implementation.

Cases	**Support Provided during Meeting**	**Support Provided during Teaching**
Demonstration position	Review the importance of demonstration position in teaching.	Researcher gave a sign to teacher where to stand when demonstrating skill/tasks.
Incorrect skill/task demonstration	Teacher with help from researcher identified the mistakes, then teacher and researcher discussed option/s what to do to prevent the same mistakes in the future.	Researcher talked with teacher briefly about what to do. Then, teacher froze the children and redid the demonstration
Classroom management	Teacher watched short-clip videos related to classroom management issues in the teaching. Then teacher with help from researcher identified factors that contribute to problem in their classroom management, such as equipment position, voice, standing position, and instruction. Then teacher made plans to solve problem in classroom management.	Researcher alert teacher when off-task behavior occurred. When issues related to children safety, researcher immediately assisted teacher and then communicated it with teacher during meeting.

Continued

Table 31 Continued

Task modification	Reviewing motor skill development stages in relation to task progress. This helped teacher to understand the progress in task and even helped to come up with their own ideas of task.	Researcher alerted and showed and teacher to modify task for student who needed it.

Formal data collection was not conducted during on-going coaching. Future research should consider collecting formal data during on-going coaching to chart the type and amount of coaching needed.

Data from the FIA showed that teachers gradually improved their teaching and had higher fidelity of teaching *INDO-SKIP* lessons at the end of the intervention (M = 91.03%, SD = 7.95). The longer duration of support received by ongoing coaching was possibly helpful for teachers who were new to motor skill development and pedagogy. Ongoing coaching also allowed me to individualize coaching to specific issues for an individual teacher. During the first five weeks of intervention, the three most frequent supports given to teachers were demonstrating the tasks in an appropriate place, transitions, and task modification. In the first two weeks, teachers often demonstrated tasks at a station where only children from one side of the room could observe them. During the third and fourth week of the intervention, teachers were supported most in transitioning children from the first to second activities, and modification of tasks. However, by the fifth week, teachers had shown a major improvement in their teaching and needed much less coaching. Informal observations suggested that during on-going coaching teachers were actively engaged in identifying problems they were facing during teaching the *INDO-SKIP* lesson and learning how to solve the problem. As a result, teachers were able to directly transfer what they learned in on-going coaching to their teaching. This active learning approach was supported by Shelton and Jonnes (1996) who explained that teachers who are engaged in active learning are more likely to transfer their learning. Future research should capture the coaching process via video analysis and qualitative interviews of the teachers.

The previous sections of the discussion have documented that teacher's learned from the workshop. Also, that teachers' demonstrated the ability to teach the *INDO-SKIP* lessons with fidelity. The next section will discuss the primary research question, the impact of the *INDO-SKIP* program on children's motor competence, perceived motor competence, and executive function. The discussion starts with explaining the baseline data followed by the effect of the eight-week *INDO-SKIP* intervention.

Baseline Data on Motor Competence, Perceived Motor Competence and Executive Function

Prior to receiving the *INDO-SKIP* intervention, participants were evaluated on baseline measures of motor competence, perceived motor competence, and executive function.

Indonesian preschooler's motor competence.

Participants' motor competence was measured by the OC subscale of the TGMD-2 (raw scores) and the Movement Assessment Battery for Children-2 (MABC-2) assessment. It was hypothesized that participants would be delayed (scored under 30th percentile) on their OC skills and MABC-2.

Baseline measures of OC skills. This study found that on average, Indonesian preschoolers were developmentally delayed (<30th percentile) on their OC skills with a grand mean percentile rank of 5.66 (SD = 7.64). Children in the *INDO-SKIP* group, on average, were at the 4th percentile and children in the control group at the 7th percentile. A total of 97.9% of participants in the sample were delayed on their OC skills. This finding is not surprising, because previous studies have shown similar trends with respect to the OC skills of children from disadvantaged populations in the USA (Goodway & Branta, 2003; Goodway,et al., 2010; Robinson & Goodway, 2009; Martin, et al., 2009; Valentini & Rudisill, 2004). Additionally, developing countries with similar populations to Indonesia, such as Brazil (Spessato, Gabbard, Valentini, & Rudisill, 2013; Valentini, Logan, Spessato, Pereira, & Rudisill, 2016) have also revealed developmental delays in fundamental motor skills. The findings from this study are also in line with a UNESCO (2003) report on Indonesian children's developmental status by highlighting that Indonesian young children were delayed on their gross motor skills. In spite of the consistency of the findings from the current study and those in the literature, caution must be exerted in these comparisons. The normative data used in this study came from an American reference population as there was no normative data for Indonesian children (Ulrich, 2000). Even though the percentile scores used in this study were based on the American norms of the TGMD-2, the participants in this study only scored 15.85 (SD= 6.05) out of a total possible 48 points (raw score) supporting the evidence of developmental delay as this constitutes only 30% of the possible criterion points for OC skills. Thus compared to proficient performance, the children in this study were not very proficient in the performance of their OC skills.

Participants in this study were children from four early childhood centers in an urban area in Padang, West Sumatera, Indonesia. As a third world country, Indonesia ranks as a lower-middle income country (World Bank, 2018). Even though data of the participants' Socioeconomic Status (SES) was not collected, staff at the schools provided information that most children enrolled in their schools were from middle-income (by Indonesian standards) families. Government data shows that most of the population in Padang is from middle-income families and only 5% of Padang's population lives under the poverty line (BPS, 2017). Previous studies in the US (Goodway & Branta, 2003; Goodway, et al., 2010; Robinson & Goodway, 2009; Martin, et al., 2009; Valentini & Rudisill, 2004) and Brazil (Spessato, et al., 2013; Valentini, et al., 2016) showed that children from disadvantaged families are delayed in their fundamental motor skills which may be due to reduced access to physical activity spaces and sport and movement programs in the community. Informal observations during this study suggest that there are similarities in the children's school, home, and community environment between the middle-income children in Indonesia and disadvantaged children in the USA. Parents informally confirmed that participants in this study had less access to physical activity spaces and programs in their homes and communities, with similarities made between the children in this study and disadvantaged children in the USA. The parents in this study reported that children tended to stay inside the house during the day due to the heat of the tropical environment and engage in mostly sedentary behaviors with little physical activity. It was apparent during the testing environment that children were not familiar with some of the object manipulation skills, such as dribbling and throwing, and their reactions to pretesting support the assertion that children had little exposure to physical activity prior to this study. Future research in this area should examine children's access to and engagement in physical activity within the home and community environment.

Another factor that may have contributed to the OC developmental delay is that schools do not provide a structured physical activity program for children to learn motor skills. During the 3.5 to 4 hours of the school day children were only allotted 30 minutes of free-play activities on the equipped playground during the school day. The majority of the school day (3 hours) was being sedentary in the classroom. UNESCO (2003) has highlighted the curriculum in early childhood centers in Indonesia was heavily focused on academic content (reading, mathematic, and writing) in the classroom. Observation (fidelity checks of the control group) of the 30 minutes of free play activities on the playground revealed that the teacher did not give specific instruction to the children to be physically active and as a result many children were sedentary on the playground. Coupled to this issue, the playground equipment consisted of a monkey bar, slide, and swing and few children were able to or chose to play on this equipment. Additionally, children did not have access to object manipulation equipment such as balls or beanbags during the playground time. As a result of these many factors the majority of children sat around in small groups at the side of playground and chatted with each other. Some children played with their personal toys that they brought from home.

From a Dynamic System Theory and Newel's Constraints perspectives, motor development is a dynamic process resulting from the interaction between external and internal subsystems of an individual (Gallahue, et al, 2012; Smith & Thelen, 2003).

These subsystems include constraints from the Individual, Task, and Environment (Gallahue, et al, 2012; Newell, 1984; 1986). One of the major constraints influencing children's delayed status in OC skills may be in the area of the environment where children had limited access to physical activity at home, in school, and the community (anecdotally reported by parents and observations in the community). Additionally children were not very familiar with several of the OC skills like striking and dribbling and this lack of exposure to these skills may have constrained these skills. As a result of little experience with physical activity children may also not have developed the appropriate individual subsystems like dynamic balance and multi-limb coordination to be able to undertake OC skills efficiently. As a result, they were delayed on those skills. Future research needs to study the individual, environmental, and task constraints that contribute to the OC developmental delays shown by preschoolers in Indonesia.

One of the initial research aims was to determine if there were gender differences in OC skills for the preschoolers in this study. This study found that there was significant gender difference in preschoolers' OC skills, in which boys (M= 18.02, SD = 6.83) performed better OC skills than girls (M = 14.13, SD = 4.71). This finding is consistent with a pilot study conducted prior to this study (Famelia, Tsuda, Bakhtiar, & Goodway, *in press*). The finding from this study also aligns with much of the literature within the USA (Gallahue, et al., 2012; Goodway, et al., 2010) and globally (Barnett, et al., 2010; Gallahue et al., 2012). The gender differences in Indonesian children's OC skills could potentially be attributed to cultural differences in child rearing between girls and boys in Indonesia. The majority of the population in Padang are the Minangkabau people, who are a Muslim community. Even though Islam encourages physical activity for all Muslims including boys and girls, informal observations noted that boys typically had more opportunities to play outside after school with their peers, while girls tended to stay inside the house with their Mothers being mostly sedentary. Therefore, boys potentially had more experience in OC skills such as kicking and catching than girls. Future research needs to examine the influence of cultural child rearing practices and influence of Islamic on the fundamental motor skills performance of children.

Overall, the baseline data on children's OC skills emphasized that Indonesian preschoolers were developmentally delayed and need an appropriate motor skill program to improve their competence on OC skills.

Baseline measures of the Movement Assessment Battery for Children-2 (MABC-2). Another measure of motor competence in this study was the MABC-2. The data from the MABC-2 showed that on average children were not delayed in their MABC-2 scores. The grand mean percentile of the MABC-2 was 70.94 (SD = 29.64), which indicates children did not have any movement difficulties. However, eleven of 156 participants were delayed (lower then 30^{th} percentile) on their MABC-2 scores. The difference in findings between the MABC-2 and TGMD-2 OC skills may be in part due to the differences in the nature of the MABC-2 as compared to the TGMD-2. The MABC-2 assessment is a product measure that assesses children's performance in manual dexterity (post coins task, threading beads task, and drawing trail task), Aiming and Catching (catching a beanbag and throwing a beanbag onto a mat), and Balance (a one-leg balance, walking with heels raised, and jumping on mats). The product focus of the MABC-2 is on how many (e.g. number of steps or minutes) or whether a child can perform the task (e.g. toss a bean bag onto a mat), but not how (process) the child performs the tasks. In contrast, the TGMD-2 measures how a child performs a skill (e.g. how they throw such as stepping with opposition). Additionally, the MABC-2 was specifically designed to identify children with more severe movement impairments in clinical settings such as developmental coordination disorder (Brown & Lalor, 2009; Henderson, Sugden, & Barnett, 2007; Wuang, SU, & SU, 2012). As such, it is less appropriate to use in typical populations such as the participants in this this study. Thus, the results from the MABC-2 assessment appeared to show a ceiling effect and did not adequately account for the variability in children's motor competence. Similar findings were also reported by Logan, Robinson, Rudisill, Wadsworth, & Morera (2014) in their study on kindergarten, first and second grade of children. However, in a previous study (Logan, Robinson, & Getchell, 2011) on preschoolers, they found that children performed almost similar in both the TGMD-2 and MABC-2. They argued that the discriminating level of theTGMD-2 and MABC-2 in measuring children's motor competence will be more significant as children age.

In contrast with the OC skill data, there was not a significant gender difference in pretest MABC-2 raw scores. The mean score of the MABC-2 for boys was 87.49 (*SD* = 15.42) and for girls was 90.56 (*SD* = 13.94). This finding is supported by a previous study conducted by Logan et al. (2014) who found that there were no gender differences on the MABC-2 total raw score. However, some previous studies using the MABC assessment (the first version of MABC) found that boys performed better in ball skills and girls scored higher in manual dexterity tasks (Junaid & Fellowes, 2006; Livesey, Coleman, & Piek, 2007) although no explanation of why was provided. Thomas and French (1985) conducted a review of literature on gender differences and proposed that social factors may contribute to these differences. However, other scholars (Piek, Gasson, Barrett, & Case, 2002) argued that biological factors could be involved to this difference. Further study should consider investigating the potential constraints resulting in gender differences in children's motor competence using the MABC-2.

Overall, on average participants were delayed in their OC skills as measured by the TGMD-2. It was also found that boys performed better than girls on the OC skills. However, MABC-2 score showed that on average, participants were not delayed on their motor competence. Also there was no gender difference on children‘s motor competence as measured by the MABC-2. The differential findings relative to gender between the TGMD-2 and the MABC-2 highlights that it is very important to use appropriate instrumentation to measure a variable in light of the population being evaluated the aims of the study. For this study, using the TGMD-2 assessment was more appropriate because the MABC-2 was designed to measure movement impairment of an individual. Yet, none of the participants in this study were identified as having movement impairments. Moreover, the TGMD-2 is a process-oriented measurement that qualitatively evaluates children's proficient performance of fundamental motor skills based on criterion elements of form (Ulrich, 2000). Therefore, the TGMD-2 was considered most appropriate to measure the effect of the intervention on motor skill development (Logan, et al., 2011).

Indonesian preschoolers perceived motor competence.

Participants' perceived motor competence was measured by using the Perceived Physical Competence (PPC) subscale of the Pictorial Scales of Perceived Competence and Social Acceptance for Young Children designed by Harter & Pike (1984). Additionally, the Perceived Motor Skill Competence (PMSC) scale designed by Barnett, et al. (2015) was used. It was hypothesized that participants would perceive themselves "pretty good" in both the PPC and PMSC instruments. Both scales used a two-part discrimination by the child. First they chose the picture most like themselves (competent or less competent), then they identified whether they were a lot like that child (score 4 or 1) or a little like that child (score 3 or 2). A score of 3 or above indicated a child was "pretty good" at motor skills.

Baseline measures of Perceived Physical Competence (PPC). The PPC subscale measures children's perceptions of their competence in performing daily activities, including tying shoes, climbing a monkey bar, swinging, skipping, hopping, and running. This study found that on average, Indonesian preschoolers perceived themselves "pretty good" on these activities (Mean = 3.36, SD = 0.47). This finding is similar to studies in other countries (Harter & Pike, 1984; LeGear, et al., 2012; Robinson, 2010; Robinson et al., 2015).

Perceived Motor Skill Competence (PMSC). The PMSC measures children's perceptions of their fundamental motor skills (i.e. OC skills and LOC skills). In this study, participants were measured on their perceptions of both LOC and OC skills. Even though the *INDO-SKIP* intervention was designed to focus on OC skill instruction, participants were provided with experiences in LOC skills in the warm up and transition between activities during sessions. Similar with PPC, it was found that on average, Indonesian preschoolers also perceived themselves as “pretty good” at fundamental motor skills competence (Mean = 3.26, SD = .62). This finding is also similar with a study by Barnett, et al., 2015.

In both the PPC and PMSC the children perceived themselves as “pretty good” at motor skills yet in contrast children’s actual OC competence revealed children were delayed in their motor skills. There is a clear mismatch between the children’s actual motor competence and their perceived motor competence. It has been suggested in the literature that young children have a tendency to overestimate their motor competencies (Brian, Haegele, Bostick, Lieberman, & Nesbitt, 2018; Robinson et al., 2015), perhaps due in part to more limited cognitive capacities. Preschool-aged children’s cognitive function is not fully developed yet. The typical 4-5 year old child is still in the preoperational stage of cognitive development (Gallahue, et al., 2012). In this stage of cognitive development they cannot conserve and cannot use multiple features from an environment in problem solving (Gallahue, et al., 2012; Wadsworth, 1996). As a result, they are not able to accurately evaluate their motor competence, and tend to overestimate their competence (Robinson et al, 2015; Stodden et al., 2008).

The PPC data mirrored the OC data where there were gender differences with boys higher (M = 3.45, SD = 0.48) than girls (M = 3.29, SD = 0.46). This finding was also true for PMSC scores with boys (M = 3.45, SD = 0.42) significantly higher than girls (M = 3.25, SD = .49). Finding of this study contradict the pilot study conducted in Padang, Indonesia (Famelia, Tsuda, Bakhtiar, & Goodway, *in press*) and other studies (Goodway & Rudisill, 1997; Planinsec & Fosnaric, 2005), which demonstrated there were no gender differences in children's perceived motor competence. However, the current findings are in line with other studies in the literature (Robinson, 2010; Rudisil et al., 1993). It is unclear why this study found gender differences when others didn't. Environmental, contextual and socio-cultural factors may have contributed to these gender differences. As a Muslim community, one might argue that young Muslim girls would have lower perceived motor competence than young Muslim boys. The data from this study supports this assumption. As suggested above, differences in opportunities to be active between boys and girls and lack of role modeling may be factors that should be examined in future research. Future studies need to examine the social-cultural context that influence children's perceived motor competence.

Despite inconclusive findings in the gender effects on children's perceived motor competence, almost all research agrees young children over inflate their perceived motor competence compared to their actual motor competence (Harter & Pike, 1984; LaGear, et al., 2012). Although there is concern about the mismatch between actual and perceived motor competence (Robinson et al., 2015), these high perceptions of motor competence in preschoolers can be seen as an asset that can motivate them to be highly engaged in motor skills and physical activity interventions. Research has suggested that we need to start such physical activity interventions in the early childhood years while children believe they are "pretty good" at motor skills and think motor skills are fun (Babic et al., 2014; Robinson et al., 2015; Stodden et al., 2008.). By middle and later childhood, if actual motor skills are low, then perceptions of competence will drop and children will be drawn into the negative spiral of disengagement suggested by Stodden and colleagues (2008). Thus, it is recommended that motor skill programs should be offered in the early childhood years.

The PPC subscale developed by Harter & Pike (1984) may have a historical measurement artifact that could potentially impact the findings of this instrument. One of the questions on how children perceive themselves tying shoelaces is problematic. Most children in the study had velcro shoes. When asked about this question they first answered that they did not know whether they could or could not tie their shoes because they did not have shoes with shoelaces. I needed to prompt participants to make a guess if they had shoes with shoelaces, did they think they would be able to tie it or not. I think future research needs to modify this question on the PPC to reflect a question that aligns with current standards of dress (e.g. velcro closures or zips).

In summary, prior to the intervention participants perceived themselves "pretty good" in both daily activity motor competence measured by the PPC and fundamental motor skills competence measured by PMSC. This finding follows a global trend that young children's perceived motor competence tend to be inflated. This study also found gender difference, in which boys had higher scores in both PPC and PMSC than girls.

Executive Function. Executive function in this study is defined as executive attention, which is associated with behavioral regulation, speed of processing, and inhibitory control (Stuss & Benson, 1986). The relationship between motor competence and cognitive development was proposed many decades ago (Diamond, 2000; Edelman, 1987; Piek et al., 2004; Weimer, 1977). According to Piaget, there is a strong relationship between cognitive development and motor motor skill development and one cannot develop without the other (Piaget & Inhelder, 1966). Moreover, some studies (Ahnert, Bos, & Schneider, 2003; Anderson, 2002; Gabbard, 2008) have suggested that motor and cognitive function develop in the same period with an accelerated development between 5 and 10 years of age. Considering this relationship, this study examined executive function development as a secondary dependent variable. In general, executive function is an umbrella term that refers to the higher order of cognitive process (inhibitory control, working memory, and attentional flexibility) that establishes goal-directed action and adaptive responses to novel stimulation or situation (Hughes, 2011). In this study, executive function is specifically defined as the executive attention that associates with behavioral regulation, speed of processing, and inhibitory control (Cameron et al., 2012; Stuss & Benson, 1986).

Executive function was measured by the Day-Night (DN) Task where children were instructed to say "day" when a card with the picture of the moon was shown and say "night" when a card with a picture of the sun was shown. The total range of scores was between 0 – 16 (Gerstadt, et al., 1994). Additionally the Head Toes Shoulder Knee (HTSK) assessment was used where children were required to touch the "opposite" body part from what they are instructed to touch (Ponitz & McClelland, 2009). Children were supposed to touch their toes when told to touch their head, or touch their knees when told to touch their shoulders. The possible total score ranged from 0 to 52, in which a correct response earns 2 points, incorrect response earns 0 point, and self-corrected response earns 1 point. At the pretest of the DN tasks, participants in the *INDO-SKIP* group had 14.40 and the control group had 15.17 out of a total possible 16 points. On average, participants had around 93% accuracy in the DN task, which is higher than American children aged 4 to 6 years who had 68.8% - 86.9% accuracy in the DN tasks (Gerstadt, et al., 1994). Similar findings were also found for Chinese children compared to American children (Sabbagh, Xu, & Carlson, 2006), and Korean preschoolers compared to British children (Oh & Lewis, 2008). These two studies along with finding from this study demonstrate a potential trend that Asian children do better on the DN tasks compared to western children. Future research should continue to explore this trend and the DN assessment in different cultures or countries.

For the pretest HTSK scores, children in the *INDO-SKIP* group scored 32.46 and children in the control group scored 39.72 out of 52. These scores were pretty high, in which children scored 62.4% - 76.3% of the total possible points on the HTKS. Overall, participants in the study had pretty good self-regulation. It may be suggested that participants heavily academic curriculum at the early childhood centers contributed to children's high self-regulation. Self-regulation involves attentional focusing skills, working memory, and inhibitory control (Ponitz, et al., 2009). Thus, having a vast majority of activities at a desk, such as learning literacy and mathematic would increase children's attention, working memory, and inhibitory control. Further research should examine this idea.

Effects of an Eight-Week *INDO-SKIP* Intervention

The primary purpose of this study was to investigate the effects of an eight-week *INDO-SKIP* intervention on Indonesian preschoolers' motor competence, perceived motor competence and executive function.

Effect of *INDO-SKIP* on OC skills. It was hypothesized that children in the *INDO-SKIP* group would have significantly higher OC skills than children in the control group at the posttest. The pretest data showed that there were significant (p<.05) group differences in OC skills, in which participants in the control group had significantly higher OC raw scores than participants in the *INDO-SKIP* group. As a result of these pretest group differences it was decided to conduct a MANCOVA to co-vary out the effect of pretests scores on posttest scores. After an eight-week *INDO-SKIP* intervention it was found that participants in the *INDO-SKIP* group had significantly (p < .001) higher OC raw scores than participants in the control group when controlling for pretest OC raw scores. Therefore, the hypothesis that children in the *INDO-SKIP* group had significantly higher OC skills than children in the control group at the posttest when controlling for pretest scores was supported. To put this in context, the eight-week *INDO-SKIP* intervention was effective in improving preschooler's OC skills from the 5th percentile (raw score M = 13.78) to 46th (raw score M = 31.01) percentile. This change in percentile scores shifted the *INDO-SKIP* group from delayed to typically developing. In contrast, children in the control group only improved their OC skills from the 7th percentile to 9th percentile, remaining developmentally delayed.

Effect size is another effective way to examine the effectiveness of the *INDO-*

SKIP intervention. The effect size for *INDO-SKIP* was $\eta^2 = .55$ (from the MANCOVA analysis) and would be considered a large effect (Lomax & Hahs-Vaughn, 2012). In order to compare this intervention to previous studies, a Cohens'd effect size was calculated (Tabachnick & Fidell, 2012) and revealed a Cohens'd of $d = 2.21$. This value can be interpreted as the *INDO-SKIP* intervention contributed to 55% of the variance in posttest OC scores. Alternatively, it can be interpreted as preschoolers in the *INDO-SKIP* group had 2.21 standard deviation higher scores than preschoolers in the control group. Overall, these data support that the *INDO-SKIP* intervention has statistically significant effects and a large impact in improving preschoolers' OC skills as a result of the intervention.

Since this study is a feasibility study of the *INDO-SKIP* intervention, which is a modification of *SKIP* from the USA, it would be valuable to compare the results of the *INDO-SKIP* intervention with previous *SKIP* studies in the USA. Table 32 shows the comparison between the *INDO-SKIP* data with other previous studies.

Table 32. Comparison of effect sizes between SKIP studies and *INDO-SKIP*.

Study	Duration	Dose	Delivered by	η^2	Cohens'd
Goodway & Branta (2003)	12 weeks, 2 x 45 mins.	1080 mins.	Motor development experts	.70	3.06
Robinson & Goodway (2009)	8 weeks, 2 x 30 mins	480 mins.	Motor development experts	.73	3.96
Brian, Goodway, Logan & Sutherland (2017a)	6 weeks, 2 x 30 mins	360 mins.	Preschool teachers	.61	2.50
Brian, Goodway, Logan & Sutherland (2017b)	8 weeks, 2 x 30 mins.	480 mins.	Preschool teachers	.56	2.27
INDO-SKIP	8 weeks, 2 x 30 mins.	480 mins.	Preschool teachers	.55	2.21

Table 32 shows that the *SKIP* intervention delivered by motor development experts had larger effect sizes (d = 3.06 & 3.96) than the *SKIP* interventions delivered by preschool teachers (d = 2.21 – 2.50). However, in comparing between the two studies of *SKIP* delivered by motor development experts, Robinson & Goodway (2009) showed the larger effect size than Goodway & Branta (2003) even though Robinson & Goodway (2009) had a lesser dose than Goodway & Branta (2003). The Goodway & Branta study was the first *SKIP* study and it may be the *SKIP* intervention has become more efficient over time. Another possible explanation of this finding is that the dose of intervention is not linearly related to the effect of the *SKIP* intervention. There will possibly be an optimum dose of *SKIP* that would show a significant improvement on children's motor competence. Therefore, future research is needed to identify the optimum dose of the *SKIP* program, along with the short-term and long-term effects of the *SKIP* program on children.

The *SKIP* program was originally designed to improve children's fundamental motor skills. However, Goodway (2017) suggested that scholars also need to look "under the skill". She proposed that as children practice their fundamental motor skills during SKIP lessons, they are also improving many motor abilities or capacities such as multi limb coordination, dynamic balance, and strength (Schmidt, & Wrisberg, 2008). For example, as children practice throwing they are also working on their dynamic balance, multi-limb coordination, and rate control. Over developmental time children can apply such capacities to the learning of other sports skills and lifetime activities (Clark & Metcalfe, 2002). Thus, future research should not only measure motor competence, but also the underlying capacities of children that are related to motor competence such as balance, and multi-limb coordination.

As *SKIP* studies have evolved they have shifted from being delivered by experts to a more ecologically valid approach by being delivered by teachers. Two studies have looked at *SKIP* delivered by teachers. Brian, et al. (2017a) found that a dose of 360 mins delivered by experienced preschool teachers who had been teaching preschool for more than 15 years had a Cohens'*d* of 2.50. In contrast, Brian, et al. (2017b) with a dose of 480 mins delivered by preschool teachers who had 1 to 15 years of experience had a Cohens'*d* of 2.27. The *INDO-SKIP* study had a dose of 480 mins, and a Cohens'*d* of 2.21 with teachers who had 3 to 8 years of experience. Among those three studies, Brian, et al. (2017a) showed the highest effect size of SKIP delivered by teachers. It may be that instructor's fidelity, instructor experience in teaching, and children's constraints (i.e. balance, coordination, behavior, attitude) are possible variables that influence the effectiveness of the different SKIP interventions. Future research needs to explore these factors. Further discussion related to fidelity of teachers will be discussed later in this chapter.

Dynamic System Theory and Newell Constraints Perspectives on *INDO-SKIP* OC Outcomes. The effect of the *INDO-SKIP* intervention on children's improvement in OC skills can be explained from a Dynamic System Theory (DST) and Newell's Constraints Perspectives. DST suggests that organism (individual) development involves complex systems (Gallahue et al., 2012). These complex systems consider the interaction of several sub-subsystems, including the biological systems within individuals and the environmental systems outside of individuals. For an individual to demonstrate improvement in a skill, the system (child) must self-organize. That is, the biological and other individual systems in the body must be at an adequate level of readiness and/or supported by environmental and task factors (Gallahue, et al., 2012) to develop.

The *INDO-SKIP* intervention was theoretically designed around a constraints approach by first considering the organismic constraints a child brings to the teaching environment (e.g. balance, motivation, prior experience). Then selecting appropriate environmental constraints or prompts (e.g. footprints, targets, ball size) to assist the child in moving to a higher level of development, and finally designing developmentally appropriate and motivational tasks. Such an approach would ensure that the environmental factors and tasks factors would align with a child's developmental level and promote children to demonstrate a more proficient pattern of a motor skill. Manipulating the environment and selecting good tasks were considered positive control parameters or affordances in the environment that promoted improvements in OC skills.

In the *INDO-SKIP* intervention, environmental constraints were consistently manipulated across the intervention to keep perturbing the child's performance. For instance, in the beginning phase of the intervention, teachers used large beach balls in a catching activity because preschoolers performed at lower developmental stages (stage 1 to 3) of catching and struggled with tracking the ball and had poor hand-eye coordination. The bigger size and lighter balls were easier for preschoolers to catch. Developmental task series were developed for each of the skills like catching going from more simplistic skills to more complex skills. For example, the children first started rolling a beach ball horizontally on the floor to a partner, then did a small vertical toss, then shifted to toss a ball horizontally in the air when children were standing close to a partner. This array of developmental tasks (there were more than the three provided as an example) acted as an affordance, in which environmental factors (ball size and weight) and task factors (rolling to tossing ball) were modified to align with the developmental level of the children catching. The *INDO-SKIP* intervention used this affordance or constraints approach as essential to elicit the developmental changes in motor skills.

Overall, the theoretical design of the intervention, using Newell's Constraints (Newell, 1986) to design activities and promote affordances in the instructional environment can be considered as strength of the *INDO-SKIP* intervention. The theoretical design of the lesson plans in the *INDO-SKIP* intervention and basing those lesson plans on 25 years of research with *SKIP* is also a strength to this study. Overall, this theoretical approach to the design of the *INDO-SKIP* intervention was effective in promoting the OC skills of the preschoolers. Future research should use such a theoretically grounded approach in the design of other lesson plans.

Core Principles of *INDO-SKIP* – The *INDO-SKIP* intervention was designed based on core task and pedagogical principles. Task principles relative to the design of lesson plans highlighted that: 1) lesson design should be developmentally appropriate, 2) a focus on OC skill instruction, 3) lessons content is based on a developmental task analysis of each skill (e.g. a series of tasks from easier to more complex tasks), 4) tasks are individualized to provide appropriate levels of challenge and success in performing the tasks, 5) maximum practice trials and practice time for children is built into the lesson, 6) repetitive cycles of skills over the intervention, 7) environmental and culturally-relevant design to motivate children's participation (e.g. throwing at Indonesian cartoon characters). Those seven task principles evolved and were developed over the past 25 years of *SKIP* studies. Tasks and the progression of tasks have successfully manipulated environmental constraints sequentially based on children's development. Therefore, children were able to navigate through the complex and the progression of tasks of the *INDO-SKIP* intervention. As a result, children in the *INDO-SKIP* group improved their OC skills significantly more than children in the control group.

Pedagogical principles included: 1) direct instructional pedagogy with student choice within some tasks, 2) stage evaluation and critical element identification of each motor skill, 3) accurate demonstration, 4) the ability to modify the task, 5) critical cue words and feedback, and 6) the same teachers taught the intervention to the same class. In the beginning of implementation of *INDO-SKIP*, teachers had difficulties in evaluating children's developmental stage of motor skills, demonstrating the skills accurately, and modifying tasks. However, teachers showed gradual progress over eight weeks of the intervention. Toward the end of the *INDO-SKIP* implementation, teachers performed those pedagogical principles in their teaching. Findings from this study showed that even though teachers had difficulties in teaching *INDO-SKIP* lesson in the beginning on intervention, at the posttest, OC raw score of children in the *INDO-SKIP* group was significant higher than children in the control group. It can be concluded that the task design in *INDO-SKIP* program was effective in promoting children's motor development.

Effect of *INDO-SKIP* on the Movement Assessment Battery for Children-2 Scores. It was hypothesized that children in the *INDO-SKIP* group would have significantly higher MABC-2 scores than children in the control group at the posttest when controlling for pretest scores in the MANCOVA. The MABC-2 instrument is widely used as a screening tool by occupational therapists, physiotherapists, psychologists, and educational professionals, specifically in Europe (Brown & Lalor, 2009), to identify and describe movement impairments and Developmental Coordination Disorder (DCD) in children and adolescents 3 year through 16 years of age (Brown & Lalor, 2009).

The pretest data showed that there were no significant group differences on MABC-2 scores between participants in the *INDO-SKIP* group (74^{th} percentile) and participants in control group (66^{th} percentile). After eight weeks of the *INDO-SKIP* intervention it was found that there was also no group differences on the MABC-2 scores between the *INDO-SKIP* group (*M*=83.04 percentile) and the control group (*M*=79.07 percentile). It was concluded that the *INDO-SKIP* intervention did not affect children's motor competence as measured by the MABC-2 assessment for the participants in this study. The lack of significant findings for the MABC-2 is not surprising given the discussion under baseline measures. That is, the MABC-2 was originally designed to measure neurodevelopmental disorders in children and detect differences in the lowest movement abilities (Brown & Lalor, 2009). However more recently this instrument has been used within the motor development world to evaluate typically developing children and thus was considered appropriate to use (Logan et al., 2011). None of the participants in this study were identified as having a neurodevelopmental disorder. It may be suggested that the MABC-2 was inadequate in detecting changes for fundamental motor skills interventions and for more typical populations of children. It may be that ceiling effects in the MABC-2 scores impacted the results.

Another factor that might explain why the *INDO-SKIP* intervention did not affect the MABC-2 scores of children is a lack of alignment between the *INDO-SKIP* intervention and the MABC-2 measurement. The *INDO-SKIP* intervention was focused on fundamental motor skills, specifically improving critical elements of proficient performance. This process-oriented approach (e.g. technique) to teaching fundamental motor skills in *INDO-SKIP* is not in alignment with the product-oriented activities measured in the MABC-2 (Henderson et al., 2007). For instance, in throwing activities, the MABC-2 measured how many times children can hit the target. It does not measure "how" children throw, whether children step with opposition or get their arm back. As a result, the MABC-2 did not measure what children were trained to do in the *INDO-SKIP* intervention. The findings from this study relative to the MABC-2 highlight the importance of intervention researchers carefully aligning the intervention goals and content with evaluation measures. If we had only used the MABC-2 to measure the effect of *INDO-SKIP* in this study, we would have concluded that *INDO-SKIP* was not effective in improving children's motor competence.

Summary of Motor Competence

Overall, the *INDO-SKIP* intervention was appropriately designed to promote

Indonesian preschoolers' OC skills with a large effect size. This study also demonstrated that it is possible to implement the *INDO-SKIP* intervention in Indonesian early childhood centers settings with preschool teachers resulting in significant improvement in children's motor competence, specifically OC competence. However, it is important to note that we need to be careful in choosing the assessment to measure the effect of an intervention. This study showed that when the measurement is not aligned with the intervention, as in the case of the MABC-2, intervention effects were not detected.

Effect of *INDO-SKIP* on Perceived Motor Competence. Children's perceived motor competence was measured by the Perceived Physical Competence subscale (PPC) of the Pictorial Scale for Perceived Competence and Social Acceptance for Young Children (Harter & Pike, 1984), and the Pictorial Scale of Perceived Movement Skill Competence (PMSC) for Young Children instrument (Barnett, et al., 2015). The PPC measures a child's perception on six general physical competencies (swinging, climbing the monkey bar, tying shoe laces, skipping, hopping, and running). The PMSC measures the child's perception on six LOC skills (run, gallop, hop, leap, jump, and slide) and six ball skills (throw, catch, roll a ball, kick, strike, and dribble). It was hypothesized that children in the *INDO-SKIP* group would have significantly higher perceived motor competence than children in the control group at the posttest when accounting for the pretest. The pretest data showed that overall participants had "pretty good" perceptions of their motor competence for both PPC and PMSC scores. In addition, there were significant group differences on PPC and PMSC scores, in which children in the *INDO-SKIP* group had significantly lower scores on PPC and PMSC than children in control group.

After the eight-week *INDO-SKIP* intervention, it was found that participants in the *INDO-SKIP* group had higher posttest score in PPC (*M* = 3.76, *SD* = 0.30) than children in the control group (*M* = 3.67, *SD* = 0.36). Similarly, children in the *INDO-SKIP* group also had higher posttest scores in the PMSC (*M* = 3.70, *SD* = .24) than children in the control group (*M* = 3.57, *SD* = 0.36) when controlling for pretest scores. These data demonstrate that children in the *INDO-SKIP* group perceived themselves close to being "really good" in posttest measures of the PPC and PMSC.

The improvement in children's perceived motor competence could be a result of children having success-oriented and positive experiences in the *INDO-SKIP* intervention. Prior to the start of *INDO-SKIP*, preschoolers did not have any motor skill program at their schools and in the community. Furthermore, children and teachers were not familiar with some of the motor skills, such as gallop, skip, dribble and strike a ball. It may be that perceptions of competence improved as the *INDO-SKIP* intervention was designed to provide an appropriate level of challenge and success in performing the tasks. The tasks developed for each skill started with simple tasks and gradually improved in difficulty based on a task analysis and manipulation of environmental and task constraints. Thus students experienced success in performing skills. Additionally, teachers provided positive, specific feedback to the children, for example "I like the way you stepped and threw the ball". Moreover, children were able to observe their friends performing skills during the intervention, which provided peer modeling. Harter (1978) suggests there are four constructs that contribute to development of perceived competence. These are, 1) past experiences, 2) difficulty or challenge associated with outcomes, 3) reinforcement and personal interaction with others, and 4) intrinsic motivation. As the *INDO-SKIP* intervention was developmentally appropriate, children had positive experiences learning motor skills that may have led to their increased perceptions of motor competence (White, 1959). In addition to that, teachers who delivered the *INDO-SKIP* intervention provided developmentally and instructionally appropriate cue words and feedback during teaching. In all of these ways, children understood they were doing well and had positive experiences during the intervention, which may have helped them to feel competent (White, 1959).

Overall, the *INDO-SKIP* intervention was effective in improving children's perceived motor competence. The tasks and instruction designed were developmentally appropriate for young children to provide positive experiences for children during the intervention.

Effect of *INDO-SKIP* on Executive Function. Executive function in this study focused on executive attention, which is associated with behavioral regulation, speed of processing, and inhibitory control (Stuss & Benson, 1986). Executive function was measured by the Day-Night (DN) Task and the Head Toes Shoulder Knee (HTSK) Assessment.

At the pretest, there was no significant group difference on pretest DN scores. After the 8-week *INDO-SKIP* intervention, it was found that there was a significant group difference at the posttest for DN scores, in which the mean rank of the *INDO-SKIP* group was higher than the control group. Participants in the *INDO-SKIP* group increased their

DN score, but participants in the control group slightly decreased their DN score from pretest to posttest. Meanwhile, the control group showed a higher mean pretest rank of HTKS scores than the *INDO-SKIP* group. By the posttest there were no significant group differences in HTKS scores. Across the intervention the children in the *INDO-SKIP* had double the improvements in HTKS scores that children in control group had. Together these findings indicated that *INDO-SKIP* intervention influenced children executive function development.

The *INDO-SKIP* intervention was not specifically designed to target children's executive function. In spite of this, much of the *INDO-SKIP* intervention involved children engaging in a variety of activities that may have developed behavioral regulation, speed of processing, and inhibitory control. For instance, children were prompted to "freeze" or to put down their equipment, be quiet, and pay attention to the teacher when the teacher was demonstrating and explaining a game. During this situation, children engaged in the process of holding information in their mind, resisting distraction, and withholding response in the presence of cues. Then, when children were prompted, they engaged in a game where they followed instructions given by teachers and adapted to modification of the tasks. This circumstance required children to have attention, an ability to manage their behavior, and correct response to the instruction. Previous studies (Bell & Livesey, 1985; Zelazo, Reznick, & Pinon, 1995) reported that in an active performance condition, young children tended to have difficulties in withholding motor responses and performed incorrect motor responses. However, Diamond and Lee (2011) suggested that programs that involve repeated practice and progressively increase the challenge successfully promoted children's executive function (e.g. attention, self-regulation). Such research may be a partial explanation for findings in this study. The *INDO-SKIP* lessons were designed to provide repeated practice trials for children and progressively increase the complexity or the level of difficulty of task challenge (as explained previously in the task principles). Such activities could possibly improve their "hot executive function", which is the ability to be emotionally prepared in controlling behavior to comply to the demands of the classroom (Brock, et al., 2009). The findings from this study contribute to the literature but are an intial step in this area. Future studies need to specifically target executive function within motor skill interventions, and align instructional activities within lessons to specific elements of executive function.

Overall, an eight week *INDO-SKIP* intervention influenced children's executive function development. It is also important to note that children in the control group slightly decreased their executive function measured by the DN instrument, while children in the *INDO-SKIP* group improved their score in both DN and HTKS tasks. Future research is needed to investigate the dose and mechanism underlying the influence of motor skills on children's executive function development.

Future Research Recommendation

During the discussion future research recommendations were suggested. This section provides a summary of the main recommendations for future research subdivided by the initial training and motor skill intervention research.

Future research recommendations for the initial training

During the initial teacher training on *INDO-SKIP* it was recommended that the current content and pedagogical approach to the *INDO-SKIP* training would stay the same. However, it was suggested that in future research teachers would have an opportunity to work with children during the training. It would be beneficial for teachers to observe children perform fundamental motor skills and allow the teachers to stage the children and identify common errors. In addition, the teachers would benefit from practice teaching with the children rather than peer teaching.

A second major recommendation is to have a week-long period of transition from the teacher training to the official beginning of the *INDO-SKIP* program. During this time teachers would teach a variety of games and music to movement which would provide them with opportunities to observe and practice teaching with children in their classroom. A third major recommendation would be to have the principals of schools and administration staff to attend the initial training in order to have the administrators understand what is going on during the *INDO-SKIP* program and encourage buy-in from the administrators. This would hopefully provide a supportive atmosphere to encourage teachers in delivering the *INDO-SKIP* motor skill program.

Recommendations for motor competence, perceived motor competence, and executive function studies

Future research related to motor competence, perceived motor competence, and executive function should:

1. Investigate the individual, environmental, and task constraints that contribute to the OC developmental delays shown by preschoolers in Indonesia. This would help to develop appropriate motor skill interventions.

2. Examine the social-cultural context that influences children's motor competence and perceived motor competence.
3. Delete the "tying shoelaces" question in the Perceived Physical Competence (PPC) instrument as many young children do not tie shoe laces as they have Velcro shoe closures; and replace it with a question on zipping a jacket or buttoning a coat or shirt that reflects more contemporary clothing.
4. Evaluate children's accessibility to physical activity in order to understand and interpret a child's motor competence in light of opportunities to be active.
5. Continue to examine the relationship between executive function, motor competence, and perceived motor competence.

For the *INDO-SKIP* intervention, future research should:

1. Measure not only motor competence improvement, but also the underlying capacities of children that are related to motor competence such as balance, and multi-limb coordination.
2. Investigate the relationship of dose of the *INDO-SKIP* intervention to children's motor competence, perceived motor competence, and executive function.
3. Develop activities within the *INDO-SKIP* intervention that explicitly target promoting children's executive function.
4. Qualitatively examine a teacher's journey and perspective in learning how to deliver the *INDO-SKIP* program.
5. Investigate the type and frequency of feedback that teachers use during teaching *INDO-SKIP*, how that changes over time, and how feedback influences children's

motor skill learning.

6. Assess the specific time children engage in each instructional task and assess practice trials during the intervention as a mediator of motor skill learning.
7. Develop and evaluate an *INDO-SKIP* program with modified lessons that can be taught in the classroom or on the playground because many centers do not have a dedicated gymnasium.
8. Duplicate the *INDO-SKIP* intervention in a fully-powered larger sample with a randomized experimental design to further evaluate the impact of the *INDO-SKIP* intervention for Indonesian children.

Implications

Findings from this study have several practical implications for policy makers, early childhood centres, and early childhood teachers to promote children's motor competence, perceived motor competence, and executive function.

Implications for policy makers and early childhood centres

Policy makers and administrative personnel in early childhood centres need to:

1. Be aware that children are delayed in their motor skill competence and are in need of structured motor skill programs.
2. Understand that boys have better OC skills than girls and also perceived motor competence, but structured programs like *INDO-SKIP* can help girls improve their OC skill competence and perceived motor competence.
3. Be aware that motor skill programs will also help promote certain aspects of executive function in preschoolers.

4. Schedule motor skill programs like *INDO-SKIP* as part of the regular school curriculum as it gives many benefit for children's development.
5. Provide professional development for teachers to learn about motor skill development and motor skill instruction.
6. Provide designated safe spaces for structured motor skill programs.

Implications for teachers

Early childhood teachers need to:

1. Be able to accommodate gender differences in OC competence and perceived motor competence by planning a variety of motor skill activities to promote boys and girls motor competence and perceived motor competence.
2. Provide lots of opportunities across the school day for children to engage in structured and unstructured motor skills.
3. Deliver developmentally appropriate instruction in teaching motor skills.
4. Educate parents about the importance of motor skills and perceived motor competence and how to promote motor development at home.

Implications for policy

Policy makers need to create policy to support the sustainable implementation of motor skill programs in early childhood centers. These policies may include:

1. Require that all early childhood centers have a physical activity space that meets the guidelines for young children.
2. Mandate that structured motor skill intervention programs are provided at early childhood centers.

3. Set a monthly community meeting program for early childhood teachers, researchers, and motor development experts to discuss and promote motor competence and perceived motor competence.
4. Provide sport development coaching program that involve researchers, experts, and early childhood teachers who involve and implement motor skill program at schools.

Summary

In summary, this study showed that the *INDO-SKIP* intervention was feasible to be implemented in Indonesia. A nine-hour initial teacher training consisting of motor skill development and *INDO-SKIP* lessons was shown to be effective in improving teacher's knowledge of motor skills and teaching motor skills in a physical education setting. Teachers successfully acquired adequate knowledge to teach the *INDO-SKIP* lesson plans.

The vast majority (97%) of participants involved in this study were developmentally delayed in their OC skill competence. The 480 minutes *INDO-SKIP* program delivered by trained early childhood teachers with 77% fidelity was effective in improving children's OC skills. *INDO-SKIP* children showed an improvement from the 4^{th} percentile (developmentally delayed) to 46^{th} percentile (typically developing). Moreover, the *INDO-SKIP* program also influenced children's perceived motor competence and executive function development. In contrast, the control children started at the 7^{th} percentile for OC skills and went to the 9^{th} percentile. In addition, children in the control group had significantly lower scores on perceived motor competence and in executive function measured by the DN task than children in *INDO-SKIP* group at the posttest.

This study was the first motor skill intervention study of its' kind conducted in Indonesia. As early childhood curriculum in Indonesia are currently heavy in academic content, it is important to note that this study demonstrated benefits to motor skill competence along with executive function. Therefore, early childhood centers and policy makers should include structured motor skill programs such as *INDO-SKIP* in the school curriculum.

Bibliography

Adamo, K. B., Wilson, S., Harvey, A. J., Grattan, K. P., Naylor, P., Temple, V. A., & Goldfield, G. S. (2015). Does Intervening in Childcare Settings Impact Fundamental Movement Skill Development?. *Medicine & Science In Sports & Exercise, 48(5)*, 926-932

Adams, A. M., Bourke, L., & Willis, C. (1999). Working memory and spoken language comprehension in young children. *International Journal of Psychology*, *34*(5-6), 364-373.

Adolph, K. E., & Berger, S. E. (2006). Motor development. In D. Kuhn & R. Siegler (Eds.). Handbook of child psychology. Cognition, perception, and language (Vol. 2, pp. 161–213). New York: Wiley.

Ahnert, J., Bos, K., & Schneider, W. (2003). Motor development and cognitive development during the preschool and school years: Findings from the Munich longitudinal study LOGIC. *Zeitschrift fur Entwicklungspsychologie und Padagogische Psychologie*, *35*(4), 185-199.

Altunsöz, I. H., & Goodway, J. D. (2016). SKIPing to motor competence: the influence of project successful kinesthetic instruction for preschoolers on motor competence of disadvantaged preschoolers. *Physical Education and Sport Pedagogy*, *21*(4), 366-385.

Ames, C. (1987). The enhancement of student motivation. In D. Kleiber & M. Maehr (Eds.), *Advances in motivation and achievement* (pp. 123-148). Greenwich, CT: JAI Press.

Ames, C. (1992a). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261 – 271.

Ames, C. (1992b). Achievement goals, motivational climate, and motivational processes. In G. C. Roberts (Eds.), *Motivation in sport and exercise* (pp. 161- 176). Champaign, IL: Human Kinetics.

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology, 80*, 260-267.

Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. *Child neuropsychology*, *8*(2), 71-82.

Anderson, G. L., Herr, K., & Nihlen, A.S. (2007). *Studying Your Own School: An Educator's Guide to Practitioner Action Research*. London: Sage Publications

Armour, K. & Yelling, M. (2004). Professional 'development' and professional 'learning': Bridging the gap for experienced physical education teachers. *European Physical Education Review, 10(1),* 71-93.

Babic, M. J., Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., White, R. L., & Lubans, D. R. (2014). Physical activity and physical self-concept in youth: systematic review and meta-analysis. *Sports Medicine*, *44*(11), 1589-1601.

Badan Pusat Statistik (BPS). (2017). Kota Padang dalam Angka 2017. Padang: Badan Pusat Statistik.

Ball, D. L., & Cohen, D. K. (1996). Reform by the book: What is: Or might be: The role of curriculum materials in teacher learning and instructional reform?. *Educational researcher*, *25*(9), 6-14.

Barnett, L. M., Morgan, P. J., van Beurden, E., & Beard, J. R. (2008). Perceived sports competence mediates the relationship between childhood motor skill proficiency and adolescent physical activity and fitness: a longitudinal assessment. *International Journal of Behavioral Nutrition and Physical Activity, 5(1),* 40.

Barnett, L. M., Morgan, P. J., Van Beurden, E., Ball, K., & Lubans, D. R. (2011). A reverse pathway? Actual and perceived skill proficiency and physical activity. *Medicine & sciences in sports & exercise*, *43*(5), 898-904.

Barnett, L. M., Ridgers, N. D., Zask, A., & Salmon, J. (2015a). Face validity and reliability of a pictorial instrument for assessing fundamental movement skill perceived competence in young children. *Journal of science and medicine in sport*, *18*(1), 98-102.

Barnett, L. M., van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2010). Gender differences in motor skill proficiency from childhood to adolescence: A longitudinal study. *Research quarterly for exercise and sport*, *81*(2), 162-170.

Barnett, L., van Beurden, E., Morgan, P., Brooks, L., & Beard, J. (2009). Childhood motor skill proficiency as a predictor of adolescent physical activity. *Journal of Adolescent Health,*44, 252-259.

Barnett, L. M., Ridgers, N. D., & Salmon, J. (2015b). Associations between young children's perceived and actual ball skill competence and physical activity. *Journal of Science and Medicine in Sport*, *18*(2), 167-171.

Barnett, L. M., Zask, A., Rose, L., Hughes, D., & Adams, J. (2015c). Three-year follow-up of an early childhood intervention: what about physical activity and weight status?. *Journal of Physical Activity and Health*, *12*(3), 319-321.

Bart, O., Hajami, D., & Bar-Haim, Y. (2007). Predicting school adjustment from motor abilities in kindergarten. *Infant and Child Development*, *16*(6), 597-615.

Bayar, A. (2014). The Components of Effective Professional Development Activities in Terms of Teachers' Perspective. *Online Submission*, *6*(2), 319-327.

Bechtel, P. A., & O'Sullivan, M. (2006). Chapter 2: Effective professional development—What we now know. *Journal of teaching in physical education*, *25*(4), 363-378.

Bell, J. A., & Livesey, P. J. (1985). Cue significance and response regulation in 3-to 6-year-old children's learning of multiple choice discrimination tasks. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology*, *18*(3), 229-245.

Best, J. R., & Miller, P. H. (2010). A developmental perspective on executive function. *Child Development, 81(6),* 1641-1660.

Birman, B. F., Desimone, L., Porter, A. C., & Garet, M. S. (2000). Designing professional development that works. Educational Leadership, 57(8), 28-33.

Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American psychologist*, *57*(2), 111.

Blair, C., Granger, D., & Peters Razza, R. (2005). Cortisol reactivity is positively related to executive function in preschool children attending Head Start. *Child development*, *76*(3), 554-567.

Blair, C., Knipe, H., Cummings, E., Baker, D., Gamson, D., Eslinger, P., et al. (2007). A developmental neuroscience approach to the study of school readiness. In R. C. Pianta, M. J. Cox, & K. L. Snow (Eds.), School readiness and the transition to kindergarten in the era of accountability (pp. 149–174). Baltimore, MD: Brookes.

Bonvin, A., Barral, J., Kakebeeke, T. H., Kriemler, S., Longchamp, A., Schindler, C., & ... Puder, J. J. (2013). Effect of a governmentally-led physical activity program on motor skills in young children attending child care centers: a cluster randomized controlled trial. *International Journal Of Behavioral Nutrition & Physical Activity,* 1090-101.

Botvinick, M. M., Braver, T. S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological review*, *108*(3), 624.

Boyle, B., While, D., & Boyle, T. (2004). A longitudinal study of teacher change: What makes professional development effective? The Curriculum Journal, 15(1), 45-68.

Branta, C. F., Haubenstricker, J., & Seefeldt V. (1984). Ages changes in motor skill during childhood and adolescence. In R. L. Terjung (Ed.). *Exercise and Sport Science Reviews* (pp. 467 – 520). New York: MacMillan Publishing Company

Brian, A., Goodway, J. D., Logan, J. A., & Sutherland, S. (2017a). SKIPing with teachers: an early years motor skill intervention. *Physical Education and Sport Pedagogy*, 1-13.

Brian, A., Goodway, J. D., Logan, J. A., & Sutherland, S. (2017b). SKIPing With Head Start Teachers: Influence of T-SKIP on Object-Control Skills. *Research quarterly for exercise and sport*, *88*(4), 479-491.

Brian, A. S., Haegele, J. A., Bostick, L., Lieberman, L. J., & Nesbitt, D. (2018). A Pilot Investigation of the Perceived Motor Competence of Children with Visual Impairments and Those Who Are Sighted. *Journal of Visual Impairment & Blindness*, *112*(1), 118-124.

Brock, L. L., Rimm-Kaufman, S. E., Nathanson, L., & Grimm, K. J. (2009). The contributions of 'hot'and 'cool'executive function to children's academic achievement, learning-related behaviors, and engagement in kindergarten. *Early Childhood Research Quarterly*, *24*(3), 337-349.

Bronfenbrenner, U. (1979). The ecology of human development: Experiments by design and nature.

Brown, T., & Lalor, A. (2009). The movement assessment battery for children-second edition (MABC-2): a review and critique. *Physical & occupational therapy in pediatrics*, *29*(1), 86-103.

Burton, A. W., & Miller, D. E. (1998). *Movement skill assessment*. Human Kinetics.

Bushnell, E. W., & Boudreau, J. P. (1993). Motor development and the mind: The potential role of motor abilities as a determinant of aspects of perceptual development. *Child development*, *64*(4), 1005-1021.

Buysse, V., Winton, P. J., & Rous, B. (2009). Reaching consensus on a definition of professional development for the early childhood field. *Topics in early childhood special education*, *28*(4), 235-243.

Cameron, C. E., Brock, L. L., Murrah, W. M., Bell, L. H., Worzalla, S. L., Grissmer, D., & Morrison, F. J. (2012). Fine motor skills and executive function both contribute to kindergarten achievement. *Child development*, *83*(4), 1229-1244.

Campbell, D. T., & Stanley, J. C. (2015). *Experimental and quasi-experimental designs for research*. Ravenio Books.

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental neuropsychology*, *28*(2), 595-616.

Carroll, B., & Loumidis, J. (2001). Children's perceived competence and enjoyment in physical education and physical activity outside school. *European physical education review*, *7*(1), 24-43.

Central Intelligence Agency (CIA). (2016). The world factbook. East & South Asia: Indonesia. CIA website: https://www.cia.gov/library/publications/the-world-factbook/geos/id.html. October 25, 2016.

Chan, R. C., Shum, D., Toulopoulou, T., & Chen, E. Y. (2008). Assessment of executive functions: Review of instruments and identification of critical issues. *Archives of clinical neuropsychology*, *23*(2), 201-216.

Chasiotis, A., Kiessling, F., Winter, V., & Hofer, J. (2006). Sensory motor inhibition as a prerequisite for theory-of-mind: A comparison of clinical and normal preschoolers differing in sensory motor abilities. *International Journal of Behavioral Development*, *30*(2), 178-190.

Clark, J. E., & Metcalfe, J. S. (2002). The mountain of motor development: A metaphor. In. J. E. Clark & J. H. Humphrey (Eds.), *Motor Development: Research and Review: Vol. 2* (pp. 62-95). Reston, VA: NASPE Publications.

Clark, J. E., & Phillips, S. J. (1993). A longitudinal study of intralimb coordination in the first year of independent walking: a dynamical systems analysis. *Child development*, *64*(4), 1143-1157.

Clark, J. E. & Whitall, J. (1989). What is motor development: The lessons of history. *Quest, 41,* 183 – 202

Centers for Disease Control and Prevention. (2010). The association between school based physical activity, including physical education, and academic performance. *Atlanta, GA: US Department of Health and Human Services*, *9*.

Center for Disease Control and Prevention. (2015). *A Report of the Surgeon General Physical Activity and Health The Link Between Physical Activity and Morbidity and Mortality.* Retrieved from: http://www.cdc.gov/nccdphp/sgr/mm.htm. January 18th, 2016.

Cohen, K. E., Morgan, P. J., Plotnikoff, R. C., Callister, R., & Lubans, D. R. (2015). Physical activity and skills intervention: SCORES cluster randomized controlled trial. *Medicine and science in sports and exercise*, *47*(4), 765-774.

Collins, A. E., Pakiz, B., & Rock, C. L. (January 01, 2008). Factors associated with obesity in Indonesian adolescents. *International Journal of Pediatric Obesity : Ijpo : an Official Journal of the International Association for the Study of Obesity, 3,* 1, 58-64.

Cools, W., De Martelaer, K., Samaey, C., & Andries, C. (2011). Fundamental movement skill performance of preschool children in relation to family context. *Journal of Sports Sciences, 29(7),* 649–660.

Danis. C. (1992). A Unifying Framework for Data-Based Research into Adult Self-Directed Learning. In H. B. Long, *Self-Directed Learning: Application and Research,* Norman: Oklahoma Research Center for Continuing Professional and Higher Education, University of Oklahoma .

Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, *44*(11), 2037-2078.

Davis, W. E., & Burton, A. W. (1991). Ecological task analysis: Translating movement behavior theory into practice. *Adapted Physical Activity Quarterly*, *8*(2), 154-177.

Deli, E., Bakle, I., & Zachopoulou, E. (2006). Implementing intervention movement programs for kindergarten children. *Journal of Early Childhood Research, 4*(1), 5-18.

Denboba, A., Hasan, A., & Wodon, Q. (Eds.). (2015). *Early Childhood Education and Development in Indonesia: An Assessment of Policies Using SABER*. World Bank Publications.

Diamond, A. (2000). Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. *Child development*, *71*(1), 44-56.

Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, *333*(6045), 959-964.

Donath, L., Faude, O., Hagmann, S., Roth, R., & Zahner, L. (2015). Fundamental movement skills in preschoolers: a randomized controlled trial targeting Object control proficiency. *Child: Care, Health & Development, 41(6),* 1179-118.

Downer, J. T., Locasale-Crouch, J., Hamre, B., & Pianta, R. (2009). Teacher characteristics associated with responsiveness and exposure to consultation and online professional development resources. *Early Education and Development 20*, 431-455.

Draper, C. E., Achmat, M., Forbes, J., & Lambert, E. V. (2012). Impact of a community-based programme for motor development on gross motor skills and cognitive function in preschool children from disadvantaged settings. *Early child development and care*, *182*(1), 137-152.

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., ... & Sexton, H. (2007). School readiness and later achievement. *Developmental psychology*, *43*(6), 1428.

Durlak, J. A., & DuPre, E. P. (2008). Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. *American journal of community psychology*, *41*(3-4), 327-350.

Edelman, G. M. (1987). *Neural Darwinism: The theory of neuronal group selection*. Basic Books.

Ellinoudis, T., Evaggelinou, C., Kourtessis, T., Konstantinidou, Z., Venetsanou, F., & Kambas, A. (2011). Reliability and validity of age band 1 of the Movement Assessment Battery for Children–Second Edition. *Research in developmental disabilities*, *32*(3), 1046-1051.

Famelia, R., Goodway, J., Bakhtiar, S., & Mardela, R. (2016). Investigating the Motor Competence and Physical Activity of Indonesian, Muslim Preschoolers from Urban and Rural Areas. *Journal of Sport & Exercise Psychology, (supplement) S33*

Famelia, R., Tsuda, E., Bakhiar., & Goodway. (In Press). Relationships among Perceived and Actual Motor Skill Competence and Physical Activity in Indonesian Preschoolers. *Journal of Motor Learning and Development*

Gabbard, C. P. (2008). Lifelong Motor Development (5th ed.). San Francisco: Pearson-Benjamin Cummings.

Gagen, L. M., & Getchell, N. (2006). Using 'constraints' to design developmentally appropriate movement activities for early childhood education. *Early Childhood Education Journal, 34(3),* 227–232.

Gall, M. D., Borg, W. R., & Gall, J. P. (2007). Educational research: An introduction (8th ed.). White Plains, NY: Longman.

Gallahue, D. L., Ozmun, J. C., & Goodway, J. D. (2012). *Understanding motor development: Infants, children, adolescents, adults (*7th ed.). New York, NY: McGraw Hill.

Garavan, H., Ross, T. J., Murphy, K., Roche, R. A. P., & Stein, E. A. (2002). Dissociable executive functions in the dynamic control of behavior: inhibition, error detection, and correction. *Neuroimage*, *17*(4), 1820-1829.

Garcia, C. (1994). Gender differences in young children's interactions when learning fundamental motor skills. *Research Quarterly for Exercise and Sport, 65*, 213-225.

Garcia, C. & Garcia, L. (2002). Examining developmental changes in throwing. In J. E. Clark, & J. Humphreys (Eds.). *Motor development: Research and reviews, volume 2,* (pp. 62-95). Reston, VA: National Association of Sport and Physical Education.

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: a review using an integrative framework. *Psychological bulletin*, *134*(1), 31.

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: performance of children 31/2–7 years old on a stroop-like day-night test. *Cognition*, *53*(2), 129-153.

Gesell, A., & Thompson, H. A. (1934). Infant behaviour: Its genesis and growth. New York, NY: McGraw-Hill.

Golos, A., Sarid, M., Weill, M., & Weintraub, N. (2011). Efficacy of an early intervention program for at-risk preschool boys: A two-group control study. *American Journal of Occupational Therapy*, *65*(4), 400-408.

Goodway, J. D., & Amui, H. (2007). Promoting motor development in disadvantaged preschoolers: To direct or facilitate?. *Journal of Sport & Exercise Psychology*, *29*.

Goodway, J. D. & Branta, C. F. (2003) Influence of a motor skill intervention on fundamental motor skill development of disadvantaged preschool children. *Research Quarterly for Exercise and Sport, 74*, 36–47.

Goodway, J. D., Crowe, H., & Ward, P. (2003) Effects of motor skill instruction on fundamental motor skill development. *Adapted Physical Activity Quarterly, 20*, 298–314.

Goodway, J. D., Famelia, R., & Bakhtiar, S. (2014). Future directions in physical education & sport: developing fundamental motor competence in the early years is paramount to lifelong physical activity. *Asian Social Science*, *10*(5), 44.

Goodway, J. D., & Robinson, L. E. (2006). SKIPing toward an active start: Promoting physical activity in preschoolers. *Beyond the Journal: Young Children*, *61*(3), 1-6.

Goodway, J.D., Robinson, L., & Crowe, H. (2010). Gender differences in fundamental motor skill development in disadvantaged preschoolers in two geographical regions. *Research Quarterly for Exercise & Sport, 81(1),* 17-24.

Goodway, J. D., & Rudisill, M. E. (1996). Influence of a motor skill intervention program on perceived competence of at-risk African American preschoolers. *Adapted Physical Activity Quarterly*, *13*(3), 288-301.

Goodway, J. D., & Rudisill, M. E. (1997). Perceived physical competence and actual motor skill competence of African American preschool children. *Adapted PA Quarterly, 14*, 314-326.

Goodway, J. D., & Smith, D. W. (2005). Keeping all children healthy: Challenges to leading an active lifestyle for preschool children qualifying for at-risk programs. *Family & Community Health*, *28*, 142-155.

Graham, G., Holt/Hale, S. and Parker, M. (2012) Children Moving (9th ed). Mountain View: Mayfield Press.

Grissmer, D., Grimm, K. J., Aiyer, S. M., Murrah, W. M., & Steele, J. S. (2010). Fine motor skills and early comprehension of the world: two new school readiness indicators. *Developmental psychology*, *46*(5), 1008.

Guskey, T. R., & Yoon, K. S. (2009). What works in PD. *Phi Delta Kappan*, *90*(7), 495-500.

Hamilton, M., Goodway, J. D., & Haubenstricker, J. (1999) Parent-assisted instruction in a motor skill program for at risk preschool children. *Adapted Physical Activity Quarterly, 16*, 415–426.

Hands, B. P. (2012). How fundamental are fundamental movement skills?. *Active and Healthy Magazine*, *19*(1).

Hardy, L. L., King, L., Kelly, B., Farrell, L., & Howlett, S. (2010). Munch and Move: evaluation of a preschool healthy eating and movement skill program. *International Journal of Behavioral Nutrition and Physical Activity*, *7*(1), 80.

Harter, S. (1978). Effectance motivation reconsidered: Toward a developmental model. Human Development, 21, 34–64.

Harter, S. (1982). The perceived competence scale for children. Child Development, 53, 87–97.

Harter, S. (1999). *The construction of the self: A developmental perspective*. Guilford Press.

Harter, S., & Pike, R. (1984). The pictorial scale of perceived competence and social acceptance for young children. *Child Development, 55*, 1969-1982.

Hartman, E., Houwen, S., Scherder, E., & Visscher, C. (2010). On the relationship between motor performance and executive functioning in children with intellectual disabilities. *Journal of Intellectual Disability Research*, *54*(5), 468-477.

Hasan, A., Hyson, M., & Chang, M. C. (2013). *Early childhood education and development in poor villages of Indonesia: Strong foundations, later success*. World Bank Publications.

Hastie, P. A., Rudisill, M. E., & Boyd, K. (2016). An ecological analysis of a preschool mastery climate physical education programme. *Physical Education and Sport Pedagogy*, *21*(2), 217-232.

Haywood, K. M., & Getchell, N. (2008). *Lifespan Motor Development (5th ed.).* Champaign, IL: Human Kinetics.

Henderson, S. E., Sugden, D. A., & Barnett, A. L. (2007). *Movement assessment battery for children-2*. Harcourt Assessment.

Hirsh-Pasek, K., Golinkoff, R. M., & Eyer, D. (2004). *Einstein never used flash cards: How our children really learn--and why they need to play more and memorize less*. Emmaus, PA: Rodale.

Hodges, N. J., & Franks, I. M. (2002). Modelling coaching practice: the role of instruction and demonstration. *Journal of sports sciences*, *20*(10), 793-811.

Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: A systematic review. *Psychology of Sport and Exercise*, *15*(4), 382-391.

Hughes, C. (2011). Changes and challenges in 20 years of research into the development of executive functions. *Infant and Child Development*, *20*(3), 251-271.

Hulleman, C. S., Rimm-Kaufman, S. E., & Abry, T. (2013). Innovative methodologies to explore implementation: Whole-part-whole-construct validity, measurement, and analytical issues for intervention fidelity assessment in education research. Applying implementation science in early childhood programs and systems, 65-93

Iivonen, S., Saakslahti, A., & Nissinen, K. (2011). The Development of Fundamental Motor Skills of Four- to Five-Year-Old Preschool Children and the Effects of a Preschool Physical Education Curriculum. *Early Child Development And Care, 181(3)*, 335-343.

Jones, R. A., Riethmuller, A., Hesketh, K., Trezise, J., Batterham, M., & Okely, A. D. (2011). Promoting fundamental movement skill development and physical activity in early childhood settings: A cluster randomized controlled trial. *Pediatric Exercise Science, 23*(4), 600-615.

Julia, M., van, W. M. M., Prawirohartono, E. P., Surjono, A., & Delemarre-van, W. H. A. (2008). Tracking for Underweight, Overweight and Obesity from Childhood to Adolescence: A 5-Year Follow-Up Study in Urban Indonesian Children. *Hormone Research, 69,* 5, 301-306.

Junaid, K. A., & Fellowes, S. (2006). Gender differences in the attainment of motor skills on the movement assessment battery for children. *Physical & Occupational Therapy in Pediatrics*, *26*(1-2), 5-11.

Knowles, M. S. (1975). *Self-Directed Learning.* New York: Association Press.

Knowles, M. S. (1980). The modern practice of adult education (revised and updated). *New York: Cambridge*.

Kordi, R., Nourian, R., Ghayour, M., Kordi, M., & Younesian, A. (2012). Development and Evaluation of a Basic Physical and Sports Activity Program for Preschool Children in Nursery Schools in Iran: an Interventional Study. *Iranian Journal Of Pediatrics,* 22(3), 357-363.

Koziol, L. F., Budding, D. E., & Chidekel, D. (2012). From movement to thought: Executive function, embodied cognition, and the cerebellum. *The Cerebellum*, *11*(2), 505-525.

Krombholz, H. (2012). The impact of a 20-month physical activity intervention in child care centers on motor performance and weight in overweight and healthy-weight preschool children. *Perceptual & Motor Skills, 115(3),* 919-932.

Langendorfer, S. J., & Roberton, M. A. (2002). Developmental profiles in overarm throwing: Searching for “attractors”, “stages”, and “constraints.” In J. E. Clark&

J. H. Humphrey (Eds.). *Motor Development: Research and Review: Vol. 2* (pp. 1-25). Reston, VA: NASPE Publications.

Lee, T.D. and White, M.A. (1990). Influence of an unskilled model's practice schedule on observational motor learning. Human Movement Science, 9, 349-367

LeGear, M., Greyling, L., Sloan, E., Bell, R. I., Naylor, P., & Temple, V. A. (2012). A window of opportunity? Motor skills and perceptions of competence of children in Kindergarten. *International Journal of Behavioral Nutrition and PA*, 9, 29.

Leon, A. C., Davis, L. L., & Kraemer, H. C. (2011). The role and interpretation of pilot studies in clinical research. *Journal of psychiatric research*, *45*(5), 626-629.

Lin, H., Lawrence, F. R., & Gorrell, J. (2003). Kindergarten teachers' views of children's readiness for school. *Early Childhood Research Quarterly, 18*, 225–237.

Liong, G. H., Ridgers, N. D., & Barnett, L. M. (2015). Associations between skill perceptions and young children's actual fundamental movement skills. *Perceptual and motor skills*, *120*(2), 591-603.

Livesey, D., Coleman, R., & Piek, J. (2007). Performance on the Movement Assessment Battery for Children by Australian 3-to 5-year-old children. *Child: care, health and development*, *33*(6), 713-719.

Logan, S. W., Kipling Webster, E., Getchell, N., Pfeiffer, K. A., & Robinson, L. E. (2015). Relationship between fundamental motor skill competence and physical activity during childhood and adolescence: a systematic review. *Kinesiology Review*, *4*(4), 416-426.

Logan, S., Robinson, L., Webster, E. K., & Barber, L. (2013). Exploring preschoolers' engagement and perceived physical competence in an autonomy-based Object control skill intervention: A preliminary study. *European Physical Education Review*, *19*(3), 302-314.

Logan, S. W., Robinson, L. E., Rudisill, M. E., Wadsworth, D. D., & Morera, M. (2014). The comparison of school-age children's performance on two motor assessments: the Test of Gross Motor Development and the Movement Assessment Battery for Children. *Physical Education and Sport Pedagogy*, *19*(1), 48-59.

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.

Lomax, R. G., & Hahs-Vaughn, D. L. (2012). *An introduction to Statistical Concepts*. (3rd edition). New York: Routledge.

Lopes, V. P., Stodden, D. F., Bianchi, M. M., Maia, J. A., & Rodrigues, L. P. (2012). Correlation between BMI and motor coordination in children. *Journal of Science and Medicine in Sport*, *15*(1), 38-43.

Lorson, K. M. & Goodway, J. D. (2008). Gender differences in throwing form of children ages 6-8 years during a throwing game. *Research Quarterly Exercise and Sport, 79(2),* 174-182

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents. *Sports medicine*, *40*(12), 1019-1035.

Luo, Z., Jose, P. E., Huntsinger, C. S., & Pigott, T. D. (2007). Fine motor skills and mathematics achievement in East Asian American and European American kindergartners and first graders. *British Journal of Developmental Psychology*, *25*(4), 595-614.

Lynch, S., & O'Donnell, C. (2005). The evolving definition, measurement, and conceptualization of fidelity of implementation in scale-up of highly rated science curriculum units in diverse middle schools. In *Annual Meeting of the American Educational Research Association*.

MacDonald, M., Lipscomb, S., McClelland, M. M., Duncan, R., Becker, D., Anderson, K., & Kile, M. (2016). Relations of Preschoolers' Visual-Motor and Object Manipulation Skills With Executive Function and Social Behavior. *Research quarterly for exercise and sport*, *87*(4), 396-407.

Martin, E. H., Rudisill, M. E., & Hastie, P. A. (2009). Motivational climate and fundamental motor skill performance in a naturalistic physical education setting. *Physical Education & Sport Pedagogy, 14(3)*, 227-240.

Mashburn, A. J., Downer, J. T., Hamre, B. K., Justice, L. M., & Pianta R. C. (2010). Consultation for teachers and children's language and literacy development during pre- kindergarten. *Applied Developmental Science*, *14*(4), 179-196.

Mashburn, A. J., Pianta, R. C., Hamre, B. K., Downer, J. T., Barbarin, O. A., Bryant, D., ... & Howes, C. (2008). Measures of classroom quality in prekindergarten and children's development of academic, language, and social skills. *Child Development*, *79*(3), 732-749

Merriam, S. B. (2001). Andragogy and self-directed learning: Pillars of adult learning theory. *New Directions for Adult and Continuing Education,* (89), 3-14.

Merriam, S. B., & Caffarella, R. S. (1999). *Learning in Adulthood: A Comprehensive Guide* (2nd Ed.). San Francisco:Jossey-Bass.

Merriam, S. B., & Kim, S. (2012). Studying transformative learning: What methodology. *The handbook of transformative learning: Theory, research, and practice*, 56-72.

Metcalfe, J., & Mischel, W. (1999). A hot/cool-system analysis of delay of gratification: dynamics of willpower. *Psychological review*, *106*(1), 3.

Mezirow, J. (2000). Learning to think like an adult. *Learning as transformation: Critical Perspectives on a Theory in Progress*, 3-33.

Monsalves-Álvarez, M., Castro-Sepúlveda, M., Zapata-Lamana, R., Rosales-Soto, G., Salazar, G. (2015). Motor skills and nutritional status outcomes from a physical activity intervention in short breaks on preschool children conducted by their educators: a pilot study. *Nutricion Hospitalaria*, 32(4), 1576-1581.

Mostafavi, R., Ziaee, V., Akbari, H., & Haji-Hosseini, S. (2013). The effects of spark physical education program on fundamental motor skills in 4-6 year-old children. *Iranian journal of pediatrics*, *23*(2), 216.

National Association for Sport and Physical Education. (2002). Active Start: A Statement of Physical Activity Guidelines for Children Birth to Five Years. Reston, VA: National Association for Sport and Physical Education Publications.

National Partnership for Excellence and Accountability in Teaching (NPEAT), (1999).

Improving Professional Development: Research-Based Principles. Washington: National Partnership for Excellence and Accountability in Teaching.

Neuman, S. B., & Cunningham, L. (2009). The impact of PD and coaching on early language and literacy instructional practices. *American Educational Research Journal*, *46*(2), 532-566.

Neuman, S. B. & Kamil, M. L. (2010). *Preparing teachers for the early childhood classroom: Proven models and key principles.* Baltimore, MD:Brookes.

Newell, K. M. (1984). Physical constraints to development of motor skills. In J. Thomas (Ed.), *Motor development during preschool and elementary years* (pp. 105-120). Minneapolis: Burgess.

Newell, K. M. (1986). Constraints on the development of coordination. In M. G. Wade & H. T. A. Whiting (Eds.), *Motor development in children: Aspects of coordination and control* (pp. 341-360). Dordrecht, The Netherlands: Nijhoff.

Nicholls, J. G. (1984). Conceptions of ability and achievement. In R. Ames & Ames & C. Ames (Eds.), *Research on motivation in education: Student motivation* (pp. 39-73). New York: Academic Press.

Nicholls, J. G. (1992). The general and the specific in the development and expression of achievement motivation. In G. C. Roberts (Eds.), *Motivation in sport and exercise* (pp. 31-56). Champaign, IL: Human Kinetics Publishers.

Nourbakhsh, P. (2006). Perceptual-motor abilities and their relationships with academic performance of fifth grade pupils in comparison with Oseretsky scale. *Kinesiology*, *38*(1), 40-48.

O'Donnell, C. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K-12 curriculum intervention research. *Review of Education Research, 78(1),* 33-84.

Oh, S., & Lewis, C. (2008). Korean preschoolers' advanced inhibitory control and its relation to other executive skills and mental state understanding. *Child Development*, *79*(1), 80-99.

Ohio Department of Education. (2015). Ohio Standards for Professional Development. Retrieved from: http://education.ohio.gov/Topics/Teaching/Professional-Development/Organizing-for-High-Quality-Professional-Developme. April 19, 2018.

Organization for Economic Co-operation and Development (2014). Obesity Update. Publication of OECD Directorate for Employment, Labor and Social Affairs.

Oja, L., & Jürimäe, T. (2002). Physical activity, motor ability, and school readiness of 6-yr.-old children. *Perceptual and Motor Skills*, *95*(2), 407-415.

Pagani, L. S., Fitzpatrick, C., Archambault, I., & Janosz, M. (2010). School readiness and later achievement: a French Canadian replication and extension. *Developmental psychology*, *46*(5), 984.

Paro, K. M. L., Hamre, B. K., Locasale-Crouch, J., Pianta, R. C., Bryant, D., Early, D., ... & Burchinal, M. (2009). Quality in kindergarten classrooms: Observational evidence for the need to increase children's learning opportunities in early education classrooms. *Early Education and Development*, *20*(4), 657-692.

Pate, R. R., Almeida, M. J., McIver, K. L., Pfeiffer, K. A., & Dowda, M. (2006). Validation and calibration of an accelerometer in preschool children. *Obesity*,*14*(11), 2000-2006.

Patton, K. & Parker, M. (2012). Moving from things to do on Monday to student learning: Physical education professional development facilitators' views of success. *Physical Education and Sport Pedagogy,* 1-16.

Payne, V. G., & Isaacs, L. D. (2016). *Human motor development: A lifespan approach*. Routledge.

Piaget, J., & Inhelder, B. (1966). L'image mcntale chez l'enfant. Paris: P.U.F.

Piek, J. P., Dawson, L., Smith, L. M., & Gasson, N. (2008). The role of early fine and gross motor development on later motor and cognitive ability. *Human movement science*, *27*(5), 668-681.

Piek, J. P., Dyck, M. J., Nieman, A., Anderson, M., Hay, D., Smith, L. M., et al (2004). The relationship between motor coordination, executive functioning and attention in school aged children. Archives of Clinical Neuropsychology, 19, 1063–1076.

Piek, J. P., Gasson, N., Barrett, N., & Case, I. (2002). Limb and gender differences in the development of coordination in early infancy. *Human movement science*, *21*(5-6), 621-639.

Piek, J. P., McLaren, S., Kane, R., Jensen, L., Dender, A., Roberts, C., & ... Straker, L. (2013). Does the Animal Fun program improve motor performance in children aged 4–6 years? *Human Movement Science, 32(5),* 1086-1096.

Planinšec, J., & Fošnarič, S. (2005). Relationship of perceived physical self-concept and physical activity level and sex among young children. *Perceptual and motor skills*, *100*(2), 349-353.

Ponitz, C. E. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly*, *23*(2), 141-158.

Ponitz, C. C., McClelland, M. M., Matthews, J. S., & Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. *Developmental psychology*, *45*(3), 605.

Pradhan, M., Brinkman, S. A., Beatty, A., Maika, A., Satriawan, E., de Ree, J., & Hasan, A. (2013). Evaluating a community-based early childhood education and development program in Indonesia: study protocol for a pragmatic cluster randomized controlled trial with supplementary matched control group. *Trials*, *14*(1), 259.

Pratt, D. D. (1998). Andragogy as a relational construct. *Adult Education Quarterly*, *32*(3), 160-181.

Raudenbush, S. W., et al. (2011). Optimal Design Software for Multi-level and Longitudinal Research (Version 3.01) [Software]. Available from www.wtgrantfoundation.org

Raver, C. C., Garner, P. W., & Smith-Donald, R. (2007). The roles of emotion regulation and emotion knowledge for children's academic readiness: Are the links causal?

In R. C. Pianta, M. J. Cox, & K. L. Snow (Eds.), *School readiness and the transition to kindergarten in the era of accountability* (pp. 121-147). Baltimore, MD, US: Paul H Brookes Publishing

Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H., & ... Grant, S. (2006). Physical activity to prevent obesity in young children: cluster randomised controlled trial. *BMJ: British Medical Journal (International Edition), 333(7577)*, 1041-1043.

Rhoades, B. L., Greenberg, M. T., & Domitrovich, C. E. (2009). The contribution of inhibitory control to preschoolers' social–emotional competence. *Journal of Applied Developmental Psychology*, *30*(3), 310-320.

Riethmuller, A. M., Jones, R. A., & Okely, A. D. (2009). Efficacy of interventions to improve motor development in young children: a systematic review. *Pediatrics*, *124*(4), e782-e792.

Rimm-Kaufman, S. E., Pianta, R. C., & Cox, M. J. (2000). Teachers' judgments of problems in the transition to kindergarten. *Early childhood research quarterly*, *15*(2), 147-166.

Rink, J. (2009). *Teaching physical education for learning.* NY: McGraw-Hill.

Rizzuto, T., & Knight, D. (1993). Relations for children in grades 2, 3, and 4 between balance skills and academic achievement. *Perceptual and Motor Skills*, *76*(3_suppl), 1296-1298.

Robinson, L. E. (2011). Effect of a mastery climate motor program on Object control skills and perceived physical competence in preschoolers. *Research Quarterly for Exercise and Sport, 82(2)*, 355-359.

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

Robinson, L., Rudisill, M., & Goodway, J., (2009). Instructional climates in preschool children who are at-risk. Part II: Perceived physical competence. *Research Quarterly for Exercise and Sport, 80*, 543-551.

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine*, *45*(9), 1273-1284.

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*(2), 79-86.

Roebers, C. M., & Kauer, M. (2009). Motor and cognitive control in a normative sample of 7-year-olds. *Developmental science*, *12*(1), 175-181.

Roemling, C., & Qaim, M. (January 01, 2012). Obesity trends and determinants in Indonesia. *Appetite, 58,* 3, 1005-13.

Rothbart, M. K., & Ahadi, S. A. (1994). Temperament and the development of personality. *Journal of abnormal psychology*, *103*(1), 55.

Rothbart, M. K., Posner, M. I., & Kieras, J. (2006). Temperament, Attention, and the Development of Self-Regulation. Blackwell handbook of early childhood development.

Rudisill, M. E., Mahar, M. T., & Meaney, K. S. (1993). The relationship between children's perceived and actual motor competence. *Perceptual and Motor Skills*, *76*(3), 895-906.

Sabbagh, M. A., Xu, F., Carlson, S. M., Moses, L. J., & Lee, K. (2006). The development of executive functioning and theory of mind: A comparison of Chinese and US preschoolers. *Psychological science*, *17*(1), 74-81.

Schmidt, R. A., & Wrisberg, C. A. (2008). *Motor learning and performance: A situation-based learning approach*. Human Kinetics.

Seefeldt, V. (1980). The concepts of readiness applied to motor skill acquisition. In R. A. Magill, M. J. Ash, & F. L. Smoll (Eds.), *Children in Sport.* Champaign, IL: Human Kinetics.

Sergeant, J. (2000). The cognitive-energetic model: an empirical approach to attention-deficit hyperactivity disorder. *Neuroscience & Biobehavioral Reviews*, *24*(1), 7-12.

Shelton, M. & Jones, M. (1996). Staff Development That Works! A Tale of Four T's. *NASSP Bulletin, 80(582),* 99–105.

Shoval, E., Erlich, I., & Fejgin, N. (2010). Mapping and interpreting novice physical education teachers' self-perceptions of strengths and difficulties. *Physical Education and Sport Pedagogy*, *15*(1), 85-101.

Siedentop, D. & Tannehill, D. (2000). *Developing Teaching Skills in Physical Education.* Mayfield: Palo Alto, CA.

Smith, L. B., & Thelen, E. (2003). Development as a dynamic system. *Trends in cognitive sciences*, *7*(8), 343-348.

Smith, L. B., Thelen, E., Titzer, R., & McLin, D. (1999). Knowing in the context of acting: the task dynamics of the A-not-B error. *Psychological review*, *106*(2), 235.

Smits-Engelsman, B. C., Niemeijer, A. S., & van Waelvelde, H. (2011). Is the Movement Assessment Battery for Children-a reliable instrument to measure motor performance in 3 year old children?. *Research in developmental disabilities*, *32*(4), 1370-1377.

Son, S. H., & Meisels, S. J. (2006). The relationship of young children's motor skills to later reading and math achievement. *Merrill-Palmer Quarterly (1982-)*, 755-778.

Spessato, B. C., Gabbard, C., Valentini, N., & Rudisill, M. (2013). Gender differences in Brazilian children's fundamental movement skill performance. *Early Child Development and Care*, *183*(7), 916-923.

Spybrook, J., et al. (2011). Optimal Design for Longitudinal and Multilevel Research: Documentation for the Optimal Design Software Version 3.0. Available from www.wtgrantfoundation.org.

Stöckel, T., & Hughes, C. M. (2016). The relation between measures of cognitive and motor functioning in 5-to 6-year-old children. *Psychological research*, *80*(4), 543-554.

Stodden, D., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A Developmental Perspective on the Role of Motor Skill Development in Physical Activity: An Emergent Concept. *Quest, 60*, 290-306.

Sturgess, J., Rodger, S., & Ozanne, A. (2002). A review of the use of self-report assessment with young children. *British Journal of Occupational Therapy*, *65*(3), 108-116.

Stuss, D. T., & Benson, D. F. (1986). *The Frontal Lobes*. Raven Press.

Tabachnick, B.G., & Fidell, L. S. (2012). Using Multivariate Statistics. Boston, MA: Pearson Education, Inc.

Taylor, E. W. (1998). The Theory and Practice of Transformative Learning: A Critical Review. Information Series No. 374

Terehoff, I. I. (2002). Elements of adult learning in teacher professional development. *Nassp Bulletin, 86,* 632, 65-77.

Thelen, E., & Smith, L. B. (1998). Dynamic systems theories. *Handbook of child psychology*.

Thelen, E., & Ulrich, B. D. (1991). Hidden skills: A dynamical systems analysis of treadmill stepping during the first year. *Monographs of the Society for Research in Child Development, 56,* (1, Serial No. 223).

Thietart, R. A., & Forgues, B. (1995). Chaos theory and organization. *Organization science*, *6*(1), 19-31.

Thomas, J. R., & French, K. E. (1985). Gender differences across age in motor performance: A meta-analysis. *Psychological Bulletin, 98,* 260-282.

Thomas, J. R., & Nelson, J. K. y Silverman, S.(2011). *Research Methods in Physical Activity. 6th Edition. Champaign, Illinois: Human Kinetics*.

Thorell, L. B., & Wåhlstedt, C. (2006). Executive functioning deficits in relation to symptoms of ADHD and/or ODD in preschool children. *Infant and Child Development*, *15*(5), 503-518.

Toftegaard-Stoeckel, J., Groenfeldt, V., & Andersen, L. B. (2010). Children's self-perceived bodily competencies and associations with motor skills, body mass index, teachers' evaluations, and parents' concerns. *Journal of sports sciences*, *28*(12), 1369-1375.

Ulrich, D. A. (1985). *The Test of Gross Motor Development, 1st edition*. PRO-ED, Austin, TX, USA.

Ulrich, D. A. (2000). *The Test of Gross Motor Development, 2nd edition*. PRO-ED, Austin, TX, USA .

United Nation. (2015). World Urbanization Prospects: The 2014 Revision. New York: Department of Economic and Social Affairs. United Nation

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2003). National Case Study on the Situation of Early Childhood Care and Education Services in Indonesia. Background Information for the Fifth Ministerial Review Meeting of the Nine High-Population Countries on Education for All. Jakarta, Indonesia: UNESCO Office.

Usfar, A. A., Lebenthal, E., Atmarita, ., Achadi, E., Soekirman, ., & Hadi, H. (January 01, 2010). Obesity as a poverty-related emerging nutrition problems: the case of Indonesia. *Obesity Reviews: an Official Journal of the International Association for the Study of Obesity, 11,* 12, 924-8Usfar et al, 2010

Valentini, N. C., Logan, S. W., Spessato, B. C., de Souza, M. S., Pereira, K. G., & Rudisill, M. E. (2016). Fundamental motor skills across childhood: Age, sex, and competence outcomes of Brazilian children. *Journal of Motor Learning and Development*, *4*(1), 16-36.

Valentini, N. & Rudisill, M. (2004). Motivational climate, motor skill development and perceived physical competence: Two studies of developmentally delayed kindergarten children. *Journal of Teaching in Physical Education, 23,* 216-234.

Venetsanou, F., & Kambas, A. (2004). How can a traditional Greek dances programme affect the motor proficiency of pre-school children? *Research in Dance Education, 5*(2), 127-138.

Vidoni, C., Lorenz, D. J., & de Paleville, D. T. (2014). Incorporating a movement skill programme into a preschool daily schedule. *Early Child Development and Care*, *184*(8), 1211-1222.

Wadsworth, B. J. (1996). *Piaget's theory of cognitive and affective development: Foundations of constructivism*. Longman Publishing.

Ward, P. & Doutis, P. (1999). Toward a Consolidation of the Knowledge Base for Reform in Physical Education, *Journal of Teaching in Physical Education*, 18, 382–402.

Weimer, W. B. (1977). A conceptual framework for cognitive psychology: Motor theories of the mind. *Perceiving, acting, and knowing: Toward an cological psychology, eds. R. Shaw & J. Bransford*, 267-311.

Westendorp, M., Hartman, E., Houwen, S., Smith, J., & Visscher, C. (2011). The relationship between gross motor skills and academic achievement in children with learning disabilities. *Research in developmental disabilities*, *32*(6), 2773-2779.

White, R. W. (1959). Motivation reconsidered: The concept of competence. Psychological Review, 66, 297–333.

Williams, K., Haywood, K. & Painter, M. (1996). Environmental versus biological influences on gender difference in the overarm throw for force: Dominant and Non-dominant arm throws. *Women in Sport and Physical Activity Journal, 5,* 29–48.

Winter, S. M., & Sass, D. A. (2011). Healthy & ready to learn: examining the efficacy of an early approach to obesity prevention and school readiness. *Journal of Research in Childhood Education*, *25*(3), 304-325.

World Bank. (2018). Low and Middle Income | Data. Retrieved from: https://data.worldbank.org/income-level/low-and-middle-income. April 21, 2018.

World Health Organization (2011) *Global recommendations on PA for health*. Retrieved from: http://www.who.int/dietphysicalactivity/leaflet-physical-activity-recommendations.pdf . March 17, 2012

Wrotniak, B. H., Epstein, L. H., Dorn, J. M., Jones, K. E., & Kondilis, V. A. (2006). The relationship between motor proficiency and physical activity in children. *Pediatrics*, *118*(6), e1758-e1765.

Wuang, Y. P., Su, J. H., & Su, C. Y. (2012). Reliability and responsiveness of the Movement Assessment Battery for Children–Second Edition Test in children with developmental coordination disorder. *Developmental Medicine & Child Neurology*, *54*(2), 160-165.

Zask, A., Adams, J. K., Brooks, L. O., & Hughes, D. F. (2012a). Tooty Fruity Vegie: an obesity prevention intervention evaluation in Australian preschools. *Health Promotion Journal of Australia*, *23*(1), 10-15.

Zask, A., Barnett, L. M., Rose, L., Brooks, L. O., Molyneux, M., Hughes, D., & ... Salmon, J. (2012b). Three year follow-up of an early childhood intervention: is movement skill sustained?. *International Journal Of Behavioral Nutrition & Physical Activity*, 9127-135.

Zelazo, P. D., & Muller, U. (2002). Executive function in typical and atypical development. In U. Goswami (Ed.), Handbook of childhood cognitive development (pp. 445–469). Oxford, UK: Blackwell.

Zelazo, P. D., Müller, U., Frye, D., Marcovitch, S., Argitis, G., Boseovski, J., ... & Carlson, S. M. (2003). The development of executive function in early childhood. *Monographs of the society for research in child development*, i-151.

Zelazo, P. D., Reznick, J. S., & Piñon, D. E. (1995). Response control and the execution of verbal rules. *Developmental Psychology*, *31*(3), 508.

Zill, N., & West, J. (2001). Entering Kindergarten: A Portrait of American Children When They Begin School. Findings from the Condition of Education, 2000.

Appendix A. Test of Gross Motor Development-2: Object Control Subscale

TGMD–2

Test of Gross Motor Development–Second Edition

Profile/Examiner Record Form

Section I. Identifying Information

Name ______________________

Male ☐ Female ☐ Grade ______________________

Date of Testing ________ ________ ________

Date of Birth ________ ________ ________

Age ________ ________ ________

School ______________________

Referred by ______________________

Reason for Referral ______________________

Examiner ______________________

Examiner's Title ______________________

Section II. Record of Scores

First Testing

	Raw Score	Standard Score	Percentile	Age Equivalent
Locomotor	____	____	____	____
Object Control	____	____	____	____

Sum of Standard Scores ____

Gross Motor Quotient ____ ____

Second Testing

	Raw Score	Standard Score	Percentile	Age Equivalent
Locomotor	____	____	____	____
Object Control	____	____	____	____

Sum of Standard Scores ____

Gross Motor Quotient ____ ____

Section III. Testing Conditions

A. Place Tested ______________________

	Interfering				Not Interfering
B. Noise Level	1	2	3	4	5
C. Interruptions	1	2	3	4	5
D. Distractions	1	2	3	4	5
E. Light	1	2	3	4	5
F. Temperature	1	2	3	4	5

G. Notes and other considerations ______________________

Section IV. Other Test Data

Name of Test	Date	Standard Score	TGMD–2 Equivalent

Section V. Profile of Standard Scores

Standard Scores	Locomotor	Object Control	Standard Scores	Quotients	Gross Motor Quotient	Quotients
20			20	150		150
19			19	145		145
18			18	140		140
17			17	135		135
16			16	130		130
15			15	125		125
14			14	120		120
13			13	115		115
12			12	110		110
11			11	105		105
10			10	100		100
9			9	95		95
8			8	90		90
7			7	85		85
6			6	80		80
5			5	75		75
4			4	70		70
3			3	65		65
2			2	60		60
1			1	55		55

8 9 10 11 12 13 12 11 10 09

1

Object Control Subtest

Skill	Materials	Directions	Performance Criteria	Trial 1	Trial 2	Score
1. Striking a Stationary Ball	A 4-inch lightweight ball, a plastic bat, and a batting tee	Place the ball on the batting tee at the child's belt level. Tell the child to hit the ball hard. Repeat a second trial.	1. Dominant hand grips bat above nondominant hand			
			2. Nonpreferred side of body faces the imaginary tosser with feet parallel			
			3. Hip and shoulder rotation during swing			
			4. Transfers body weight to front foot			
			5. Bat contacts ball			
					Skill Score	
2. Stationary Dribble	An 8- to 10-inch playground ball for children ages 3 to 5; a basketball for children ages 6 to 10; and a flat, hard surface	Tell the child to dribble the ball four times without moving his or her feet, using one hand, and then stop by catching the ball. Repeat a second trial.	1. Contacts ball with one hand at about belt level			
			2. Pushes ball with fingertips (not a slap)			
			3. Ball contacts surface in front of or to the outside of foot on the preferred side			
			4. Maintains control of ball for four consecutive bounces without having to move the feet to retrieve it			
					Skill Score	

Skill	Materials	Directions	Performance Criteria	Trial 1	Trial 2	Score
3. Catch	A 4-inch plastic ball, 15 feet of clear space, and tape	Mark off two lines 15 feet apart. The child stands on one line and the tosser on the other. Toss the ball underhand directly to the child with a slight arc aiming for his or her chest. Tell the child to catch the ball with both hands. Only count those tosses that are between the child's shoulders and belt. Repeat a second trial.	1. Preparation phase where hands are in front of the body and elbows are flexed			
			2. Arms extend while reaching for the ball as it arrives			
			3. Ball is caught by hands only			
					Skill Score	
4. Kick	An 8- to 10-inch plastic, playground, or soccer ball; a beanbag; 30 feet of clear space; and tape	Mark off one line 30 feet away from a wall and another line 20 feet from the wall. Place the ball on top of the beanbag on the line nearest the wall. Tell the child to stand on the other line. Tell the child to run up and kick the ball hard toward the wall. Repeat a second trial.	1. Rapid continuous approach to the ball			
			2. An elongated stride or leap immediately prior to ball contact			
			3. Nonkicking foot placed even with or slightly in back of the ball			
			4. Kicks ball with instep of preferred foot (shoelaces) or toe			
					Skill Score	
5. Overhand Throw	A tennis ball, a wall, tape, and 20 feet of clear space	Attach a piece of tape on the floor 20 feet from a wall. Have the child stand behind the 20-foot line facing the wall. Tell the child to throw the ball hard at the wall. Repeat a second trial.	1. Windup is initiated with downward movement of hand/arm			
			2. Rotates hip and shoulders to a point where the nonthrowing side faces the wall			
			3. Weight is transferred by stepping with the foot opposite the throwing hand			
			4. Follow-through beyond ball release diagonally across the body toward the nonpreferred side			
					Skill Score	
6. Underhand Roll	A tennis ball for children ages 3 to 6; a softball for children ages 7 to 10; two cones; tape; and 25 feet of clear space	Place the two cones against a wall so they are 4 feet apart. Attach a piece of tape on the floor 20 feet from the wall. Tell the child to roll the ball hard so that it goes between the cones. Repeat a second trial.	1. Preferred hand swings down and back, reaching behind the trunk while chest faces cones			
			2. Strides forward with foot opposite the preferred hand toward the cones			
			3. Bends knees to lower body			
			4. Releases ball close to the floor so ball does not bounce more than 4 inches high			
					Skill Score	
			Object Control Subtest Raw Score (sum of the 6 skill scores)			

Appendix B. Movement Assessment Battery for Children-2 (MABC-2)

Movement Assessment Battery for Children – 2

Test Record Form Age Band 1 (3-6 years)

Name: Gender: M / F

Home address:

School: Class/year/grade:

Assessed by:

Referral source:

Preferred (writing) hand:

	Year	Month	Day
Date tested			
Date of birth			
Chronological age			

Movement ABC-2
Checklist completed? Y / N

Item Scores and Equivalent Standard Scores

Item code	Name of item	Raw score (best attempt)	Item Standard Score
MD 1*	Posting Coins preferred hand		
	Posting Coins non-pref hand		
MD 2	Threading Beads		
MD 3	Drawing Trail 1		
A&C 1	Catching Beanbag		
A&C 2	Throwing Beanbag onto mat		
Bal 1*	One-Leg Balance best leg		
	One-Leg Balance other leg		
Bal 2	Walking Heels Raised		
Bal 3	Jumping on Mats		

Total Test Score
Sum of 8 item **standard** scores:

*For Posting Coins and One-Leg Balance, look up standard score for

Three Component Scores†

Manual Dexterity^ MD 1 + MD 2 + MD 3

Component score	Standard Score	Percentile

Aiming & Catching^ A&C 1 + A&C 2

Component score	Standard Score	Percentile

Balance^ Bal 1 + Bal 2 + Bal 3

Component score	Standard Score	Percentile

^In each case sum the item standard scores.

Total Test Score	Standard Score	Percentile Rank

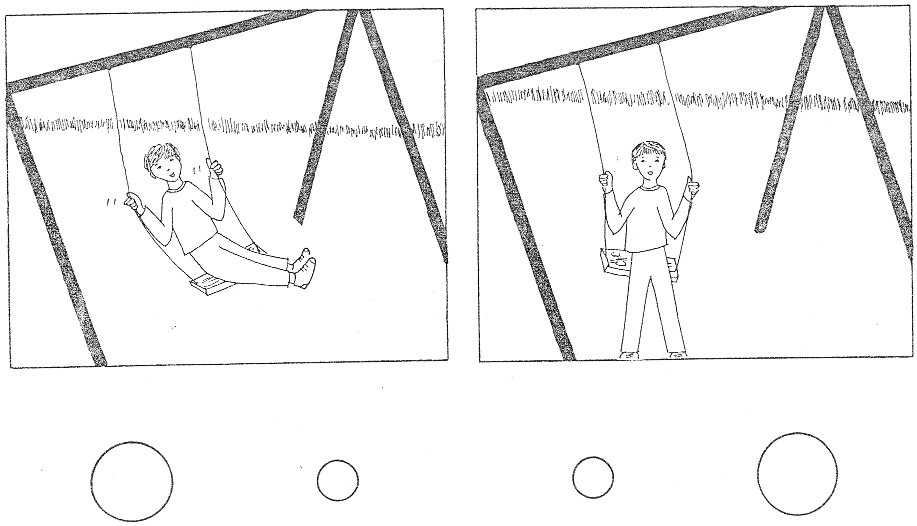
Appendix C. Sample Question of The Pictorial Scale of Perceived Physical Competence for Young Children

The Pictorial Scale of Perceived Competence and Acceptance for Young Children

Plates — Preschool and Kindergarten, Male
Susan Harter and Robin G. Pike

In collaboration with Carole Efron and Christine Chao
Illustrated by Deborah Kolbo Ellsworth
1980

University of Denver



ITEM 3

This boy isn't very good at swinging by himself.
Are you:

Not too good OR Sort of good

1 2

This boy is pretty good at swinging by himself.
Are you:

Pretty good OR Really good

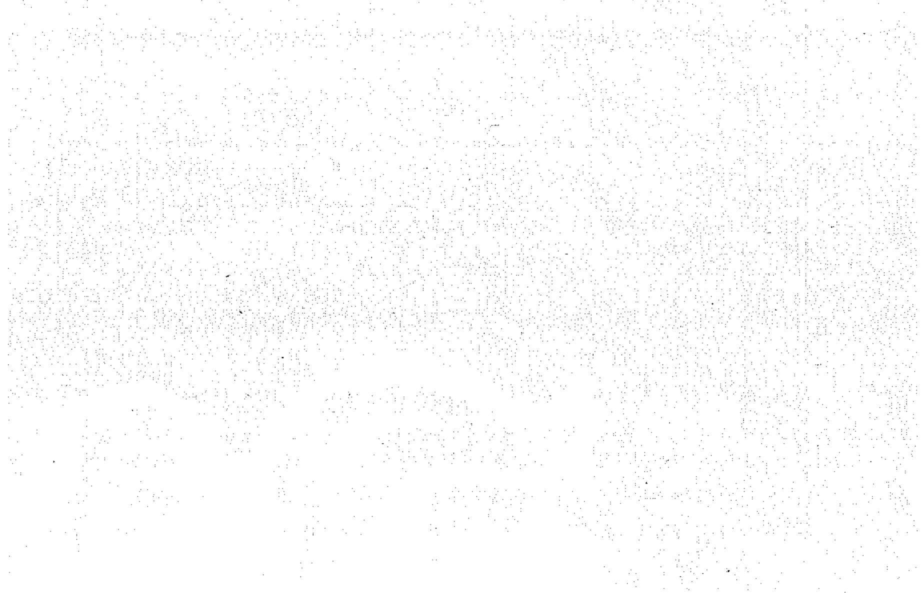
3 4

Appendix D. Sample Question of The Pictorial Scale of Perceived Motor Skill Competence for Young Children

Pictorial Scale of Perceived Movement Skill Competence for Young Children

FIRST YEARS OF SCHOOL

Developed by Lisa Barnett, Nicola Ridgers, Avigdor Zask and Jo Salmon,
Deakin University



Illustrations by Bill Mezzetti

The concept of the pictorial scale and item wording was taken from 'The Pictorial Scale of Perceived Competence and Acceptance for Young Children'. Susan Harter and Robin G. Pike 1980

ITEM 10

This girl is pretty good at hitting a ball.

Are you:

Really good at hitting a ball OR Pretty good

4 3

This girl isn't very good at hitting a ball.

Are you:

Sort of good OR Not too good at hitting a ball

2 1

Appendix E. Head-Toes-Knee-Shoulder Task

PART I PRACTICE:

	Incorrect	Self-Correct*	Correct
B1. **Touch your head**	0 (head)	1	2 (toes)
B2. **Touch your toes**	0 (toes)	1	2 (head)
B3. **Touch your head**	0 (head)	1	2 (toes)
B4. **Touch your toes**	0 (toes)	1	2 (head)

PART I TESTING:

We're going to keep playing this game, and you keep doing the opposite of what I say.

If the child does not understand the task, you will have gone through the directions at most four times (once at the beginning, and up to three times in the TRAINING and PRACTICE sections).
DO NOT explain again after testing begins. Administer all 10 items below for Part I Testing.

	Incorrect	Self-Correct*	Correct
1. **Touch your head**	0 (head)	1	2 (toes)
2. **Touch your toes**	0 (toes)	1	2 (head)
3. **Touch your toes**	0 (toes)	1	2 (head)
4. **Touch your head**	0 (head)	1	2 (toes)
5. **Touch your toes**	0 (toes)	1	2 (head)
6. **Touch your head**	0 (head)	1	2 (toes)
7. **Touch your head**	0 (head)	1	2 (toes)
8. **Touch your toes**	0 (toes)	1	2 (head)
9. **Touch your head**	0 (head)	1	2 (toes)
10. **Touch your toes**	0 (toes)	1	2 (head)

If the child responds correctly to 5 or more items on the above 10, then continue to Part II.
If not, end task here. Stop recording.

NOTE

Definition of self-correction**: Mark "self-correct" on both the training and testing portion if the child makes *any discernible* motion toward the *incorrect* answer, but then changes his/her mind and makes the correct response. Pausing to think, not moving, and then responding correctly does ***not count as a self-correction.

PART II TESTING:

Now that you know all the parts, we're going to put them together. You're going to keep doing the opposite from what I say to do, but you won't know what I'm going to say.

There are four things I could say.

If I say to touch your head, you touch your toes.
If I say to touch your toes, you touch your head.
If I say to touch your knees, you touch your shoulders.
If I say to touch your shoulders, you touch your knees.

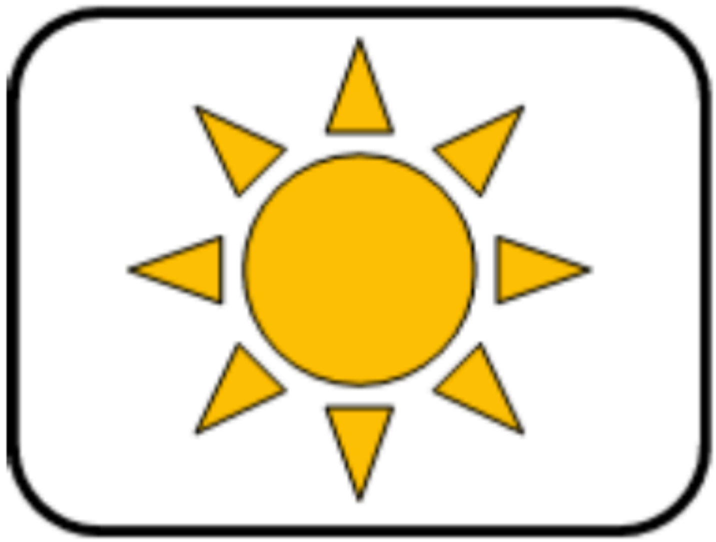
Are you ready? Let's try it.

	Incorrect	Self-Correct*	Correct
11. **Touch your head**	0 (head)	1	2 (toes)
12. **Touch your toes**	0 (toes)	1	2 (head)
13. **Touch your knees**	0 (knees)	1	2 (shoulders)
14. **Touch your toes**	0 (toes)	1	2 (head)
15. **Touch your shoulders**	0 (shoulders)	1	2 (knees)
16. **Touch your head**	0 (head)	1	2 (toes)
17. **Touch your knees**	0 (knees)	1	2 (shoulders)
18. **Touch your knees**	0 (knees)	1	2 (shoulders)
19. **Touch your shoulders**	0 (shoulders)	1	2 (knees)
20. **Touch your toes**	0 (toes)	1	2 (head)

After the child completes the task, say:

Thank you for playing this game with me today!

Appendix F. Day and Night Task



DAY AND NIGHT TASK RECORD FORM

Participant ID#: ....

Date of Test: ....

No	Card	Correct	Incorrect	Response latency (sec)
1	Night	Day (1)	Night (0)	
2	Day	Night (1)	Day (0)	
3	Day	Night (1)	Day (0)	
4	Night	Day (1)	Night (0)	
5	Day	Night (1)	Day (0)	
6	Night	Day (1)	Night (0)	
7	Night	Day (1)	Night (0)	
8	Day	Night (1)	Day (0)	
9	Day	Night (1)	Day (0)	
10	Night	Day (1)	Night (0)	
11	Day	Night (1)	Day (0)	
12	Night	Day (1)	Night (0)	
13	Night	Day (1)	Night (0)	
14	Day	Night (1)	Day (0)	
15	Night	Day (1)	Night (0)	
16	Day	Night (1)	Day (0)	
TOTAL SCORE				
AVERAGE SCORE				

NB: Circle child's response

Appendix G. Fidelity of *INDO_SKIP* Assessment

Fidelity of *INDO-SKIP* Assessment

Date & Lesson#:

Teacher ID#:

Location (indoor/outdoor):

The size of class:

The size of group (if applied):

Components	0	1	2	Comment
Task 1				
Time Started:	*Time Ended:*			
Activity				
1. Teacher set up task correctly				
2. Teacher correctly and individually modified task/equipment				
3. Teacher provided corrective feedback				
4. Children did task the way teacher explained				
Instruction				
1. Teacher explained task correctly				
2. Teacher demonstrated skill/task correctly				
3. Teacher demonstrated the task in place				
4. Teacher reinforced the critical elements of skill				
Task 2				
Time Started:	*Time Ended:*			
Activity				
1. Teacher set up task correctly				
2. Teacher correctly and individually modified task/equipment				
3. Teacher provided corrective feedback				
4. Children did task the way teacher explained				
Instruction				
1. Teacher explained task correctly				
2. Teacher demonstrated skill/task correctly				
3. Teacher demonstrated the task in place				
4. Teacher reinforced the critical elements of skill				